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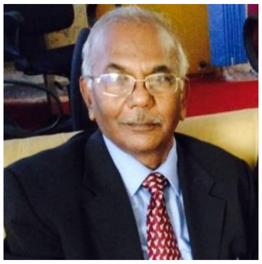
YVMV Resistance Breeding in Okra

Invited article id: 1000

Hari Har Ram



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Okra, lady's finger (*Abelmoschus esculentus* L. Moench, 2n = 2x =130) is a fast growing annual herb where young pods are consumed as vegetable. It is cultivated on a wider scale in warmer parts of temperate Asia, southern Europe, northern Africa, the United States of America, and almost all parts of the tropics. It has better adaptation to short rainy season and is considered to be a never fail crop in north-east Brazil. India is a major country growing okra spread over West Bengal, Orissa, Bihar, UP, Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, Punjab, Haryana, Madhya Pradesh, Rajasthan, and north-east regions covering an area of about 500,000 ha with the productivity of 10.5 tons/ha. India occupies first rank in okra production in the world. Other countries growing okra on a substantial scale are Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Myanmar (Burma), Japan, Malaysia, Brazil, Ghana, Ethiopia, Cyprus, and southern USA (Ram, 2012).

Four species of okra are under cultivation. The main crop (*Abelmoschus esculentus*) is an annual vegetable, grown from seed (not transplanted) in tropical, sub-tropical and Mediterranean climatic zones. In west and central Africa, it is cultivated in association with *A. caillei* where the former which flowers earlier is known as the rainy season okra and the latter which has longer cycle (up to 1 year) is known as the dry season okra. Plants of *A. manihot* whose pods are too prickly to be consumed and have sometimes lost their flowering ability are only cultivated in Paua New Guinea for their leaves. *A. moscahtus* has seeds which are used as musk mallow (Hamon and Sloten, 1995).

With increasing crop intensity and the crop rotations being more congested, the disease control measures and management issues have become more pronounced and urgent. This problem has been compounded further with increasing spread of very few superior cultivars and hybrids leading to development of disease infestations of epidemic proportions which may pose disastrous consequences. In spite of spectacular advances in control of several diseases through use of chemicals, the use of resistant cultivars still represents the most economical means of control against several widespread and destructive pathogens like YVMV of okra. Therefore, most plant breeding programmes all over the world accord high priority to disease resistance breeding.

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Breeding for Resistance to Yellow Vein Mosaic Virus in Okra

Virus and Symptoms

This disease was first reported in India by Kulkarni (1924) followed by Uppal *etal.* (1940) and Capoor and Varma (1950).Yellow vein mosaic virus of okra is caused by typical virus commonly called as yellow vein mosaic virus (YVMV). This virus belongs to begomovirus of the family Geminiviridae. The virus particles are geminate measuring 18-20 nm in diameter. The virus reacts with SCR-18 monoclonal antibodies of African cassava mosaic virus (Handa and Gupta, 1993; Singh, 2005). The virus can be detected by serology, electron microscopy, PCR and genome sequencing. Kothari *et al.* (1982) have found the virus particles as spherical, isometric, measuring 28-30 nm in diameter along with X- bodies as observed under electron microscope. Singh (1990) did electron microscopy of ultrathin sections of YVMV infected okra mid-rib and found presence of very small geminate particles (18-20 nm in diameter) in the form of aggregates in the phloem sieve tube nuclei. Several nuclei exhibited more or less uniform granular material differing from chromatin in electron density and texture. Coat protein gene of an isolate of okra YVMV and associated DNA-beta satellite obtained from eastern India have been cloned and nucleotide sequences characterized to know its molecular status and phylogenetic relationship (Ghosh *et al.,* 2008). Multiple nuclear localization signals (NLSs) were detected at the N-terminal region of coat protein endoplasmic reticulum membrane retention signals in beta C1 protein of beta satellite. The sequence of coat protein gene shared highest sequence identity with that of the south Indian isolate (BYVMV-(MAD):Var3, Accession No. AJ278861) and formed cluster with it, whereas the beta satellite molecule (BYVB-(IN:Bar:061) characterized in the study shared highest sequence identity and formed cluster with that recorded to be associated with another isolate of BYVMV on Bhendi plants from Pakistan (BYVB-(PK:Bah:97, Accession No. AJ316030).

The YVMV is the most severe and destructive disease of okra infecting the crop at all the stages of the growth. In early infection of the plants, the infected plants remain stunted bearing only a few pods of small size. Under late infection, the plants bear fruits but they are reduced in size. Thus, the disease causes considerable loss in yield and fruit quality. Sastry and Singh (1974) reported that if okra plants are infected within 20 days of germination, the plants are too much stunted and hardly produce any fruits. Even if any fruits are produced, they remain small, deformed and unmarketable leading to total yield loss. In case of infection taking place 35-50 days after germination, the yield loss has been estimated to be 50-80 %.

The characteristic symptoms include homogeneous interwoven network of yellow veins scattered in the green tissues of the leaves. In the initial stages, the infection appears on the leaves where infected leaves show only yellow coloured veins. However, in the later stages, the entire leaves turn into complete yellow. In severe cases, the infected leaves become completely light yellow or cream coloured without any trace of green colour. The chlorophyll of the leaves is partially or completely destroyed. Sometimes, enations are also seen on the under surface of the leaves which are fully infected. There is normally thickening of veins in the infected leaves. This thickening of veins is conspicuous on the dorsal surface of the leaves. If the plants are severely infected in the early stage, they usually remain stunted. The fruits from the infected plants show pale yellow colour, are often deformed, small and tough in texture (Singh, 2005).

YVMV Transmission, Insect Vector and, Conducive Weather Conditions for YVMV

The virus is neither sap transmissible nor seed. The natural transmission is through whitefly (*Bemisia tabaci* Gen) in a semi-persistent

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manner. In case of semi-persistent manner of virus transmission, the virus is ingested into the alimentary canal. Acquisition access feeding time is somewhat longer than for non-persistent viruses. Transmission improves with increased acquisition feeding time. There is no latent period in the vector. Inoculation feeding is longer than for non-persistent viruses. Retention in the insect is longer than for the non-persistent viruses. The minimum number of whiteflies required to induce 100 % infection is 10/plant, although a single whitefly can transmit the YVMV effectively. The whiteflies can acquire the virus from diseased plant after acquisition feeding for a period of one hour, and viruliferous whiteflies can transmit the virus to healthy plants after feeding on them for 30 minutes. Preliminary fasting up to 4 hours seems to improve the efficiency of whiteflies as vectors. Longer feeding periods have been shown to be ineffective. The minimum incubation period of the virus in the whitefly has been found to be 7 hours. The whiteflies feeding for 12-14 hrs on the diseased plants remain infective throughout their lives. The female whiteflies are more efficient than the male whiteflies in transmitting the disease (Singh, 2005).

Whiteflies and YVMV are largely influenced by weather conditions. Under Bangalore conditions, the occurrence of whitefly and that of YVMV is the highest during March to June. In contrast to this, the vector population and YVMV incidence are less during the cooler months. This happens as the hot and dry weather conditions favour fast multiplication of whitefly and also these conditions facilitate easy movement of whiteflies transmitting the YVMV. Low temperature is not conducive for whitefly buildup and their movement.

In north India, YVMV severity is pronounced in rainy season crops due to high temperature and humidity. It has been reported that okra sown in June and pods reaching to marketable stage in July-August were least susceptible to YVMV (4.1 %) as compared to 92.3 % infection in okra sown in July and maturing in August-September (Roychaudhary *et al*., 1997).

Hot-Spots for YVMV

The occurrence of YVMV is severe in certain locations in certain seasons and accordingly these locations are called as hot-spot locations for field screening of genotypes against YVMV. In north India, in general, rainy season is most conducive for occurrence and spread of YVMV. In rainy season also, certain locations are most ideal for screening against okra YVMV. These locations include Karnal, Tarai region of Uttarakhand, Nadia district of West Bengal and Varanasi area of Uttar Pradesh. In central/south India, the disease is pronounced in summer season at several locations, the prominent ones being Guntur in Andhra Pradesh, Jalgaon in Maharashtra, Surat in Gujarat and Coimbatore in Tamil Nadu. For western Maharashtra, summer season is conducive for YVMV than the rainy season (Prabu *et al.,* 2007). In Pune, the disease occurs severely if the crop is planted in mid-April and harvested in beginning of June. For screening at hot-spot locations, Pusa Sawani is sown all around the experimental plots and within the experimental plots at regular intervals to provide inoculums in abundance. No spraying should be done to control insects and YVMV.

Artificial Screening for Resistance to YVMV

For artificial screening of resistance to YVMV, virus free whiteflies are placed on virus-infected test plant to feed (acquisition feeding). Depending on the virus, it may take from a few seconds to a few days for the insect to become infected. The acquisition period varies depending upon the insect, the virus, and the host plant. After the insects have acquired the virus, they are immediately transferred to a virus-free test plant for transmission feeding (inoculation feeding). Some insects can transmit the virus immediately, but others can do so only after a latent period which may vary from a few hours to several weeks (Green, 1984). This

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latent period, i.e. the time between acquisition and transmission can be determined by successive transfers of the insects to virus-free test plants at hourly intervals after acquisition feeding. In case of okra, acquisition period, in general, is 1 hour and incubation period is from 30 minutes to 7 hours (Singh, 2005). After the inoculation feeding, the insects are normally destroyed using insecticides to allow development of typical virus symptoms without any confounding effect of symptoms which arise due to infestation by sucking pests like whiteflies. The plants are observed for one to three months.

To check the possibility of insect culture being infected with virus and to detect virus-like symptoms caused by insect feeding only, some insects should be transferred from the culture plants directly to test plants without feeding on a virus source. Insects collected from the field should be transferred to test plants to ensure that they are not already viruliferous. Non-inoculated plants should be placed in a greenhouse to detect accidental spread and to ensure that the test plants were not infected before inoculation.

For feeding of whiteflies on virus infected plants and the test plants, wooden plant cages are needed. Alternatively, separate small greenhouses can also be used. The cage size is approximately 35 x 35 x 50 cm. The sides are covered either with fine wire netting (15mesh/cm) or a nylon screen. The top and front door of the cage are covered with a glass plate for easy view of the test plants. For whiteflies, a cage with two wooden side walls can be used. Each wall should have a round access hole approximately 18 cm in diameter, just large enough for a hand to pass through. The whiteflies are prevented from escaping during handling by black cloth tubes attached to the holes at one end and held closed by rubber bands at the other. Plastic cylinder whole plant cage is also used. In this case, the top of a 13 inches diameter plastic cylinder is covered with cheesecloth and the bottom is pressed into the soil of the pot.

An aspirator is used to handle whiteflies. It consists of a small glass bottle closed with a rubber stopper having two holes. A small straight glass tube is inserted through one hole. The other end of this glass tube is connected to a piece of rubber tubing which serves as mouthpiece and the inner end is covered with a small piece of screen. A slightly longer glass tube which has been bent to the desired shape is inserted through the other hole. Insects are sucked into the bottle through this tube (Green, 1984).

Scoring for Reaction to YVMV

YVMV intensity means percentage of plants affected with the virus. This observation is taken at 30, 60, 90 and even 120 days after sowing. This is a simple calculation as given below:

YVMV intensity or percentage disease incidence (PDI) = (Number of plants affected by virus/Total number of plants under observation) x 100.

Based on percentage disease intensity or incidence (PDI), corresponding symptom grades (0-5) are assigned. Simultaneously, response values (0-1) are also assigned. After this, coefficient of infection (CI) is calculated by multiplying the percentage of disease incidence (PDI) by the response value assigned to each severity grade. Based on CI, the YVMV reaction is assigned as given in the Table 1 (Prabu *et al.*, 2007).

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Table 1: Scale for classifying YVMV reaction in okra.

PDI	Symptom grade	Response value	CI	Reaction
Absent	0	0	0-4	Highly resistant
< 25 % leaves	1	0.25	4.1-9.0	Resistant
25-50 % leaves	2	0.50	9.1-19.0	Moderately resistant
51-75 % leaves	3	0.75	19.1-39.0	Moderately susceptible
75-90 % leaves	4	1.00	39.1-69.0	Susceptible
>90 % leaves	5	1.00	69.1-100	Highly susceptible

Genetics of Resistance to YVMV and Breeding Approaches for Resistance to YVMV

Abelmoschus species are largely self-pollinated. However, there are reports of variable and high levels of cross-pollination. For *A. esculentus* 0-69 % out-crossing has been reported in Puerto Rico (Martin, 1983). The structure of flower in accordance with Crudens's index based on log (pollen/ovule) gives mean values of 2.0 (*A. esculentus, A. caillei*) and 2.2 (*A. manihot, A. moschatus*). Thus, the breeding system of okra is intermediate between obligate and facultative autogamy (Hamon and Sloten, 1995). Accordingly, breeding procedures on pure-line development and hybrids are equally applicable to okra.

Stable and reliable sources of resistance to YVMV in okra have been reported. These include primarily wild types, namely, *A. angulosus, A. tetraphyllus, A. moschatus, A. caillei* and *A. manihot.* In these wild type accessions, there could be variation in level of resistance among various accessions within a species. Besides wild types, resistant lines have been reported in the cultivated types as well.

Pure-line selection, pedigree method, modified pedigree method, hybrid development are most common breeding methods. Mutation breeding has also been used with limited success.

Pure-line selection is applicable to landraces/cultivars collected from farmers' field. This breeding method has not given rise to any YVMV resistant cultivar so far. Pedigree method of breeding is applicable to the segregating generations after hybridization between desirable promising complementary parental lines. The individual plant selection must start in the F2 generation and continue up to F5 or F6 generation from which the individual plants having resistance to YVMV and other desirable features are selected for growing plant-to-progeny rows. The selected plant progenies are bulked and the produce is given a selection number for further evaluation. The basic requirement of resistance breeding including that for YVMV is that the segregating generations must be exposed to adequate inoculums/virus either under hot-spot locations or under artificial inoculation so that one can make a difference between the resistant and susceptible plants for effective selection and advancement of generations.

Genetics of resistance to YVMV has been investigated by Indian scientists and the information obtained is of importance to raise the effective plant population size and to do the selection. Singh *et al.* (1962) reported the involvement of two recessive genes (*yv1/yv1*, *yv2/yv2*) in a field resistant line IC 1542 originating from West Bengal. In this situation, a breeder will find 1/16 of the F_2 population to be resistant carrying the genes *yv1/yv1*, *yv2/yv2*. Once these plants are identified and selected, they will breed true for resistance to YVMV in the subsequent generations as they are homozygous for both the recessive genes. Here one must raise large F2 population of about 500 plants. However, Thakur (1976) while studying the genetics of resistance to yellow vein mosaic virus of okra in inter-specific cross of *A. esculentus* x *A. manihot* ssp *manihot* under natural epiphytotic conditions, reported that the resistance was governed by two complementary dominant genes, although they noted hybrid sterility as well. In this case the typical F_2 ratio for resistant vs susceptible plants will be 9: 7 implying that only those F_2 plants will be resistant which carry both the dominant genes for resistance. In this case there will be segregation for resistance in the segregating generations and the breeder must be aware of this issue. Jambhale and Nerkar (1981) crossed *A. manihot* (resistant to YVMV) with Pusa Sawani (susceptible cultivar). The hybrids were resistant and partially fertile. The segregation pattern for disease reaction in F_2, BC_1 and subsequent generations revealed that resistance to YVMV is controlled by a single dominant gene. In this case, ¼ of the F_2 population will be homozygous dominant for resistance gene and these plants identified based on progeny performance will always breed true for resistance to YVMV in the segregating generations. Here, the effective F2 size can be small (100-200 plants).

Mohammad Ali (2000) crossed yellow mosaic virus tolerant okra cultivar IPSA Okra 1 with three susceptible cultivars, viz. Parbhani Kranti, SL 44 and SL 46 to determine the nature of inheritance of tolerance of IPSA Okra 1. Grafting was also done to know the nature of tolerance as to whether it was genetically determined or was due to escape. To test the transmissibility of YVMV through graft union, two week healthy seedlings of IPSA Okra 1 (tolerant) were grafted with same aged seedlings of SL 44 (susceptible) through tongue grafting technique. IPSA Okra 1 and Parbhani Kranti were also used likewise. Grafted and non-grafted plants were allowed to grow up to ripening of last fruit. In case of 22 grafted plants, all the susceptible components of graft combination produced disease symptoms but none of the tolerant components produced any symptoms. All non-grafted plants of IPSA Okra 1 were symptomless while susceptible non-grafted plants of SL 44 were severely infected. The grafting results revealed that the tolerance of IPSA Okra 1 was genetic and not due to escape. The F_1 hybrids were tolerant to YVMV. The F_2 segregated in a ratio of 9 tolerant: 7 susceptible and the BC1 generations of F_1 x susceptible parents segregated in a ratio of 1 tolerant: 3 susceptible. However, the segregation pattern of BC_1 generation with resistant parent (F_1 x resistant parent) did not fit with the expected ratio of 1 tolerant: 0 susceptible plants. In this case, some susceptible plants were found in the BC_1 generation . Thus, in general, the segregation pattern of the F_2 and backcross generations with both the parents suggested that tolerance to YVMV in IPSA Okra 1 could be controlled by two dominant genes. However, the deviation observed in the backcross generation of F_1 with the resistant parent denoted the possibility of the presence of a few more factors in the tolerance system of IPSA Okra 1 and / or contribution of minor tolerance factors from susceptible parents.

Considering overall segregation ratio, it could be hypothesized that the inheritance of tolerance was quantitative with possibly two major factors and dependent on gene dosage. The oligogenic nature and gene dosage dependency characterize tolerance as incompletely dominant rather than fully dominant. Fraser (1990) reported oligogenic resistance in some crops against viruses and supported the hypothesis that gene dosage dependent resistance is incompletely dominant. As the tolerance of IPSA Okra 1 is assumed to be gene dosage dependent, it might be symptomless carrier type. Similar conclusion has been drawn by several scientists with other materials.

Nariani and Seth (1958) reported that *A. tuberculatus* (2n = 58), *A. angulosus* (2n = 138) and *A .manihot* (2n = 66) carry the virus without symptoms. They also reported that a variety of cultivated species of okra IC 1542 proved to be a symptomless carrier. Thakur (1976) studied the inheritance of tolerance to YVMV of *A. manihot*

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ssp *manihot* (2n = 194) and concluded that tolerant plants carried virus but these were symptomless. Fraser (1990) also stated that the gene dosage dependent tolerance mechanism tend to allow spread of virus through the plant but inhibit multiplication or symptom severity which supports the hypothesis of symptomless carriers.

Heterosis breeding i.e. development of hybrids in okra gets priority by most of the Indian seed companies and the MNCs operating in India. Here among other things, the main focus remains on the resistance to YVMV. These seed companies sell more seeds of open pollinated cultivars of okra, of course having desirable features and tolerance to YVMV. However, in case of hybrids, the Indian seed companies are somehow very sensitive and do not want to sell any hybrid of okra unless the level of resistance to YVMV is very high i.e. the hybrid should be resistant to YVMV. This is due to the fact that the hybrid seed is sold at higher price than the seed of OPs and naturally the product selling at the higher price should have some value addition and that comes through incorporation of resistance to YVMV particularly in hybrids. These hybrids are generally produced as a result of crosses between pure-lines derived from inter-varietal crosses or those from inter-specific crosses involving *A. esculentus and A. manihot*.

Mutation breeding for YVMV resistance has been practiced in Thailand (Phadvibulya *et al*., 2009). Yellow vein mosaic virus disease (YVMD) caused by a begomovirus is the most serious factor affecting okra production for both exporting and domestic consumption in Thailand. Seeds of two okra varieties, Annie and Okura were irradiated with gamma rays at doses of 400 and 600 Gy. Screening of YVMD resistant plants was conducted for M_2 and M_4 plants under field conditions in Petchaburi and Phichit provinces under greenhouse conditions using whitefly transmission in Bangkok. One M_4 plant of Okura (B-21) irradiated at 400 Gy was found to be highly resistant but none of Annie. M_5 plants of B-21 were screened further for YVMD resistance under both greenhouse and field conditions. The resistant lines obtained by screening for YVMD resistance up to M_7 were selected for yield trials at Phichit Horticultural Research Centre (PHRC) and Chiangmai Horticultural Research Station (CHRS), both located in the northern Thailand. Three of the mutant lines were further tested at Kanchanaburi Horticultural Research Centre (KHRC) in Kanchanaburi province, an okra growing area in the west of central Thailand where YVMD was seriously widespread. At KHRC, all tested mutant lines showed resistance up to a month, when the susceptible check variety already showed symptoms of disease. However, only a small portion of the plants of the mutant lines appeared to be resistant throughout the whole growth duration, others eventually exhibited the yellow vein symptoms. In conclusion, the mutation breeding could not deliver the desired results. There are reports of YVMV tolerant cultivars developed through mutation breeding in India. These include MDU 1 developed by TNAU, Coimbatore in 1978 from Pusa Sawani and Punjab 8 (EMS 8) developed by B. R. Sharma and S. K. Arora in 1989 at PAU, Ludhiana from Pusa Sawani treated with 1 % EMS. All these cultivars are no more in cultivation apparently due to break-down of resistance or lack of strong stable resistance in the mutants. These examples do not speak strongly in favour of mutation breeding for resistance to YVMV in okra.

Stability of Resistance to YVMV

After the experience of Pusa Sawani, both the breeders and pathologists have been very much concerned about the stability of resistance/tolerance in the newly developed cultivars and hybrids. In Pusa Sawani, tolerance was due to symptomless carrier condition indicating thereby the presence of virus and

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multiplication of virus within the host plant. This amounts to the fact that resistance to virus may take the form of an ability on the part of host to tolerate the presence of high concentrations of virus within its tissue without exhibiting symptoms or without suffering a serious loss of production. Naturally in such a condition, manifestation of the symptoms is suppressed but it is liable to break-down any time. In other words, symptomless carrier condition is always to be treated as resistance for a limited period of time. The new strains of virus may also develop and may break-down the tolerance. Another problem in such varieties was that the seed was multiplied in an off season or at a different region which was disease free and this facilitated multiplication of susceptible plants in a disease free condition. One should not forget that the newly bred cultivars or hybrids may not have absolute resistance and in the seed multiplication programme, continuous roguing of the disease affected plants (1-5 %) will have to be done meticulously to maintain high level of resistance year after year. In case of hybrids, this exercise will have to be done during multiplication of the parental seeds. In absence of these strict compliances, the varieties/hybrids get deteriorated because of lower initial resistance/tolerance/symptomless carrier conditions. The breeder should always have alternate resistant cultivars/hybrids to substitute earlier released ones 8-10 years ago. Hence continuous search for new sources of resistance and development of better varieties/hybrids with higher level of resistance should receive attention of breeder and resistance breeding has to be viewed as a continuous on-going project. Horizontal resistance (resistance evenly spread against all races of the pathogen) is supposed to be more stable and durable and need to be looked into seriously (Seshadri, 1998).

However, there are examples of virus tolerant cultivars surviving under commercial cultivation for a very long time in some other crops, for example, strawberry variety Huxley has survived and remained under cropping in south England for more than 30 years while susceptible varieties such as Royal Sovereign were completely crippled by the virus. Huxley behaved as a symptomless carrier of strawberry virus and retained its position as a major strawberry variety. The symptomless tolerance of King Edward potato variety to the virus para-crinkle, is another well known example of the effectiveness of this type of resistance in ensuring the continued success of a variety in spite of infection by a virus (Williams, 1964).

YVMV Resistant Cultivars and Hybrids of Okra

In India, inter-varietal hybridization followed by pedigree selection produced the widely cultivated, high yielding, yellow vein mosaic virus tolerant cultivar, Pusa Sawani. This was called as symptomless carrier and is no more tolerant. Kashi Pragati (VRO 6), Kashi Mohini (VRO 3), Varsha Uphar, Hisar Unnat came later on as a result of inter varietal crosses and were reported to be tolerant to YVMV. Inter-specific hybridization (with *Abelmoschus manihot* L. Medikus subsp. *Manihot*) has been followed in development of YVMV tolerant cultivars like Punjab Padmini, P 7, Parbhani Kranti, Arka Anamika, Arka Abhaya, etc. In case of inter-specific hybridization, 1-2 backcrosses have normally been used and then the material has been handled as per pedigree method of breeding. However, at present, none of the above cultivars are showing stable and durable tolerance to YVMV due to break-down of tolerance as they were in all probability symptomless carriers or else new strains of virus have evolved. The hypothesis of evolution of new strains of virus seems to be one of the factors leading to break-down of tolerance as the tolerance in most of the cases has been reported to be location specific.

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Private sector seed companies in India have taken a decisive lead in development of YVMV tolerant/resistant hybrids mostly through inter-varietal crossing and accumulating the two dominant genes for resistance to YVMV along with possible minor genes into the hybrids from complementary sources i.e. improved lines. A major portion of okra seed in the market is from the improved OPs where all major seed companies are developing such cultivars and selling the seed. The prominent hybrids of okra currently under commercial cultivation in India and showing tolerance/ resistance to YVMV developed by several private sector seed companies are as follows:

Mahyco	:	Mahy 100, MH 10
Nunhems	:	Sonal, Samrat
Syngenta	:	OH 2324
Bioseeds	:	Abha, Komal, Miss Okra 18
JK Agrigenetics	:	JKOH 700, JKOH 7, JKOH 7315
Namdhari Seeds	:	Hyb 862, 7755
Advanta	:	Raadhika, Navaya, Jaani, Lavanya, Venus Plus
Nuziveedu	:	Shimiran, Rohini, Myna 24
Seminis	:	001, 8999, 5151
Clause	:	Chiranjeevi
East-west	:	Commando
Rasi	:	sarthi, shatabdi
Sakata	:	O:kra 713, 715, Poorvi, prerna,
Kaveri Seeds	:	1107, 703
Dayal Seeds	:	DHO 40, DHO 50, Komal, Urvashi
DCM Shriram	:	Ankita, Suhani
Metahelix	:	Jaya
Tokita	:	Durga, Kushal

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Darjeeling Mandarin: Steps to mitigate the challenge of its decline

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INTRODUCTION

Mandarin orange is one of the important commercial fruit crops in Darjeeling and Kalimpong districts of West Bengal. The *Citrus sp*, native to Darjeeling and Kalimpong district, is commonly known as Darjeeling mandarin (*Citrus reticulata* Blanco). This high quality orange is world famous for its aroma, juice, easy-to-peel rind and segments, excellent quality and bright colour and is completely different from the varieties cultivated in other states of our country. It is grown in about 4000 hectares of land in the hills with an annual production of 39.55 metric tons (National Horticulture Board, 2017). Mandarins are rich in vitamin A, B, C and phosphorus, which are consumed fresh or in the form of juice, jam, squash and syrup. It is one of the main sources of peel oil and citric acid. The decline of orange orchards in Darjeeling is apparently due to general neglect and associated with absence of scientific cultivation practices. The major causes have also been identified after extensive and systematic survey in Darjeeling, Kalimpong and adjoining area of the Sikkim covering all age groups of plants in different orchards.





The major causes of decline are:

1. Inadequate use of manures and fertilizers.
2. Macro and micro nutrient deficiency in soil particularly N, P, K, Cu, B, and Zn.
3. Problems of pests and diseases.
4. Use of poor quality seedling in new orchards.
5. Problems of weeds and parasites.
6. Cultivation of ginger, large cardamom, maize and vegetables in orange orchards.

Other than these, non-availability of wide terraces is also a limiting factor for production and productivity of mandarin orange in this district.

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Citrus splitting


Yellowing leaves


Nitrogen Deficiency


Multi-cropping


Lichens


Weeds

Month wise calendar for scientific management of orange orchards in the districts of Darjeeling and Kalimpong

For establishing a new orchard

January

- Select a variety resistant/ tolerant to major pests.
- Select healthy rootstocks/planting material. Treat the rootstocks/planting material with recommended pesticides especially biopesticides.
- Select a suitable land with plenty of sun light at height between 300- 1600 hundred masl (meter above sea level).
- Select land with deep soil having a depth of 80-90 cm, well drained, fertile and pH 5.0-6.5 with proper irrigation system.
- Deep ploughing before establishment of orchards, remove the weeds, use those for manure preparation.
- Digout pits in suitable terrace (preferably slopy), 6m × 6m × 5 m apart and pit size: 60 cm × 60 cm for 250-330 plants per hectare.
- Good sanitation practices are essential to avoid nematode infestations.
- Fill the pits with well decomposed FYM (25 kg), neem cake (2-3 kg) and rock phosphate/ dolomite (1kg) per pit mixed with equal quantity of top soil. Cover the pit (raised up to 2-3 inch) and put a peg at the centre.
- Apply *Trichoderma spp*. and *Pseudomonas fluorescens* for seed/seedling/planting material as nursery treatment and also for soil application.
- Soil application of Neem cake and *Paecilomyces lilacinus* ($1×10^9$ CFU/ml or $1×10^8$ CFU/gm) @ 10 lit or 12 kg/ha to control heavy infestation of nematodes.
- Marigold can be grown as inter crop to reduce nematode attack.

For existing orchard

- Harvesting of fruits should be completed in the month.
- Clear weeds and tillage of orchards followed by pruning of dead wood and infested branches.
- Grasses to be used for manure preparation.
- Removal of loranthus from orange tree.
- Mosses and lichens particularly on the trunk (60-75cm) should be cleaned with gunny bag pieces.
- Pruned branches should be treated with paste made with Copper Oxychloride 50WP @ 100 gm/250ml of water.

February

- Clearing of orchards and tillage.

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- Application of dolomite @ 2-3 kg per tree at 3 years interval irrespective of age group of plant by light digging (not below 15 cm) around the canopy area leaving 30-45 cm area near the trunk.




Planting material Tillage practices Pruning Manure preparation

March

- Flowering starts in this month. New flushes of leaves also emerge.
- Aphid, Asian citrus psylla and leaf miner attack take place on the newly emerged flushes.
- Collect and destroy mined leaves and infected twigs and if required trees should be removed as soon as die-back symptom appears.
- Use yellow sticky trap @ 5/acre.
- Spray Neem oil/NSKE (Nimbicidine EC) @ 5ml/lit of water.
- Apply FYM/compost @10kg for 1-5 years, @ 25-30 kg for 6-10 years and @ 50 kg for 11-40 years old trees per plant below the canopy area and mix it in the soil.
- Application of fungicide Myclobutanil 10% WP @ 1.5gm/lit or Penconazole 10% EC 0.5 ml/lit to control powdery mildew.



Citrus Aphid

Symptom of leaf miner weeding

April

- Inititation of fruiting takes place.
- Aphid, leafminer and psyllid attack continues resulting in die back.
- Spray Neem oil/NSKE (Nimbicidine EC) @ 5ml/lit of water can also be sprayed, if required.
- Painting the trunk (up to 2ft-3ft) from ground level with a paste made of Copper oxychloride 50WP (100 gm)+ 10-15 gm red coloured fine soil + 25 gm botanical oil + 125 gm lime per liter of water.
- Foliar spray 2% $ZnSO_4$ at fortnightly interval.

May

- Fruiting continues
- Rain start at the end of the May
- Locate the stem borer holes, remove the wooden frass present in between the joints and plug the holes with wet soil after inserting petrol or kerosene soaked cotton @ 10 ml/tunnel with the help of syringe or apply Carbofuran 3G @ 5gm/hole.

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For establishing a new orchard

- Select a variety resistant/tolerant to major pests.
- Select healthy rootstocks/planting material.
- Give light irrigation immediately after planting if there is no rain.
- Stake the planted seedlings, if required so that the wind or rain may not disturb it for early establishment.
- During planting, care should be so taken that rain water do not accumulate around the plants.
- Remove sprouts which emerge out from trunk.
- Treat the rootstocks/planting material with recommended pesticides especially biopesticides.
- Apply *Trichoderma viridae*. (Bio-Cure-F: 1×10^9 CFU/ml or 2×10^6 CFU/gm) and *Pseudomonas fluorescens* (Bio-Cure-B: 1×10^9 CFU/ml or 1×10^8 CFU/gm) @ 10 ml or 20 gm/ lit of water for seed/seedling/planting material as nursery treatment and also for soil application.
- Spray with Copper oxychloride 50WP @ 1 kg/acre of water after planting.
- Spray Neem oil/NSKE (Nimbicidine EC) @ 5ml/lit of water at weekly interval.
- Soil application of Neem cake and *Paecilomyces lilacinus* (1×10^9 CFU/ml or 1×10^8 CFU/gm) @ 10 lit or 12 kg/ha to control heavy infestation of nematodes.


Initial stage of fruits


Citrus trunk borer

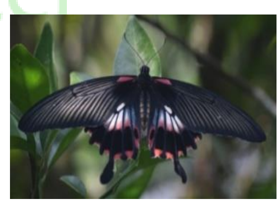

Spraying neem oil

June

- Egg laying in fruits by adult female of citrus fruit fly *Bactrocera minax* (Enderlein).
- Repeat plugging of trunk borer holes.
- Remove sprouts which emerge out from trunk
- Handpicking and destruction of various stages of citrus butterfly larvae.
- For newly planted and 1-5 years old plants de-shooting/de-budding at basal 40-50 cm height may be done at monthly interval.
- Apply per plant FYM/compost @10kg for 1-5 years, @ 25-30 kg for 6-10 years and @ 50 kg for 11-40 years old trees. Apply manure below the canopy area and mix it in the soil.
- Spray Neem oil/NSKE (Nimbicidine EC) @ 5ml/lit of water at weekly interval (in sunny days when available).
- Apply Cymoxanil 8% + Mancozeb 64% W.P. @ 2.5gm/lit or Fenamidone 10% + Mancozeb 50% w/w WG (60 WG) @ 3 gm/ lit to control citrus gummosis.
- Application of fungicide Myclobutanil 10% WP @ 1.5gm/lit or Penconazole 10% EC 0.5 ml/lit to control powdery mildew.


Citrus trunk borer


Citrus fruit fly


Citrus butterfly

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July

- Rain continues
- Spray Neem oil/NSKE @ 5ml/lit of water at weekly interval (in sunny days when available).
- Fruit growth starts
- Upto middle of july fruit fly egg laying takes place
- Repeat control of trunk borer and removal of water suckers from trunk and general cleaning.
- Removal of undesirable growth and parasitic plants.
- spraying of Wettable Sulphur (1.5kg/200 litres of water)
- If gummosis is found to be a severe problem: Alternate Spray of Cymoxanil 8% + Mancozeb 64% W.P. @ 2.5gm/lit or Fenamidone 10% + Mancozeb 50% w/w WG (60 WG) @ 3 gm/ lit to control citrus gummosis.

Citrus gummosis

Parasitic plants

August

- Fruit growth continues
- Repeat plugging of holes of trunk borer, removal of parasitic growth carefully so that fruits are not damaged.
- If possible Spray Neem oil/NSKE @ 5ml/lit of water at weekly interval.
- Application of fungicide Myclobutanil 10% WP @ 1.5gm/lit or Penconazole 10% EC 0.5 ml/lit to control powdery mildew

September

- Stink bug attack starts
- Weeding
- If possible Spray Neem oil/NSKE @ 5ml/lit of water
- Repeat application of fungicide to control powdery mildew.
- Repeat application of fungicide to control citrus gummosis.
- Application of micronutrient mixture (according to availability of market).
- Apply Streptocyclin @1gm + Blitox @2.5 gm /lit to control citrus bacterial canker.

Weeding

Citrus stink bug

October

- Rain seizes
- Fruit, green in colour.
- Fruit drop starts at the end of October due to fruit fly and stink bug attack.

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- Poly-mulching should be done from 1st week of the month and continues up to fruit harvesting
- Repeat trunk borer control
- Weeding
- Apply fungus *Metarhizium anisopliae* (1×10^9 CFU/ml or 1×10^8 CFU/gm) @ 5 ml or 6 gm/lit as soil treatment to control fruit fly larvae.
- If possible Spray Neem oil/NSKE @ 5ml/lit of water.
- Apply Mancozeb 75% WP @ 2.5gm/lit to control citrus anthracnose disease.


Fruit dropping


Poly- mulching


Citrus stink bug

November

- Heavy fruit drop takes place
- Collect infested drop fruit and dip into water kept in a bucket. Apply kerosene in the water.
- Harvesting starts at the end of this month
- Poly-mulching continues


Collection of infested drop fruit

December

- Major fruit harvesting takes place in this month
- Collection of dropped fruits and dip into water kept in a bucket mixing kerosene.
- Light pruning after harvesting
- Paste Copper Oxychloride 50WP @ 100 gm/250ml of water on the cut surfaces of the branches after pruning.

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Allele mining: Approaches and its Importance in Crop Improvement

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What is allele mining?

Mining is extraction of any non resources such as Petroleum, natural gas, minerals, or even water etc. It is a finding of superior allele from the natural population. In other words introgression of novel or superior allele from wild relatives into cultivated one.

Approaches for allele mining

There are three approaches for allele mining such as modified tilling procedure called ecotilling-based allele mining, sequencing-based allele mining and association mapping-based allele mining. Modified Tilling procedures called Eco-Tilling TILLING (Targeting Induced Local Lesions IN Genomes) is a technique that can identify single base-pair allelic variation in target gene (more specifically induced point mutations) while Eco-Tilling technique detects natural mutation. It allows the rapid detection of variation in many individuals and is cost effective because only one individual for each haplotype need to be sequenced. Tilling consists of several major steps: Development of a mutagenized population, DNA preparation and pooling, and mutation discovery. At first, random mutations are induced in genomes by using chemical mutagens. Seeds are mutagenized by treatment with ethylmethanesulfonate (EMS) etc. The resulting M1 plants are self-fertilized, and M2 individuals are used to prepare DNA samples for mutational screening. DNA is extracted from test samples. The DNA samples are pooled and arrayed into 96 wells containing microtiter plates. Screening for mutations begins with PCR amplification of a target fragment using gene-specific infrared dye-labeled primers. The forward primer is 5‟- end labeled with a fluorescent dye that is detected at 700 nm (IRDye 700) and the reverse primer is labeled with the IRDye 800 nm4. These PCR products are denatured and re-annealed to allow the formation of mismatches or heteroduplexes, which represent naturally occurring single nucleotide polymorphisms (SNPs) and induced SNPs. Samples, are then incubated with a single strand specific nuclease to digest mismatched base pairs. For mismatch-specific cleavage, several enzymes, including S1 nuclease, T4 endonuclease VII6 and Cel-1 7 have been used. Cleaved bands representing mutations or polymorphisms are visualized using denaturing polyacrylamide gel.

Steps involved in allele mining:

- Selection of target trait
- Identification of accessions with desired phenotypic trait
- Target gene
- Primer designing for whole length of gene
- PCR amplification of the gene
- Sequencing and finding variation

Sequencing-based allele mining

Sequencing based allele mining involves amplification of alleles in diverse genotypes through PCR followed by identification of nucleotide variation by DNA sequencing techniques. In other words, multiplication of specific segment of deoxy-ribose nucleotides as well as, we can identify various allele among the cultivars through sequence based allele mining.

Association mapping-based allele mining

This strategy is used to establish regions of the genome associated with critical phenotypes by association or linkage-disequilibrium mapping. The approach relies on the assumption that alleles responsible for a phenotype, along with

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the markers which flank the locus, are inherited as a block. Using DNA markers has been suggested as a means to identify useful alleles in the vast reservoirs of genetic diversity.

Importance of allele mining in crop improvement: - It helps in tracing the evolution of alleles. Also helps in identification of new haplotypes and development of allele-specific markers for use in marker-assisted selection (MAS). This capability will be important for giving breeders direct access to key alleles conferring:

- resistance to biotic stresses
- tolerance to abiotic stresses
- greater nutrient use efficiency
- enhanced yield
- Improved quality such as cooking, protein, starch including human nutrition.

It can also provide insight into molecular basis of novel trait variations and identify the nucleotide sequence changes associated with superior alleles.

Applications of Allele Mining

Allele mining can be effectively used for gene prediction, expression study, evolutionary study, discovery of superior alleles, identification of new haplotypes, similarity analysis-inter and intra species and functional molecular marker development for MAS.

Crop	Allele/locus	Trait/name of the protein
Wheat	Viviparous-1	Pre-harvest sprouting tolerance
Rye	*Alt3*	Aluminum tolerance
Apple	*Mal d 3*	Allergenicity
Apricot	*S*	Self-incompatibility
Barley	*Amy32b*	α amylase
Barley and wheat	transcription factor - GAMYB	GAMYB-involved in gibberellin signaling
Barley	*VRN-H1* and *VRN-H2*	Vernalization requirement
Barley	*Bmy1*	β-amylase I- starch break down enzyme
Tomato	*Pto*	Disease resistance
Barley	*Gpc-B1*	Grain protein content
Barley	*rps2*	Ribosomal protein S2
Grapevine	*VvmybA1*	Transcriptional regulator of anthocyanin biosynthesis
Wheat	*Pm3*	Powdery mildew resistance
Pea	*TI1*	Trypsin inhibitors characterization
Phaseolus sp.	Lectin locus	Storage and defense proteins
Potato	*Rpi-blb1*	Late blight resistance
Rice	*Badh2*	Fragrance
Rice	*Pi ta*	Blast resistance

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Agniastra (Agni missile) - The elixir for modern day agriculture

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Dependence on Chemical fertilizers and pesticides has made farming operations unsustainable on all fronts. The massive use of fertilizers and pesticides, has not only robbed the soil of its inherent vigor and vitality it has also made production and productivity stagnant. Management of paddy insect-pests by organic approaches was a challenge for present agriculture scenario. Among the various organic treatments against insect pests and their safety to natural enemies important aspect for consideration. Natural organic pesticide control had no insecticide application and the control was largely due to the activities of naturally occurring plant material and animal waste. It also promote high level of predatory spiders and lady bird beetles were found in the fields of natural biological control compared to field of need and schedule base protection. The population of natural enemies was minimum at 60 days after transplanting in schedule base protection when the population of brown planthopper was also high. Application of 'Agniasthra' 50 ml/l lower planthopper population of BPH, WBPH and leaf folder damage.

INTRODUCTION:

Among various constraints in rice production, damage due to insect pests is substantial and needs regular attention. Large-scale cultivation of high yielding varieties, monocropping, close planting, water regime, excessive use of nitrogenous fertilizers and irrational and abuse of agrochemicals have further aggravated the pest incidence. Over 1400 insect species attack standing and stored rice in the world (Grist and Lever, 1969) while, Kalode and Pasalu (1986) reported that over 100 species of insect pests attack rice crop at various stages of its growth.

In India, moreover loss incurred due to different insects pests of rice is reported to the tune of 15,120 million rupees which works out to be 18.60 percent total losses (Chandramani et al., 2010). In Karnataka the crop is being affected by BPH, WBPH, GLH in Kharif and stem borer and leaf folder in Rabi. The primary and conventional mode of managing them is pesticide intensive approach (5-6 month of sprays). From time to time several insecticides have been tried and recommended for management of stem borer, leaf folder, brown planthopper, white backed planthopper and green leafhopper but few of them are showing resistance to some insecticides (Balasubramanian et al., 1983). India is bestowed with a lot of potentials to produce all varieties of organic products due to its agro-climatic regions. In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market.

The application of insecticides, however, can cause several problems: development of insecticide resistant biotype, environmental pollution and undesirable effects on non-target organisms including the natural enemies of the target pests (Kiritani, 1979). In contrast, the use of botanicals less toxic to natural enemies should conserve natural enemy populations and the surviving natural enemies may suppress the pest populations,

What is agniastra:

A complete organic pesticide prepared with the Indian traditional methodology. It acts as a manure for the soil and plants and it can remove all kind of pests, insects and also increase the richness of the soil. Moreover it acts as an enricher for the greenery of the plant, can be used for vegetables, fruits, flowers and other agriculture crops.

Composition of agniastra:

- Desi Cow's Urine
- Natural Herbs(Neem seed, Neem leaf)
- Garlic
- Pepper
- Jaggery
- Green Chilly
- Water

Application methodology:

- Use once in four days for the first and second application.
- Once in a week on subsequent application

Ideal time for the application?

- Best suggested time for application of Agni-Astra being either in early morning hours or evening hours.

Dosage:

- 1 litre can be mixed with 50 litres of water and it can be sprayed on the crops.
- **Note:** Do not mix any other chemicals with Agni-Astra.

Needs of agniastra:

Some biological processes of plants involved in acquiring nutrients such as nitrogen are inhibited by adding nitrogen fertilizers and lead to a deficiency of micronutrients. Hence, organic farming avoids the use of chemicals and encourages the use of organic compost. Soil fertility can be improved through the use of agniastra. Well-fed, healthy soil that is rich in micro-flora and micro-fauna takes care of crop nutrient requirements.

Mode of action:

Insecticide, Fungicide, Bactericide, Viricide, Acaricide, Nematicide, Termiticide

Benefits of agniastra:

- Protect fruits and flowers from the effect of insects.
- Keep the plants healthy.
- Less material required for preparation.
- It also act as biofertilizer.
- Reduce the development of biotype.

CONCLUSION:

Saving on the cost of seeds, Fertilizer and plant protection chemical has been substantial. Because of continuous incorporation of organic residues and replenishment of soil fertility. Helps to maintain soil health. The new system of farming has freed the farmers from the debt trap and it has installed in them and renewed sense of confidence to make farming an economically viable venture.

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Contemporary water management innovations related to water harvesting and water budgeting based on agro-ecological principles

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INTRODUCTION

These contemporary water management innovations (CWMI) solve the serious problems related to fast depletion of ground water resources and deterioration of its quality in the dryland agriculture. The majority of farmers depend mainly on bore wells for irrigation purposes. Due to increase in well density and over-exploitation of groundwater through bore wells, many functional wells were found to be giving poor yields and some were turning dry. The farmers, the NGOs have been applying many water harvesting technologies such as restoration of traditional water bodies, gully control, construction of check dams, percolation tanks, Recharge pits (with layers of stones, sand, soil), Slug test (water table measuring test), Soaking pits, De-silting, Stone layering (with stone pellets), Deep trenches across slopes, etc., for recharging groundwater.

Notions that farmers held earlier

There was a mindset among the people that if one's bore well was not yielding sufficient water, his/her alternative option was to drill a new bore well. But most of the times, this kind of approach ended up in big financial losses to the farmers and even suicides.

CWMI used by farmers for water harvesting and water budgeting

recharge pits: Innovative recharge technique is a relatively new technique which is used for directly recharging the functional bore wells and/or abandoned bore wells. Instead of drilling new bore wells in water scarce regions, direct recharging of poorly yielding bore wells or bore wells in depleted groundwater zones yields better results. The main output from this simple technology is immediate improvement of water levels in the bore wells and improved water quality. A recharge pit dug around the bore-well depends upon the dimension of borewells.

Fig-1 Recharge pits

Slug test (water table measuring test): As has been explained by farmers of Ananthapur district, it is a test done for measuring of water table. The device used is known as water level indicator. The process of measuring the water table includes dropping an electronic based device into the bore well and when it goes inside the bore-well and touches the layer of water present, it would start giving beep sound. A meter on the indicator

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represents water level present in the bore well at that time. Based upon the water level farmers go for either drip irrigation or sprinkler irrigation.

Soaking pits: By using soaking pits, rain water, without getting wasted as run off, slowly percolates into the soil and gets gathered in the ground water aquifers and thereby increasing our ground water resources.

Fig-3 soaking pit

De-silting: De-silting is the process of removing silt deposited from the water storage structures: farm ponds, water tanks and large water reservoirs, deep open wells so that all water bodies get renewed. In fact, over a period of time, the soil, silt and sand coming with run-off rain water gets deposited at the bottom of the water bodies and reduces the storage capacity of the tank. In addition, the silt deposited at the bottom of the water bodies plugs all the holes in the tank and does not allow any water to percolate into deeper layers of the ground. If the water in water bodies percolates into deeper layers of soil, ground water accumulation occurs, thereby recharging ground water aquifers. Another benefit of de-silting can be seen in the way farmers apply the se-silted soil in their own fields for good soil enrichment, as silt is found to be enhancing soil structure and soil fertility in drylands.

Fig-4 De-silting

Stone layering (with stone pellets): Stone layering is a process laying stones at the bottom of the water bodies, after de-silting is done. This is done by using stone pellets for ground water recharge. Stone layering is also done on the sloping bunds of tanks, ponds and reservoirs as well for checking tank bund breaks and avoiding erosion of sloping soil bunds of tanks.
Dried up big deep open wells are also repaired by digging out the silt deposited at the bottom and covered with stone pellets for increasing percolation and water holding capacity.

Deep trenches (across slopes): Farmers practicing agriculture in the catchment areas where run off (water) is very high due to uneven soil topography, face twin problems of losing run-rain water at high speeds and also the fertile top soil, which gets eroded in the process. Hence, diggings soaking pits and deep trenches across the slope are suggested to solve these problems. By doing so, rain water storage in underground layers gets naturally enhanced and not wasted as run off causing soil erosion.

Fig-6 Deep Trenches

Water budgeting

Water Budgeting was accepted as an innovation among all the farmer respondents. Here crop-water contingency plans were made for all farmers. Depending on the rain water harvested and the ground water available in the bore well (as measured on first day of every month in the water sharing groups), decisions were made on the amount of water required for all crops in the group, and the crop growth stage, and whether this water is adequate enough for sprinkler irrigation or drip irrigation method of distribution. Thus judicious decision making allows for water sharing equitably among all group members. *'Decision by consultation, discussion and consensus'* was followed in all group meetings.

Water budgeting concept was geared towards instilling an understanding of how water aquifers get charged, its judicious use and long term availability, following the principles of equity and water requirements for all group members. Farmers were made aware of the hydrological cycle and their dependencies on it. Rainfall data provided by Automated Weather Stations (AWSs) installed in villages was used. Community based water management involve surface and ground water monitoring, water availability estimation, water conservation and productivity enhancement, appropriate crop planning and farmers field schools.

CONCLUSION

Dryland regions depend on groundwater in the post monsoons, communities were capacitated to monitor their groundwater levels using a water level indicator. Bi-monthly data collected captures the groundwater fluctuation and is publicly displayed. Based on this information, crop plans were made (prior to the Rabi sowing, taking care to secure sufficient water for livestock and domestic purposes in summer). Efficient irrigation methods (drips, sprinklers, micro irrigation systems) were being adopted by the farmers of our country to efficiently manage their life to sustain with water management crisis.

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Tree leaves - A potential supplementary fish feed

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INTRODUCTION

Aquaculture is playing a significant role in ensuring the nutritional security. The consumption and demand of fish across the world has been increasing along with the time span. In this regard, the supply and provision of quality fish feeding materials becomes a crucial part for necessitate the growing demand of fish. However, the situation of price increasing in the fish feed along with their inconsistent quality had created a major holdup in the expansion of aquaculture operations. In this context, the exploration and use of alternative fish feeding materials which is having high protein source would become economical and substantial one. Fish feeds which have been derived from several tree species such as *Moringa oleifera*, *Leuceana leucocephala, Sesbania grandiflora,* etc can be considered and successfully incorporated in the fish ingredients. Since, trees being a perennial in nature as well as easily locally available. However, the use of tree originated feeds may face certain limitation initially, but the improvement strategies could be identified and can be successfully incorporated as important ingredients in the formulation of fish feeds.

Key points to be considered while selecting the fish feed materials

- Digestibility
- Palatability and its acceptability,
- Availability
- Cost involved

Some of the potential tree species use for fish feeding materials

1. Species: *Leucaena leucocephala*

Nature: Fast growing leguminous tree

Nutrient content status: Contains more than 20 % crude protein

Used in fish feed: Verma et al (2018) reported that fish feed containing of 33 % *Leucaena leucocephala* seed powder helps in improving the immune system of *Clarias gariepinus*. Feeding of mimosine free *L. leucocephala* up to 20-50% by replacing fish meal protein of Nile tilapia does not produced any negative impacts on the health of fish (Wee and Wang, 1987). Similarly, Mamat et al. (2017) also reported that *L. leucocephala* fish meal can be successfully replaced up to 25 % diets of *Macrobrachium rosenbergii* without compromising the growth.

2. Species: *Moringa oleifera*

Nature: Small deciduous tree

Nutrient content status: Rich in protein, lipids, vitamins and minerals

Used in fish feed: Ayotunde et al (2016) demonstrated that *Moringa oleifera* leaf meal can be successfully replaced up to 10 % of the fish meal of *Clarias gariepinus* without compromising the growth. Replacement up to 10 % of fish diet with *M. oleifera* leaf meal could enhanced the released of chelating nutrients required for higher growth in Labeo rohita fingerlings (Hussain et al., 2015). Afuang et al. (2003) had observed that solvent extracts of moringa leaves can replace 30% of fish meal in *Oreochromis niloticus* diets and produced better growth.

3. **Species:** *Morus alba*

Nature: Fast growing medium sized tree

Nutrient content status: High protein content and mineral elements

Used in fish feed: Olaniyi et al (2016) observed that replacement of fish meal of *Clarias gariepinus* up to 15 % by *Morus alba* leaves produced

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optimum growth. M. alba based feed yield better survival percentage, feed conversion ratio and specific growth in *Heteropneustes fossilis* as compared to ground nut cake and dried earthworm based fish feeds (Bag et al. 2012). Mondal *et al.,* (2012) also found that protein derived from leaves of *M. alba* can be successfully replaced the protein requirement in *Labeo bata* diet.

4. **Species:** *Sesbania grandiflora*

Nature: Shrubby or small plant

Nutrient content status: Reported to be high protein content (29.6 %).

Used in fish feed: Karpagam and Krishnaveni (2014) reported that supplementation of *Oreochromis mossambicus* feed with *Sesbania grandiflora* powder produce better growth as compared to control feed (without sesbania powder). Addition of *S. grandiflora* leaf meal helps in retention of protein, fat and energy which will eventually influence on the growth and development of black tilapia, *Orieochronus niloticus* (Firmani and Cahyoko, 2015).

Major constraints of tree based fish feeds

- Alkaloid or tannin content
- Requirement of standardization of feeding regime
- Adverse effect on fish growth and health when feed at higher amount

CONCLUSION

The supply and provision of quality fish feeding materials becomes a crucial part for necessitate the growing demand of fish. From the findings of previous studies, it is concluded that tree leaves based fish feeds can be successfully incorporated in the diets of several fish species. The ease of availability and increasing in the price trends of artificial fish feed exaggerated the demand and consideration of tree based fish feed as a potential supplementary fish feed. However, the use of higher concentration of these feed could hamper the growth of fish and need proper standardization before it is incorporated in the artificial fish feed.

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Major problems faced by chilli growers due to biotic stress in garhwal regions of Uttarakhand and its integrated management

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Chilli is an important crop for earning good profit to small scale farmers in many regions of India. It is very sensitive against biotic and abiotic stresses. And it is reported that there are so many pathogen are there in soil and air which causes so many diseases and mitigated the production of chilli. To cope up with this problem farmers are use chemical pesticide on large scale in their field which is not safe for human health as well as environment. So we have to move towards new strategies to minimize uses of chemical pesticides.

INTRODUCTION

Chilli *(Capsicum annuum* L.*)*, is an important vegetable crop grown worldwide. It is exists as an annual herbaceous vegetable or perennial shrub of the Solanaceous family grown in both tropical and sub-tropical regions. Chilli is suitable for the diets of the obese and is useful in the control of cancer of the stomach and colon. Chilli is nutritious crop, every 100 g of green and dry chilli yield about 229 and 297 calories of energy. Chilli peppers are low in sodium, cholesterol free, rich in vitamins A and C and are a good source of potassium, folic acid and vitamin E. Fresh green chilli peppers contain more vitamin C than citrus fruits and fresh red chilli has more vitamin-A than carrots. India is largest producer, with 36% share in global production. Andhra Pradesh, Orissa, Maharashtra, West Bengal, Karnataka, Rajasthan and Tamil Nadu are found to be important chilli growing states in India.

In Uttarakhand although climatic conditions are favorable for chilli production but in comparison to other states of India Uttarakhand accounts very low chilli growing area and production *i.e* 2.0 (000 ha) and 7.2 (000, MT), respectively (NHB 2015). This low production is because of farmers of Uttarakhand especially in garhwal regions, face many problems and one of the major problems which create barrier to chilli production in garhwal region of Uttarakhand is biotic stress resulting in diseases. Fifty one different pathogens have been reported to cause diseases on various parts of chilli Out of them; thirty nine belong to the fungi of classes Mastigomycotina, Ascomycotina and Deuteromycotina. Fungal diseases are still an obstacle to the economic production of chilli. The most serious diseases of chilli in garhwal regions of Uttarakhand which is decrease the interest of farmer to cultivating chilli are anthracnose, Powdery mildew, Fusarium wilt, Cercospora leaf spot and Bacterial wilt etc.

Anthracnose or fruit rot

Anthracnose of chilli caused by *Colletotrichum capsici* (Syd.) it is seed born and one of the most economically important disease reducing marketable yields from 10% to 80%. *Colletotrichum* is capable of causing disease on virtually all parts of the chilli plant during any stage of plant growth. However, fruit lesions are the most economically important aspect of anthracnose disease. The initial symptoms are appear on leaves as small black, circular, sunken spots, these spots are markedly delimited by a thick and sharp black outline enclosing a lighter black or straw coloured area. On fruits the symptoms are appear as spot usually circular and sunken with black margins, these spots are covered by pinkish mass of fungal spores and in later stage the die back symptoms are observed. The infected plants bear fewer fruits of low quality and fruit rot reduces dry weight of capsaicin and oleoresin content of affected fruits and leading to reduction in the medicinal properties of chilli.

(A) Anthracnose symptoms on chilli fruits

(B) Anthracnose symptoms on leaf IDM Practices

1. Disease free seeds should be employed to avoid seedling infection and mortality in nursery beds

2. Seed treatment with *Trichoderma harzianum* and *Pseudomonas fluorescens* @ 5g per kg seeds, Thiram, Captan and Brassicol @ 2.5-3.0 g per kg seeds and hot water treatment @ 52^{0}C for 30 minutes has been found effective in the elimination of seed borne inoculums.

3. It always better to protect the plants from seedling stage by spraying the newly emerged seedlings with Captan or Ziram at 5-7 days interval.

4. Sanitation is very important. Debris of a diseased crop should be collected and burnt. Solanaceous weed host should not be allowed to grow in the vicinity of the field.

5. Spray the crop with Neem and Garlic extract @ 2000 ppm or *T. harzianum* 1% at 20, 35 and 50 days after transplanting can effectively control the disease.

6. Spray with chemical fungicides like mancozeb, zineb @ 0.2% or Propiconazole, carbendazim @ 0.1% at 15 days interval.

Cercospora leaf spot

Cercospora leaf spot of chilli is one of the major problems of chilli cultivation. It is caused by *Cercospora capsici.* The infection occurs luxuriantly when temperature goes blew 28^{0}C, 92% relative humidity and pH 5-6. The disease does not develop when relative humidity below 90%. The fungus survives in plant debris, primary infection coming from air-borne spores derived from it. The symptoms appear as circular spots with a light gray center and a reddish-brown margin, growing up to 1 cm in diameter. Spots later become tan with a dark ring and a yellowish halo around the ring, resulting in a "frog-eye" appearance. *Cercospora capsici* was shown to be consistently associated with leaf spot of chilli, reducing appreciably the photosynthetic activity of infected plants leading to losses in yield. When numerous spots occur on the foliage, the leaves turn yellow and may drop or wilt. Defoliation is often serious, exposing fruits to sun scald.

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Symptoms of Cercospora leaf spot caused by *Cercospora capsici*

IDM Practices

1. Use seed from disease-free areas. Cultural practices like inter-cropping, adjustment of time of sowing, rouging, collect and burn the infected plant debris, follow crop rotation and maintain proper drainage in the field.

2. Space plants properly in the field to allow for good air circulation and to avoid extended periods of leaf wetness.

3. Physical methods like hot water treatment of seed at 52°C for 30 minutes. Alternatively, use seed disinfectant if seed come from infected plants.

4. Treat the seeds with captan (0.3%) and spray the crop with carbendazim (0.1%) or thiophanate methyl (0.1%) or combination of mancozeb (0.25%) and carbendazim (0.05%) or difenoconazole (0.03%) and repeat at 10 to 14 days interval.

Fusarium wilt

Fusarium wilt of chilli caused by *Fusarium oxysporum* has emerged as a serious problem in past decade with the disease incidence of 2 to 85 per cent in different regions of India and the yield losses vary from 10-80 per cent worldwide depending upon the variety being grown and prevailing climatic conditions. The pathogen has necrotrophic nature and typically soil-borne. It favors the dry weather condition and excessive soil moisture for development of disease. The characteristic symptoms of the disease are observed as brown vascular discoloration followed by upward and inward rolling of the upper leaves and subsequently wilting of the plant. Fusarium wilt is a typical soil borne disease and the fungus survives for several years in soil. The pathogen is extremely adaptable, variable and capable of long persistence in the soil in the form of chlamydospores

IDM Practices

1. Among the different management practices, chemicals are neither economically viable, nor safe for the environment. The best way of management of this disease is only use of resistant cultivars like CO-4, HC-1, GC-1, GC-2, Kashi Gaurav, Ajeet-6 and DKC-8 etc.

2. Specific control measures for Fusarium wilt are usually not used. However, many of the controls recommended for Fusarium root rot may minimize Fusarium wilt, such as crop rotation soil solarization and flooding have been successfully used for the control of Fusarium wilt diseases.

3. Soil treatment with broad-spectrum fumigants such as methyl bromide, chloropicrin, or methyl isothiocyanate both alone or in mixtures successfully controlled Fusarium wilt of chilli and increased crop yield

Powdery mildew

Powdery mildew causes by *Leveillula taurica* is unique foliar pathogen having ability to infect large number of plants and one of the devastating disease of chilli that cause significant yield losses up to 24 per cent. Powdery mildew is prevalent in all the major chilli growing states of India. The pathogen *Leveillula taurica* is an obligate parasite and having ectendophytic mycelium. It produces conidia on long and multi-branched conidiophores. High relative humidity during night than day time and temperatures around 24-28^{o}C are favorable for the disease development. In hilly areas of Uttarakhand the disease occurs during the last week of august to September the first symptoms can be seen on older leave which later progress to younger leaves. The symptoms appear as chlorotic spot which becoming necrotic can be seen on upper surface of leaves. The under surface corresponding to these lesions is covered with white to grey-coloured powdery growth of fungus and affected leaves are curl upwards. The premature senescence of the leaves results in defoliation and in severe infection it may cause die-

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back of the twigs or branches and stunting of plants followed by fruit drop.

IDM Practices

1. Cultural practices like wider plant spacing for increase proper air circulation, sprinkler irrigation and misting in protected structures are effective in keeping the disease under check.

2. Foliar spray with *Trichoderma viride* @ 5 g/lit of water and *Pseudomonas fluorescens* @ 10 g/lit of water are effectively control the disease. Neem oil @ 1000 ppm also reduces chilli powdery mildew disease.

3. With the initiation of disease spray the crop with systemic fungicides like hexaconazole (0.05%) or carbendazim (0.1%) or difenoconazole (0.03%) and repeat at 10 to 14 days interval

Bacterial wilt

Bacterial wilt is a serious soil borne disease of many economically important solanaceous crops. It is caused by *Ralstonia solanacearum* this species was known for many years as *Pseudomonas solanacearum.* This disease occurs in warm temperate, subtropical and tropical regions of the world. The disease is also called southern bacterial wilt, solanaceous wilt, southern bacterial blight and by many other common names in countries wherever it occurs. The initial symptom is wilting of terminal leaves, followed by a sudden and permanent wilt. Sometimes wilting occurs only in few branches of the plant, during hot days followed by recovery throughout the evening and early hours of the morning. The wilted leaves maintain their green color and do not fall as disease progresses. Under favorable conditions complete wilt will occur. Additional symptoms are vascular browning, water soaking of pith followed by browning and browning of cortex near the soil line during the later stages of infection. Bacterial streaming occurs when a freshly cut stem is suspended in water.

IDM Practices

Bacterial wilt is very difficult to control after it is established in the field. No single measure totally prevents losses caused by the disease.

1. Quarantine regulation must, therefore, be enforced to prevent introduction of exotic strains in this portion of the country

2. Cultural practices like long crop rotation with non-solanaceous crops viz., maize, cotton, soybeans, grasses, and rice, shifting of date of transplanting to avoid period of high temperature, heavy rainfall or both, avoid the movement of irrigated water from infected field to healthy cropping areas. Fields should not be over-irrigated, because excess soil moisture favors disease build-up.

3. Bacterial antagonists such as *Pseudomonas fluorescens, P. glumae, P. cepacia* and *Bacillus* spp. have also been known to reduce disease incidence.

4. Application of bleaching powder (15 kg/ ha) has also been found effective against this disease. Seedling dip in Streptocycline (100 ppm) for 30 minutes is also effective to some extent.

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Biotechnology techniques to improve drought tolerance breeding schemes

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The recent progress in genomics and bioinformatics are offering better opportunities to assess and enhance diversity in germplasm collections, introgress valuable traits from new sources and identify genes that control key traits. The creation of synthetic wheats and their extensive use in breeding, the development of intergeneric crosses, the monitoring and use of chromosomal translocations and substitutions represent significant practical progress, particularly for cereal crops. Significant advances have been registered in the development of in vitro selection methods and the selection of somaclonal variants. The manipulation of heterosis and polyploidy is offering new perspectives for improving yield potential and adaptation to abiotic stresses. Progresses in the understanding of the physiological basis are expected to increase the chances to select for more efficient enzyme, thus enhancing yield potential and resilience. The level of resolution and repeatability of phenotyping methods have improved, thanks in particular to the development of remote sensing methods. The adoption of new technologies in developing countries is however limited and heterogeneous, particularly in developing countries with low or mid-level economies. This is due mainly to limited human resources and well trained staffs, poor phenotyping infrastructure, insufficient high-throughput genotyping facilities and lack of information systems or adapted analytic tools. In most of those countries, there is a need for valorizing the importance and role of agriculture and agricultural research. New incentives and funding mechanisms are needed to improve field and laboratory infrastructures, information and communication technologies and the social status of scientists. Adoption of new technologies and their better integration in breeding programs are urgently required in developing countries to overcome the bottlenecks that still limit the translation of innovations in plant science into concrete benefits for poor farmers.

1. Doubled Haploids

The term “haploidy” is used for the gametic chromosome number and is denoted by “n”. Haploid chromosome number equals monoploid (n=x) in diploid species while in polyploid species, haploidy is called polyhaploid. In tetraploid species, gametic chromosome number is dihaploid (n=2x). It has been noted that 65% of the genes responsible for cell structure and tolerance to stresses are expressed during the gamteophytic stage causing variation among gametophytes for drought tolerance. The undesirable (conferring drought susceptibility) haploid cells or gametes are eliminated from the population within single generation as compared to field screening of the plants where heterozygous plants continue to show segregation for drought tolerance in every generation. In vitro screening has been carried out for the selection of drought tolerant microspores. Ambrus et al. (2006) screened maize microspores against the reactive oxygen species (ROS) induced by drought. It was noted that ROS species decreased the callus induction and regeneration potential. However, stress only allowed tolerant microspores to proliferate and to be regenerated into complete plantlets.

2. Embryo Rescue Technique

Wild species are a good source of drought tolerance and genetic variability (Sharma et al.1996). However, success rate of wide crosses is very low due to embryo abortion sooner or later after pollination. Embryo abortion occurs due to differences in ploidy levels, inhibition of chromosomal pairing, poor connection between chalzal cell and cytoplasm, degenerated endosperm and lack of starch availability at syngamy. In vitro embryo rescue techniques have been recommended to overcome post fertilization barriers. These techniques are highly dependent on the age of embryo. An early rescue (3–5 days after pollination) can be done to cultivate immature seeds, flowers or siliques (Smith 2013).On the other hand, embryo (at 10 or more days after pollination) may be directly dissected from the seed and grown on a suitable media to directly germinate into seedling (Lulsdorf et al. 2014). For instance it facilitated the development of drought resistant interspecific hybrid in sunflower (*Helianthus annuus* × *Helianthus argophyllus*; Sauca et al. 2011), wheat (*Triticum durum* × *Aegilo pstauschii*; Trethowan et al. 2014), Brassica (*Eruca sativa* × *Brassica compestris*; Agnihotri et al. 1990).

Table 1.Different protocols used for embryo rescue in interspecific crosses

Crosses	Media	Age of embryo	Stress	Reference
Helianthus annuus × *Helianthus argophyllus*	MS media without hormone	Ten days after pollination (DAP)	Drought tolerance	Sauca et al. (2011)
Hylocereus polyrhizus × *H. undatus*	Half-strength basal MS medium containing 680 µM glutamine, 0.55 µM NAA, 0.45 µM TDZ and various concentrations of sucrose	5 DAP	Aridity	Cisneros and TelZur (2010)
Aegilo pstauschii × *Hordeum bulbosum*	MS media	12 DAP	Chromosome elimination	Inagaki et al. (2014)

NAA: naphthaleneacetic acid; TDZ: thidiazuron

3. Marker Assisted Selection for Drought Tolerance

Most of the economical traits including those related with drought tolerance are quantitative and strongly influenced by the environment. The term quantitative trait loci (QTL) applies to genome regions that control these traits. The progress of molecular genetics made possible to identify regions which are associated with a quantitative trait. Molecular markers has been shown to be helpful for the selection and improvement of complex quantitative traits such as yield under drought and of traits that are highly laborious or cannot measured in breeder segregating population due to their destructive nature (eg, traits related to root architecture, water use efficiency, osmotic adjustment). Moreover, molecular markers are helpful in the introgression from wild genotypes in reducing number of backcrosses and linkage drag (introgression of undesirable genes along with gene of interest). Microarray techniques have been widely exploited to understand the differential pattern of gene expression and identify drought responsive genes, which expression increases under drought stress, and drought inducible genes which only express under drought stress. Huang et al. (2008) identified 2000

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drought stress responsive genes in Arabidopsis thaliana which expression increases several folds during stress treatment. About one third of genes were regulated by ABA and the ABA analogue 1425. Concentration of ABA and its catabolites showed a significant increase under water stress and declined to a normal level within three hours after rewatering.

4. Transgenic Breeding

Transgenics has been successfully created in various crop species. Some exhibited enhanced drought tolerance due to over expression of transgenes under drought stress.The commercial success of these transgenics is limited due to the relevance of transgenes to plant survival rather than plant productivity under drought stress. Few commercial successes in delivering drought tolerant transgenic varieties have been however reported. One such example is MON 87460, a transgenic variety of maize over expressing the cold shock protein B which has been released for cultivation in water deficit areas of US northern Great Plains (Chang et al. 2014). Detailed analysis of transgenes has also increased our understanding of the functional mechanisms of drought tolerance (Nir et al. 2014). Review of the current research activities shows that trangenes were mainly created with the aim to over express specific molecule which enhanced plant survival (Nir et al. 2014, Zhu et al. 2014). Nir et al. (2014) noticed that transformation of tomato plants with GA methyl transferase (ATGAMT1) increased drought tolerance by reducing the transpiration and maintaining water contents. Similarly, over expression of EsWax1 increased the cuticular wax deposition on leaves and consequently reduced transpiration. However, cuticular depositions were negatively correlated with functional properties of the leaves and reduced the productivity of the plants (Zhu et al. 2014). Over expression of the β carotene hydroxylase Chy B gene increased the productivity of plants under drought stress by maintaining photosyntheis and reducing leaf necrosis under drought stress (Zhao et al. 2014).Transformation of the alfalfa with GsWRKY20 increased proline and sugar contents (Tang et al. 2014).

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Parthenocarpic fruit development in Cucurbits

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INTRODUCTION

Vegetables are important in income and employment generation, with various health benefits and providing food security to the country. The vegetables belonging to the diverse family of Cucurbitaceae are the largest group of vegetables. There is a great diversity in the family and the range of adaptation of species to tropical, subtropical regions, arid deserts and temperate locations and now also in high altitude areas. The family Cucurbitaceae consists of 117 genera and 825 species and there are approximately 30 species belonging to 9 genera of cucurbits that are used as cultivated plants. Among the different genera belonging to this family, two are of great nutritive importance *viz., Momordica* and *Trichosanthes.*

Kakrol and pointed gourd has a number of problems relating to its yield and fruit quality. Among the problems low yield, small sized fruit, low bearing, lack of flowering synchronization of male and female plants, regular cumbersome hand pollination (increase cost of production), presence of a large number of hard seeds in the fruit (decrease palatability) are considered to be important. Among the problems related to fruit quality, presence of hard seeds in the fruits after 14-16 days after anthesis deteriorates the palatability of the vegetable. As kakrol is a dioecious cross-pollinated crop female flowers need to be hand pollinated for high rate of fruit setting. Besides, early fruit development and seed formation restricts the development of additional fruits (Denna, 1973; Tiedjens 1978). This may be due to competition for metabolites by early developing fruit over later fruits or to the production of growth hormones by developing seeds, which inhibit further development (McCollum, 1934). If a seedless or less seeded fruit could be developed the above two problems could be avoided and the harvesting period could be extended.

PARTHENOCARPY

Parthenocarpy, i.e. the development of fruits without seeds, is a comparatively rare incidence. Two types of parthenocarpy exist in nature. In vegetative parthenocarpy, fruits develop without pollination. In stimulative parthenocarpy, fruit set arises from the stimulus of pollen-grain without subsequent fertilisation. Seedless or less seeded fruits could be developed through parthenocarpy. Parthenocarpy is considered the most efficient way to produce fruits under environmental conditions adverse for pollination and fertilization. It improves fruit quality and increase productivity, as pollinator plants are no longer needed. It allows early fruit production and harvest (Vijay and Jalikop, 1980). Parthenocarpic fruits can increase fruit acceptance by consumers (Ratino *et al*., 1997).

Unlike, parthenocarpy, pollination and fertilization are essential for fruit set which increase the level of phytohormones in the ovary, stimulate cell division and lead to fruit set. There are many methods available to produce parthenocarpic fruits in many crops. They are the uses of synthetic growth promoting factors, transport inhibitors of growth promoting factors, mutants capable of parthenocarpic development pollination with incompatible pollen, X–ray irradiated mentor pollen or plants altered in their ploidy level (Sugiyama and Morishita, 2002).

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The developing ovule is a source of auxin and exogenous auxin can replace the developing ovules to sustain fruit growth. Subsequently, an endogenous increase in auxin synthesis and content within the ovules during early phase of floral and fruit development might be a way to support fruit setting and growth without pollination (Ratino *et al*., 1997).

In absence of natural or genetic parthenocarpy, alternate method should be adopted to have seedless fruit. Parthenocarpy can be induced in many crops (cucumber, tomato, bottle gourd, brinjal, *Cucurbita*, watermelon, etc.) by applying exogenous auxins gibberellins and cytokinins and also auxin transport inhibitors (Cantliffe, 1977).

Use of growth regulators for parthenocarpic fruit development in cucurbits

Kim *et al*. (1992b) observed that parthenocarpic fruit set of ''Khira'' was promoted by applying fulmet. They also reported that application of Naptalam, TIBA, GA_3 and CPPU (N_1-(2-chloro-4-pyridyl)-N_3-phenylurea) to the ovary or peduncle significantly increased the IAA content in ovary of cucumber, which enhanced parthenocarpy.

Applying a 200 ppm solution of CPPU (N_1-(2-chloro-4-pyridyl)-N_3-phenylurea) to pollinated ovaries of watermelon (*Citrullus lanatus* Matsum) at anthesis increased fruit set from 26.9% (control) to 95%. Applying CPPU solutions to non pollinated ovaries at anthesis induced parthenocarpy, yielding 65% and 89.5% fruit set, respectively with 20 and 200 ppm applications. However, 64% of the 20 ppm CPPU treated parthenocarpic fruit stopped growth 10 days after treatment. Growth, of CPPU- treated, pollinated and non-pollinated fruit increased significantly compared with growth of control fruit during the first 10 days after treatment, but, except for the 20 ppm CPPU parthenocarpic fruits, growth subsequently slowed, resulting in fruit equal in size to the control by harvest (Hayata *et al*., 1995).

Application of 2,4-D and 2,4,5-T at 25, 50 and 100 ppm was effective in producing parthenocarpic fruit in Kakrol. The maximum fruit set of 88.88 percent was obtained at 100 ppm 2,4-D and 2,4,5-T. The average length per fruit and average weight per fruit was maximum at 50 ppm 2,4,5-T while the average girth per fruit was more in hand pollination. The hand pollinated fruits contained 18 bold seeds while no seed coat developed in the induced parthenocarpic fruit and the fruits were completely seedless (Vijay and Jalikop, 1980).

Rasul (2003) conducted an experiment with a view to find out suitable hormone (s) with suitable concentration and appropriate time of application for inducing parthenocarpic fruit in kakrol (*Momordica dioica* Roxb). Out of seven growth regulators, only three growth regulators (2,4-D, Fulmet and CPPU) were responsive to parthenocarpic fruit development in kakrol. Fruit size and weight were increased with increase of concentration of PGRs. 2,4-D at 25 ppm concentration when applied either a day before or at anthesis showed better performance over others. High fruit percentage (95%) was observed by hand pollination with full of seeds as compare to hormone (86%) which were seedless.

CONCLUSION

By application of various growth regulators at appropriate stage of growth in cucurbits seedless ness can be achieved. As the seeds in fruits like pointed gourd, kakrol are hard and decreases palatability and obstructs during consumption. So, Parthenocarpic fruit development by growth regulator spray can reduce the number of seeds or eliminate the seeds completely.

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Importance of sensory garden

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A sensory garden is a garden or other plot specifically created to be accessible and enjoyable to visitors, both disabled and non-disabled. The purpose of such a provision is to provide individual and combined sensory opportunities for the user such that they may not normally experience.

A sensory garden may contain features plants and other design elements are selected with intention to provide experiences for sight, smelling, hearing, touching, and tasting. Some sensory gardens are devoted specifically to one sense, such as a fragrance garden. Others may focus on several senses, with separate sections devoted to each sense. A third approach is a blend that enlivens all of the senses throughout the garden.

An objective in sensory garden design is to encourage users to interact with the plants, often directly, for instance by breaking off leaves to smell or taste. Therefore, plants that would require pesticide applications in order to do well should not be selected for sensory gardens. Poisonous or allergenic plants also should be avoided. Some plant species can serve multiple roles in a sensory garden. For example, mints provide both scent and taste opportunities.

Sight

Plants with interesting visual texture add to the sensory garden experience. Excellent additions for sensory gardens include smooth, rough, ruffled, fuzzy, or lacey-textured plants. The overall texture of a plant is another consideration. For example, a fine-textured plant has small leaves and a somewhat sparse appearance, while a coarse-textured plant has large leaves and a fuller appearance. Plants come in many forms, including upright, open, weeping, cascading, or columnar. Individual parts of plants, such as leaves or fruit, have their own forms, such as round, toothed, and spherical.

Sound

Opening the ears in a garden expands the senses and broadens the garden Opportunities can be provided in a sensory garden for sitting under a tree to hear the sound of wind rushing through the leaves. Many plants offer sounds with a small amount of wind or jostling: bamboo stems knock together, grasses rustle, palm fronds sway. Seed pods of some plants make natural maracas, or sound shakers. Leaves can be left on the ground to crunch underfoot.

Smell

The sense of smell is deeply emotional and associative. Scent in the garden can create a lasting sensory experience. This can be especially meaningful for the visually impaired. A fragrance can evoke long-buried memories. Crushing and smelling a plant part is also a classic method of plant recognition and identification.Many edible species also have strong fragrance, such as tomatoes, citrus, and of course, herbs and spices.

Touch

In a sensory garden, people should be encouraged to touch plants. Plants should be chosen that are durable enough to withstand frequent brushing or handling. Some species offer a variety of textures within a single plant. A classic example is the rose, with its delicate petals and thorny stems. Others include silver buttonwood, with its rough bark and soft grey leaves, or southern magnolia, with its leaves slick, shiny, and dark green above, and soft, felted brown beneath.

Taste

In a sensory garden, the tastebuds can tingle from edible fruits, vegetables, herbs, and

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spices. To ensure that everyone gets a taste, include plants that can produce a large number of edible parts over time, such as mint leaves, strawberries, or edible flowers, rather than species with more limited production, such as cantaloupe.

Benefits of sensory garden

The benefits of sensory gardens are well known, if not fully understood.

Therapeutic Benefits of a Sensory Garden

- Provides a safe, non-threatening environment in which individuals can feel free to explore and express themselves
- Promotes better communication between a service user/student and their therapist/teacher
- Helps individuals with sensory disorders to develop or reactivate their remaining senses

Benefits for Mental Health

- Helps individuals get back in touch with nature, nurturing a sense of calm and relaxation
- It Can be used as a coping strategy, improving mental, emotional and physical wellbeing in the long term
- Resolves negative thoughts and feelings, including anxiety and fear
- Minimises counterproductive and harmful behaviours such as aggression and substance abuse
- Heightens awareness (AKA mindfulness), enabling individuals to get the most out of life

Benefits for Personal Development

- Aids the development of fine and gross motor skills, including hand-eye coordination
- It improves the individual's ability to interact, communicate and share with others
- Increases confidence and helps the individual develop a strong sense of empowerment
- Promotes self-care and resilience

Benefits for Learning

- Engages students on multiple levels to appeal to all different 'learning styles'
- Helps individuals digest, understand and retain information more effectively
- Encourages greater involvement in class and one-on-one tutorials
- Heightens focus and concentration
- Promotes creativity

CONCLUSION

Understanding the characteristics of Sensory gardens is pertinent to every clinician and student's professional knowledge base. The benefits of sensory gardens are recognised across a number of different sectors and establishments, including care homes, psychiatric hospitals, and mainstream and special schools helps to address practices to meet healthcare's changing expectations for improved patient care and efficient and effective resource management. Continued research studies will help contribute to evidence based research and further implementation of best practices.

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Spatial variability mapping: a step towards precision farming

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INTRODUCTION:

Soil is a dynamic natural body which develops as a result of pedogenic natural processes during and after weathering of rocks. It consists of mineral and organic constituents, processing definite chemical, physical mineralogical and biological properties having a variable depth over the surface of the earth and providing a medium for plant growth (Biswas & Mukherjee, 1994). Before 1980s, the farmers used to put all their resources uniformly in their farm without considering the variability in soil properties. But after precision agriculture emerged, due importance was given to variability in soil with respect to space and time. Farmers could divide their heterogeneous plot into small homogenous units, thus applying inputs based on the requirement of the area. This led to increased efficiency of input management, crop yield as well as quality (Mulla, 2016).

Soil is a heterogeneous and dynamic system and its properties change in time and space continuously (Rogerio *et al.,* 2006). Heterogeneity may occur at a large scale (region) or at small scale (community), even in the same type of soil or in the same community (Du *et al.,* 2008). Soil which is a natural resource has variability inherent to how the soil formation factors interact within the landscape. However, variability can occur also as a result of cultivation, land use and erosion. Salviano (1996) reported spatial variability in soil attributes as a result of land degradation due to erosion. Spatial variability of soil properties has been long known to exist and has to be taken into account every time field sampling is performed and investigation of its temporal and spatial changes is essential. The variability in space can be studied and quantified more thoroughly by using statistics. Two major methods are used *viz* classical statistical approach and geostatistical approach. Classical statistical approach involves measurement of central tendency by calculating mean, median and mode. The variation about mean can be described by coefficient of variation (CV), standard deviation (SD), and variance. CV is the ratio of standard deviation to mean multiplied by 100. More is the CV more is the variation in soil properties. It was seen that pH and organic carbon had very low CV values, showing very low magnitude of variability, whereas, the properties that represented the movement of solute in soil had very high magnitude of variability.

Classical statistics was found to be very simple but it had some major drawbacks. It was found to be very labour intensive because more number of samples had to be collected so as to increase confidence and decrease tolerance. It can't be used for interpolation techniques. In classical statistics samples were random variables without any defined physical coordinates Z(x,y). So this led to growing importance of geostatistics tools as it successfully fulfilled all the above drawbacks. Geostatistics not only interpolates unknown data points from known but also shows the degree of relationship between those points.

Steps involved in spatial variability mapping

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Suhardiman *et al*. (2013) gave steps for data interpolation and mapping of site-suitability maps (Fig.1). They considered only three soil parameters namely clay, sand, and salinity. Then after data normalization, interpolation operation was followed so as to get the approximate data of unknown points. All these data were classified into classes of low, medium, high by the knowledge of their threshold values. After classification, site-suitability maps are prepared by use of GIS spatial analysis.

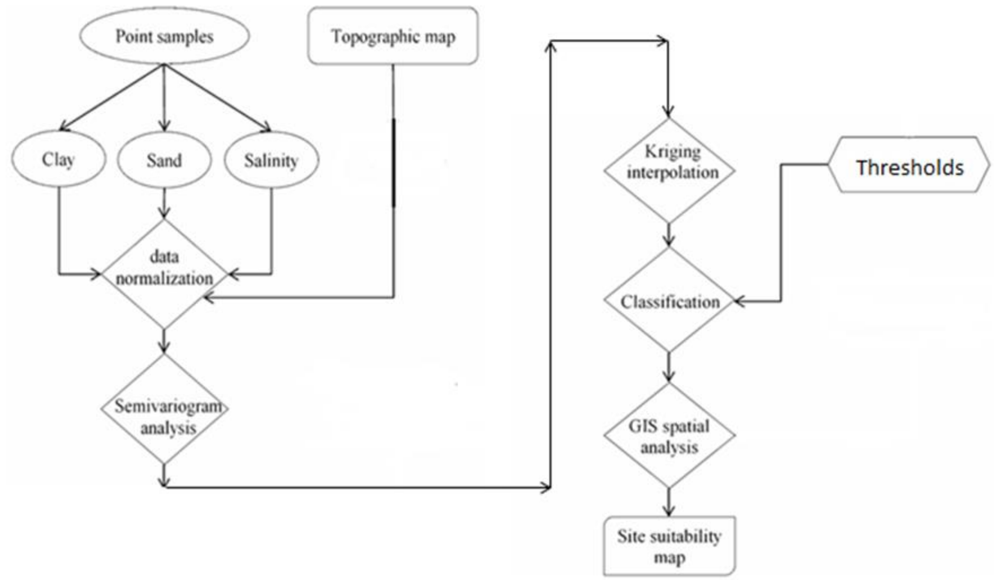
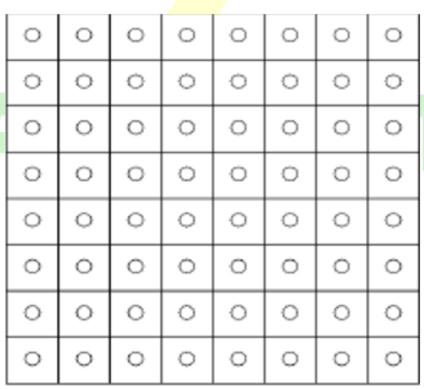


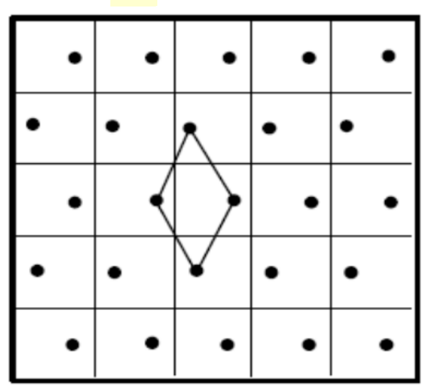
Fig.1: The flow chart of the study, showing the major steps and the site-suitability map as the final result.

Sampling of soils

Grid sampling methods are generally used for variability mapping of soil properties. Grid soil sampling subdivides a field into an arrangement of cells (usually squares) and a sample is taken from each of these cells. There are several sampling pattern schemes that might be considered in grid sampling. These include regular systematic point, staggered start point, systematic unaligned point, and random composite cell.



Regular systematic point



Staggered start point

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Systematic unaligned point

Random composite cell

Understanding interpolation analysis

Interpolation predicts values for cells in a raster from a limited number of sample data points. It can be used to predict unknown values for any geographic point data, such as elevation, rainfall, chemical concentrations, and noise levels. The assumption that makes interpolation a viable option is that spatially distributed objects are spatially correlated; in other words, things that are close together tend to have similar characteristics. For instance, if it is raining on one side of the street, you can predict with a high level of confidence that it is raining on the other side of the street. You would be less certain if it was raining across town and less confident still about the state of the weather in the next county. An example of interpolation application includes prediction of rainfall surface, elevation surface, concentration surface *etc.*

The interpolation tools are generally divided into deterministic and geostatistical methods.

- The deterministic interpolation methods assign values to locations based on the surrounding measured values and on specified mathematical formulas that determine the smoothness of the resulting surface. The deterministic methods include IDW (inverse distance weighting), natural neighbour, trend, topo to raster, topo to raster file and Spline.
- The geostatistical methods are based on statistical models that include autocorrelation (the statistical relationship among the measured points). Because of this, geostatistical techniques not only have the capability of producing a prediction surface but also provide some measure of the certainty or accuracy of the predictions.
- Kriging is a geostatistical method of interpolation. It uses statistical tools for interpolation. Kriging is a technique that considers both the distance and the degree of variation between known data points when estimating values in unknown areas. A kriged estimate is a weighted linear combination of the known sample values around the point to be estimated. Kriging is a robust interpolator, even a naive selection of parameters will provide an estimate comparable to many other grid estimation procedures.

Understanding semivariance and semivariogram

Kriging uses a property called the semivariance to express the degree of relationship between points on a surface. The semivariance is simply half the variance of the differences between all possible points spaced a constant distance apart.

The semivariance at a distance d=0 will be zero, because there are no differences between points that are compared to themselves. However, as points are compared to increasingly distant points, the semivariance increases. At some distance, called the Range, the semivariance will become approximately equal to the variance of the whole surface itself. Relationship between Variance among measure points and distance showing that the more point you use and hence the further away they are the greater the variance in data that will result. This graph is called a semivariogram. The semivariogram depicts the spatial autocorrelation of the measured sample points. Because of a basic principle of geography (things that are closer are more alike), measured points that are close will generally have a smaller difference squared than those farther apart. Once each pair of locations is plotted (after being binned) a model is fit through them. There are certain characteristics that are commonly used to describe these models. The semivariogram depicts the spatial autocorrelation of the measured sample points. Because of a basic principle of geography (things that are closer are more alike), measured points that are close will generally have a smaller difference squared than those farther apart.

CONCLUSION:

Geostatistical methods could be accurately used to evaluate spatial variability of various soil properties. But assessing variability in biological properties is very difficult, as they vary to a great extent with variation in climatic conditions. The success of the variability mapping depends largely upon sampling strategy applied. This is because the errors have its source largely from the sampling technique used. Since soils usually exhibit considerable spatial dependency, systematic sampling can provide a higher level of precision than random sampling with the same sample density. Spatial variability maps can also be used to make fertiliser recommendations within the locality. It is also gaining importance in precision agriculture as customized doses of agrochemicals can be applied in homogenous units under heterogeneous plot, which fulfils the main objective of precision farming.

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Nitrogen Management in Rice by using Leaf colour Chart (LCC)

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Nitrogen is an important essential nutrient for better growth and development of the plant. Nitrogen promotes plant growth and improves grain yield and grain quality through higher tillering, leaf area development, grain formation, grain filling, and protein synthesis and nitrogen is highly mobile within the plant and soil. Nitrogen is the most limiting element in almost all soils. Thus, proper application of N fertilizers is vital to improve crop growth and grain yields, especially in intensive agricultural systems. Insufficient and/or inappropriate fertilizer N management can be detrimental to crops and the environment. Optimal N management strategies aim at matching fertilizer N supply with actual crop demand, thus maximizing crop N uptake and reducing N losses to the environment.

Yellowing of rice leaves indicates the deficiency of nitrogen, but it is difficult to decide the quantity of nitrogen to be applied based on the extent of yellowing. Leaf colour chart developed by International Rice Research Institute can be utilized for efficient nitrogen management in paddy. Purpose of using LCC is to apply adequate amount of nitrogen and avoid application of fertilizer more than required. Use of LCC helps to determine nitrogen demand of the crop and guide right time of fertilizer nitrogen application so as to prevent unwanted nitrogen losses and their serious impacts on the ecosystem. It was proved to reduces N use by up to 30% and ensures disciplined in N application Thus, LCC helps improve yield by maximizing crop N uptake and reducing N losses.

LCC is usually a plastic ruler-shaped strip containing six panels, colors matching the rice. Simple leaf color chart (LCC) is a simple tool which is a proxy for leaf N is used as an indicator of leaf color, which is related to the plant's nitrogen content. . LCC has 6 different color shades from light yellowish green (which is number 1 on the chart) to dark green (which is number 6) and in between strips are with varying intensity of green colour. Time of nitrogen application is decided by LCC score. Reading is taken from 2 weeks after transplanting to initiation of flowering. Leaf color is measured comparing leaf color with the color shades of LCC.

How to use the leaf colour chart?

1. Randomly select ten fully opened disease-free new leaves (i.e. third leaf from the top) from ten hills/plants in the filed as index leaf in paddy plant for assessing the leaf colour. Place the middle part of the leaf on a chart and compare the leaf color with the color panels of the LCC. Do not detach or destroy the leaf. Match the colour of the selected leaves and assess the colour intensity (LCC value) during morning hours (8-10 am) under the shade of your body, (direct sunlight affects leaf color readings). The same person should take the LCC readings at same time of the day between 8:00 a.m. and 10:00 a.m. from first up to the last reading.

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Fig 1. Leaf colour chart for nitrogen application

2. Take average of two if the leaf colour matches between two colour strips of the chart.

3. Commence the assessment of the leaf colour with LCC at 14 DAT in transplanted rice or 21 DAS in direct seeded rice and continue up to flower initiation/heading at an interval of 7-10 days.

4. Critical LCC value varies with the type of paddy genotypes. LCC critical value is 3.0 in low N response cultures. In Karnataka for drill sown paddy (Intan variety) the critical LCC value is 3 and for Abhilash variety the LCC value is 4.

5. Assess the average LCC values of 10 leaf samples. If more than 5 out of 10 leaves have readings below 4 in transplanted rice and below 3 in direct wet-seeded rice, apply 30 kg N/ha during dry season (DS) or 23 kg N/ha during wet season (WS).

6. Repeat LCC readings every seven days until the first flowering. Different sets of 10 leaves can be used for each weekly reading

7. The top dressing of nitrogen depends on the crop growth and stage as indicated in the following table developed by U.A.S.

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Table 1: Quantity of nitrogen to be top dressed to paddy crop when assessed average LCC value is below the critical LCC value (Karnataka)

Crop stage	Duration(days after planting/sowing)			Quantity of nitrogen (kg/ha)	
	Short duration (100-115days)	Medium duration (125-135days)	Long duration (145-165days)	Summer	*Kharif*
Transplanted paddy					
Initial growth period	14-28	14-42	14-63	30	20
Grand growth period	29-48	43-70	64-85	45	30
Lag growth period	49-flowering stage	71-flowering stage	86-flowering stage	30	20
Drill sown paddy					
Initial growth period	21-34	21-56	21-70	30	20
Grand growth period	35-55	57-84	71-90	45	30
Lag growth period	57-flowering stage	85-flowering stage	91-flowering stage	30	30

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The need of plant health clinic and farmer advisory center at tehsil or block level

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INTRODUCTION

In India, the range of different climatic conditions supports a variety of different crops. Almost all type of crops including staple food crops, horticultural crops, medicinal plants, flowers crops and timber crops are grown in India by farming communities in their respective area. The problems and constraints in farming are also diverse according to the crops and their location. In India, new innovative technologies related to agriculture is invented and promoted by ICAR institutes, SAUs, KVKs and state agriculture departments. Even though the extensions services are unique in nature and working throughout the clock but still these are unable to cater to the needs of the farmer standing at last in a row. For a successful agriculture venture and profitable income, there is an immediate need to enhance the extension services at Tehsil or Block level.

The regular problems faced by the farming communities?

1. Timely analysis of soil for the availability of nutrients
2. Problems related to undiagnosed pest or pathogen
3. Needs of pure quality seeds
4. Lack of knowledge of newly developed techniques
5. In the changing scenario, lack of knowledge of organic or natural farming practices
6. Lack of understanding of beneficial government policies for the farmer
7. Confusions regarding the nutrient deficiency symptoms
8. Not knowing the exact doses of insecticides, fungicides and nutrient spray

Who tackles problems at the front line?

The KVKs at the district level are working to rectify these problems. But in India, nor each farmer can reach to KVKs for his problems or neither KVKs can facilitate the whole farming communities. Thus in lack of proper guidance, farmers used to adopt unnecessary steps like applying excess nutrients, or other nutrients rather than the optimum dose of required nutrients, abrupt pesticidal sprays etc. which in turn reduces the net profit to the farmers.

The need for a plant health clinic and farmer advisory centres?

There is an immediate need to develop plant health clinic and farmer advisory centres at Tehsil or Block level to cater to the needs of farmers effectively. Because if a farmer faces a constraint in farming, then he has to spend extra time and money to get rectify his problems. A plant health clinic is a place where the farmer can meet the agricultural experts to seek advisory for their particular problems related to farming. The plant health clinics, where the agriculture experts like entomologist, pathologist, and agronomist, nematologist, and soil experts sit together and understand the farmer's problems and in accordance issue an advisory. Basically, these experts are known as plant doctors and these clinics have minimum facilities required for routine diagnosis and detection purposes. These

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plant health clinics concept is followed earlier in many African countries and even in some states in India. This concept has proven its applicability for prospering the farmer by providing timely guidelines and advisory services.

The facilities should be provided by a plant health clinic and farmer advisory centres?

1. Rapid detection of pests, disease and weeds related problems
2. Diagnosis of nutrient deficiency analysis
3. Advisory for the pest and disease management
4. Demonstration to the farmer for new innovation and techniques
5. Promotion of organic farming
6. Seminars on integrated farming system models
7. Promotion of custom hiring of agricultural machinery
8. Promotion of mixed farming
9. Promotion of water harvesting facilities and tree planting at bunds
10. Spreading knowledge on seeds availability and purity of seeds

How it will work?

If a farmer faces a problem related to his farming, he can travel to the nearest located Plant health clinic and farmer advisory centre and bring his samples. The samples will be diagnosed and detected for the real cause by plant doctors in an appropriate time and based on the spectra of the problem the plant doctor will advocate the remedy, which must be locally available and affordable. In this way the farmer can saves surplus investment of money and time in these unproductive tasks related to their constraints.

Summary:

The idea of a plant health clinic and farmer advisory centre has been successfully adopted in any part of the world. In India, this concept has been adopted in Kerala, Tamil Nadu, Haryana and some other states. But these services have huge benefits and should be extended to all states, which will enhance the farmer's productivity and will also create employment opportunities for the skilled agri-graduates.

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Plant breeding for organic agriculture:

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INTRODUCTION:

Organic farmers still largely depend on varieties produced for conventional farming systems with high inputs of artificial, mineral fertilisers and chemical crop protectants. The organic sector is not only striving for organically produced seeds from conventional varieties, but is also urging for breeding programmes for better adapted varieties. However, the fact that the organic sector is still a small market does not stimulate many conventional breeders to start special organic breeding programmes.

To date, there are only few varieties that were specifically bred for organic and low-input systems in developed countries. It is estimated that more than 95% of organic agriculture is based on crop varieties that were bred for the conventional high-input sector with selection in conventional breeding programmes. Recent studies have shown that such varieties lack important traits required under organic and low-input production conditions. A range of breeding goals desired for the organic sector, such as yield, resistance to biotic and abiotic stress, baking quality (wheat) and sensory qualities demanded by consumers do not differ from conventional breeding goals, but it is essential that such traits are expressed under low-input conditions, which cannot be guaranteed if selection is done in high-input agronomic backgrounds. However, a range of traits are of primary interest for organic farming, at least on the short term (e.g., increased competitiveness against weeds and resistance to seed-borne diseases such as common bunt in wheat). Also, some traits relevant for conventional high-input farming may have negative side-effects on organic systems. For example, the main focus of most commercial wheat breeding programmes has been on improving yield by increasing the harvest index. This involved the introduction of semi-dwarf genes into cereals and other crops, resulting in short-straw varieties. In cereals this approach resulted in (1) reduced size and depth of root systems, (2) increased reliance on high inorganic-N inputs to attain satisfactory protein contents, (3) lower nutrient-use efficiency, (4) decreased competitiveness against weeds or decreased robustness against mechanical weed control (and thereby greater reliance on herbicides), (5) greater susceptibility to diseases such as powdery mildew, Septoria [7] and Fusarium, and (6) reduced protein content [8], but (7) improved lodging resistance [9].

The concept of organic plant breeding:

The concept of organic breeding is relatively new and less developed than the concept of participatory plant breeding. Organic agriculture is simply agricultural production without the use of synthetic inputs (e.g., pesticides, fertilizers, herbicides). To achieve this, organic producers apply agro-ecological principles that promote the self-regulating capacity of the agro ecological system (i.e., self-regulation of the soil,plant and animals).

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The issue of "naturalness"

Organic production is also described as the "natural" way of production (alluding to the absence of synthetic inputs). Some researchers insist that naturalness of organic agriculture should not be limited to the absence of synthetic inputs or adherence to ecological principles but also to an acknowledgement of integrity and wholeness in the production system.

The concept of integrity implies a belonging to a specific natural entity (just like the concept of species) that can freely interbreed but which is genetically separated from others belonging to another natural group. To be organic, this naturalness must be accorded proper consideration in how plants are propagated, cultivated, or genetically manipulated to be in conformity with the ideals of true organic agriculture. Further, plants are ascribed an intrinsic value that indicates that they are ethically relevant (in accordance with the attitude society has towards nature).

Methods and tools:

Organic plant breeding is restricted to specific conventional breeding practices, in general to crossing methods that do not break the reproductive barriers between species, and to selection methods based on the evaluation and selection of whole plant performance, i.e., (1) intraspecific crossing, (2) backcrossing, (3) mass and individual selection, (4) selection via DNA markers, (5) hybrid cultivars- as long as next generation is fertile and the hybrid production does not chemically induce sterility, and (6) meristem culture. On the other hand, the technologies or methods that engineer plants at the DNA level are considered to be incompatible with OPB e.g., (1) genetically modified organisms and (2) the application of synthetic hormones and colchicines treatments.

New breeding techniques make it possible to precisely incorporate particular characteristics from wild crop relatives or landraces into modern crops. In that line, some scientist have analyzed the possibility of implementing modern technologies in OPB to rewilding modern crop cultivars and whether this modern techniques can fit within the four principles of Organic Farming (health, ecology, fairness, and care).

Development of cultivars adapted to Organic Farming conditions can be successfully achieved if plant breeding programs combine the selection of the progeny in optimal and organic or low-input environments. This can be seen as one of the elements under which the Green Revolution took place: shuttle breeding, which consists in exchanging segregating generations between different environments to achieve wide adaptation or broad disease resistance. Alternation of germplasm between CF and OF at later segregating generations is considered an important component of commercially sustainable OPB programs by some authors. A modality of this shuttle breeding scheme, is to only carry out selections of advanced generation progenies, developed by conventional breeding procedures, under optimum organic environments to determine their value for cultivation and use in further testing; this is advantageous, particularly when there is limitation of financial, human, and institutional resources in OPB.

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What Needs to Be Done for Organic Plant Breeding??

OPB has certainly made steps forward toward the development of cultivars adapted to Organic Farming, particularly after finding that conventional plant breeding cannot always provide suitable cultivars for Organic Farming in various crops such as cereals and pulses. Below we list some points that may contribute to the further development of cultivars for Organic Farming conditions.

(A) Broad multi-location testing to better exploit G × E and thus identify key locations within regions to conduct cultivar yield trials .

(B) Examine the implementation of shuttle breeding between OF and CF to open the possibility of developing cultivars adapted to both conditions.

(C) Larger screening of plant materials deposited in gene-banks to identify useful genetic resources for OPB.

(D) Evaluate the possibility to implement prediction of germplasm performance in key locations with the aid of high throughput genotyping platforms and phenotypic information derived from multi-location testing.

(E) Determine if breeding perennial crops will be suitable for sustainable OF, however if crop rotation is part of the OF system, this may not be possible.

(F) Assess the incorporation of remote sensing phenotyping for traits like weed competitiveness so evaluation and selection intensity can be increased and higher genetic gains can be achieved faster.

(G) Undertake quantitative and association genetics research to understand both the extent of variation and genetic architecture of useful traits in OF.

(H) Appraise the use of cultivar mixtures to deploy host plant resistance or increase resilience in agro-ecosystems prone to abiotic stress. There is a need to preserve the integrity of plants. Conventional plant breeding methods sometimes violates natural barriers (genetic engineering, wide crosses) and consequently the integrity of plants.

Organic plant breeding is a relatively new concept of crop improvement. Currently, organic crop producers depend on seed and other propagules that are developed by conventional breeding procedures. If the integrity of an organic production system is to be maintained, the planting material used to initiate production should have organic origin.

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Estimation of weekly climatic water balance and water availability period

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INTRODUCTION

Water is the most important and limiting natural resource in the world. The economic development of any country depends on many factors in which water is one of the most important factors. It is the main requirement for the survival of any living organism and also plays an important role in agriculture and industry. The distribution of rain varies greatly in time and space. The magnitude, frequency and intensity are the three main characteristics of rain that vary from place to place, day to day, month to month and also from year to year. The detailed knowledge of these characteristics is crucial for the planning of crops in a region and the full use of rainwater.

A proper analysis of the precipitation pattern of a region for several years is very useful for making decisions regarding efficient crop planning. In particular, the annual and monthly rainfall of a region is very useful for farmers to decide when and where to plant and harvest for a successful cultivation with the appropriate use of available water and irrigation resources. . In order to have a sustainable development of water resources and better planning of development operations in a given area, it is important to know the water availability period during the individual months, seasons and years.

Crop production in an area has a direct relation with amount and distribution of rainfall. Correct evaluation of water availability, water deficiency is very important for crop planning. The climatic water balance is a widely used method for this (Thornthwaite and Mather, 1955, 1957). A climatic water balance technique asses the water availability, water deficiencies and length of growing period for agricultural planning. Based on weekly climatic water balance it is possible to identify the suitable crops and cropping pattern for the area. It also asses the effective rainfall water surplus and deficit during different growth phases.

The estimation of the components of the water balance, that is, the actual evapotranspiration (AET), the surplus of water (SUR) and the water deficit (DEF) over an area are extremely important in the field of Hydrology, Agriculture, Ecology, etc. in identifying the eligible regions for different crops. The calculation of the water balance is one of the most important tools in applied climatology, which has innumerable applications namely, climate classification, crop planning, the potential for water collection and studies of climate change.

Water deficit is a complex and nonlinear phenomenon, since it depends on several interacting climatological parameters such as precipitation, temperature, humidity, wind speed, bright sunshine hours etc. Choice of crop varieties withstanding moisture stress, adoption of appropriate conservation measures and lifesaving irrigation through recycling surplus water are the viable measures for combating moisture stress. Climatic shifts, though temporary are of significance in the assessment of the climatological potentialities of a region for development. Thus to address the above issues, one can go with climatic water balance procedure (Srinivasa Reddy *et al.,* 2008). In the view of all the above facts the assessment of climatic water balance and water availability period is necessary.

The climatic water balance components calculated were soil moisture storage (SMS),

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actual evapotranspiration (AET), water surplus (SUR) and water deficit (DEF). Thronthwaite (1948) developed the procedure to compute the water balance by considering the monthly rainfall and potential evapotranspiration (ET_o). Later Thronthwiate and Mather (1955) developed a water balance technique as explained below which is used in this study to estimate the climatic water balance.

Computation of Weekly Climatic Water Balance by Thronthwaite and Mather's Method (1955)

To compute the weekly climatic water balance according to Thronthwaite and Mather's method (1955), following information at a place were collected.

- Weekly rainfall in mm.
- Weekly potential evapotranspiration in mm.
- Available water holding capacity of the soil.

Procedure to calculate weekly water balance

The different steps involved in the calculation of weekly water balance were given below:

Step-1: Reference evapotranspiration (ET_o) was computed on weekly basis by using Penman-Monteith FAO-56 method.

Step-2: Estimation of accumulated values of P-ET_o for each week.

Step-3: Estimation of actual storage of soil moisture for each week by using the following equation:

$$STOR = AWC \times e^{\left(\frac{Acc(P-ET_O)}{AWC}\right)} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

STOR – Actual Storage of soil moisture, mm,

AWC – Available soil water content, mm,

P – Rainfall, mm,

Acc (P-ET_o) – Accumulated values of (P-ET_o),

ET_o - Reference evapotranspiration, mm.

Step-4: Computation of change of actual storage from week to week (ΔSTOR). When the storage remains at capacity level, the ΔSTOR = 0. When the STOR reaches values of less than the capacity, STOR is calculated as the subtraction of STOR of present week from the previous week.

Step-5: Weekly actual evapotranspiration (AET) was estimated as given below:

a) When ΔSTOR is negative,

$$AET = P + abs(\Delta STOR) \qquad \ldots\ldots\ldots\ldots\ldots (2)$$

b) When ΔSTOR is positive,

$$AET = ET_o \qquad \ldots\ldots\ldots\ldots\ldots (3)$$

Step-6: Weekly water deficit (DEF) values can be determined by using the following expression:

$$DEF = ET_o - AET \qquad \ldots\ldots\ldots\ldots\ldots (4)$$

Step-7: Weekly surplus water (SUR) was detimated by using the following expression:

$$SUR = P - AET \qquad \ldots\ldots\ldots\ldots\ldots (5)$$

SUR is the amount of water percolating to the water table and becoming as runoff to the underground system. It occurs only when (P-ET_o) is positive and when storage has reached the capacity level.

Step-8: Climatological Indices:

The climatological indices such as Humidity Index (I_h), Aridity Index (I_a), Moisture Index (I_m) and Moisture Adequacy Index (MAI) are the output of the water balance analysis. The indices viz. aridity index, humidity index and moisture index are useful in climate classification and to find the type of climate of a particular place. Moisture Adequacy Index (MAI) provides a good indication of the moisture status of the soil in relation to the water need, high values of the index signifying good moisture availability and vice-versa. Aridity Index (I_a) was considered to evaluate the drought condition in terms of the drought intensity. Based on Moisture Index (I_m) the type of the climate in the region was determined (Subramanyam, 1982).

Table 1 Type of climate on basis of Moisture Index (I_m)

S. No	Moisture Index (I_m)	Type of climate
1.	> 100	A – Per humid
2.	80 – 100	B_4 – Humid
3.	60 – 80	B_3 – Humid
4.	40 – 60	B_2 – Humid
5.	20 – 40	B_1 – Humid
6.	0 – 20	C_2 – Moist sub humid
7.	-33.3 – 0	C_1 – Dry sub humid
8.	-66.7 - -33.3	D – Semi arid
9.	-100 - -66.7	E - Arid

The climatological indices may compute using the following expressions:

$$Humidity\ Index\ (I_h) = \frac{Water\ Surplus\ (SUR)}{ET_o} \times 100$$ ………………… (6)

$$Aridity\ Index\ (I_a) = \frac{Water\ Deficit\ (DEF)}{ET_o} \times 100$$ ………………… (7)

$$Moisture\ Index\ (I_m) = I_h - I_a$$ ………………… (8)

$$Moisture\ Adequacy\ Index\ (MAI) = \frac{AET}{ET_o}$$ ………………… (9)

Estimation of Water availability period (Length of Growing Period)

a) Based on MAI

The ability to provide so much water for the irrigation area during each irrigation period depends mainly on the availability of water. To determine the water availability period, the Moisture Adequacy Index (MAI) which is the ratio between actual evapotranspiration and potential evapotranspiration has been considered. The growing season considered as a week when MAI was greater than or equal to 0.75 (Gupta *et al.,* 2010), which was considered as a minimum moisture level for starting the sowing of crops. The termination of a growing period was taken at a week from where MAI is less than 0.25 (Krishnan *et al.,* 1980).

b) Based on Surplus/Deficit

Water Surplus

Under the average rainfall condition the water availability period would be high (surplus water is observed in the weeks) if AET greater than the 50% of ET_o. Under such conditions we can say that there is a surplus water available during that period.

Water Deficit

Under the average rainfall condition the water availability period would be less (deficit water is observed in the weeks) if AET less than the 50% of ET_o. Under such conditions we can say that there is a deficiency of water during that period.

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Nano Fertilizer: A Boon to Agriculture

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Agriculture is the backbone of most of developing countries across the world. This sector is facing various global challenges such as climate change, environmental issues, urbanization, sustainable use of resources and accumulation of pesticides and fertilizers, ultimately degrading the soil quality, under water resources and human health. Nanotechnology has the potential to revolutionize the agriculture. Many countries including India have identified the potential of nanotechnology in the field agriculture such as precision farming, smart delivery systems, food industry, food processing, packaging, food safety etc. The word 'nano' is derived from a Greek word meaning 'dwarf' which technically means 10^{-9},or one billionth of something, referring to materials with the size of 0.1 to 100 nanometers (nm) which is specifically known as nanoparticles. The term "Nanotechnology" was first defined in 1974 by Norio Taniguchi of the Tokyo Science University and it is focusing on special properties of materials emerging from Nano metric size along with manipulating matter at an atomic and molecular scale.

Characteristics of Nanoparticles

a) They exhibit extremely high specific surface area.
b) They have high super para magnetism property.
c) They have high Brownian motion.
d) They possess high zeta potential.
e) They have high encapsulation energy.

What is Nano Fertilizer?

Nano-fertilizers are nutrient carriers that are being developed using particles with nano dimensions (1 – 100 nm). Nano Fertilizers" are synthesized or modified form of traditional fertilizers, fertilizers bulk materials or extracted from different vegetative or reproductive parts of the plant by different chemical, physical, mechanical or biological methods with the help of nanotechnology used to improve soil fertility, productivity and quality of agricultural produces. (Brunnert *et al.*, 2006). These are also called smart fertilizer as they provide new opportunities to enhance the nutrient use efficiency and reduce costs of environmental protection (Baruah *et al.*, 2009 and Sun *et al.*, 2010).

Why Nano Fertilizer?

Cui *et al.,* 2010 (Table.1) concisely compared the Nano fertilizer and conventional fertilizer giving an idea of the usefulness of the Nano fertilizers over conventional fertilizers. The extent of nutrient deficiencies in the country is in the order of 89, 80,50,41,49 and 33 % of N,P, K, S, Zn and B, respectively. There is utmost need to meet future needs i.e, increased production rate and crop yield, increased efficiency of resource utilization and reduction of waste production. The use of Nano fertilizers in agriculture aims in minimize nutrient losses and increase yields through optimized nutrient management.

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Table 1: Comparison of nano-fertilizers and conventional fertilizers applications.

Index	Nano Fertilizer	Conventional Fertilizers
Dispersion of mineral micronutrients	Improved dispersion of insoluble nutrients	Lower solubility due to large particle size
Soil adsorption and fixation	Reduced	High
Bioavailability	High	Low
Efficiency of nutrients uptake	Increased uptake ratio; saves fertilizer resource	Conventional fertilizer is not available to roots and the nutrients uptake efficiency is low
Controlled release	Release rate and pattern precisely controlled	Excess release leading to toxicity and soil imbalance
Solubility	High	Low

Soil macronutrient and micronutrient deficiencies or insufficiencies in soils limit crop productivity and nutritional value of food. They play fundamental physiological roles in plant metabolism, being activators of specific enzymes or are part of plant defensive systems against diseases or abiotic stress. But either by applying through soil or through foliar the nutrient use efficiency (NUE) of the conventional fertilizers are less as compared to the efficiency of the Nano fertilizers. There is no harmful soil residual effect of Nano fertilizers, enhancing the quality of the soil and ground water resources. Nano fertilizers are cost effective as compared to the conventional fertilizers. They can reduce loss rate of fertilizer nutrients into soil by leaching.

Release pattern of Nano fertilizers

Nano capsules are designed to allow the controlled release of nutrients [(Fig. 1) Marchiol, 2018]. To do so the outer shell of Nano capsules is engineered and programmed to open when stimulated by environmental factors or man-induced pulses. The use of Nano materials for delivery of fertilizers is expected to reduce the dosage and ensure controlled slow delivery. Coatings and binding of Nano and Sub nano composites are able to regulate the release of nutrients from the fertilizer capsule.

Potential Nano Fertilizers designs:

- **Slow release**: The capsule releases its payload slowly over a longer period of time so as to synchronize plant assimilation and limit leaching.
- **Quick-release**: The capsule shell breaks upon contact with a leaf surface.
- **Specific release**: The nutrient release occurs through a recognition mechanism between a receptor (molecule or functional group) bound to the shell and a target molecule.
- **Moisture release**: The shell breaks down and releases nutrients in the presence of water.
- **pH release**: The shell breaks up only in specific alkaline/acidic environment (e.g., within plant tissues or inside a cell).
- **Magnetic/ultrasonic pulses**: The shell opens in response to a magnetic or ultrasonic pulse emitted by a man-controlled system (precision agriculture).

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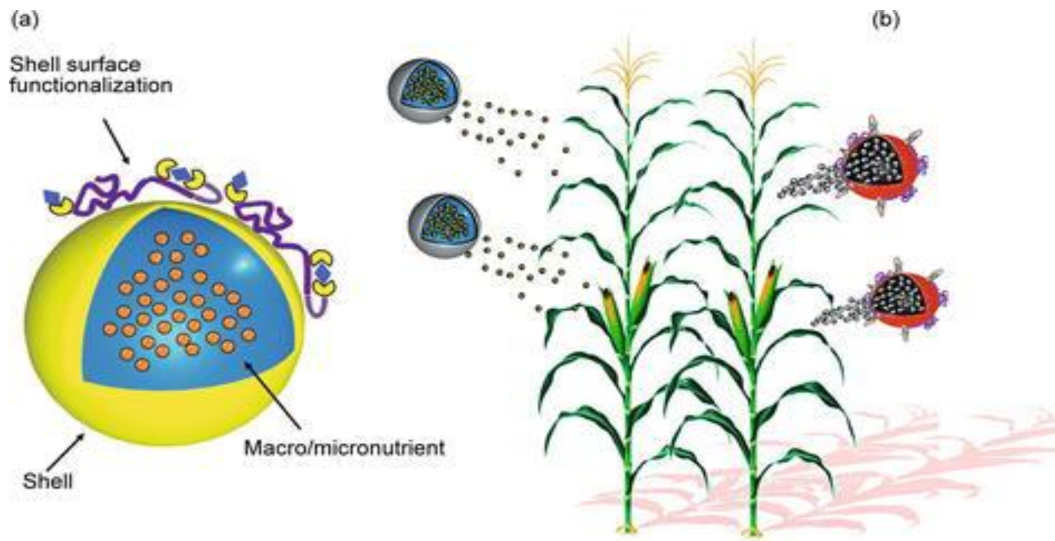
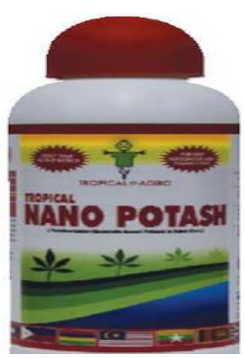


Fig.1: Model of nanocapsule containing macro/microelements. (a) Opening strategies of nanocapsule (b) Release of nutrients as function of time to avoid or limit nutrient losses. (Marchiol, 2018)

Classes of Nano Fertilizers

Three classes of Nano Fertilizers have been proposed (Mikkelsen, 2018)
1. Nano scale fertilizer (nanoparticles which contain nutrients)
2. Nano scale additives (traditional fertilizers with nano scale additives)
3. Nano scale coating (traditional fertilizers coated or loaded with nanoparticles)

Some commercialized nano fertilizers



Challenges of Nano Fertlilizers in Agriculture

Inspite of various advantages of the Nano fertilizers there are some challenges which nano fertilizers are facing

- A lot of care should be taken by applying Nano fertilizers in field as they are very minute particles and there will be chances of getting into the human body when come in contact causing many diseases.
- It is a challenge to the government and industries as there are no specific regulations for assessing the toxicity or environmental impact of nanoparticles.

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- Lack of infrastructure and trained professionals for more commercialized production of the Nano fertilizers in the country.
- Farmers are still not aware of this technology.

CONCLUSION

Nano fertilizers are envisioned to have the potential to revolutionized agriculture. Public awareness about the advantages and challenges of Nano Fertilizers will lead to better acceptance of this emerging technology in near future. There is need of "Second Green Revolution" across the globe which might be possible by the judicious use of Nano technology in the agriculture.

Future Scope

Nanotechnology applications in agriculture are still at the nascent stage and a lot more applications can be expected in the years to come. In the near future, Nano scale devices with novel properties could be used to make agricultural system 'smart'. Smart field systems detect, locate, and report on pathogen, then apply pesticides and fertilizers as needed prior on the onset of symptoms. There is utmost need to optimize concentration and doses of Nano fertilizers for different crop and site specific management of Nano Fertilizers in precision agriculture.

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Biological approach in Integrated Pest Management

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The term Biological control was first used by Smith in 1919 to signify the use of natural enemies (whether introduced or manipulated) to control insect pests. Biological control have been defined by DeBach as the action of parasites, predators or pathogens in maintaining another organism's population density at a lower average than that would occur in their absence.

Predator: A predator is a free living organism throughout its life; it kills its prey, is usually larger than its prey and require more than one prey to complete its development. Adult predators may be monophagous, oligophagous or polyphagous. If highly mobile polyphagous predators may be effective in managing insect pests, in disturbed systems, whereas monophagous and oligophagous predators tend to be associated with the prey in the more stable system.

Parasite and Parasitoids: A parasite is an organism which is usually much smaller than its host and a single individual usually does not kill the host. They may complete their life cycle in the single host or they have complicated life cycle involving several host species. Whereas parasitoid is a special kind of parasite which is often about the same size as its host, kills the host and requires only one host to develop into free living adults.

Pathogens: these organisms are capable of causing disease in insect pests. They include bacteria, fungi, nematodes, viruses, protozoa, mycoplasma, rickettsia. The control of insect-pests by pathogens is termed as Microbial control.

Entomopathogens such as bacteria, fungi, nematodes, viruses and protozoans are extensively used to manage insect pest population below ETL.

Entomopathogenic Bacteria:
Bacteria belonging to the family Enterobacteraceae, Pseudomonaceae, Bacillaceae, Streptococcaea, are used as entomopathogens. Family Bacillaceae is mostly exploited for insect pest control. Members of this family (*Bacillus* and *Clostridium*) are gram positive motile or non-motile rods and produce endospores. *Bacillus* is facultative aerobic while *Clostridium* is anaerobic. Most exploited bacteria *Bacillus thuringiensis* which is motile, gram positive, spore forming bacterium and in addition to endospores, produces a proteinaceous parasporal crystal in the sporangium at the time of sporulation. Some other potential entomopathogenic bacteria are:

a) *Brevibacillus laterosporus* Laubach: is a spore former. It's a natural inhabitant of water, soil and has also been isolated from insects. Its biopesticidal potential has been reported against insects in different orders, such as Coleoptera, Lepidoptera, mosquitoes and black flies, house flies, nematodes and phytopathogenic fungi. Different insecticidal toxins produced by diverse *B. laterosporus* strains have been identified and characterized against various targets. The spores that are heat stable low molecular weight protein inhibiting nematode juvenile development have been isolated from this bacterium. The insecticidal roles of secreted binary toxins (ISP1A and I SP2A) homologous to Bt Cry proteins act against different coleopteran species (*Diabrotrica*

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spp., Leptinotarsa spp. and Anthonomus spp.). A toxin mediated process is involved in the alteration of permeability of midgut epithelial membrane leading to osmotic disorders, cell alteration and disruption.

b) *Chromobacterium subtsugae:* it is a gram negative beta proteo bacterium developing violet-pigmented colonies, due to the production of violecein, (a tryptophan derivative). It shows the insecticidal potential by ingestion against *Leptinotarsa decemlineata*, *Diabrotica virgifera, Diabrotica undecimpunctata*, *Plutella xylostella*, *Bemisia tabaci.* In addition to mortality, they also show significant sub-lethal effects, with special regard to feeding inhibition. *C. subtsugae* strain PRAA4-1T has now been developed into a commercially available product (Grandevo, Marrone Bio Innovations Inc.) for the management of chewing and sucking insect species.

C*) Yersinia entomophaga:* It is a non-spore-forming bacterium that secretes a multi subunit toxin complex (Yen-Tc) which includes three protein families exhibiting insecticidal activity termed A (YenA1, YenA2), B (YenB) and C (YenC1, YenC2) and two chitinases (Chi1 and Chi2) with high endochitinase activity.

Entomopathogenic Fungi:

They are characterized by their ability to attach to and penetrate host cuticle and to replicate internally within the host, usually in the haemoceol. Nutrients in the haemolymph become depleted by the rapid growth of the fungus causing host death. Among the entomopathogenic fungi Beauvaria bassiana, Metarhizium anisopliae, Verticillium lecanii are mostly exploited. In addition to these some of the new fungal products have also come up in the market.

a) The formulation containing *Metarhizium breunneum* spores which is found to be effective against wide range of coleopterans and lepidopterans.

b) ATRACAP capsules**:** they contain a strain of an entomopathogenic fungus and aim to control wireworms (the most pressing problem in potato production in both conventional and organic systems). These fungal spores are applied to the soil, thereby restricting their unintended passive dispersal. This limits interactions with aboveground organisms and also the belowground organisms such as earthworms are not attracted to the capsules.

Entomopathogenic Nematodes:

They kill insect pests by septicemia due to bacteria carried by them. Nematodes belonging to the two families i.e. Steinernematidae including genus *Steinernema (Xenorhabdus:* associated bacteria) and Heterorahbditidae including genus *Heterorhabditis (Photorhabdus:* associated bacteria). Some recently discovered EPN include: *Steinernema thermophilum*, *Steinernema asiaticum*, *Oscheius* spp. (Rhabditid nematode). The two nematodes i.e. *Steinernema asiaticum*, *Oscheius* spp. are effective against the rice yellow stem borer and rice gall midge respectively. The EPNs are mostly used against the soil bacterium since they require the moist environment for their movement. While *S. feltiae* and *S. carpocapsae* are effective against *B. tabacci (*under greenhouse conditions) and *Plutella xylostella.* They are incorporated into the gel, foam and are applied on the crops. The gel or foam provides the adequate conditions for their movement.

Entomopathogenic Viruses:

A virus is an entity whose genome is an element of nucleic acid, either DNA or RNA which is reproduced inside the living cells. It uses its host's synthetic machinery to direct the synthesis of the specialized particle called virion (nucleic acid and coat) which contains the viral genome. Six major groups of viruses are recognized to be causing disease in insect and mites. These are:

- Baculoviruses (Baculoviridae)

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- Cytoplasmic polyhedrosis viruses (Reoviridae)
- Entomopox viruses (Poxviridae)
- Irridoviruses (Tridoviridae)
- Densoviruses (Parvoviridae)
- Small RNA viruses (unclassified)

Bacuoviruses and Cytoplasmic polyhedrosis viruses are mostly utilised for causing diseases in insects.

Entomopathogenic Protozoans:

These are extremely diverse group of organisms commonly referred to as microsporidians. They are generally host specific and slow acting, producing chronic infections with general debilitation of the host. The spore formed by the protozoan is the infectious stage and has to be ingested by the insect host for pathogenecity. The most notable entomopathogenic protozoa belong to *Nosema* spp. and *Variomorpha necatrix*. *Nosema locustae* is the only commercially available species of the microsporidian and is marketed for control of grass hoppers and crickets in USA, Canada, Argentina, China and Mali. *Nosema pyrausta* reduces fecundity and longevity of the adults and also causes mortality of the larvae of European corn borer.

Genetic Improvements of Predators and Parasitoids:

The indiscriminate use of pesticides and global warming has led to the reduction in the number as well as the efficiency of the natural enemies. Under Integrated Pest Management programmes agrochemicals usage cannot be completely avoided since, for instantly lowering the pest population usage of chemicals is the only solution. Thus, arises the need to genetically modify natural enemies capable of resisting the environmental stress and ill effects of pesticides. Success has been achieved in this respect. Some of the examples have been listed below:

- *Trioxys pallidus* (Parasitic wasp of wallnut aphid *Chromaphis juglandicola*) developed resistance to Azinphosmethly.
- The predatory mite *Metaseilus occidentalis* acquired resistance to organophosphate and Sulphur.
- In the year 2008 *Trichogramma chilonis* strain tolerant to three major insecticides i.e. Endosulfan, Monocrotophos, Fenvelerate has been developed.

A new study appearing in the *Journal of Economic Entomology* has found that the selective insecticide sulfoxaflor is just as effective at controlling soybean aphids (*Aphis glycines*) as broadspectrum insecticides, without causing significant harm to some beneficial predators of the aphid. Therefore, sulfoxaflor could play a larger role in integrated pest management, which attempts to minimize the adverse impact on beneficial insects while effectively controlling pests.

CONCLUSION:

Biocontrol, typically involving active human role relies on parasitism, predation and other natural mechanisms to mitigate the effects of insect pest population. The indiscriminate and widespread use of agrochemicals to manage insect pest population has caused significant damage to the environment, natural enemies and other non-target organisms. However, the most likely obstacle in its implementation is the low adoption rate by the farmers. Therefore, the need is to integrate the research with the extension agencies to disseminate the benefits of this technology among the growers.

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Wax Apple: Cultivation, post harvest processing and value addition

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INTRODUCTION

Wax apple (*Syzygium samarangense*) belongs to the family Myrtaceae and it is abundantly cultivated in the tropics mainly in Southeast Asia. The major wax apple growing countries include China, Indonesia, Malaysia, Taiwan, Thailand, Vietnam, Philippines and India. In India, this fruit is mostly cultivated in the states of Kerala and Tamil Nadu. This tropical fruit tree is known by various common names which include wax apple, love apple, Java apple, royal apple, bell fruit, Jamaican apple, water apple, mountain apple, cloud apple, wax jambu and rose apple. Wax apple tree generally grows to a height of 12- 15 m tall but in well managed orchards, it is pruned and height of 4 – 5 m is maintained. It possesses 20-30 cm long and 6-12 cm broad evergreen leaves. The flowers are generally white in colour with 2.5-3.0 cm diameter, four petals and numerous stamens.

Wax apple is highly nutritive, crispy, and juicy with deep red, pink, green or white colour and apple aroma. Other characteristics include; bell shaped, edible berry; fresh fruit is glossy and waxy; fruit colour ranges from milky white, pale green or green to red, pink, purple, or crimson to deep purple or even black (Wang *et al*., 1994). Fruits are 4-6 cm long in wild plants. When mature, the tree is considered a heavy bearer yielding a crop upto 700 fruits. Small bushy type cultivars can also be grown in pots. The ripe wax apple resembles like an apple on the outside in terms of color. In terms of flavour it is similar to that of a snow pear, and the liquid-to-flesh ratio on the wax apple is comparable to watermelon. Unlike either apple or watermelon, the wax apple's flesh has a very loose weave. The seed is situated in middle as a sort of cotton-candy-like mesh. This mesh is edible, but flavourless. The colour of its juice depends on the cultivar; it may be purple to entirely colourless.

Nutritional Value

The fruit flesh or pulp contains spongy tissue and it comprises of about 92 per cent water, owing to this, the consumption is more in extreme summer. The detailed nutritional composition is given in Table 1.

Table 1: Nutritional composition of wax apple fruit

tritional composition	lue (per 100g)
ter (g)	00
ergy (kcal)	00
tein (g)	0
al lipids (fat) (g)	0
bohydrate (g)	0
cium (mg)	00
n (mg)	7
gnesium (mg)	0

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osphorous (mg)	0
tassium (mg)	3.00
c (mg)	6
amin C, total ascorbic \(mg)	30
amin (mg)	2
oflavin (mg)	3
cin (mg)	0
amin A, RAE (µg)	00
amin A(IU)	9.00

Source: USDA Nutrient Database for Standard Release, 2012

Health benefits

The various parts of wax apple tree as well as the fruit are proved to be effective from medical science point of view. The description is given as under:

- In Chinese medical science, wax apple fruits, leaves and seeds are anti-febrile and the roots are diuretic. In the summer season, it protects from sunstroke or dehydration and also relieves from stomach discomfort.
- Crushed leaves of malay apple have been used as a medicine for sore throat.
- It also boosts immune system as it is a good source of vitamin C.
- The presence of high potassium and anti – oxidants helps in prevention of heart diseases and stroke.
- Prevent diabetes due to the presence of alkaloid compound present in wax apple fruit.
- Prevent constipation as it is a rich source of fibre content.
- It helps in detoxifying liver and kidney.

Varieties of wax apple

The most popular varieties of wax apple found in Southeast Asia are green pearl and black pearl. ‘Black pearls’ have purplish red fruits which are highly priced and while the variety ‘Green Pearls’ have small fruits with green colour. The economically important varieties of wax apple are given below:

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Pink variety


Big fruit variety


Indonesia big fruit variety


Thub thim chan variety


Big Red Variety (Malaysia)


Vietnam white variety

Cultivation practices

The climatic conditions of tropical and sub-tropical countries are suitable for cultivation. The optimum temperature required for its growth is 25 - 30° C as it enhances total soluble solids (TSS) and skin anthocyanin accumulation. It even requires considerable amount of water supply. This fruit is grown in soil types that are ranging from mild acid to mild alkaline, and sandy to clayey are the most appropriate for higher production. Wax apple varieties that are grown in coastal area with mild alkaline and clayey soil usually get high quality fruits that contain dark red skin and higher TSS. The most appropriate climate for producing high quality wax apple is during summer season with few rainy days.

Harvesting

For attaining good quality of wax apple, maturity level is very important. This maturity level is determined by flesh colour and reddish patch spread over the fruit. For instance, for winter or spring wax apple, flesh colour appears to be crimson, but the wax apple fruit in the summer season exhibit light pink to pink colour. Hence the farmers must regulate relationship between harvesting season and maturity period in order to produce better and stable quality and consequently enhancing the income from the sale of the produce. The market prefers larger size fruit, dark red flesh colour and high TSS ie10 - 12° Brix.

Post harvest handling

This is a very important stage when concerned with wax apple because this fruit has a thin and dehydrated fruit skin, wax apple has to be graded and packed immediately after harvesting. After the harvesting, farmers should keep the fruits in cloth bags and store in a cool place and then they should be graded based on size and flesh colour. Later, the graded fruits should be covered with Styrofoam net to transport them to market. Due to the thin skin of fruit, farmers should pay more attention in handing the fruits during grading, packaging and storage. The fruits easily loose moisture and may become soft and wrinkled after too much time in storage. The various stages in post-harvest handling include:

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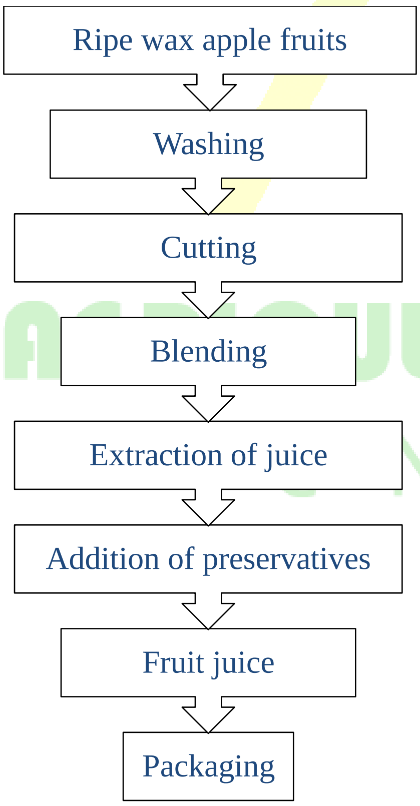
- **Pre-cooling**- this is very much necessary to bring down the temperature of fruits and there by extend the shelf life. The recommended pre-cooling temperature is 10 - 12° C.
- **Grading** – The wax apple fruits are graded on the basis of varieties, fruit size and shape. Local market grading standard are distinguished by single fruit weight, viz., grade-I: 40 - 50 fruits per box (120 - 150 g/per fruit); Grade-II: 50 - 60 fruits per box (100 - 120 g/per fruit); and grade III: 60 - 70 fruits per box *i.e* 85 - 100 g/per fruit (Huang *et al*., 2014).
- **Packaging** – generally it is packed in 12 - 15 kg cardboard boxes that are separated into 2 - 3 layers, with stuff shredder paper to minimize the fruit crash. In order to reduce serious dehydrated situation, the usual pack box-inbox and cover the outer box with polyethylene plastic bag.
- Loading and transportation

Value added products

The wax apple is commonly eaten as a raw fruit, it is often served uncut but the core is removed to preserve the bell shape of the fruit. But in the cuisine of Indian Ocean islands, the fruit is frequently used in salads. This fruit can also be used in making pickles (chambakk aachar). From wax apple, one can also prepare juice, jelly, sauce, syrup and wine. Wax apples can also be cold brewed or distilled to produce fruit liquor with a unique taste. The process protocol for preparation of various value added products of wax apple is briefed below.

1. Wax apple juice

In the processing of the fruit into juice, the freshly harvested wax apples are rinsed in clean water, cut into pieces for blending. The wax apple juice is extracted from the blended rose apple fruits using sieve, this is depicted in given process flow chart. Additives can be added to the juice and then packaged for storage.



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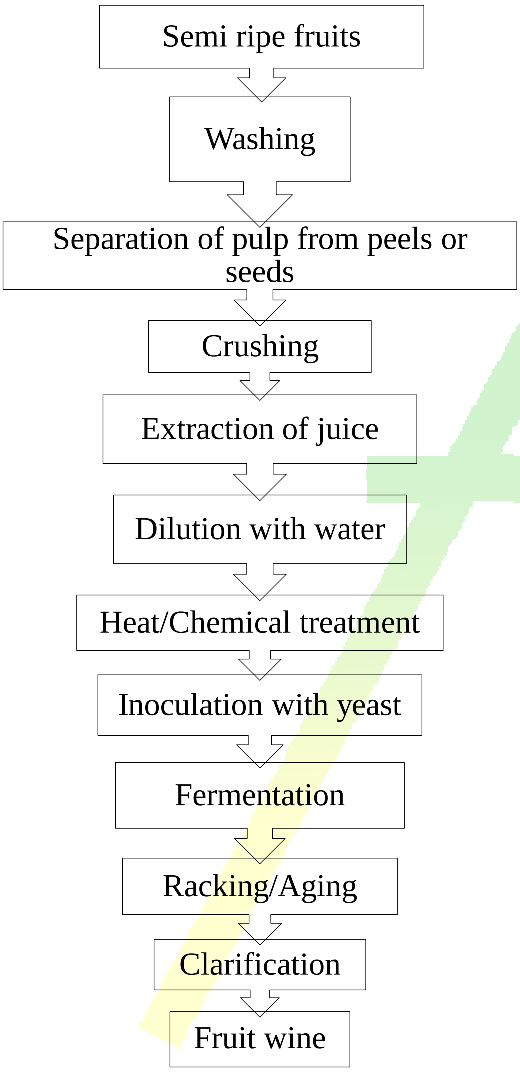
2. Wax apple wine

The wax apple fruit juice can also be used for preparation of wine through the process of fermentation. However, fermentation in juice is due to the oxidation of organic compound present in the juice by bacteria and fungi. The following flowchart shows the processing of fruit pulp into fruit wine.



CONCLUSIONS

Owing to its nutritional composition and other health beneficial characteristics, it is gaining popularity among consumers. Nowadays apart from being used as raw fruit, it is also being used in producing value added products like pickle, juice, jelly, however the popularity is less. The main constraint in cultivation of wax apple is the climatic change. The fruit quality is deteriorated due to global warming and extreme weather conditions which consequently increases the cost of production. Moreover, this fruit has a thin and dehydrated fruit skin, so it has to be graded and packed immediately after harvesting. Therefore post-harvest management is important to retain the quality of these species.

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Conservation agronomic innovations and its agro-ecological approaches to bring sustainability in agriculture

Article id: 21667

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INTRODUCTION:

For arable soils, the most effective conservation practices for reducing surface evaporation were those that provide some degree of surface cover for the soil. A cover can be best provided by mulches or by tillage practices that leave plant residues on the soil surface.

Mulch is any material placed on a soil surface for the purpose of reducing evaporation or controlling weeds. Mulches act as barriers to movement of moisture out of the soil. They can be either natural (e.g. straw, wood chips, peat) or man-made (e.g. transparent or opaque plastic sheeting). Mulches can also enhance soil temperature, depending on the type of mulch being used. In addition to reducing evaporation, vegetative mulches can reduce the spread of soil borne diseases, reduce weed growth, reduce soil erosion, and provide nutrients and organic matter and aid in infiltration. Mulches improve infiltration by protecting the soil surface from the impact of raindrops and eliminate soil crusting. Mulches can however, be expensive and labour intensive to obtain, transport and apply to the soil. Mulching is usually more practical for high value crops such as vegetables.

Specially prepared plastics can also control evaporative loss. Black plastic can also effectively control weeds. These types of mulches are often applied by machinery and there are holes or slits present for plants to grow through. These mulches are commonly used for vegetables and small fruit crops. The use of plastic mulches has some disadvantages. The formation of a barrier on the surface of the soil decreases ET, but also acts as a barrier to infiltration of additional water from rainfall. There are also problems associated with the removal of plastic mulches at the end of the growing season. It is difficult to completely remove the mulch and debris can build up after several years, interfering with water movement and cultivation.

Table 1: Conservation Agronomic Practices for Water Management in Dryland Agro-Ecosystem

Group	No.	Practices
A. Drought evasive technique	1.	• Wind break • Contingency crop planning
B. Moisture conservation 1. Before crop sowing	2.	• Field bunding • Desilting of tank • Deep ploughing- summer deep ploughing (to reduce pest, weed) • Repeated blade harrowing • Preparatory cultivation with country plough • Use of traditional implement • Deep tillage to increase percolation of rain water.

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1. During crop sowing		• Sand application • Thinning to avoid drought damage • Transplanting of seeding of millets • Seed treatment (with hing, with drought inducing chemical)
2. Intercultural operation		• Defoliation of leaf at the bottom of the plant • Mulching: • dust mulching • mulching with groundnut shell • Antitranspirants • Efficient use of biomass as a mulch • Use of harvested weed as mulch • soil mulch • plastic mulch • mulching at critical stages of plant
Nutrient management	3.	• Making provision of foliar spray of water • Supplemental irrigation or protective irrigation • Application of FYM • Nutrient management through fertigation
Alternate cropping pattern	4.	• Intercropping • Mixed cropping • Trap cropping • Crop rotation • Crop substitution • Contour farming • Strip farming • Alternate cropping pattern

Some of the agro-ecological principles behind soil moisture conservation were:

- Plants do not need water but they need a little moisture in rhizosphere zone of plants.
- So drip irrigation is sufficient to maintain adequate soil moisture levels.
- Soil moisture is essential for ion exchange process of nutrient availability to root system and uptake of nutrients.
- Soil moisture allows for humus presence in soil, which allows for chemical reactions inside the soil for making nutrients available to plants for uptake.
- Hence soil moisture levels, humus and organic carbon all are essential to maintain soil fertility.
- If soil moisture dries up, the soil chemistry slows and stops. Soil nutrient uptake too stops.
- In the absence of adequate soil moisture around root zone of plants, plants suffer severe soil moisture stress and begin to wilt, wither and die.

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CONCLUSION

The above given numbers of conservation methods is to reduce excessive soil water loss. Most of the practices provide additional advantages such as building soil structure, improving organic matter or weed control. Soil moisture conservation may be the most efficient and economical way of increasing net returns over the long term.

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Seed quality and it's importance in crop production

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INTRODUCTION:

Seed may be defined as "Structurally a true seed is a fertilized matured ovule, consisting of an embryonic plant, a store of food and a protective seed coat, a store of food consists of cotyledons and endosperm"

However, from the seed technological point of view seed may be sexually produced matured ovule consisting of an intact embryo, endosperm and or cotyledon with protective covering (seed coat). It also refers to propagating materials of healthy seedlings, tuber, bulbs, rhizome, roots, cuttings, setts, slips, all types of grafts and vegetative propagating materials used for production purpose.

Thus seed is the most vital and crucial input for crop production, one of the ways to increase the productivity without adding appreciably to the extent of land now under cultivation by planting quality seed.

Quality Seed

Quality seed is defined as varietally pure with a high germination percentage, free from disease and disease organisms, and with a proper moisture content and weight.

Quality seed insures good germination, rapid emergence, and vigorous growth. These aspects translate to a good stand (whether greenhouse or field). Poor quality seed results in "skips," excessive thinning, or yield reductions due to overcrowding, all of which diminish profitability.

Importance of quality seed

1. Seed is a vital input in crop production;
   - It is the cheapest input in crop production and key to agriculture progress.
   - Crop status largely depends on the seed materials used for sowing
   - Response of other inputs in crop production depends on seed material used
2. The seed required for raising crop is quite small and its cost is so less compared to other inputs
3. This emphasis the need for increasing the areas under quality seed production
4. It is estimated that good quality seeds to improved varieties can contribute about 20 -25% increase in yield.

The advent of modern plant breeding methods and biotechnological advances in seed industry plays a significant role in developing of high yielding varieties and hybrids.

Benefits of using quality seeds

1. They are genetically pure (true to type).
2. The good quality seed has high return per unit area as the genetic potentiality of the crop can be fully exploited.
3. Less infestation of land with weed seed/other crop seeds.
4. Less disease and insect problem.
5. Minimization of seed/seedling rate i.e., fast and uniform emergence of seedling.
6. They are vigorous, free from pests and disease.

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7. They can be adopted themselves for extreme climatic condition and cropping system of the location.
8. The quality seed respond well to the applied fertilizers and nutrients.
9. Uniform in plant population and maturity.
10. Crop raised with quality seed are aesthetically pleasing.
11. Good seed prolongs life of a variety.
12. Yield prediction is very easy.
13. Handling in post-harvest operation will be easy.
14. Preparations of finished products are also better.
15. High produce value and their marketability.

Factors affecting seed quality

Seed quality is determined by a number of genetic and physiological characteristics. The genetic component involves differences between two or more genetic lines, while differences between seed lots of a single genetic line comprise the physiological component.

➢ **The genetic factors that can influence quality include**:
- Genetic make-up
- Seed size
- Bulk density

➢ **The physical or environmental characteristics include:**
- Injury during planting and establishment
- Growing conditions during seed development
- Nutrition of the mother plant
- Physical damage during production or storage by machine or pest
- Moisture and temperature during storage
- Age or maturity of seed.

Deterioration in seed quality may begin at any point in the plant's development stage from fertilization onward. Seed quality depends upon the physical conditions that the mother plant is exposed to during growth stages, as well as harvesting, processing, storage and planting. Temperature, nutrients and other environmental factors also affect seed development and influence seed quality.

➢ **High quality seeds are the result of good production practices, which include:**
- Proper maintenance of genetic purity
- Good growing conditions
- Proper timing and methods of harvesting
- Appropriate processing during threshing, cleaning and drying
- Appropriate seed storage and seed distribution systems.

1. Structural concept of seed quality

Knowledge about the various quality aspects of seeds greatly contributed to agricultural development in the past and will continue to play a major role in future enhancement of crop production. Seed quality is a multiple concept comprising several components (Thomson, 1979). The components are divided in four major groups:

i. Genetic quality

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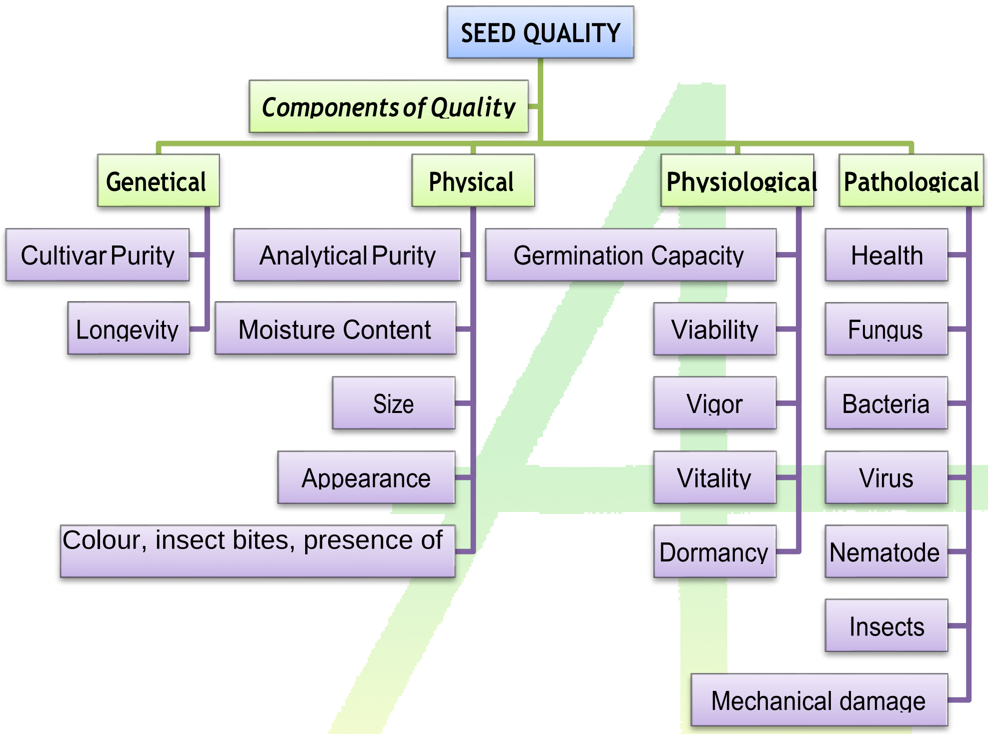
ii. Physical quality
iii. Physiological quality
iv. Pathological quality



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Genetic attributes of seed quality

1. **Seed of the same variety:**

Within crops (species) such as maize, rice or groundnuts there are thousands of distinct kinds of these crops. These distinct kinds of the particular crop are referred to as varieties or cultivars. Plants produced by seeds of a variety present the same characteristics and that these characteristics are reproducible from a generation to another. The definition of a cultivar is an assemblage of cultivated plants which is clearly distinguished by any characteristics (morphological, physiological, cytological, chemical or others) and which, when reproduced (sexually or asexually) retains its distinguishing characters.

There are modern varieties that are the result of plant breeding and varietal development programmes, multi-location trials, national variety release systems and formal seed production systems. Another kind of crop varieties are traditional varieties (landraces) that are produced and conserved by farmers which can be local population of plants selected by farmers or sometimes are modern varieties that were released many years ago.

Seed of different varieties of the same crop are often difficult or impossible to distinguish once it is harvested. Mixing of different varieties of the same crop or species can occurs when the grain/seed is sold and it enters into the formal and informal marketing system.

2. **A mixture of varieties can be a problem because:**

- Mixed varieties may mature at different times which lead to problems in harvesting, postharvest handling, and results in lower yields.
- Additionally, each seed of an undesired variety in a mixture will produce seed when it is planted and those seeds will produce more seed so that each year the proportion of the undesired variety becomes greater.
- Field inspection followed by roguing (removal of undesirable plants) during the growing period of the seed crop is one of the steps taken to insure varietally pure seed in certified seed.

However, it must be pointed out that traditional varieties or landraces particularly of cross pollinated varieties used by subsistent farmers are often populations of plants that are not very uniform. This heterogeneous character can be an advantage in some circumstances of low rainfall, low fertility and pest and disease pressure. In other situations such as seed for bean in Burundi, farmers prefer to plant a mixture of several different kinds of beans.

3. Adapted to the local conditions:

The length (days) of the growth cycle is a critical characteristic in particular for rainfed crops so that they mature while there is sufficient moisture for grain filling. Adaptation to soil, soil fertility, diseases, pests, day length, and moisture regimes are all important characteristics of a crop variety. Plants will grow well and produce an abundance of seed only in the proper environment. It is difficult to anticipate how a variety will respond to a different agro-ecological zone until it is actually grown there. Therefore variety trials are important as they establish the recommended zones of adaptability for varieties. Though earlier maturing

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varieties may be of interest to farmers in drought condition it is not always the best option. For example bird attacks on the maturing grain of varieties that mature earlier than the conventional longer duration variety can be quite severe and discourage farmers from planting early maturing varieties.

However, when early maturing varieties must be grown, there are some varieties of some crops tolerant to bird damage to minimize the effect of this pest e.g. in rice, sorghum etc.

4. Pest and disease tolerance:

Tolerance to pests and diseases (biotic factors) means that a plant can live with these organisms without significant loss of yield and quality. Obviously tolerance to important diseases and pest is extremely important and a major objective of plant breeders. Disease and pest resistance is considered absolute resistance to damage by the organisms. Tolerance and resistance can breakdown with time due to mutations in the parasites or hosts. New sources of resistance and tolerance are always being sought by plant breeders. Having precise information on disease and pest tolerance of a variety is important when considering the introduction of new crops and varieties.

5. High yielding ability:

High yielding ability is linked to a range of plant characteristics including plant architecture, nutrient use efficiency and factors mentioned above i.e. adaptation to local conditions, pest and disease tolerance etc. Higher yields mean more food and income for farmers. With resource poor farmers it is important that the high yield can be achieved under low input conditions (minimal or no fertilizer and pesticides) or with the use of organic or mineral soil amendments.

Physical attributes of seed quality

Physical seed quality refers to the percentage of pure seed of the right crop in a seed lot; sometimes seed size is also accounted for. It is measures by some components viz. Analytical purity, moisture content, size, appearance, colour, insect bites, and presence of other undesirable materials.

1. Analytical purity

Analytical purity also called physical purity, indicates how much of the sample consist of seed of the species being tested and how much contamination of in the form of other seed and inert matter is present (Wingell, 1983).

It is essential to have specific information on purity about the seed lot such as:

a) species purity
b) presence of obnoxious weed seed
c) inert matter

2. **Pure Seed:** The pure seed shall refer to the species stated by the sender, or found to predominant in the test, and shall include all botanical varieties and cultivars of that species.

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3. **Other Seed:** Other seeds shall include seeds and seed like structures of any plant species other than of pure seed.
4. **Species purity:** When it is desirable to avoid contamination of one crop species by another similar type, a larger sample is examined and the number of seeds of the species is counted. The result is then expressed as the number of seeds in the weight of seed examined, e.g. two per kg. (Thomson, 1979).
5. **Obnoxious weed:** There are some species of weeds which are not universally present on all farm and which one established are difficult to eradicate. Weeds of this kind are described as obnoxious weed. Certified seed should be free from them. It is expressed by number in the weight of seed examined. (Thomson, 1979 and ISTA, 1985).
   - **Inert Matter:** Pieces of broken or damaged seed one half of the original size or less, straw, chaffs, stone, dust, nematode, gall, dead or living units, ergots etc. i.e. materials which have no life and which are not considered as seed of any plants are separated as inert matter (Thomson, 1979 and ISTA, 1985). And percent by weight is calculated.

2. Moisture Content

A seed can be regarded as a structure composed of complex substances such as cellulose, starch, fat and protein, with some water (Thomson, 1979). The moisture content of a sample is, either, the loss in weight when dried, or the quantity of water collected when it is distilled. It is expressed as a percentage of the weight of the original sample. It is the chief reason that causes loss of viability. It is generally assumed that the high respiration at high temperature is related in some way to rapid loss in germination (Harrington, 1972).

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Canopy management of fruit crops: Need of the hour for doubling fruit grower's income

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Fruit and vegetables are known as protective food as they supply the daily requirement of vitamins and minerals. Till now the availability of fruit crops in India is much below the recommended dose by ICMR i.e. 120 g per day. Steady increase in population desire more productivity and best quality fruits to feed the nutritionally starving mouths of the country. While the country achieved commendable position in food production, farming itself turned non-profitable overtime due to rising costs and uneconomical holdings. The contagion of farmers' distress across the country has shaken the agrarian foundations. Enhancing incomes of the farmers and ensuring their income security, thus, has been of concern to all. Unless farmers' income increases substantially, distress cannot be tackled. National Commission on Farmers under the chairmanship of Dr. M. S. Swaminathan has addressed the issue of distress and farmers' welfare through a series of recommendations. The Hon'ble Prime Minister in an address to farmers exhorted to double the incomes of farmers by 2022, which already stated that we still have requirements of more food as well as profit for the demanding society and farmer respectively. As the land resource is constant, and most of the lands are diverted to industrial purposes, we have to utilize every minute land area efficiently.

Coming to fruit growing, till now most orchards are under old, senile and low yielding crops which are unmanaged thus providing poor productivity and low cost benefit ratio, hence farmers are not taking care of them properly. Poor productivity must be reversed by increasing total production, productivity and quality by innovative approaches of canopy architecture with suitable root stock varieties and effective technologies.

Cause of Poor Fruit Productivity:

Poor production and productivity of fruit crops are attributed to the following factors;

1) Non availability of quality planting materials.
2) Traditional orchading system involving less yielding varieties.
3) Mono-cropping.
4) Low density plantation.
5) Poor canopy, nutrient and water management.
6) High incidence of insects, pests and diseases.
7) Heave pre and post harvest losses.

Among the above several factors poor canopy management and low density orchading are important factors leading to low productivity. In the absence of full canopy, the full potential of the trees can't be exploited as it has direct impact on productivity and quality. Canopy management is the manipulation of the tree canopy to optimize its production potential with excellent quality fruits. In lay mans language canopy can be defined as the vegetative part of the plant and canopy management includes the technology by which the large and unmanaged trees are properly managed for getting more production and quality.

Essential Features of an Ideal Fruit Plant Canopy:

Following are the various features of a highly productive fruit plant canopy;

1) Strong frame of primary branches.

2) Wider crotch in secondary branches.

3) Healthy and well distributed secondary branches.

4) Sufficient fruiting terminals in most productive area of the plant

5) Healthy foliage with high photosynthetic efficiency.

6) Enough space for air circulation in the canopy.

7) Finally the canopy must be able to support and protect the fruits from various environmental disorders like sunburn.

Objective of Canopy Management:

Canopy management is different for new and old orchard. For example initial training and pruning are given to new orchard, whereas reduction of biomass by cutting the unwanted parts in old orchards. The objectives of canopy management are proper distribution and utilization of solar radiation; maintaining proper airflow within the canopy; enhancing production, productivity and quality; facilitate cultural practices and control disease and pest attacks.

Principles of Canopy Management:

The basic rule behind the canopy management of the fruit tree is to make the best use of land and solar radiation for increased productivity. Improved production and quality has come from producing more fruit from smaller trees as small trees are more efficient and better at capturing and converting into fruit than larger trees. Maximum utilization of light; avoidance from building up of micro climate congenial for growth of harmful macro and micro-organisms; convenience in carrying out the cultural operations; maximizing the productivity and quality and economy in obtaining the required canopy architecture are the important principles of canopy management.

Techniques of Canopy Management:

Canopy management is an interrelationship between tree physiology with its growth and production. Orchard architecture largely depends on orchard production system which is a combination of variety, root stocks, tree spacing, training and pruning etc. to optimize yield and quality the efficient canopy is a must. Training, pruning (dormant pruning, summer pruning and summer pruning), branch orientation (example like bending in guava for induction of more flowering branches), scoring, girdling, bark inversion, selection of proper rootstock (dwarf root stock, semi dwarf root stock, biotic and abiotic stress resistance root stock, high yielding rootstocks etc.), use of plant growth regulators (for reduction of canopy), appropriate use of fertilizers (by soil and plant tissue analysis), deficit irrigation (to induce early reproductive growth), use of genetically engineered plant (for like dwarfing, high yielding etc.) etc., would help in maintaining the ideal canopies of the fruit trees.

CONCLUSION

Awareness, training, top to bottom approaches in transfer of technologies from scientific to farming community, encouragement of the farmers who adopt the advanced technology in their field, provision of materials nearer, cheaper as well as in specific time, involvement of agriculture and allied science students directly in the farmers field etc., are the best way and solutions for achieving the food and nutritional security while mitigating the low income of farmers and helps the action plan "Doubling the farmers income by 2022" to achieve in the targeted way.

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Mode of action of herbicides for commercial and fibre crops

Article id: 21670

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Mode of action of herbicides:

The mode-of-action is the manner of herbicide how it affects the plant tissue or cells. Herbicides have the same translocation/movement and have similar injury symptoms with the same mode-of-action. Selectivity on crops and weeds, behavior in the soil and use patterns are less predictable, but are often similar for herbicides with the same mode-of-action.

Cotton

- Fluchloralin 45% EC @ 1.0 l/ac has to be applied as pre-emergence. Mode of action is Microtubule assembly inhibition
- Pendimethalin 30% EC @ 1.3-1.6 l/ac has to be applied at 0-1 DAS. Mode of action is Microtubule assembly inhibition
- Alachlor 50% EC @ 1.5-2.5 l/ac has to be applied at 0-1 DAS. Mode of action is Inhibition of VLCFAs (Inhibition of cell division)

Grasses

- Quizalofop ethyl 5% EC @ 400 ml/ac has to be applied at 25-30 DAS. Mode of action is Inhibition of acetyl CoA carboxylase (ACCase)

Broad leaved weeds

- Pyrithiobac sodium 10% EC @ 250 ml/ac has to be applied at 25-30 DAS. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

Directed spray

- Paraquat 24% SL @ 1.0 l/ac. Mode of action is Photosystem-I-electron diversion

Sugarcane

- Atrazine 50% WP @ 2.0 kg/ac in 450 litre of water has to be applied at 3rd or 4th DAP. Mode of action is Inhibition of photosynthesis at photosystem II
- Metribuzin 70% WP @ 0.6 kg/ac in 450 litre water has to be applied at 3rd or 4th DAP. Mode of action is Inhibition of photosynthesis at photosystem II
- 2,4-D 80% WP+ Paraquat 24% SL @ 1.8 kg + 1.0 l/ac in 450 litre water has to be applied at 20 & 60 DAP. Mode of action is Action like indole acetic acid (synthetic auxins) +Photosystem-I-electron diversion
- Metribuzin 70% WP+ 2,4-D sodium salt 80% WP @ 0.4 kg + 0.8 kg/ac in 450 has to be applied at 25-30 DAP. Mode of action is Inhibition of photosynthesis at photosystem II + Action like indole acetic acid (synthetic auxins)

Creeper weeds

- (Chlorimuron ethyl + metsulfuron methyl) 20% WP @ 8.0 g/ac has to be applied at 75 DAP. Mode of action is inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

Sugarcane nursery

- Atrazine 50% WP @ 2.0 kg/ac in 450 litre has to be applied within 3 DAP. Mode of action is Inhibition of photosynthesis at photosystem II
- Metribuzin 70% WP @ 600 g/ac in 450 litre water has to be applied within 3 DAP. Mode of action is Inhibition of photosynthesis at photosystem II
- Metribuzin 70% WP + 2,4-D 80% WP @ 400 g + 800 g/ac has to be applied at 20-25 DAP. Mode of action is Inhibition of photosynthesis at photosystem II + Action like indole acetic acid (synthetic auxins)

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Ratoon sugarcane

- Atrazine 50% WP @ in 450 litre water has to be applied immediately after ratooning. Mode of action is Inhibition of photosynthesis at photosystem II
- Metribuzin 70% WP @ 0.6 kg/ac in 450 litre water has to be applied within 3 days after ratooning. Mode of action is Inhibition of photosynthesis at photosystem II

Jute

- Fluchloralin 45% EC @ 0.8 l/ac has to be applied as pre-emergence. Mode of action is Microtubule assembly inhibition
- Dalapon @ 2.4 kg/ac has to be applied at 3 WAS.

Mesta

- Fluchloralin 45% EC @ 0.8 l/ac has to be applied as pre-emergence. Mode of action is Microtubule assembly inhibition

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Mode of action of herbicides for cereals

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Mode of action of herbicides:

The mode-of-action is the manner of herbicide how it affects the plant tissue or cells. Herbicides have the same translocation/movement and have similar injury symptoms with the same mode-of- action. Selectivity on crops and weeds, behavior in the soil and use patterns are less predictable, but are often similar for herbicides with the same mode-of-action.

Rice nursery:

- Benthiocarb 50% EC @ 1.5 l/ac can be applied at 7-8 DAS. Mode of action is inhibition of lipid synthesis - not ACCase inhibition
- Pretilachlor 50% EC @ 1.5 l/ac can be applied at 7-8 DAS. Mode of action is inhibition of VLCFAs (Inhibition of cell division)
- Butachlor 50% EC @ can be applied at 7-8 DAS. Mode of action is inhibition of VLCFAs (Inhibition of cell division)
- Pyrazsoulfuron ethyl 10% WP @ 100 g/ac can be applied at 7-8 DAS. Mode of action is inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

***Echinocloa* sp.:** Cyhalofop p butyl 10% EC @ 400 ml/ac can be applied at 14-15 DAS. Mode of action is Inhibition of acetyl CoA carboxylase (ACCase)

Rice main field:

Annual grassy weeds:

- Butachlor 50% EC + sand @ 1.0-1.5 l/ac + 25 kg/ac can be applied at 3-5 days of transplanting. Mode of action is Inhibition of VLCFAs (Inhibition of cell division)
- Anilofos 30% EC + sand @ 500 ml/ac + 25 kg/ac can be applied at 3-5 days of transplanting. Mode of action is Inhibition of VLCFAs (Inhibition of cell division)
- Pretilachlor 50% EC+ sand @ 500 ml/ac + 25 kg/ac can be applied at 3-5 days of transplanting. Mode of action is Inhibition of VLCFAs (Inhibition of cell division)
- Oxadiargyl 80% WP+ sand @ 35-50 g (mixed with 500 ml of water) + 25 kg/ac can be applied at 3-5 days of transplanting. Mode of action is Inhibition of protoporphyrinogen oxidase (PPO)

All type of weeds in equal ratio:

- Butachlor 5% granules + 2,4 D ethyl ester 4% granules + sand @ 4 kg +4 kg + 20 kg/ac can be applied at 3-5 DAT. Mode of action is Inhibition of VLCFAs (Inhibition of cell division) + Action like indole acetic acid (synthetic auxins)
- Bispyribac sodium 10% SC@ 80-120 ml/ac can be applied at15-20 DAT. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)
- Pyrazosulfuron ethyl 10% WP @ 80 g/ac can be applied at 8-10 DAT. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)
- Cyhalofop p butyl 10% EC @ 400 ml/ac can be applied at 15 DAS. Mode of action is Inhibition of acetyl CoA carboxylase (ACCase)
- Ethoxy sulfuron 15% WP @ 50 g/ac can be applied at 15-20 DAS. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

Broad leaved weeds:

- 2,4-D sodium salt 80% WP @ 400 g/ac can be applied at 25-30 DAT. Mode of action is Action like indole acetic acid (synthetic auxins)

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Aerobic rice:

- Pendimethalin 30% EC @ 1.0 l/ac can be applied at 2-3 DAS. Mode of action is Microtubule assembly inhibition
- Pretilachlor 50% EC+ safener @ 500 ml/ac can be applied at 2-3 DAS. Mode of action is Inhibition of VLCFAs (Inhibition of cell division)
- Oxadiargyl 80% WP @ 35 g/ac can be applied at 2-3 DAS. Mode of action is Inhibition of protoporphyrinogen oxidase (PPO)
- Byspiribac sodium 10% SC @ 120/10 ml can be applied at 15-20 DAS. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

Direct sowing:

- Oxadiargyl 80% WP + sand @ 35 g/ac + 20 kg can be applied at 3-5 DAS. Mode of action is Inhibition of protoporphyrinogen oxidase (PPO)
- Pretilachlor 50% EC+ sand @ 400 ml/ac + 20 kg can be applied at 3-5 DAS. Mode of action is Inhibition of VLCFAs (Inhibition of cell division)
- Pyrazosulfuron ethyl 10% WP+ sand @ 100 g/ac + 20 kg can be applied at 3-5 DAS. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

Drum seeder:

- Bispyribac sodium 10% SC @ 80-120 ml/ac can be applied at 20 DAS. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

***Echinocloa* sp.:**

- Cyhalofop butyl 10% EC @ 300-400 ml/ac can be applied at 20 DAS. Mode of action is Inhibition of acetyl CoA carboxylase (ACCase)

Broad leaved weeds:

- 2,4-D sodium salt 80% WP @ 400 g/ac can be applied at 20 DAS. Mode of action is Action like indole acetic acid (synthetic auxins)

Maize

- Atrazine 50 %WP @ 800-1200 g/ac can be applied at 2-3 DAS. Mode of action is Inhibition of photosynthesis at photosystem II
- 2,4-D sodium salt 80% WP @ 500 g/ac can be applied at25-30 DAS. Mode of action is Action like indole acetic acid (synthetic auxins)

Maize + pulses

- Pendimethalin 30% EC @ 1.0 l/ac can be applied at 0-2 DAS. Mode of action is Microtubule assembly inhibition

Sorghum

- Atrazine 50% WP @ 800 g/ac in 250 litre water can be applied at 0-2 DAS. Mode of action is Inhibition of photosynthesis at photosystem II

Sorghum witch weed

- Atrazine 50% WP @ 800 g/ac can be applied at -2 DAS. Mode of action is Inhibition of photosynthesis at photosystem II
- Ammonium sulphate @ 10 kg/ac can be applied after emergence of weed.
- Urea @ 40 kg/ac can be applied after emergence of weeds.
- 2,4-D sodium salt 80% WP @ 400 g/ac can be applied at. Mode of action is Action like indole acetic acid (synthetic auxins).

Bajra

- Atrazine 50% WP @ 600 g/ac can be applied at 0-2 DAS. Mode of action is Inhibition of photosynthesis at photosystem II

Finger millet

- Pendimethalin 30% EC @ 600 ml/ac can be applied before transplantation. Mode of action is Microtubule assembly inhibition

Broad leaved weeds

2,4-D Sodium salt 80% WP @ 400 g/ac can be applied at 25-30 DAS. Mode of action is Action like indole acetic acid (synthetic auxins).

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Mode of action of herbicides for oilseeds

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Mode of action of herbicides:

The mode-of-action is the manner of herbicide how it affects the plant tissue or cells. Herbicides have the same translocation/movement and have similar injury symptoms with the same mode-of-action. Selectivity on crops and weeds, behavior in the soil and use patterns are less predictable, but are often similar for herbicides with the same mode-of-action.

Groundnut

- Fluchloralin 45% EC @ 1-1.2 l/ac has to be applied as PPI. Mode of action is Microtubule assembly inhibition
- Pendimethalin 30% EC @ 1.3-1.6 l/ac has to be applied at 0-3 DAS. Mode of action is Microtubule assembly inhibition
- Butachlor 50% EC/Metalachlor 720 EC @ 1.25-1.5 l/ac has to be applied at 0-3 DAS. Mode of action is Inhibition of VLCFAs (Inhibition of cell division).
- Oxyfluorfen 23.5% EC @ 0.6-0.8 l/ac has to be applied as pre-emergence. Mode of action is Inhibition of protoporphyrinogen oxidase (PPO)
- Imazethapyr 10% SL @ 300 ml/ac has to be applied at 20DAS. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)
- Quizalofop ethyl 5% EC @ 0.4 l/ac has to be applied at 20 DAS. Mode of action is carboxylase (ACCase)

Sunflower

- Pendimethalin 30% EC or Alachlor 50% EC @ 1.0 l/ac has to be applied at 0-1 DAS. Mode of action is Microtubule assembly inhibition/ Inhibition of VLCFAs (Inhibition of cell division)

Castor

- Pendimethalin 30% EC @ 1.3-1.6 l/ac has to be applied at 0-1 DAS. Mode of action is Microtubule assembly inhibition
- Alachlor 50% EC @ 0.8-1.0 l/ac has to be applied at 0-1 DAS. Mode of action is Inhibition of VLCFAs (Inhibition of cell division)
- Fenoxaprop ethyl 9.3% EC/Quizalafop ethyl 5% EC/Propaquizofop ethyl 10% EC/Cyhalofop p butyl 10 % EC @ 250 ml/ac. Mode of action is Inhibition of acetyl CoA carboxylase (ACCase)

Safflower

- Pendimethalin 30% EC or Alachlor 50% EC @ 1.0 l/ac has to be applied at 0-1 DAS. Mode of action is Microtubule assembly inhibition/ Inhibition of VLCFAs (Inhibition of cell division)

Sesamum

- Pendimethalin 30% EC or Alachlor 50% EC @ 0.8-1.0 l/ac has to be applied at 0-1 DAS. Mode of action is Microtubule assembly inhibition/ Inhibition of VLCFAs (Inhibition of cell division)

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Mode of action of herbicides for pulses

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Mode of action of herbicides:

The mode-of-action is the manner of herbicide how it affects the plant tissue or cells. Herbicide has the same translocation/movement and has similar injury symptoms with the same mode-of- action. Selectivity on crops and weeds, behavior in the soil and use patterns are less predictable, but are often similar for herbicides with the same mode-of-action.

Green gram and black gram:

- Pendimethalin 30% EC @ 1.0-1.5 l/ac has to be applied at 0-1 DAS. Mode of action is Microtubule assembly inhibition
- Alachlor 50% EC @ 1.0 l/ac has to be applied at 0-1 DAS. Mode of action is Inhibition of VLCFAs (Inhibition of cell division)

Broad leaved weeds

- Imazethapyr 5% SL @ 200 ml/ac has to be applied at 20-25 DAS. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

Grassy weeds

- Quizalofop ethyl 5% EC @ 0.4 l/ac has to be applied at 20-25 DAS. Mode of action is Inhibition of acetyl CoA carboxylase (ACCase)
- Fenoxaprop ethyl 9% EC @ 250 ml/ac has to be applied at 20-25 DAS. Mode of action is Inhibition of acetyl CoA carboxylase (ACCase)

Cuscuta

- Pendimethalin 30% EC + sand @ 1.0 l + 20-25 kg has to be applied before emergence of weed. Mode of action is Microtubule assembly inhibition
- Imazethapyr 5% SL fb Urea 1.0% (5-7 DAS) @ has to be applied at. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

Pigeonpea

- Pendimethalin 30% EC @ 1.0-1.5 l/ac has to be applied at 0-1 DAS. Mode of action is Microtubule assembly inhibition
- Alachlor 50% EC @ 1.0 l/ac has to be applied at 0-1 DAS. Mode of action is Inhibition of VLCFAs (Inhibition of cell division)

Grasses and broad leaved weeds

- Imazethapyr 5% SL @ 300 ml/ac has to be applied at 20-25 DAS. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

Grasses

- Quizalofop ethyl 5% EC @ 400 ml/ac has to be applied at 20-25 DAS. Mode of action is Inhibition of acetyl CoA carboxylase (ACCase)

Bengal gram

- Fluchloralin 45% EC @ 1.0 l/ac has to be applied at Within 24 hours after sowing.

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Mode of action is Microtubule assembly inhibition

- Pendimethalin 30% EC @ 1.0-1.2 l/ac has to be applied at Within 24 hours after sowing. Mode of action is Microtubule assembly inhibition

Soybean

- Fluchloralin 45% EC @ 1.0 l/ac has to be applied before sowing. Mode of action is Microtubule assembly inhibition
- Pendimethalin 30% EC @ 1.4 l/ac has to be applied at 0-1 DAS. Mode of action is Microtubule assembly inhibition

Grassy weeds

- Quizalofop ethyl 5% EC @ 400 ml/ac has to be applied at 20-25 DAS. Mode of action is Inhibition of acetyl CoA carboxylase (ACCase)

Grassy weeds and broad leaved weeds

- Imazethapyr 10% SL @ 250 ml/ac has to be applied at 20-25 DAS. Mode of action is Inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS)

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Coccinia grandis (Ivy gourd) - Miracle of medicinal values

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Coccinia grandis (Ivy gourd) is occasionally cultivated as a garden vegetable in the tropical and sub-tropical regions of the world. It is believed to be native to central Africa, India and Asia. Its long history of usage, cultivation and transportation by people has obscured its base. It is a common weed in South-East Asia. It is considered a valuable wild vegetable by the indigenous people of Southeast Asia and India. The plant as a whole has widespread medicinal values. The plant has also been used extensively in Ayurvedic and Unani practice in the Indian subcontinent.

Morphological characters

1. Leaves: Leaves are 5-10 cm, long and broad, bright green above, paler beneath, studded and sometimes rough with papillae, palmately 5-nerved from a cordate base, often with circular glands between the nerves, obtusely 5-angled or sometimes deeply 5-lobed, the lobes broad, obtuse or acute, apiculate, more or less sinuate toothed, petioles 2-3.2 cm. long.

2. Flowers: Male flowers: Peduncles are 2-3.8cm.long and subfiliform. Calyx-tube is glabrous, broadly campanulate and 4-5 mm. long. Corolla is 2.5 cm. long, veined, pubescent inside and glabrous outside. Female flowers: Peduncles are 1.3-2.5cm. long. Ovary is fusiform, glabrous and slightly ribbed.

3. Fruits: Fruits are fusiform-ellipsoid, slightly beaked, 2.5-5by 1.3-2.5 cm. sized, marked when immature with white streaks, bright scarlet when fully ripe.

4. Seeds: Seeds are obovoid and rounded at the apex, slightly papillose, much compressed and yellowish grey.

5. Roots: The fresh root is thick, tuberous, long tapering, more or less tortuous with a few fibrous rootlets attached to it. Roots are flexible, soft and break with a fibrous fracture. A transaction of root shows circular outline and is characteristic of storage type. Parenchyma is full of starch grains and thorough permeation of parenchyma with vascular elements is observed. The cork is composed of rows of cells.

Nutrient composition of *Coccinia grandis* (Sargunam, 2017)

Parameters	Composition
Carbohydrate	12.62 %
Total protein	15 %
Water-soluble protein	11.25 %
Lipid	4.00 %
Total Phenol	61.92 mg/100 g
Vitamin C	25.55 mg/100 g
β-Carotene	70.05 mg/100 g
Potassium	3.3 mg/100g
Phosphorous	1.15 mg/100 g
Sodium	0.95 mg/100 g
Iron	2.23 mg/100 g
Calcium	3.79 mg/100 g

Chemical constituents

The plant contains resins, alkaloids, fatty acids, flavonoids and proteins as chief chemical constituents. Aspartic acid, Glutamic Acid, Asparagine, Tyrosine, Histidine, Phenylalanine,

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Threonine, Valine, and Arginine are also found. The methanolic extract of fruit contains alkaloids, steroids, tannins, saponins, ellagic acid, phenols, glycosides, lignans, and triterpenoids. Roots contain Triterpenoid, saponin coccinioside, Flavonoid glycoside ombuin 3-o-arabino furanoside, Lupeol, β-amyrin, and β-sitosterol and Stigmast -7-en-3-one (Kumar *et al*., 2018).

It contains many chemical constituents in every of its part. They include:

- Aerial part:- Heptacosane, Cephalandrol, β -sitosterol, Alkaloids Cephalandrins A and B.
- Fruits:- β-Amyrin Acetate, Lupeol, Cucurbitacin B, Taraxerone, Taraxerol, β-carotene, Lycopene, Cryptoxanthin, Xyloglucan, Carotenoids, β-sitosterol, Stigma-7-en-3one.
- Root: -Resin, Alkaloids, Starch, Fatty Acids, Carbonic acid, Triterpenoid, Saponin Coccinoside, Flavonoid Glycoside, Lupeol, β-amyrin, β-sitosterol, Taraxerol (Harshitha *et al*., 2018)

Medicinal value of various parts of *Coccinia grandis*

Parts	Medicinal values
Leaf	Antidiabetic, oxidant, larvicadal, GI disturbances, Cooling effect to the eye, Gonorrhea, hypolipidemic, skin diseases, urinary tract infection.
Fruit	Hypoglycemic, analgesic, antipyretic, Hepatoprotective, tuberculosis, eczema. anti-inflammatory.
Stem	Expectorant, antispasmodic, asthma, bronchitis, GIT disturbances, urinary tract infection, skin diseases,
Root	Hypoglycemic, antidiabetic, skin diseases, removes pain in joint, urinary tract infection

Heal benefits of *Coccinia grandis*

- The juice of the roots and leaves is considered to be a useful treatment for diabetes
- The juice of the stem is dripped into the eyes to treat cataracts
- Tender fruit of this plant is chewed raw to treat mouth ulcers.
- Leaves are heated mildly and wrapped around the place of swelling to reduce swelling and pain associated with it
- Juice of the leaves and fruits of ivy gourd is given in a dose of 20-25 ml to treat jaundice
- For the control of diabetes, juice of the leaves and roots of ivy gourd is given in a dose of 15-20 ml
- The fruit has sometimes been used as an eye-medicine
- An infusion of the leaves is given to women to drink when a birth is overdue
- A decoction is drunk in the treatment of gonorrhoea
- The leaves are used externally as a poultice in treating skin eruptions
- The plant is laxative.
- A decoction of the plant is used to treat chest colds
- The plant is crushed and applied externally to affected areas in order to relieve the pain of headache and rheumatism

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Propagation of cassava through minisett production

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CASSAVA

Cassava (*Manihot esculenta*) popularly known as tapioca is the most important tuber crop cultivated in India. Apart from its role as a subsidiary food, during the past few decades there has been growing recognition of the value of cassava roots as a low cost energy source for livestock but recently there has been a growing interest in cassava as a source of industrial starch and as a substrate for the production of fuel alcohol.

Time of planting

Under irrigated conditions, planting of cassava can be done throughout the year. As a rain fed crop, the best time of planting is April-May with the onset of pre-monsoon showers. The next best season is August-September, with the onset of north-east monsoon showers.

Land preparation

Soil physical condition influences the plant growth and hence proper tillage is required for the successful cultivation of cassava. Loosening the soil to a depth of 20-25 cm either by tractor ploughing facilitate better rooting. Different methods of land preparation, such as flat method, mound method and ridge method did not show any significant different in yield. According to the situation different methods are being followed. In light textured soil flat method of land preparation, in heavy textural soil mound method and under irrigated condition ridges and furrow method of land preparation is suggested.

Selection of planting material

Disease and pest free planting material of 7-10 months maturity having a thickness of 2-3 cm may be selected for planting. For better establishment and root yield stakes obtained from bottom and middle portion of the stem after discarding the 1/3 from the total length of the stem from the top is preferred for the preparation of setts for planting. While preparing the setts, it is better to have a smooth circular cut rather than an irregular cut for uniform callus formation and root initiation.

Sett length and depth of planting

A sett length of 15-20 cm is found to be advantageous for higher yield. Shallow planting facilitates production of a greater number of roots. When the soil is sufficiently loose and friable setts can be planted to a depth of 5 cm. Planting the setts deeper results in swelling of the mother stem with consequent reduction in root size and yield. This is especially true when the soil becomes compacted.

Method of planting setts

Different methods of planting setts such as vertical (90^o to the ground), slanted (45^o angle) and horizontal, showed that vertical planting resulted in more uniform formation of callus tissue around the cut surface, which helped in the uniform distribution of tuber forming roots all around the base of the plant.

Minisett technique

In traditional system, stakes of 20 cm length with 10 to 12 nodes are used as planting material. However, only two buds are normally allowed to sprout and then retained, while the rest are discarded and hence wasted. By minisett technique it is possible to utilize the potential of every bud to sprout and grow as a new plant and thus enhance the multiplication ratio. Once the bud sprouts, roots would start drawing nutrients from the soil and no more from the mother planting material. Therefore, the size of planting material actually may not matter, as far as sprouting is concerned. The sett size could hence be reduced to two nodes instead of the traditional 20 cm long setts with 10 to 12 nodes.

For producing minisetts, first step is selection of mature, disease free stems (preferably those obtained from meristem culture). Two node cuttings are taken from these stems using a sharp hack saw. Top one-third portion is usually discarded in the traditional system, however in minisett technique it is also utilized. Tip of the stem (about 5 to 6 cm long) is carefully cut without causing damage. For preventing dehydration, it is advisable to place the tip cuttings in water. The stem just below the growing tip is very tender with prominent axillary buds. Hence from this portion, cuttings with four nodes are taken instead.

Tip cutting **Four node** **Two node** **20 cm setts**

The next step is preparation of nursery. Select a well-drained flat site, preferably near a water source for the nursery. Shade net house of 35 per cent shade is ideal for the germination and growth of minisetts. Make raised beds of convenient length and mix the soil with fine sand. Nursery area of 145 m^2 is required for producing minisetts for planting one hectare on land. Raised beds of 1 metre width, convenient length and 20 cm height will be ideal. Two node cuttings are planted end to end horizontally, about 5 cm deep, with the buds facing either sides. A spacing of 5 cm is provided between two rows. Growing tips and four node top setts should be planted erect at 5 x 5 cm spacing to prevent decay due to excess moisture content in these tender parts. Irrigating frequently, preferably with micro sprinklers help in early sprouting and proper establishment of the minisetts.Minisetts would sprout in a week's time. Roguing of cassava mosaic virus infected plants should be done as

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soon as such symptoms are expressed, to keep the nursery disease free. Weekly spray of systemic insecticide like Dimethoate @ 0.05% to control white files that transmit cassava mosaic virus is advisable. The minisetts will be ready for transplanting in about three to four weeks' time. Minisetts are carefully uprooted from the nursery causing least injury to the root and plant. Uprooted minisetts are then carefully planted on ridges. Make sure that there is sufficient moisture in the soil. Multiplication ratio in cassava planting material by this process is enhanced to 1:60 from traditional 1:10. On harvest from a hectare of land about 60,000 cassava stems and 75 tons of tuber could be obtained. If minisett technique is adopted for further multiplication, about 70 ha could be planted in the next generation.

Spacing and plant population

Based on the branching behavior, cassava genotypes are classified into branching, semi-branching and non-branching types. Non-branching types requires a spacing of 75x75 cm while semi-branching and branching types require 90x90 cm for optimum production. Normally, one sett is planted/hill but planting two/hill could improve the total yield but reduce the tuber size resulting adversely the market quality of the tuber.

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Pradhan Mantri Mudra Yojna – An Entrepreneurship Development Initiative

Article id: 21676

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Micro enterprises constitute a major economic portion in our nation. It gives large employment after agriculture in India. This economic portion includes micro units, small business enlist in manufacturing, trading and other sector. Micro Finance is an economic development tool whose objective is to provide income generating opportunities to the people who are financially excluded. It covers a variety of financial services which include, in addition to the provision of credit, many other credit plus services, financial literacy and other social support services. Many entrepreneurs of micro enterprises belong to the economically weaker section of society so that is why they are unable to access financial services. Government of India launched a new scheme called Micro Units Development and Refinance Agency, popularly known as MUDRA for uplifting the informal sector and connecting them to the financial mainstream of the country's economy. Funding this unfunded section of the society is the main aim behind the formation of Pradhan Mantri MUDRA Yojana (PMMY). MUDRA grants loan such micro enterprises which engaged in trading, manufacturing and service sector for loan amount up to Rs. 10lakh. This scheme is available from all bank branches across the country.

Financial Inclusion:

Finance is one of the most effective tool to fight poverty and provide opportunities. Financial Inclusion is one of the most treasured strategies in India. Financial Inclusion means process of ensuring access to appropriate financial services to all the sections of society such as low income groups and weaker section at an affordable rate.

Entrepreneurship is the most powerful weapon in the hands of one to fight against poverty and unemployment. Entrepreneurship plays a significant role in the economic development of the nation as it leads to generation of employment, contribution in national income, rural development, industrialization, technological development, export promotion etc. etc. In India, entrepreneurship can prove as one stop solution for addressing the major problems like unemployment and poverty.

In India, micro enterprise constitutes a major economic segment in our country and provides large employment after agriculture, therefore play a crucial role in the growth of the economy According to the National Sample Survey Office (NSSO) 2013 Survey, there are around 5.77 crore small scale units, engaging around 10 cr. people. But major part of this sector faces financial crises, lack of technical knowledge, managerial skills, availability of resources and infrastructure, awareness about entrepreneurship schemes and regulatory framework, market linkage which obstruct the growth and development of entrepreneurship in the country. Government of India (GOI) has introduced a number of financial inclusion initiatives such as Pradhan Mantri Mudra Yojana (PMMY), Pradhan Mantri Jan DhanYojana (PMJDY), Pradhan Mantri Jeewan Jyoti Beema Yojana (PMJJBY), Pradhan Mantri

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Surakhsha Beema Yojana (PMSBY) etc for the weaker section, low income groups, small business man and micro enterprises. Among the initiatives taken by GOI, PMMY plays a major role in achieving of greater financial inclusion in India.

PMMY was announced by the Hon'ble Prime Minister Shri Narendra Modi on 8th April, 2015 along with the announcing of Micro Units Development & Refinance Agency Ltd (MUDRA) bank for promoting the small medium enterprises by providing fund facility. It is also known as the Mudra loan scheme. Slogan of this scheme is "Punji - Safalata ki Kunji". The purpose behind the launching of PMMY is to provide credit inclusion to small businesses whose credit requirement is up to Rs.10 lakh.

MUDRA is Non-banking finance institution for supporting the micro enterprises segment in the country. MUDRA was introduced to provide the SMEs in India with a financial support and a better position to sustain themselves with larger players. Pardhan Mantri Mudra Yojna (PMMY) is open and available from all bank branches across the country. Small businesses, societies, small banks, schedules commercial banks, trust sec 8 companies and rural banks refinance all the financiers or financial institutions by the MUDRA, so that money can be lent to SMEs for their trading and manufacturing purposes. The Mission of MUDRA is "To create an inclusive, sustainable and value based entrepreneurial culture, in collaboration with our partner institution in achieving economic success and financial security." Its aim is not only the funding the unfunded but also aims to increase the funding gap to micro enterprises and help the existing micro units enhance their activities.

MUDRA Bank:

Micro Units Development Refinance Agency (MUDRA) Bank has been set up on 8th April 2015 for development of micro units to encourage entrepreneurship in India and provide the funding to the non corporate small business sector. MUDRA Bank was registered as a Company in March 2015 as per Companies Act, 2013. MUDRA Bank is not a full-fledged bank but it is a refinancing agency. MUDRA Bank is also a Non-Banking Finance Institution or NBFI with the Reserve Bank of India. MUDRA Bank provides refinance to Banks, MFIs, NBFCs etc. for loans to micro units having loan requirement from Rs 50000 to Rs. 10 lakh. Under MUDRA Yojana, MUDRA Bank has launched three products named Shishu, Kishore and Tarun to signify the stage of growth and funding needs of entrepreneurs.

- **SHISHU:** These loans are sanctioned specifically to provide the young entrepreneurs with financial aid. Shishu loan limit is up to Rs. 50000.

- **KISHORE:** There loans are authorized up to Rs.5 Lakh and not below Rs.50000 for those who are already having their business for some period of years.

- **TARUN:** They are authorized for loans amounting to more than Rs. 5 Lakhs and not below Rs. 10 Lakhs for those who want to grow their small business into larger enterprises.

MUDRA has been basically formed as a wholly owned subsidiary of Small Industries Development bank of India or SIDBI with 100% capital being capital being contributed by it at its initial stage. The authorized capital of MUDRA is 1000 crores & paid up capital is 750 crore, subscribed by SIDBI. It manages the web portal for monitoring the PMMY data.

MUDRA Card: The MUDRA card can just be used as an ATM card, the pre-approved credit can be utilized by the holder of the card while making a purchase of raw materials, machinery and other components, from registered producers on an

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online platform. The card could be linked with Pradhan Mantri Jan Dhan Yojana Savings Account of the borrower and the withdrawals could also be enabled through the Bank's ATM network for meeting the immediate liquidity problems of the micro enterprises.

Beneficiaries of Scheme: Any Indian Citizen who has an income generating plan from micro business activities in trading , manufacturing and processing and whose loan requirement is less than Rs.10 lakh can approach for availing MUDRA loans under PMMY. Lending rate in this regard is issued by Reserve Bank of India (RBI) time to time. Non corporate small business sector (NCSBS) engaged in service sector, micro manufacturing units, fruits & vegetable vending, maintenance & repairing, handicraft making and operating food services etc. inboth areas rural as well as urban are mudra borrower under the scheme. From financial year 2016-2017 onwards, agriculture activities had made eligible under this scheme.

Impact on the Indian economy:

Since MUDRA scheme will be benefiting many micro and small entrepreneurs and unemployed educated youth who are seeking financial support from the formal banking sector, its impact will be

1. **Employment Generation**: Approximately 5.77 small businesses are expected to be benefited from MUDRA scheme who employs nearly 12 crore of people. No doubt, with the increase in capital, there will be rise in employment.

2. Growth of GDP: Because of MUDRA, availability of organized financial system will be possible and will contribute in developing the country's GDP.

3. Empowerment of Women: The general belief that the role of women is to look after homely affairs, has been changed because of PMMY, as MUDRA scheme focuses on skill development, women will also be economically independent.

4. Living Standard and Quality life: Since the increase in the income is achieved, spending will also increase in direct proportion, and as a result of this, the flow of money will be smoothening in the economy.

5. Promote capital formation: When job seekers will be the job creators because of MUDRA, automatically capital will be formed and economy will be strengthened.

6. Increase entrepreneurial spirit: MUDRA will act as a PUSH factor for bringing individuals' in the businesses and creating many 1st Generation entrepreneurs.

CONCLUSION: PMMY is a new financial inclusion initiative of Government of India. Its aim is not only the funding the unfunded but also aims to increase the funding gap to micro enterprises and help the existing micro units enhance their activities. The desired transformation can be achieved through this scheme. If implemented properly at the bottom level, it may act as a game changing idea and may boost and prosper the Indian economy in a short span. MUDRA can act catalyst for development of employment, GDP and entrepreneurship at large.

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Improving cutting tool life by coated material

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INTRODUCTION

The manufacturing industry is constantly striving to decrease its cutting costs and increase the quality of the machined parts as the demand for high tolerance manufactured goods is rapidly increasing. The increasing need to boost productivity, to machine more difficult materials and to improve quality in high volume by the manufacturing industry has been the driving force behind the development of cutting tool materials. Numerous cutting tools have been developed continuously since the first cutting tool material suitable for use in metal cutting, carbon steel, was developed a century ago.

Coating Machining efficiency is improved by reducing the machining time with high speed machining. When cutting ferrous and hard to machine materials such as steels, cast iron and super alloys, softening temperature and the chemical stability of the tool material limits the cutting speed. Therefore, it is necessary for tool materials to possess good high-temperature mechanical properties and sufficient inertness. The machining of hard and chemically reactive materials at higher speeds is improved by depositing single and multi-layer coatings on conventional tool materials to combine the beneficial properties of ceramics and traditional tool materials.

The effect of coatings in the following statements:

1. Reduction in friction, in generation heat, and in cutting forces
2. Reduction in the diffusion between the chip and the surface of the tool, especially at higher speeds (the coating acts as a diffusion barrier)
3. Prevention of galling, especially at lower cutting speeds

Coating Materials

The majority of inserts presently used in various metal cutting operations are cemented carbide tools coated with a material consisting of nitrides (TiN, CrN, etc.), carbides (TiC, CrC, W_2C, WC/C, etc.), oxides (e.g. alumina) or combinations of these. Coating cemented carbide with TiC, TiN and Al_2O_3 dramatically reduces the rate of flank wear. A primary contributor to the wear resistance of the coating materials is that they are all much less soluble in steel than WC at metal cutting temperatures. High hardness is beneficial in resisting the abrasive wear. Retention of hardness even at higher temperatures is very important since the tool bit experiences a temperature in the range of 300-1000°C depending on the machining parameters and the materials to be machined. They all exhibit a decrease with an increase of temperature, and the decrease of hardness was much more pronounced in the case of TiC. Interestingly, the micro hardness of Al_2O_3 was significantly lower than TiC at room temperature but retained almost 40 % of its room temperature hardness at 1000 °C

Coating with three layers of TiC-Al_2O_3-TiN as seen from the substrate are widely used for machining of many types of steels. This type of coating improves the wear resistance of the tool by combining the properties of the three materials. The ranking of the solubility products and limits of TiC, TiN and Al_2O_3 in iron, compared to the carbide substrate, is in the order TiC > TiN > Al2O3. Therefore, there is less driving force for significant dissolution-diffusion wear of Al2O3 to take place. Thus, having a coating layer of Al2O3 over an under layer of TiC help decrease the dissolution/diffusion wear at the TiC coating layer. This enhances the performance of the cutting tool, by including the TiC layer with a low wear rate and protecting it with a layer of Al2O3 to decrease the effect of diffusion/dissolution wear. The softer TiN outer layer helps in reducing the propagation of cracks into the inner coating layers, in addition to decreasing the welding of the chips to the cutting tool. Another reason for having the TiN as an outer layer, as opposed to inner layer, is that at higher temperatures of oxidation, the growth of TiO2 (rutile) under layer may affect the performance of the protective alumina over layer of the oxide.

Surface Finish Surface roughness and tolerance are among the most critical quality measures in many mechanical products. As competition grows closer, customers now have increasingly high demands on quality, making surface roughness become one of the most competitive dimensions in today's manufacturing industry. There are several measurements that describe the roughness of a machined surface. One of the most common is the arithmetic average (AA) value usually known as Ra. The AA value is obtained by measuring the height and depth of the valleys on a surface with respect to an average centerline. The higher the AA value is, the rougher the machined surface.

CONCLUSION

The geometry of tool wear also causes a change in surface roughness as machining time elapses. Flank wear is along with groove wear are the types of wear that most influence this change in surface roughness. Some studies have claimed that the change in surface roughness is primarily caused by cutting-tool flank wear.

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The status of INDIAN agriculture: Current issues and solutions

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INTRODUCTION:

Agriculture is one of the most important component of India's economy. This sector is involved in providing approximately 50 percent of jobs available in India and contributes around 15 percent (http://statisticstimes.com) to the GDP. Almost two-thirds of the employed class in India are engaged with agricultural activity directly or indirectly. According to the report of economic data of financial year 2018-19, agriculture has contributed 15.87 percent in India's GDP. Forty three percent of India's geographical area has been occupied by agriculture. India is the world's largest producer of rice, wheat, pulses, and spice products. India also has significant contribution in dairy, meat, poultry, fisheries and food grains production. India has come up with the second largest producer of fruits and vegetables in the world. According to the data provided by Department of Economics and Statics, food grains production for the year 2018-2019 is about 281 million tons which is increased when compared to (2017-2018), 277 million tons.

Agriculture in India:

Indian agriculture contribution to the total world's economic production is around 6.4%. In terms of total agricultural output, China is the largest contributor followed by India accounting for 19.49% and 7.39% respectively. India is one of the first and foremost country which economy is based on agriculture with 50 % of its working population employed in the agriculture sector while China employs only 29.5% of its population in agriculture. In the first quarter of 2019, GDP from Agriculture in India decreased to 4860.94 INR Billion compared with 5869.41

INR Billion in the fourth quarter of 2018. From 2011 to 2019, GDP From Agriculture in India averaged 4134.73 INR Billion reaching an all-time high of 5869.41 INR Billion in the fourth quarter of 2018 and a record low of 2690.74 INR Billion in the third quarter of 2011.(www. tradingeconomics.com).

Production in 2018-19 (2nd AE)

Crops	2018-19(2nd AE)
Food grains	281.37 million tonnes
Horticulture crops	314.67 million tonnes
Total 9 oilseeds	315.02 lakh tonnes
Sugarcane	3808.34 lakh tonnes
Cotton	300.87 lakh bales

Source: Directorates of Economics & Statistics

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Production of food grains for 2018-19

Group/ Commodity	Production MT	
	2017-18	2018-19
Rice	111.01	115.6
Wheat	97.11	99.12
Jowar	4.66	3.75
Bajra	9.26	7.45
Maize	27.14	27.8
Barley	1.99	1.92
Coarse cereals	45.42	42.64
Cereals	253.54	257.35
Tur	4.02	3.68
Gram	11.1	10.32
Total Pulses	23.95	24.02
Total Food grains	277.48	281.37

Source: Directorates of Economics & Statistics, GoI.

Area and Production of Horticultural Crops – All India:

Commodity	2018-19 (1st Adv. Estimate)	
	Area(m ha)	Production(MT)
Total fruits	6.53	96.75
Total Vegetables	10.43	187.47
Flowers	0.33	2.85
Aromatic	0.71	0.88
Total Plantation	3.76	17.99
Total spices	4.08	8.59
Honey	…	0.11
Total	25.87	314.67

Source: Dept. of Economics and Statistics

Problems & Issues of Agriculture in India:

1. **Farming Debt:**

According to the report of All India Financial Inclusion Survey (NAFIS) conducted by NABARD in 2016-17, around 43.5% agricultural households have borrowed money from some source or the other. 60.4% of them have taken money from institutional sources. Further, 30.3% borrowed from only informal sources and 9.2% of agricultural households borrowed money from both sources. The rural population is mainly dependent on local money lenders for loans who charge very high interest rates for their given money. According to 2015 National Crime Records Bureau data, almost 8,007 Indian farmers committed suicide in 2015, which show an increase of 41.7% as compared with 5,650 in 2014.

2. **Agriculture Land Holdings:**

According to report of NAFIS, the average size of agricultural land holding in India is about 1.1 hectare in 2015-2016. Even the state wise average land holding seems quite uneven. Nagaland (2.1 ha), Rajasthan (1.9 ha) and Haryana (1.7 ha) possess higher land sizes per household, whereas it is around 0.5 ha in Bihar, West Bengal, Tripura, Sikkim and Jammu & Kashmir. The smaller size of land leads to less productivity.

3. **Equipment's:**

- **Seeds:** One of the main factor which decide the yield is the quality of seed. High Yielding Variety Programme (HYVP) was launched in 1966-67 to increase the seed production in India. Although the seed production has increased but the quality seeds are still not available to a large number of farmers due to their high prices.
- **Chemicals:** India's low yields are subjected to the continuous production without adequate soil nourishment which is generally done using manure and fertilizers. Chemical fertilizers are

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generally costly. Therefore cow dung can be most effective natural manure but it is mainly used as kitchen fuel in form of dung cakes. India has the potential of 650 million tonnes of rural and 160 lakh tonnes of urban compost but its effective utilization is still a challenging issue.

- **Mechanical Equipment:** Despite large scale mechanization in some parts of the country, majority of farmers including small and marginal farmers still use conventional hand tools for most of their farming operations. NAFIS showed that only 5.2% of agricultural households in the country have a tractor and 1.8% owned a power tiller. This leads to wastage of human labour and lower yields per capita labour force.

4. **Irrigation:**

India is the second largest irrigated country in the world after China still only one-third of cultivated land in India is irrigated. India, where rainfall is uncertain, irrigation can be considered a major factor that needs to be looked upon to increase yields. Access to drip irrigation and sprinkler is limited to 1.6% and 0.8% families respectively according to NAFIS.

5. **Lack of Marketing and Storage:** After harvest, farmers usually sell their produce at throw-away prices due to lack of storage facility and the ever-increasing burden of debt. They generally sell their produce to local traders and money lenders at very low price. Many market surveys have revealed that middlemen take away about 50% of the price of rice, groundnuts and potatoes which is offered by consumers. Apart from this about 6.6% of the total produce is lost due to inadequate storage facilities.
6. **Low Farm Productivity:**

Although India's total land area is slightly more than one-third of China's, but its arable land is marginally bigger than China, being second only to that of USA. India contributes to only 7.39% of the global agricultural output while China contributes 19.49%. The productivity of Indian agriculture is quite low as compared to that of China because of high land-man ratio, lack of mechanization, lower capital and many other reasons.

To address the problems of Indian Agriculture, Government has taken following steps:

1. **Innovative Schemes:**

- **Rythu Bandhu Scheme 2018:** It is also known as the Farmers' Investment Support Scheme, a welfare program started by the Government of Telangana in May 2018. It is the first direct farmer investment support initiative in India, where cash is paid directly to the farmers. Rs 4000 per acre are to be provided to each farmer twice a year. Till now, 58.33 lakh farmers are recipients of this fund.
- **AGRI UDAAN 2017:** ICAR and the NAARM technology business incubator a-IDEA launched Agri-Udaan, a food and agribusiness accelerator 2.0 in August 2017 along with IIM Ahmedabad's Centre for purpose of Innovation, Incubation and Entrepreneurship (CIIE). This Scheme aims to promote agricultural innovation and start ups and helps them gain mentorship and potential investment.

- **SAMPADA 2017:** To obtain the goal of doubling farmers' income by 2022, the Government of India approved Pradhan Mantri Kisan SAMPADA Yojana which is Scheme for Agro-Marine Processing and

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Development of Agro-Processing Clusters with an allocation of Rs 6000 crore during 2016-20. The objective of this scheme is to create modern infrastructure and an effective supply chain management from farm to retail to help farmers for getting better returns on their produce.

2. **Farm Loan Waiver:**
Following in the footsteps of Andhra Pradesh and Telangana who waived off 24000 crore and 17000 crore respectively in 2014 and 2016. Tamil Nadu waiving off 6095 crore in 2017-18 and all the other states such as Maharashtra has waived 34000 crore, Uttar Pradesh 36000 crore, Punjab 10000 crore and Karnataka 8000 crore of farm loans. Most recently, Madhya Pradesh, Rajasthan and Chhattisgarh also started this process in December 2018.

3. **Increased Storage and Better Marketing:**
Agriculture storage capacity in India reached to 131.8 million metric tonnes. The Government also launched an umbrella scheme Pradhan Mantri Annadata Aay SanrasHan Abhiyan (PM-AASHA) in September 2017 which aims to help farmers in getting adequate prices for their produce. This scheme has three parts Price Support Scheme (PSS), Price Deficiency Payment Scheme (PDPS) and Private Procurement and Stockist Scheme (PPSS).

4. **Agriculture Export Policy 2018:**
The Union Cabinet approved an export policy for agriculture in December 2018 and removed all restrictions on organic and processed food. This is an initiative to help the government achieve its goal of doubling farmers' income by 2022. The policy aims to increase agriculture exports to $60 billion from $30 billion in 2017.

CONCLUSION:

Agriculture is the primary source of livelihood for about half of India's population. To address the current issues of farmers, Government should frame local and need based policies for the farmers and its proper execution and timely review of policies will be effective in order to make farming as a profitable venture. Detailed indigenous knowledge and greater skills in order to blend modern and traditional technologies to enhance productive efficiency will be the main key to the farming success and sectoral growth. New technologies are needed to push the yield frontiers further, which can help in utilizing inputs more efficiently and diversify to more sustainable and higher value cropping patterns. Strong research and extension activity can play an important role for resolving the farming issues in India.

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Advances in breeding of Coffee (*Coffea spp.*)

Article id:

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Common Name: Coffee

Botanical Name: *Coffea arabica* (Arabica coffee)
Coffea canephora (Robusta coffee)

Family: Rubiaceae

Chromosome No: 2n = 44 (tetraploid) C. arabica,
2n = 22 (diploid) C. canephora

Centre origin: Highland of Ethiopia

Mode of pollination: *C. arabica* is self-pollinated
C. canephora is cross-pollinated

INTRODUCTION

Coffee is the second most important beverage crop of India next only to tea. Coffee plant requires hot and humid climate with temperature varying between 15°C and 28 °C and rainfall from 150 to 250 cm. In Arabica coffee, inflorescence, clusters of 2-19 white flowers with 5 or 6 petals, grow at the leaf axils on the lateral branches. While the cultivated coffee has dense clusters of white fragrant flowers, without fragrance, other is cream, even tinged with pink or purplish red. After pollination, the flowers wither and bring forth a fruit, a drupe, the cherry, 1.5cm in diameter, ripening in 7 to 9 month, (9 to 11 month in Robusta, only 3 month for *C. racemosa*), depending on climate and variety.

The two cultivated spp. C. arabica and C. canephora exhibit camiderable difference in their botanical, genetic, agronomical, chemical and morphological characteristics. Among C. arabica cultivar, the most common morphological is an oval convex seed with an S- shaped longitudinal slit (the central cut) on the flat side, C. canephora seeds are rounder with a straight central cut.

Cytogenetic

The basic chromosome number of coffee is x = 11. The ploidy of coffee ranges from diploid 2n=2x = 22 (C. canephora) to tetraploid i.e. allotetraploid (2n= 2x = 44), C. arabica is a natural allotetraploid 2n = 44 chromosome may have arisen from a natural hybridization between ancestral diploid spp. (2n =22) fallowed by unreduced genetic formation, differentiation and stabilization. One diploid ancestral or seems to be *C. engenioides* or *C. congensis*.

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Inheritance of traits

- All coffee beans have high trigonelline alkaloid content, *C. arabica* have a higher content than C. canephora. At roasting temperature, this alkaloid produces pyridines and parole derivatives which are important volatile coffee flavor components.
- Trigonelline is also involved in the nicotinic acid formation and in the biological stred form of niacin. In addition it is coridered to be important for both taste and nutrition.
- Glucose content has been negatively chordate with aroma levels and positively with cup sweetness, while fructose content has been negatively correlated it sweetness.
- Coffee is appreciated and consumed for its pleasing aroma, which is the result of roasting.
- The main psychoactive component in coffee is caffeine. It is considered as the most widely used psychoactive substances in the world. The influence of caffeine on the central nervous system is well known. Higher dose (5 cup daily) of caffeine rather induces negative effect such as anxiety, restlessness, insomnia and tachycardia.

Germplasm Resources

Presently there are 360 surviving collection of Arabica, 15 types of Robusta and 17 different species of coffee at central coffee Research Institute (CCRI). Apart from the coffee spp., Psilanthus bengalensis, P. wightiana and P. travancorensis are native to India occurring wild in forests of Karala, Timal Nadu, and Assam.

Breeding objective

To evolve varieties ideotypes with durable resistant to leaf rust combined with high productivity, improved quality (low caffeine) and better adaptability.

Problem of coffee breeding

- Narrow genetic base
- Self-incompatibility, self sterility in diploid coffee
- Variation in ploidy level among coffee species.

Breeding method

The systematic work on coffee improvement has been undertaken at Central Coffee Research Institute (CCRI), Balahanun, Kernataka. As a result a large number of improved selections in Arabica coffee has been released.

Introduction

Important introductions of coffee include Agro, Gierha (source of rust resistance), and San roman (mutant and dwarf), Cioccie (susceptible to leaf spot), S12 kaffa, coorge, Tafarikala and cutura. Tree coffee (Coffee liberica) is a source of resistance to leaf rust with SH3 factors.

Hybridization

Hybridization has played an important role for the improvement of coffee in the country. The improved coffee varieties are given in the table below

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Improved selection of Robusta coffee

Selection	Distinguishing character
Selection 1R	A cross between S274 and S270
Selection 2 R	BR 9, 10 and 11 series 12 original seedling progenies and 17 mother plants were selected, comparative assessment of clonally propagated and seedling progenies led to the selection of superior selection 9, 10, 11
Selection 3R	The back crossing of the F1 from the cross between C. cengensis and C. canephora (compact, bush, high quality) with C.cangensis followed by the selection resulted in the release of selection 3R

Improved hybrids of coffee

Improved selection	Distinguishing features
Selection 3	Kents x S228 gave the S795 which on crossing with Agro gave. Selection 4 on crossing with Cioccie produced selection 3
Selection 4	5795 x Agro disease resistance and good quality.
Selection 5	Spontaneous hybrid between Robusta and Arabica indigenous in origin.
Selection 6	A hybrid between C. cangensis (2n) and Robusta (2n).
Selection 7	San roman hybrid, dwarf stature, spotted in costa rica.
Selection 7.2	A hybrid between san roman and Agro.
Selection 7.3	A hybrid between san roman x HDT
Selection 8	A spontaneous inter specific hybrid, Arabica crossed with Robusta followed by pure line selection. Selected at CCRI

Breeding for specific objectives

Dwarfness sources for dwarfness are San Roman, Caturra and Villararchi

Robusta Coffee

The improvement of Robusta coffee is achieved through mass selection, clonally propagation, pedigree selection, dialogic crossing and inter specific hybridization.

CONCLUSION:

To evolve light yielding hybrid/ select strains possessing drought tolerance and resistance to rot wilt. Investigation should be made on the phenomenon failed to established conclusive reasons for the occurrence of barren nuts. To identify cultivars and develop hybrids with short state, precocious and resistant to biotic and abiotic factors and potential to produce yield of nuts and oil.

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Advances in breeding of Tea (*Camellia spp.*)

Article id: 21680

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Common Name: Tea
Botanical Name: *Camellia sinensis* (China Tea)
Camellia assamica (Assam Tea)
Family: Camelliaceae
Chromosome No: 2n=30
Centre origin: Central China (Vavilov, 1926)
Mode of pollination: Cross pollinated

INTRODUCTION

Tea bush is a tropical and sub-tropical plant and thrives well in hot and humid climate. There is a very close relation between climate, the yield and the quality of tea. The ideal temperature for its growth is 20°-30°C and temperatures above 35°C and below 10°C are harmful for the bush. The China Tea Plant :- Flower are borne single or in hairs in the catuphyllaary axils pedicel short, 6-10mm long, clavate, glabrous with 2-3 sub opposite scars little below the middle making the losition of caduceus bracteoles 2-5 mm long, sepals are 5-6, imbricate, leathery, ovate or orbicular, 3-6mm long, glabrous green, petals are 7-8, shallowly cup-shaped, 1.5-2 cm long, broad oval to sub- orbicular, generally white sometime with pale pink pigmentation. Stamen numerous arranged in two whorls, inner ones shorter and fewer in number, outer longer and more numerous 8-13mm long, united at the base for a few mm with the corolla lobes. Ovary is white densely hairy, 3 locular ovule 3-5 in each loculous, placentaion axial, style generally 3, sometimes up to 5, free from the greater part of their length. Occasionally free up to the base of the ovary. Stigma is apical, the number of capsules in 1,2 or 3, cocotte containing 1-3 nearly spherical seeds, 10-15mm in diameter.

2. The Assam tea plant (*C. assamica*):- flower are single or in hairs on the cataphllary axils pedicels with scars of 3 caduceus bracteoles. Smooth and green, sepals are 5-6 unequal, leathery and persistent. Petals are white 7-8 in numbers, occasionally with pale yellow pigmentation at the base of the petals. Stamens are numerous as in *C. sinensis.*

(ii) The Southern form or combed tea borne singly or in clusters in the axis of cataphylls (scale leaves) of a mature tea bush. The tea flowers with a short pedicel. A fully developed flower has a prsistatend calyx with variable number of sepals. Usually 5-7. Petals are white in colour, at the base they are fuse one another and to stamens. The stamens are 8-12 mm. long in size contain yellow coloured twin called anthers. The ovary hairy and has a single, short style, which is splitted into 3-5 arms development of the flower bud in tea plant is related to the phase growth of shoot produced by the tree. The flower bud take considerably long time, about 120-150 days from the stage of initial affianced to flowering.
The flowers are pollinated by insects, as tea hollens are heavy and thickly in nature and occur mostly in clumps wind pollination is not possible.

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Cytogenetic

Tea is diploid (2n=30; basic chromosome number X=15) and cerotype of chromosomes ranges from 1.28m to 3.44m. The consistencies in diploid chromosomes number suggest a monophytic organ of all camellia spp. However, few higher ploidy level such as triploid example TV-29, HS-10A, UPASI-3 (2n=45), triploid (2n=60).

Breeding objectives of tea

To developed high yielding variety
To developed tolerance to drought, disease and pest.

Bottleneck of tea breeding

- ✓ Long juvenile.
- ✓ Lack of pre selection criteria.
- ✓ Owing to its highly cross pollinated nature, it is different to maintain a pure line variety.
- ✓ Self-incompatibility limits pure line breeding useful for hybridization.
- ✓ Time consuming procedure of prolonged field treating of clones and hybrids.

Germplasm resources

Progress and achievement of tea breeding works in certain tea producing countries have been well reviewed. The initial emphasis was to collect and evaluate the indigenous or exotic germplasm for befitting the local environment. However, the increase of region specific need of the industry, almost all tea producing countries has developed their own clones or seed stocks.

Since, 1949 a total 32 clones, 14 biclonal seeds stocks and 134 TRA have been developed in Tocklai experimental station, Assam. In south India, the breeding work started by united planter's association of south India (UPASI). Tamil Nadu during early 1960s has result in the release of 28 clones and 5 biclonal stocks.
Bangladesh tea research institute ha s developed 13 clones and 2 biclonal seed stocks. Kenfa's tea germplasm is predominating of the Assam type (*Camellia sinensis* var. assamica).

Breeding methods

Hybridization: The presence of self-incapability limits the production of pure line in tea by conventional methods. Line breeding techniques, crossing between clones processing desirable traits is common methods used for improvement. The F1 generation of which has come to be known as bi or poly-clonal seed stocks the progenies of such hybrid exhibit a fair amount of morphological uniformity, some of released bi- chemical seeds stock from Tocklai experimental station. Johrat include TS-449, TS-450, TS-462.

Clonal selection cloning of processing, vigorous, industrial plant from amongst the biclonal progeny. Therefore, a continual clones- seed-cycle should maintain the hatrozygosity of germplasm. Some of the improved colonial selection of tea is as follows;

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Improved clones of tea

Clones	Name	Distinguishing characters
UPASI-9	Athrey	Drought tolerant and withstand high soil pH
UPASI-8	Golcendda	Suitable for all heights, tolerant to drought and wind
UPASI-2	Jayaram	High quality and yield
UPASI-3	Sundaram	High quality and yield
TRI-2024	Sri Lanka	High yielding
TRI-2025	Sri Lanka	Average yielding

Polyploidy

Most of the tea plants under cultivation are diploid (2n=30), though natural triploids, tetraploids and pentaploids have also been reported. Through Bezbaruah (1971) reported that the quality of tetraploids and natural triploids are inferior to the diploids, yet, to commercial clones UPASI-3 and TV-29 are triploids which produce acceptable quality of tea.

Mutation breeding

The improvement of tea through mutation breeding is not promising. A limitated affords have been made in this regards, seed and cuttings are used for mutation. Both chemical and physical have failed to vive useful result irradiation causes reduction in vigour as reflected by their lover number of branches and stunted growth.

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Can African mahogany [*Khaya senegalensis* (Desr.) A. Juss] be introduced as a component of any agroforestry systems in India?

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African mahogany (Khaya senegalensis) is actually a fast growing timber trees mostly known for its multiple uses viz., timber, firewood, fodder, bark as medicinal, etc.. Being a fast growing species, it is having high potential in carbon sinks and thereby having the potential to reduce the rate of global warming and the resultant climate change. Moreover, it can be grown at varying ranges of soil, climate and topography. Hence, this species could be an ideal component of any agroforestry systems to achieve a win-win solution by inflowing into the carbon budgeting with nominal cost factor.

INTRODUCTION

African mahogany comprises of four different species *viz., Khaya anthoteca, K. ivorensis, K. senegalensis* and *K. grandifoliola.* Among all the species of this genus, the species *Khaya senegalensis* (African mahogany) is the most suitable indigenous species for timber production in the world, growing up to 35 m in high and 1.5 m in a diameter on fertile soil, with an 10-16 m clean bole, it's wood is hard, dense, reddish in colour and highly resistant to biodegradation. The wood has attractive colour, mostly straight grain orientation and a high luster (Egbewole *et al.,* 2017). It is one of the most economically important forest tree species which is very popular for timber and is used for high-class furniture making, joinery, building and construction purposes. This species is also known for having high traditional medicinal values and used as an ornamental tree for gardens and avenues in many countries. But introducing this species as a component under agroforestry systems in India is a matter of question. Furthermore, this species is a fast growing tree, grows well under varied soil and climate, and posses multiple uses; then why not to introduce them and use this species as an alternate to Indian mahogany as well as other species under agroforestry.

India is already having a total area of 328.72 M ha, out of which approximately 142 M ha areas are under cultivation, 69.79 M ha areas under forest cover (FSI, 2013) and approximately120 M ha areas are under degradation (FSI, 1999). All those degraded lands can be rehabilitated by means of planting trees "so called Multipurpose Tree species (MPTs)" (Shinde *et al.,* 2017; Sarkar *et al.,* 2019a; Sarkar *et al.,* 2019b; Shinde *et al.,* 2019) under agroforestry systems, which provide both tangible (Das *et al.,* 2016; Das *et al.,* 2017; Sarkar *et al.,* 2017c; Das *et al.,* 2019; Sarkar *et al.,* 2019c) as well as non-tangible benefits (Sarkar, 2019a), also helps in improving livelihood security by increasing the total productivity per unit area of land (Sarkar *et al.,* 2017c; Sarkar, 2019b). Hence, this *Khaya* species may find a place as a tree component under agroforestry systems in India. Moreover, there is very scarce information available on this species (*K. senegalensis*), even though it is seen to grow in many places in India *viz.,* West Bengal, Jharkhand, Chhattisgarh, *etc*.

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Ecology and distribution

The *Khaya* genus, belongs to Meliaceae family, is comprised of four species in mainland Africa but some are endemic to some places like Comoros and Madagascar. This genus belongs to sub-family *Swietenoideae* and most closely related to *Carapa* and *Swietenia.* The tree, *Khaya senegalensis* (Desr.) A. Juss, a deciduous evergreen tree (having chromosome number $2n = 50$), belongs to Meliaceae family, commonly known as African mahogany, *Khaya* or dry-zone mahogany (Didier *et al.,* 2016). But this species is very close to *K. anthotheca* (Welw.) C.DC. and *K. grandifoliola* C.DC.

This *Khaya* species is a multipurpose tree species, but mainly it is grown for the timber purpose to suffice the demands of global wood markets. It is also an important fodder crop for cattle, provides wood for fuel and is believed to have important medicinal properties. The seed oil is rich in oleic acid which is used in cooking and in cosmetics (Arnold, 2004). The tree typically grows up to about 30 m in natural condition and has a wide crown, but under cultivation can grow even more than 35 m and attain diameters up to 1.5 m. Flowering in this species is mainly observed shortly before or early in the rainy season. The fruit apparently remains on the tree throughout the dry season, but when it gets ripen, the colour changes from grey to black. It begins to bear seed when the tree is 20-25 years old (Egbewole *et al.,* 2017). Moreover, it is reported as monoecious, insect pollinated and wind dispersed, with poor natural regeneration (Didier *et al.,* 2016).

The tree, *K. senegalensis* is native to twenty African countries *viz.,* Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Ivory Coast, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, Sudan, Togo and Uganda (Egbewole *et al.,* 2017) and occurs naturally within a seasonally-dry belt from Senegal-Guinea in the west to Sudan-Uganda in the east. It is a native species of Benin listed in Red list of IUCN as vulnerable and endangered in Benin red list (IUCN 2015-3; Didier *et al.,* 2016). It is rated as the tenth among the world's 20 most widely used and prioritized tree species suitable for development of forest industries and planted forests (FAO, 2014). It is also classified as vulnerable on the IUCN 2010 red list of threatened species (International Union for Conservation of Nature) because of overexploitation for timber, fodder, and medicine, and as a result of habitat loss and degradation (Nikiema and Pasternak, 2008). Efforts to restore the depleted mahogany resource can be possible if being introduced under plantation programme. Furthermore, this species can be grown in a wide range of altitudinal (up to 1800 m a.m.s.l.), climatic conditions (like varying rainfall range from 700 mm to about 1750 mm with dry season lengths of 2-8 months), edaphic and ecological conditions (Nikles *et al.,* 2008).

Uses of African Mahogany

This tree (*K. senegalensis*) is known to be a multipurpose tree having variety of economic and environmental values (Nikiema and Pasternak, 2008). It is considered as one of the major timber species in West Africa. It is also known for it's good quality red wood which is very hard and is having the resistance against fungus and termite. The timber is highly valued for carpentry, joinery, furniture, ship building, and as a decorative veneer. The bark is used in traditional medicine to treat malaria, diarrhoea, dysentery, anaemia, *etc*. Recently, the stem bark has been found to contain chemicals (limonoids) that exhibit antiproliferative activity against human cancer cell lines (Zhang *et al.,* 2007). It is also a good source of fodder for cattle, because of its high dry matter but relatively low crude protein content (Ouedraogo-Kone *et al.,* 2008) and is also a source of edible and cosmetic oils (Nikiema and Pasternak, 2008). In West Africa and in many other countries (like South Africa, Egypt, Australia, Sri Lanka, China, Indonesia, Malaysia, India and Vietnam), the species has become an important urban amenity tree, commonly planted as a roadside or ornamental shade tree and also for the purpose of timber production (Arnold, 2004).

Bark, timber and firewood properties

The bark of this tree (*K. senegalensis*) is known to be medicinally important. It's extracts has the *in vitro* antiviral property. Even one experiment showed the *in vitro* antibacterial properties against stains of *Enterococcus faecalis* and *Streptococcus* sp. The same was reported to have property of exhibition of leishmanicidal activity. Earlier reports depict that the heartwood is mainly of pinkish brown, sometimes darkening to reddish brown with purplish tinge upon exposure but is distinctly demarcated from the paler, up to 8 cm wide sapwood especially in dry wood. The grain is usually interlocked, sometimes straight having moderately coarse texture. Wood density is reported to be varied up to 900 kg m^{-3} at 12% moisture content. While the sapwood is susceptible to trunk borer insect like *Lyctus sp.*. The heartwood is strongly resistance to impregnation but the sapwood is moderately resistant. The wood is also useful for firewood. The total energy value of firewood is reported as 19,900 kJ kg^{-1}(Nikiema and Pasternak, 2008).

Nursery management

Natural regeneration of African mahogany (*K. senegalensis*) from seed is poor as the seeds lose their viability after only two or three weeks under natural conditions. The viability of the seeds can be prolonged by drying to moisture content below 5% and storing them at a low temperature of around 5 ^{0}C (Egbewole *et al.,* 2017). Moreover, there is a major problem of mahogany shoot borer attack (*Hypsipyla robusta* Pyralidae (Phycitinae), which kills the main stem of young trees, causing excessive branching and contributing to mortality and poor quality timber production (Ky-Dembele *et al.,* 2011) that destroys the growth of plantations. Even, there was a report of causing leaf spot caused by *Alternaria argyroxiphii* (Teixeira *et al.,* 2017) and wilting caused by *Ceratocystis fimbriata* on *Khaya senegalensis* plantations in Brazil (Firmino *et al.,* 2017). Few studies reported that the fresh seed germinates readily after about 10 to 14 days with high germination rates (around 90%) when sown in a sand and peat mixed in flat trays. The seedlings can be picked out and grown in the nursery until they reach at a height of 25 to 40 cm. They should be planted into the field just after the onset of monsoon (Nikiema and Pasternak, 2008). Another method of planting stock is to use striplings or wildlings (Egbewole *et al.,* 2017), which are of small sized seedlings of about 40 to 50 cm in height having pencil thickness diameter, growing at the base of large mature trees. During the wet season, individual seedlings can be pulled out of the ground and, after stripping the leaves and pruning the root section, they can be planted directly into the field after sufficient rain, or potted in containers.

Khaya senegalensis grows in a wide range of soil types (Didier *et al.,* 2016). The pH tolerance can range between neutral to very strongly acidic; however, a neutral pH is more desirable (GFRA, 2005). It prefers well-drained soils. Sandy loams are ideal, whereas poorly-drained clays or duplex soils should be avoided. It should not be planted in shallow soils as this will prevent the large taproot from developing and anchoring the tree. One experiment revealed that potting mixture composition of vermicompost and red soil in the ratio of 1:1, resulted in maximum seedling growth in terms of height, collar diameter, root length, number of leaves and seedling biomass at 120 days after sowing, followed by T5 (Sand: Red soil: FYM of 1:1:1) and T7 (Neem cake: Red soil of 1:1

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ratio) in *Khaya senegalensis* (Sondarva *et al.,* 2017).

The vegetative propagation using leafy stem cuttings has been successful (Ky-Dembele *et al.,* 2011) in African mahogany (*K. senegalensis*). An experiment conducted in Thailand revealed that hedge height of *Khaya* at 20-30 cm from root collar provided greater rooting percentage than 30-50 cm, while cutting position (top, middle, and proximal section of the stump) had no significant effect on cuttings rooting capacity. Moreover, various grafting methods like Chip budding, cleft grafting, and side-veneer grafting have been successfully used for *K. senegalensis* seedling grafting in Burkina Faso (Ou´edraogo, 2004). But, micro-cuttings had also been successfully applied to micrografted plants with scions collected from 6-year-old trees of *K. senegalensis* (Brunck and Mallet, 1993). Another study reported that, leafy cuttings rooted well (up to 80%) compared to leafless cuttings (0%). Even, the cuttings taken from seedlings rooted well (at least 95%), but cuttings obtained from older trees rooted maximum upto 5% (Ky-Dembele *et al.,* 2011). The rooting ability of cuttings collected from older trees was improved (16% maximum) by pollarding. On the other hand, the plant growth hormones like auxin application enhanced the root length and the number of roots, while other treatments like smoke solution did not improve cuttings' rooting ability.

In another experiment of *In vitro* shoot multiplication, Danthu *et al.* (2003) reported that the rooting of micro-cuttings was successful in a less concentrated medium (MS/2) and a weak auxin concentration (IBA 5.2 µM) or by a 1- to 7-day long induction on a medium with IBA 260 µM, followed by transfer to a regulator-free medium. A method of micro-grafting of *K. senegalensis* was also developed, where grafting of apices or buds taken from young shoots onto the epicotyl of young seedlings grown *in vitro* was done.

African mahogany as agroforestry component

In many other countries, this tree is grown as a main crop either in solitary or in mixed system. One study revealed that, *Khaya senegalensis* saplings intercropped with cassava at agroforestry plantation plot had attained a maximum height, basal girth, diameter at breast height and leaf count within a period of 36 months of planting on the field while compared with monocropping system (Egbewole *et al.,* 2017).

In contrast to African mahogany, there is another species like Indian mahogany (*Swietenia macrophylla* King) of the same family, which is in common use under agroforestry systems in India for timber purpose. But under field condition in one trial during 2015-19, conducted at ICAR-Research Complex for Eastern Region, Research Centre, Plandu, Ranchi, the growth of African mahogany (*Khaya senegalensis*) was found far better than Indian mahogany in all aspects *viz.,* tree height, girth, canopy spread, crown height, *etc*. Hence, African mahogany can act as a best alternate substitution of Indian mahogany and many other species as a tree component under agroforestry systems in India and can integrate with other crops and/or animals for crop diversification (Kumar *et al.,* 2016).

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African mahogany based agroforestry model (3 years old) at ICAR RCER, RC, Ranchi

Carbon sequestration potential

Sathaye and Ravindranath (1998) reported that an agroforestry can be sequester of an average of 25 Mg C ha^{-1}, but there are differences in biomass production in different regions of the country and hence, variations do exist in carbon sequestration too (Sarkar *et al.,* 2017a; Sarkar *et al.,* 2017b; Sarkar *et al.,* 2017c; Sarkar, 2019a; Sarkar, 2019b). Moreover, the fast growing tree plantations are considered to be highly efficient in carbon sinks and having potential to reduce the rate of global warming and the resultant climate change (Sathaye and Ravindranath, 1998; Sarkar *et al.,* 2017c), largely contributing to climate change mitigation. Among all the fast growing existing trees, African mahogany is reported as one such example for good carbon sink in tree itself (Warnasooriya and Sivanantharwer, 2015). A study reported that, greater biomass of African mahogany at tree level was recorded for many age classes in Kurunegala division of Sri Lanka attributing to moisture rich growing conditions, while less annual rainfall and prolonged drought resulted a significantly lower tree level biomass grown at Anuradhapura divisions of Sri Lanka. The average above ground carbon sequestration of *Khaya i.e.,* 88.98 and 127.92 tonnes per ha in Anuradhapura and Kurunegala divisions of Sri Lanka were well ahead of the IPCC's benchmark of plantation forests in 'Tropical Dry' climate *i.e.,* 30 tonnes per ha, indicating its potential of climate change mitigation, besides the timber use (Warnasooriya and Sivanantharwer, 2015). The total amount of carbon sequestered by existing *Khaya* plantations amounted to 21,785.25 and 27,969.10 tonnes in Anuradhapura (741.92 ha) and Kurunegala (475.20 ha) divisions, respectively.

CONCLUSION

African mahogany (*Khaya senegalensis*) is actually a fast growing timber trees mostly known for it's multiple uses. Moreover, it can be grown at varying ranges of soil, climate and topography and having the high potential in carbon sinks. Hence, this species could be an ideal component of any agroforestry systems to achieve a win-win solution by inflowing into the carbon budgeting with nominal cost factor.

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Honey and its value-added products for a profitable apiculture venture

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INTRODUCTION:

Apiculture practices are an interesting and skillful scientific art to rear honey bees for the production of honey. Nowadays beekeeping practices are in the trend either in backyard farming or as an integral part of agriculture. Honey is the main product of the beekeeping, contains nutritional properties as well as have a huge economic impact. Since ancient times honey is included in the food and other dietary habits throughout the world. Honey is also employed in the making of Ayurvedic medicines as well as in various religious activities. Apart from the honey, there are various primary products which are directly isolated from the hives and bees. These primary products include wax, pollen, propolis, royal jelly, venom etc. all these products have their own economic importance and also enhance the quality of other derived secondary products.

Honey itself is involved in the making of various kind of value-added products, which involves creamed honey, comb honey, beer, various paste edible and for dressing, honey with nuts, honey filled with pollen and propolis, jelly, biscuits, caramel, and liquid syrups. The value-added products are listed below in the following section:

1. Creamed honey

Once you eat the creamed honey it may alter your preference over normal honey, as it is tastier and fetches more income. As the name is indicating, creamed honey is completely crystallized, more thickly, and a homogeneous material with a soothe appearance. It can be eaten raw or with bread in the breakfast.

2. Comb honey

Honey Bees make hexagonal shape chambers in hives naturally and the honey is stored in that in liquid form. Honey is not extracted separately while combs are cut along honey in their chambers, packed in various sizes and sold in the market. As this type of honey remains in its natural form until not consumed. Once you extract honey it losses it various antibiotic and therapeutic properties, while these losses can be avoided by using the comb, honey.

3. Tahini paste

Tahini paste is a thick paste, made of honey and sesame seed butter. Tahini paste contains high protein content and vitamins. Tahini paste is used as edible material in food directly or can be used as a dressing material on vegetable salads.

4. Fruits in honey

Various fruits are seasonal and perishable in nature. But these fruits can be preserved in honey and be used throughout the year. Many kinds of fruits like apple, pear, grapes etc. can be sun-dried and chopped finely and placed directly in honey. This type of fruits in honey can be stored for a long period of time.

5. Dry nuts in honey

As with the fruits, dry nuts can also be stored in honey.in this case light colored and slow crystallizing honey can be used. It can be made in various proportions of honey and nuts, bottled and sold.

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6. Honey beer

Honey brewing to make beer is faster and easier to make. Honey beer is a fermented product. It cannotbe stored for a long time and revitalized by the addition of more honey.

7. Honey with pollen and propolis

Bee pollens are rich in vitamin B complexes, folic acids and contain many other proteins. While propolis which is used by the bee to seal cracks in hives is a resinous compound. Propolis has various medicinal properties. Honey with pollen and propolis is generally recommended in the diet for a healthy life.

8. Honey wound dresser paste

Honey with wax and propolis in a proportion is used to make a wound dresser paste. This paste can be directly applied to wounds and can be packed in a jar and stored in a dark place. Honey and other bee products have been proved to contain antibacterial properties.

9. Honey jelly

Honey jelly is made with honey, pectin, tartaric acid and water in a definite proportion. Honey jelly can be eaten with loaves of bread.

10. Honey syrups

Honey syrups are so easier to make. Just mix the equal proportion of honey and water and boil it until honey melt in the water. In this syrup, lime juice can also be blended to enhance flavor and antioxidant values

11. Salted honey butter caramels

Caramel is a nutritious product and contains mostly sugars. Caramel used in the topping of food items and add flavors in desserts. Ingredients like salt, honey, glucose, caramel,water etc. are used to make salted honey butter caramel.

12. Greek halvah

Halvah is a deliciously sweet, prepared for the various occasion. Greek halvah is prepared by using honey, sesame oil, ground nuts, flour, sugars, cloves, and cinnamons.

13. Honey biscuits

Honey biscuits are made easily by an individual. The components of biscuits are eggs, honey, baking powder, oats and warm water.

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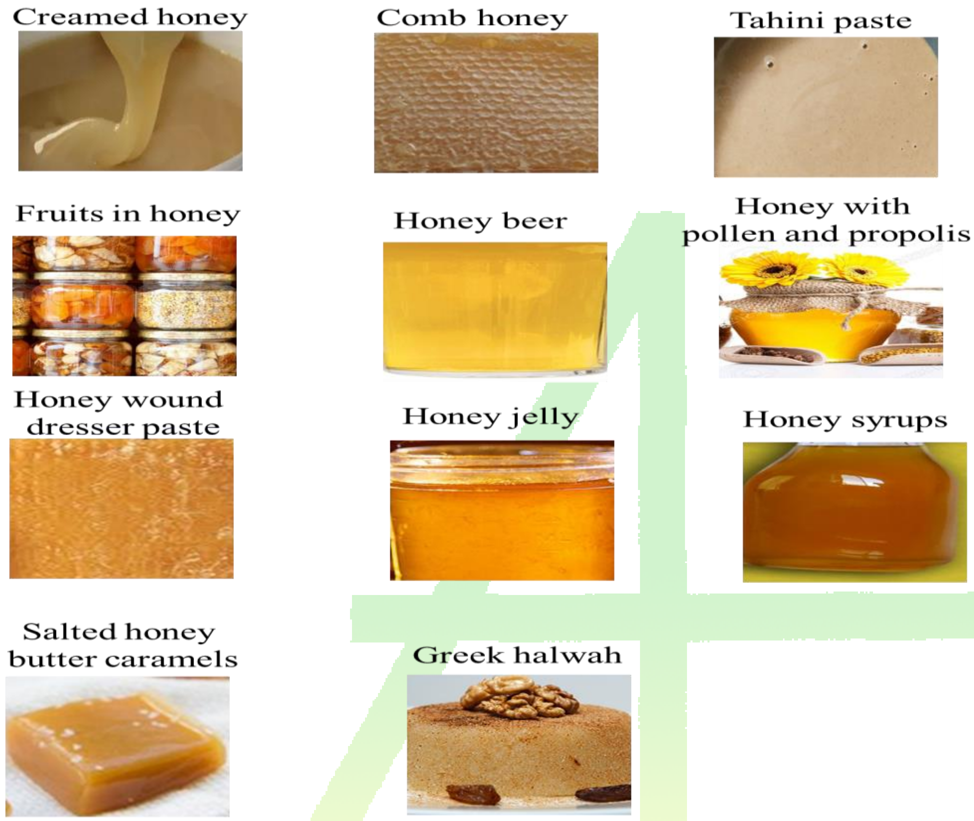

Value added products of honey

CONCLUSION:

There are many other dishes can be made with honey. As in India, half of the population is rural and indulged in subsistence farming. Beekeeping, a scientific and skillful art can be learned easily and should be integrated into the agriculture practices. Selling honey in the market directly fetches income, but if it is converted to value-added products, the income earned by an individual will to boosts. The learning of making value-added products of honey is easy. All the recipes and procedure are documented in the literature and available on the internet. In a short scale honey production, it can be adopted as a hobby in a household as a component of backyard farming while for a large scale production, the individual should get proper training and should get expertise in the art of apiculture. The current scenario and the motto of doubling the farmer income by 2022, apiculture practices should be developed and the knowledge should be extended to the farming communities to achieve their goal.

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Maturity indices in vegetable crops

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INTRODUCTION:

Identifying the correct stage of maturity and harvesting at proper time are important pre harvest factors. Maturity indices are important for deciding when a given commodity should be harvested to provide some marketing flexibility and to ensure the attainment of acceptable eating quality to the consumer. Maturity is the stage of development leading to attainment of the consumer for a particular purpose.

Determination of maturity indices: Maturity can be judged by various means like.

1. Computational methods

a) Calendar date
b) Days after anthesis/pollination

2. Physical methods

a) Increase in size
b) Colour development
c) Softening of tissues
d) Seediness
e) Development net like structure
f) Yellowing and drying of foliage or top
g) Flowering and bolting

3. Chemical methods

a) Increase in sugar content
b) Increase in fibre content
c) Increase in sugar: acid ratio

4. Physiological methods

a) Respiration rate
b) Ethylene evolution rate

Maturity indices for important vegetables

1. Tomato:

a) Immature green: It is the stage of fruit, before the development of seeds fully and before surrounding the seeds by a jelly like substance. The fruits are harvested at this stage only for frying purpose.

b) Mature green: It is the stage of fruit when it is fully grown, and show brownish ring at the stem scare on removal of calyx and light green colour at blossom end changes to yellowish green and seeds are surrounded by jelly substances filing seed cavity. The fruits at this stage are harvested for shipment to long distance and for long storage too.

c) Turning (breaker stage): It is the stage of fruit when one-fourth of the surface at blossom end shows pink colour. The fruits at this stage are harvested for local market.

d) Pink stage: It is the stage of fruit when three-fourth of the fruit surface shows the pink colour. The fruit at this stage are also harvested for local markets.

e) Hard ripe stage: It is the stage of fruit when nearly the whole fruit skin shows red or pink colour but flesh is still firm. The fruits at this stage are harvested for table purpose, processing and for the extraction of seed too.

f) Over ripe stage: It is the stage of fruit when the fruit is fully red coloured and soft. At this stage, the fruits can be used only for the extraction of seeds, not for table purpose and processing since the fruits onward start decaying (Rana, 2014).

2. Capsicum:

a) Green pepper varieties: Fully mature green fruits should be harvested before ripening.

b) Red and yellow varieties: Fully mature green fruits should be harvested at the onset of colour change.

c) Pepper fruits at the time of harvest should be firm and crisp not tender and immature.

3. Onion:

Bulbs are considered mature when the neck tissues begin to soften and tops are about to abscise and decolorizes. Maturity can be judge by the neck of the plants drying up, tops falling over while the leaves are still green (Rana, 2008).

4. Sweet Potato:

When the leaves turn yellow and begin to shed, tubers can be harvested. Immature tuber, the cut surface shows dark greenish colour while the colour will be milky white in fully mature tubers.

5. Okra:

Immature green tender fruits should be picked 3rd to 5th day from the time of first pod formation or 3 to 7 day after flowering. Okra should be harvested when the fruits are bright green, the pods are fleshy and seeds are small.

6. Moringa: Fruits of sufficient length and girth are harvested before they develop fibre.

7. Cucumber: Fruits can be harvested from 45 days after sowing. The tender fruits (for salad) can be harvested on 8th to 10th day of flowering.

8. Bottle Gourd: Fruits should be light green, 30-35 cm long, tender with little pubescence persisting on the skin.

9. Muskmelon:

a) Fruits are generally harvested 60-70 days after sowing, 30-40 days after anthesis and 25-30 days after setting, observing other changes of outer colour of the skin.

b) Muskmelon is generally picked at 'half-slip' stages for commercial marketing (part of the pedicle remains attached to the fruit, i.e., abscission layer is not fully developed). Sugar and flavour are not found optimum, at this stage. Full slip is stage at which the pedicle separates easily from the fruit with little or no pulling. Fruits for distance market should be harvested when mature but before full ripeness to minimize to breakdown in texture and damage during transport. (Rana, 2008).

10. Watermelon:

a) The fruits are ready for consumption in about 30-40 days after anthesis (Nath et al., 1987).

b) The portion of fruit resting on ground starts turning colour from creamy white to yellow.

c) On ripening, the rind become hard enough that resists penetration of thumbnail.

d) The sugar content of fruit measured as soluble solids using hand refractometre is reached 10 % or more in flesh near centre of fruit.

e) On thumbing, the immature fruits give out metallic ringing sound and the ripened dull hollow sound (Chauhan, 1972).

11. Garden pea:

a) Early cultivars require as few as 1000 heat units to achieve maturity, whereas, late sowing cultivars may require more than 1600 heat units.

b) The pods are harvested when they are filled, tender, having high sugar content and changing colour from dark green to light green. Any delay in harvesting turns the pods to poor quality due to conservation of sugar into starch, and this conversion takes place more rapid at high temperature.

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12. Chilli: Chilli should be harvested at fully mature and before change from green to red whereas on approaching the ripe stage.

13. Potato: Yellowish and drying of haulms.

14. Cabbage: Solidity, firmness, squeaking of heads indicates maturity (Kalia, 2011).

15. Cauliflower: Curd size and colour are deciding factors. Snow white or creamy white, compact curds surrounded by turgid green leaves (Kalia, 2011).

16. Knol- khol: Harvest when the knobs are light green, tender and with delicate flavour having 5 – 8 cm dm.

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Influence of liquid organics on soil properties and crop production

Article id: 21684

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INTRODUCTION:

Any material which contains carbon, one or more element other than hydrogen and oxygen and is essential for plant growth known as organic. Liquid organics are prepared from natural substances containing nutrients, growth promoter and microbes that improve the growth and productivity of plants. It also enhance physical, chemical and biological properties of the soil. Ultimately it improves soil health too. Nowadays, liquid organics is the main component behind the biodynamic farming cultivation.

Nutrient Content of Different Organic Liquid Manures

Parameter	Panchagavya	Beejamruth	Jeevamruth	Vermiwash
pH	6.82	8.20	7.07	7.11
Soluble salt (EC)	1.88 dsm^{-1}	5.50 dsm^{-1}	3.40 dsm^{-1}	15.37 dsm^{-1}
Total Nitrogen	1000 ppm	40.00 ppm	770 ppm	200 ppm
Total Phosphorus	175.40 ppm	155.30 ppm	166 ppm	48.86 ppm
Total Potassium	194.10 ppm	252.00 ppm	126 ppm	245.67 ppm
Total Zinc	1.27 ppm	2.96 ppm	4.29 ppm	0.03 ppm
Total Copper	0.38 ppm	0.52 ppm	1.58 ppm	0.35 ppm
Total Iron	29. 71 ppm	15.35 ppm	282 ppm	2.21 ppm
Total Manganese	1.84 ppm	3.32 ppm	10.7 ppm	0.04 ppm

Gore and Sreenivasa (2011)

Microbial Population in Different Organic Products

Parameter	Panchagavya	Beejamruth	Jeevamruth
Bacteria (cfu/ml)	26.10×10^5	15.40×10^5	19.70×10^5
Fungi (cfu/ml)	18.0×10^3	10.50×10^3	13.40×10^3
Actinomycetes (cfu/ml)	4.20×10^3	6.80×10^3	3.50×10^3
N_2 – fixers (cfu/ml)	2.70×10^2	3.10×10^2	4.60×10^2
Phosphate solubilizers (cfu/ml)	5.70×10^2	2.70×10^2	4.20×10^2

Gore and Sreenivasa (2011)

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Why Liquid Organic Manures?

Problems with Chemical Fertilizers: Burns a hole in the pockets of farmers, Environmental and health hazards and Continuous use leads to soil degradation.

Problems with Animal Manure: Immediate application of manures is impractical, Composting may result in large nutrient losses, Immobilization and pest problems with undecomposed manures and required in larger quantities.

Need of Liquid Organics

- To minimize reliance on chemical fertilizers,
- To overcome temporary nutrient shortage,
- For conservation and use of organic sources,
- Long shelf life
- Avoid soil health problems
- Disperse in water

Characteristics of Liquid Organic Sources

- Potent source for macro and micro nutrients
- Presence of plant growth promoting factors
- Immunity enhancer
- Pesticide & fungicidal property
- Efficacy is influenced by inputs used and method of preparation
- Used for seed/seedling treatment, enhancing decomposition, improving soil fertility and productivity
- Effective and potent tool for fertigation

Constraints in Adopting Liquid Organics: Lack of awareness about its uses, sometimes during fermentation contamination occurs and Limited availability of its products in markets.

Precautions for using the liquid organics: Application/mixing should always be done in shade & cool areas, Dose of application should not exceed the recommended dose, when applying in the soil, there should be optimum moisture in the soil and seedlings after dipping should be kept in the soil.

Review of literature:

Physical properties:

Tharmaraj *et al.* (2011) observed that mixture of vermicompost and vermiwash treated plots showed maximum water holding capacity, porosity and moisture content in soil at initial and final stage of rice compared to other treatments. Bokare (2013) reported that application of enriched banana pseudostem sap @ 2% spray recorded lower bulk density with higher Infiltration rate and WSA (0.5-1.0 mm sized) (%). Whereas, WSA (>1.0 mm sized) (%) found higher in application of Banana pseudostem sap @ 2% spray: Enriched banana pseudostem sap @ 2% spray (1:2) in soil after harvest of onion. Laharia *et al.* (2013) reported that lower Bulk Density (BD) and significantly increased Hydraulic Conductivity (H.C.), mean weight diameter (MWD) and Available Water Capacity (AWC) with application of 100% RDN through vermicompost +jeevamrut (30 &45 DAS) in soil after harvest of soybean as compared to other treatments. Parmar (2013) revealed that lower BD and significantly higher WSA (>1mm and 0.5-1.0 mm size) recorded with application of 50% NADEP compost + 50% castor cake in soil after harvest of maize and remained statistically at par with T_1 - NADEP compost 100%, T_9 - Jeevamrut 500 lit ha^{-1} + Panchagvaya 50 lit ha^{-1} (15 days interval), T_{10} Jeevamrut 500 lit ha^{-1} + Panchagvaya lit ha^{-1} (30 days interval). Bag *et al.* (2015) reported that application of BC: VC: CC + enriched sap (1%) recorded lower bulk density and higher WSA (0.5-1.0 mm size) whereas, higher WSA (>1mm size) found higher in application of BC: VC: CC + panchagavya (2%) in soil after harvest of chickpea as compared to rest of the treatments. Lunagariya *et al.* (2018) reported that application of Banana pseudostem sap @ 5 L ha^{-1} recorded lower particle, bulk density as well as higher porosity (%) as compared to other treatments.

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Chemical properties:

Laharia *et al.* (2013) reported that application of 100%RDN through vermicompost + jeevamrut (30 &45 DAS) significantly decreased the pH, EC and increased Organic Carbon (OC) and available N, P, K content in soil after harvest of soybean as compared to control. Jondhale (2014) reported that the foliar application of 1% banana pseudostem sap showed significantly higher available N, P, K and micro nutrient in soil after harvest of rice as compared to other treatments. Anonymous (2015) observed that treatment T_4 : T1 + NOL Drenching @ 500 lit ha^{-1} + NOL Foliar @ 50 lit ha^{-1} at 30 and 45 DAS recorded significantly higher OC (%) and Av. P_2O_5 (kg/ha) as compared to initial. Akhila (2017) reported that foliar application of 2% seaweed sap recorded significantly higher organic carbon, N, P, K in soil after harvest of greengram as compared to other treatment. Siddaram *et al.* (2017) observed that application of FYM 12.5 t + BDLME (Bio-digested liquid manure equivalent) to 150 Kg N ha^{-1} recorded significantly higher OC whereas, available N, P, K found higher in application of FYM 12.5 t + BDLME to 75 kg N ha^{-1} in soil after harvest of rice as compared to other treatments. Lunagariya *et al.* (2018) reported that application of Banana pseudostem sap @ 5 L ha^{-1} recorded significantly higher organic carbon, N, P, K in soil after harvest of fenugreek as compared to other treatment.

Biological properties:

Ghodpage *et al*. (2009) reported that application of vermicompost @ 2.5 t ha^{-1} + amrutpani + biofertilizer @ 3 kg ha^{-1} recorded higher population of bacteria, whereas fungi found higher in application of vermicompost @ 2.5 t ha^{-1} + amrutpani and actinomycetes found higher in application of RDF + Amrutpani in soil after harvest of cotton as compared to control. Patil *et al*. (2012) reported that application of 100% RDN through vermicompost + jeevamrut recorded significantly higher population of bacteria, fungi and actinomycetes after harvest of soybean as compared to control. Gopakkali and Sharanappa (2014) observed that application of EBDLM (Enriched Bio-digested Liquid Manure) at 125 kg N equivalent ha^{-1} + 3 sprays of panchagavya (3%) recorded significantly higher bacteria, fungi and actinomycetes population in soil after harvest of chilli as compared to other treatments. Anonymous (2016) observed that treatment T_4 : T1 + NOL Drenching @ 500 lit ha^{-1} + NOL Foliar @ 50 lit ha^{-1} at 30 and 45 DAS recorded higher AZOTO, AZOSP and Total Bacterial Count, while PSB recorded higher in T_8 treatment as compared to initial. Siddaram *et al.* (2017) reported that application of FYM 10 t + BDLME to 35 kg N ha^{-1} showed significantly higher population of bacteria, fungi and actinomycetes after harvest of field bean as compared to control.

Crop production:

Vennila and Jayanthi (2010) revealed that the significantly higher number of fruit $plant^{-1}$, fruit length, fruit weight and fruit yield of okra with the application of 100% RDF + panchagavya spray (2%) as compared to the control. Bag *et al.* (2015) reported that application of BC: VC: CC + cow urine (2%) significantly improved the grain yields and straw yields of chickpea as compared to the control. Jadhav *et al.* (2015) revealed that the significantly higher root diameter, single root length, single root weight, yield ha^{-1} and B: C ratio of radish with the application of 1: 3 (water: vermiwash) as compared to the control. Saranraj and Thiruppathi (2015) revealed that the significantly higher nutrient uptake, straw yield and grain yield of rice with the application of vermiwash 5% at tillering and flowering as compared to the control. Anonymous (2016) observed that treatment T_4 : T1 + NOL Drenching @ 500 lit ha^{-1} + NOL Foliar @ 50 lit ha^{-1} at 30 and 45 DAS recorded significantly higher seed yield but higher value observed in stover yield, gross return, net return as well as BC ratio also observed higher in same treatment as compared to rest of the treatments. Akhila (2017) reported that foliar application of 2% seaweed sap recorded significantly higher stover yield and seed yield after harvest of greengram as compared to other treatments. Highest B: C ratio was recorded with treatment EBPS 1%. Patel *et al.* (2017) revealed that application of 100% RDF (20-40-00 NPK Kg ha^{-1}) and panchagavya spray @ 6% at flowering gave maximum number of pods/plant, number of seeds pod, seed yield and stover yield followed by 75% RDF (15-30-00 NPK kg ha^{-1}) and panchagavya spray @ 3% at flowering. Punchal *et al.* (2017) revealed that application of Panchagavya 4 % at Branching and flowering recorded significantly higher seed and stover yield, similarly gross, net return and BCR observed higher compared treatment T_{10}. Lunagariya *et al.* (2018) reported that application of Banana pseudostem sap @ 5 L ha^{-1} recorded significantly higher no. of pods per plant, seed per pod, seed and straw yield (kg ha^{-1}), while protein and fiber (%) reported significantly higher in same treatment as compared to control.

CONCLUSION:

Use of liquid organics improve physical (BD, WSA, IR, Porosity), chemical (EC, pH, OC, available macro and micro nutrient in soil) and biological (population of bacteria, fungi and Actinomycetes) properties of soil as well as nutrient uptake and yield of different crops.

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Diseases of mango

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1-Powdery Mildew

Causal organism - *Oidium mangiferae*

Symptoms-

The disease affects inflorescence, leaves and young fruits. The characteristic symptom of the disease is the white superficial powdery growth of the fungus comprising a large number of conidia borne on conidiophores.

Management-

I. The disease can be managed by pruning of diseased leaves and malformed panicles.
II. Fungicides spray at different stages starting with Wettable Sulphur (0.2%) at the panicle size of 7.50 -10.00 cm followed by Dinocap (0.1%) after 15-20 days of first spray and Tridemorph (0.1%) after15-20days of second spray.
III. Wettable Sulphur (0.2%) can be used in all the three sprays and number of sprays may be reduced as per appearance time of disease.

2- Anthracnose

Causal organism- *Colletotrichum gloeosporioides*

Symptoms-

It affects all the above ground parts of the plant particularly leaves, petioles, twigs, blossoms and fruits. It is one of the important post-harvest diseases of mango.

Management-

I. Disease may be reduced by removal of diseased parts from the tree and its destruction by burning.
II. Infection on blossom could be reduced effectively by 2 sprays of Carbendazim (0.1%) at 15 day intervals.
III. Its foliar infection can be managed by 2 sprays of Copper oxychliride (0.3%), while latent infection of the pathogen on fruits could be reduced by pre-harvest sprays of Thiophanate methyl or Carbendazim (0.1%).
IV. Post-harvest infection of this pathogen can be managed by post-harvest dip of fruits either with hot water alone (45 ± 20°C) or hot water in combination of fungicides, Thiophanate methyl or Carbendazim (0.05%).

3- Dieback

Causal organism- *Lasodiplodia theobromae*

Symptoms-

The disease is characterized by drying back of twigs from top downwards particularly in older trees followed by dying of leaves. Dark patches are seen on young green twigs. Cracks are seen on branches and gum exudes from the cracks before its death. Graft union of nursery plants is also affected by the disease and it dies.The gummosis is found more prominent during winter after rainy season. This pathogen also attacks ripe fruit in storage at the base of pedicle (stem end rot) and the circular brown area near the stem end further develops towards the lower portion of the fruit. Later entire fruit surface is covered with the dark brown to black area and complete fruit rots in 2 to 3 days. The disease may also start from injured portion on the fruit surface.

Management-

I. The disease can be reduced by pruning of infected plant parts from 7- 10 cm below the infection site and pasting the cut ends with clay mixed cow dung or Copper oxychloride or Bordeaux mixture.

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II. In case of gummosis diseased parts may be cleaned / removed and pasted either with Bordeaux or Copper oxychloride paste.

III. Application of Copper sulphate (500 g t -1) in soil around the tree trunk is also found effective in reducing gummosis.

IV. The stem end rot can be minimized by pre-harvest spray of Carbendazim or Thiophanate methyl (0.1%) 15 days prior to fruit harvest. Fruit should be harvested with stalk (5 cm), if not, the opening must be sealed with wax.

V. Post-harvest phase of the disease can also be controlled by dipping the fruit in hot water (52 ± 10°C) with Carbendazim for 5 minutes.

4 - Scab

Causal organism- *Elsino mangiferae*

Symptoms-

It affects leaves, panicles, blossoms, twigs, stem bark and fruits. The symptom produced by the pathogen is almost similar to anthracnose but lesions produced are smaller than anthracnose on leaves and down surface is covered by delicate velvety growth. The disease may cause crinkling, distortion and premature shedding of leaves under severe conditions. Sometimes irregular shot holes are also observed on leaves. The blotches on the stem bark are grayish and irregular in shape.

Management-

I. The disease can be controlled by regular sprays of Copper oxychloride (0.3%).

5- Mango Malformation

Caused organism- *Fusarium subglutinans*

Symptoms-

It produces two types of symptoms, i.e., vegetative and floral. Vegetative malformation is more pronounced on young mango seedlings and plants. The affected plants develop swollen abnormal vegetative growth with short internodes. Leaves are small, narrow and often produced on the top of seedlings in clusters, giving it a bunchy appearance. The characteristic symptoms of the floral malformation are compact and clustery appearance of flowers. The flower buds transform in vegetative form and leaves. The flower bud seldom opens and remains dull green in colour. Some malformed panicles are not compact but both types of malformed panicles do not bear fruit.

Management-

I. Mango malformation can be minimized with removal of malformed panicles and flower in late December and early January .

II. Application of NAA (200 ppm) in the first week of October.

6- Mango Bacterial Canker Disease (MBCD)

Causal organism- *Xanthomonas campestris* pv . *mangiferae*

Symptoms-

Affects all the above ground parts of plant, i. e., leaves, petioles, twigs, branches and fruits. Lesions on leaves are angular to irregular, dark brown to black, cankerous on lower side but occasionally on both the sides and surrounded by chlorotic halo. Cankers on petioles are raised and dark brown to black in colour, while on twigs and branches are raised with longitudinal fissures. Lesions on fruits are raised and dark brown to black which gradually develop in to cankers. Under favourable condition lesions increase in size and sometimes cover complete fruit. Fruits may drop off, if infection comes at stem end.

Management-

I. MBCD can be minimized by regular inspection of orchards and sanitation

II. Use of healthy stones for root stock.

III. Three sprayings of Streptocycline (200ppm) or Copper oxychloride (0.3%) alone or its combination and use of bio-control agents, *Bacillus coagulans*, *B. amyloliquifaciens* , *B. subtilis* and fluorescent pseudomonads.

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Biosensors: Application in agriculture

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INTRODUCTION:

The quality of food, environment fundamentally depends upon their biochemical composition. There is a growing need of analytical instruments which can provide quality monitoring for the entire food processing operation, including starting materials and final products (Whitaker, 1994). Biosensors are analytical devices which include a combination of biological detecting elements like sensor system and a transducer. These sensors are advanced in the conditions of selectivity as well as sensitivity. The applications of these biosensors mainly include checking ecological pollution, Agriculture field as well as in food industries. The main features of biosensors are stability, cost, sensitivity, and reproducibility. Fruit quality monitoring is one of the major concerns within the food industry. The current economics of food production allows the produce of one country to be shipped to consumer countries anywhere in the world. Consumers demand for quality food is increasing day by day with severe economic consequences to those producers who cannot meet these demands along with guaranteed consistency. Producers must therefore carefully monitor the quality of fruit through all the stages of production, storage and transport. The selection of a particular foodstuff by a consumer is largely based on sensory perceptions with taste, which is influenced by diverse factors including saltiness, sweetness, bitterness and acidity as perhaps the most important factors. Texture is also a key parameter and is dictated by many factors including moisture content and fat, carbohydrate and protein levels. Other important sensory factors include the aroma, shape and color of the foodstuff. Therefore; rapid, portable and accurate methods for the assessment of fruit quality and physiological state are required. Due to their numerous attributes, biosensors potentially offer an accurate, fast, relatively cheap, stable, portable and user-friendly device for in situ monitoring of fruit maturity and quality.

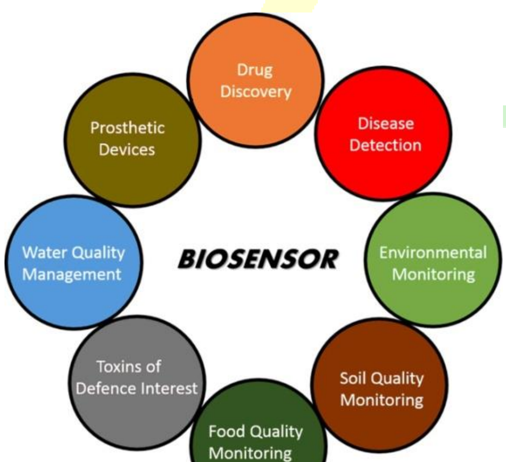
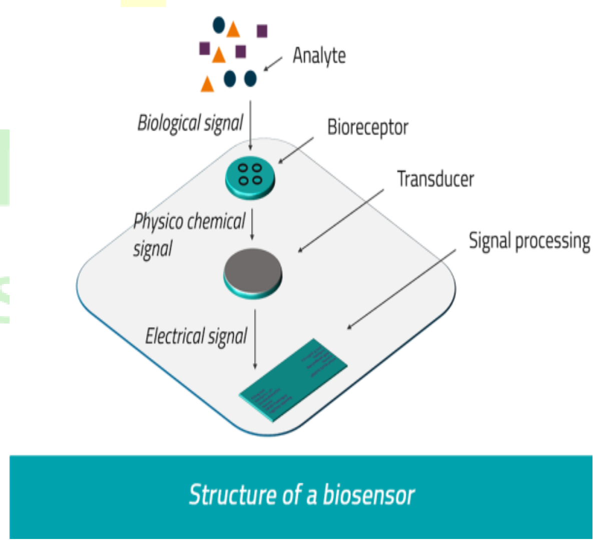


Fig.a Applications of Biosensor



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Principle and working of Biosensor:

Usually, a specific enzyme or preferred biological material is deactivated by some of the usual methods, and the deactivated biological material is in near contact to the transducer. The analyte connects to the biological object to shape a clear analyte which in turn gives the electronic reaction that can be calculated. In some examples, the analyte is changed to a device which may be connected to the discharge of gas, heat, electron ions or hydrogen ions. In this, the transducer can alter the device linked converts into electrical signals which can be changed and calculated. The electrical signal of the transducer is frequently low and overlay upon a fairly high baseline. Generally, the signal processing includes deducting a position baseline signal, obtained from a related transducer without any biocatalyst covering. The comparatively slow character of the biosensor reaction significantly eases the electrical noise filtration issue. In this stage, the direct output will be an analog signal however it is altered into digital form and accepted to a microprocessor phase where the information is progressed, influenced to preferred units and o/p to a data store.

There are different types of Biosensors:

- **Electrochemical Biosensor:** Generally, the electrochemical biosensor is based on the reaction of enzymatic catalysis that consumes or generates electrons. Such types of enzymes are named as Redox Enzymes. The substrate of this biosensor generally includes three electrodes such as a counter, reference and working type. Electrochemical Biosensors are of four types; Amperometric Biosensors, Potentiometric Biosensors, Impedimetric Biosensors and Volta metric Biosensors.
- **Physical Biosensor:** physical biosensors are the most fundamental as well as broadly used sensors. The main ideas behind this categorization also happen from inspecting the human minds. As the general working method behind the intelligence of hearing, sight, touch is to react on the exterior physical stimuli, therefore any detecting device that offers reaction to the physical possessions of the medium was named as a physical biosensor. The physical biosensors are classified into two types namely piezoelectric biosensor and thermometric biosensor.

Application of Biosensors in Agriculture:

Application in Plant Pathology:

Infectious Plant Diseases are caused by pathogenic microorganism such as Fungi, bacteria, viruses, virioids, phytoplasmas and nematodes. Worldwide, plant pathogenic infections are among main factors limiting crop productivity and increasing economic losses. Plant pathogen detection is important as first step to manage a plant disease in greenhouses as well as under field conditions. There are various immunological techniques used to detect pathogens in plant include enzyme-linked immune-sorbent assays (ELISA) and direct tissue blot immunoassays (DTBIA) DNA-based techniques such as polymerase chain reaction (PCR), real time PCR (RT-PCR) and dot-blot hybridization have also been proposed for pathogen identification and detection. However these methodologies are time-consuming and require complex instruments, being not suitable for in-situ analysis. Consequently, there is strong interest for developing new bio sensing systems for early detection of plant diseases with high sensitivity and specificity at the point-of-care. In this context, we revise here the recent advancement in the development of advantageous biosensing systems for plant pathogen detections based on both antibody and DNA receptors. The use of

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different nonmaterial such as nanochannels and metallic nano-particles for the development of innovative and sensitive biosensing systems for the detection of pathogens (i.e. bacteria and viruses) at the point-of-care is also shown. Plastic and paper-based platforms have been used for this purpose, offering cheap and easy-to-use really integrated sensing systems for rapid on-site detection. QCM (Quartz Crystaline Microbalancer) biosensor or acoustic biosensor is used to detect phytopathogens such as Pseudomonas syringae pv. tomato, Xanthomonas campestris pv. vesicatoria and Ralstonia solanacearum. SPR based immunosensor working on the antigen and antibody interaction and it helps in the diagnosis of rust in early stage of the disease that leads to control the disease by eco-friendly way. Detection of maize chlorotic mosaic virus (MCMV), SPR (Surface Plasmon Resonance) is a devise used for rapid sensitivity detection of maize chlorotic mosaic virus by using antibody and antigen concentration.

Application in Food/ Fruit Quality Control

Quality of food is need of the hour. Quality control is the essential part of any food industry and efficient quality assurance is becoming increasingly important. Consumers expect good quality and healthy food at a given price; with good shelf life and high safety while food inspections require good manufacturing practices, safety, labeling and compliance with the regulations. Consumers are placing significant importance on the quality of food products that they purchase.

This has forced the agricultural and the food industries to place an increased emphasis on quality monitoring of products. Food borne pathogens pose a risk to food safety and are a threat to the global food supply chain. The detection and identification of pathogens in raw food materials, food products, processing and assembly lines, hospitals and drinking water supplies continue to rely on time consuming conventional culturing techniques. Biosensors have the potential to revolutionize food and water supply monitoring by detecting the presence of residues, traces, chemicals, pathogens and toxins quickly.

E-nose: It is an device, able to mimic human olfactory function. It is broadly used for the detection, recognition and classification of volatile compounds and odours. E-nose consist of sensing element, signal collection unit and suitable pattern recognition algorithm. In agricultural applications, the e-nose has been implemented successfully for the fruit ripeness determination, detection of soil borne pathogens, inspection of fish etc.

Land, water and air pollution monitoring

Biosensors for the detection of environmentally significant metal ions primarily use enzymes as recognition elements. Babkina and Ulakhovich (2004) developed an amperometric biosensor made of mercury film electrode and cellulose nitrate membrane containing single stranded DNA. They employed this biosensor for measuring ions of metals in water and air samples. The biosensor was able to determine the heavy metals based on the concentration of metal ions on the biosensor due to adsorption followed by the destruction of DNA – metal complex. A bi-enzymatic optical and conductimetric biosensor based on phosphate alkaline and esterase activities on algae cells, was designed by Durrieu et al. (2004) to determine the chemicals in fresh water. Researchers at Colorado State University have developed a fibre-optic biosensor for measuring multiple organic contaminants in groundwater (Fiber Optic Biosensors, 2001). The device uses a two layer detection element

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immobilized on the tip of an optical fiber. The presence of a contaminant leads to a pH change on the fiber tip, which is measured as a quantified change in fluorescence.

Advantages of Biosensors:

- It is a sophisticated tools for the detection and monitoring of phyto-pathogens. • It gives specific and accurate readings.
- It is easy to handle.
- It can also measure non-polar molecules.
- There is no need of continuous monitoring.

Disadvantages of Biosensors:

- Heat sterilization is not possible.
- High cost.
- Lack of reusability - Some types of biosensors such as colorimetric test.
- Strips have single use.
- It only focuses on the scientific basis of the technology.

CONCLUSION: Due to their unique characteristics and flexibility, biosensors show great promise for food safety and environmental monitoring applications. Advances in areas such as toxicity, bioavailability and multi pollutant screening could widen the potential market and allow these techniques to be competitive. Biosensors certainly enhance and sustain our quality of our life. There is a need for the commercialization of biosensors in the food and the agricultural industries. All food processing industries are potential customers for a quick, easy and reliable pathogen device. Biosensors with quicker detection time and reusable features will be much coveted by customers for real-time diagnostics of pathogens and chemicals. As the world becomes more concerned with safe food and water supply, the demand for rapid detecting biosensors will only increase.

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Methods for genetic improvement of entomopathogenic nematodes, a natural insect's killer

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INTRODUCTION:

Entomopathogenic nematodes are excellent biological control agents. They are ubiquitously distributed and comprise the families Heterorhabditidae and Steinernematidae (Chitwood and Chitwood, 1937). These nematodes are characterized by their ability to carry specific pathogenic bacteria, *Photorhabdus* and *Xenorhabdus* belonging to the family Heterorhabditidae and Steinernematidae respectively. These bacteria are released into the insect haemocoel after penetration of the insect hosts by nematode vector. These nematodes possess many attributes of an excellent biological control agent. They are environmentally safe and acceptable can be produced in large quantities with artificial media and are easily applied with standard spraying equipment or irrigation systems. But limitations like susceptibility to environmental extremes and diverse host finding behaviour hampers their optimum utilization. One solution to this problem is to develop genetically improved strains with enhanced traits for biological control.

Selection: This can be employed by selecting or finding genetically superior nematode. A heat tolerant strain of *H. bacteriophora* designated as IS5 was discovered in Negev desert of Israel in 1966 and superior to commercial available strain HP88. Genetic selection of *H. bacteriophora* strain HP88 resulted in an 8-9 fold increase in resistance to phenamiphous and avermectin (Thomas, G.M. and Poinar, 1979).

Hybridization: The transfer of beneficial genes by hybridization can provide a powerful approach of for genetic improvement of entomopathogenic nematodes. A trait for heat tolerant was transferred from *H. bacteriophora* designated as IS5 was discovered in Negev desert of Israel to the wild type *H. bacteriophora* HP88 strain. The hybrids progeny were confirmed by use of marker mutant isolates and by backcrossing (Poinar, 1976).

Mutagenesis: The isolation of mutants nematodes with distinct morphological characteristics can serve as genetic markers for the analysis of mutants displaying desired traits or for the mapping of beneficial genes. *H. bacteriophora* is particularly suited for mutagenesis because it has a short generation time and self-reproducing hermaphrodite (Bedding, 1984). Homozygous development from a single parent allows pure lines to be obtained and maintained easily, and the appreciable male production of subsequent generation provides the vehicle for the exchange of genetic material between individuals.

Genetic transformation: Genetic engineering of EPNs offers significant advantages over selective breeding and mutagenesis, making it possible to produce small defined beneficial changes in the genotypes. A heat –inducible *Caenorhabiditis*

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elegans heat shock gene, *hsp 70*A, has been transferred in to *H. bacteriophora* HP88 (Baxter *et al*., 1998). The 70 KDa heat shock protein encoded by the gene enables the cell to eliminate or renature proteins damaged by high temperatures. The transgenic nematodes were 18 times more heat tolerant of heat shock than wild type. Although he transferred gene was inherited extrachromosomally, the transformation was stable for 15 generations. Desiccation and osmotic tolerance were enhanced in *S. feltiae* adults nematodes by using heat- inducible promoter derived from *C. elegans* and the *tsp-1* gene.

CONCLUSION:

Nowadays the changing interest of growers towards organic agriculture and several Eco safety issues are encouraging the scientific societies to develop alternative methods against traditionally used chemical management tactics. The uses of EPNs offers a perfect alternative choice for the farmers, but their effectiveness and delivery methods are yet to be standardized**.**

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Technological advances in fertilizer nitrogen management for enhancing its use efficiency

Article id: 21688

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INTRODUCTION

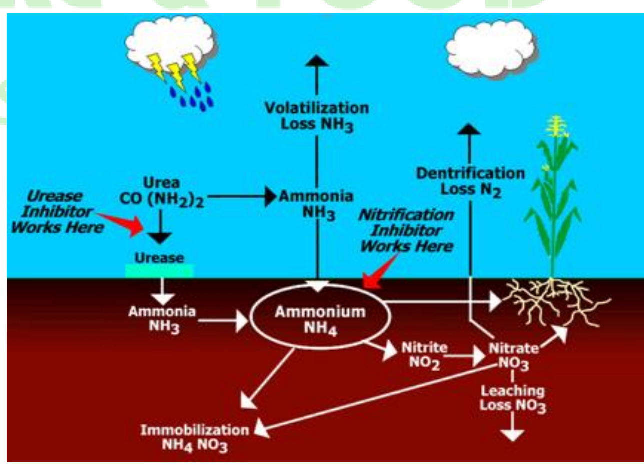
Nitrogen (N) has been widely known to be universally deficient nutrient in crop production. Around 89% of soils in India are low to medium in N. Of the total N fertilizer applied globally, 60% is consumed by rice, wheat and maize. Remaining N is lost from the soil and affects ecosystem functions. In 2018 total N fertilizer consumption was hovering around 16.9 Mt. (FAI, 2017-18). In India different N fertilizers are used like ammonium sulphate, urea, ammonium chloride *etc.* Among these, contribution of urea is highest which accounts to about 81% (FAI, 2017-18). Data suggests that there has been a rapid increase in N fertilizer consumption with a declining trend of corresponding unit factor productivity. Due to various losses involved in N transformation processes no doubt its use efficiency is quite low hovering around 30-35% in case of cereals. Thus, efficient use of N is crucial for improving crop production and environmental safety.

Forms and Fate of Nitrogen in Soil

There are three major forms or states of nitrogen in soil: organic nitrogen (Org-N), ammonium nitrogen (NH_4^+-N), and nitrate nitrogen (NO_3^--N). Plants can only use ammonium and nitrate forms of nitrogen. So mineralization occurs when organic nitrogen is broken down to form ammonium nitrogen, which is available for plant use. Nitrification occurs as ammonium is further changed by microorganisms to the nitrate form which is available to plants. Unlike ammonium, nitrate (NO_3^-) has a negative charge, which causes it to be repelled by negatively charged soil particles. As a consequence, nitrate travels readily through the soil profile with water in a process called leaching. An additional potential fate for nitrate nitrogen under specific field conditions is its conversion to nitrogen gas (N_2) through a process called denitrification. This occurs when soil is totally saturated by flooding and no oxygen is present. Ammonia volatilization is a function of concentration of aqueous ammonia in soil solution and partial pressure of ammonia in atmosphere. With increase in concentration of ammonium ion in soil solution, volatilization loss increases.

Reasons for low N use efficiency (NUE)

Apart from various mechanism in N transformation other factors like imbalance fertilization, blanket application of fertilizers, inappropriate rate, time and method of application could result in high N loss from soil. Even degradation of soil due to salinity, sodicity and acidity could add up to N losses to a



significant rate. According to EU nitrogen balance panel (2014) desirable range of NUE is 50 – 90%. If it goes below 50% wastage of nitrogen fertilizer occurs. If it goes beyond 90% then soil mining occurs.

Strategies for increasing NUE

Different methodologies have been developed till date by researchers in order to cater to the urgent problem of low NUE these are discussed here.

Smart N management

For on field management of nitrogen different tools are used like leaf colour chart and SPAD meter. Leaf colour chart is a simple tool used measure relative greenness of leaf which is related to nitrogen content of leaf. It is plastic scale like having four strip of colour varying from yellowish green to dark green. Leaf colour chart based nitrogen fertilizer application at peak demand time has been seen to have increased yield significantly. SPAD stands for subsystem positioning aid device. It measures chlorophyll content or greenness of leaf to reduce risk of yield limiting deficiency or over fertilizing. SPAD meter based fertilizer application helps in applying fertilizer at time of plant need which meets crop peak demand. That's why both yield as well as use efficiency increased (Ghosh *et al*., 2013).

Site specific nutrient management (SSNM)

It is a plant based approach for managing nutrient requirement which is based on principle of supplying nutrient as and when needed to achieve high yield while optimising use of nutrient from indigenous sources. SSNM is based on principle of 5R; the right time, the right amount, the right source, the right place and the right manner. SSNM differs from whole field managment, in whole field management action is same throughout the field irrespective of nutrient status of field. In SSNM whole field id divided int different cells or plots and management action is followed according to fertility status of each plot.

Nutrient expert

Nutrient expert is an easy to use interactive and computer based decision support tool that can accurately provide nutrient recommendation for an individual farmer field with or without soil testing data. Nutrient expert helps to evaluate current nutrient management practice determine attainable target yield and determine nitrogen fertilizer application, translates fertilizer into nutrient sources.

Slow release nitrogen fertilizer

As most of nitrogen fertilizers are water soluble thus are susceptible to various losses. To mitigate this slow release fertilizers are developed. The main purpose is to slow down their release to synchronise the supply of nitrogen with crop demand and to reduce losses from soil. These are of mainly two types;

1. Coated slow release nitrogen fertilizer: coated with materials which act as physical barrier such as sulphur coated urea, polymer coated urea. Nitrogen is released to soil solution through diffusion process.
2. Uncoated slow release nitrogen fertilizer: Urea formaldehyde, isobutylidenediurea (IBDU), urea z *etc*.

Use of urea super granules (USG)

Surface application of urea leads to volatilization loss of nitrogen in the form of ammonia. To avoid this urea super granules are produced. Urea super granules are pellets or granules of 1cm diameter and 1g weight. USG are deep placed and its low solubility reduces losses. One of main difficulty is its deep placement.

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Bangladesh agriculture research institute had developed a BARI USG applicator which also reduces damage to plant root.

Urease inhibitor

Urease inhibitors are chemicals that inhibits the hydrolytic action on urea by urease enzyme. These chemical bind with Ni , which is a critical metal constituent of urease enzyme. Most commonly used urease inhibitors are PPD (phenyl phsphorodiamidate) and NBPT (n-butyl thiophosphoric triamide). They slow down the conversion of urea to ammonium ion and reduce potential for ammonia volatilization.

Boric acid as urease inhibitor

Boric acid (H_3BO_3) acts as a competitive inhibitor of urease enzyme. The inhibition is maximal between pH 6.2 and 9.3, suggesting that only the neutral trigonal H_3BO_3, and not the $B(OH)_4^-$ anion is an inhibitor of urease.

Nitrification inhibitor

Nitrification inhibitors delays or inhibit the bacterial oxidation ammonium ion The objective is to reduce leaching loss and production of N_2O by denitrification thus increasing NUE. The most commonly used nitrification inhibitors are N-serve (2-chloro-6-trichloro methyl pyridine) and DCD (dicyandiamide).

CONCLUSION

Precise N management through SSNM, SPAD meter and LCC gives higher grain yield and NUE as compared to blanket N recommendation. Optimal time, rate and methods of application of specially formulated forms of fertilizer, including urease and nitrification inhibitors are the potential means for improving N use efficiency. By altering the management practices like irrigation, INM and application of biofertilizers can help to effectively manage the resources and increase the use efficiency of N.

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Meditational use of night jasmine (Harsingar)

Article: 21689

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Harsingar normally name night jessamine or Parijat. It full with helpful qualities and is native to geographic area and South Asia. It's a small tree or a ligneous plant growing up to thirty five feet tall with a gray flaky bark. The leaves square measure quite broad with a margin. The flowers come upon exciting with five to eight white coil petals, having an orangish-red centre. The fruit that this flower bears could be a brown spherical to heart formed capsule of two cm diameter containing one seed. This flower is found in abundance in province, Asian country and conjointly in Kanchanaburi Province in Thailand. This flower loses its brightness throughout daytime and is most ordinarily used as a yellow dye for wear.

Cultivation of Harsingar: Harsinger normally grows in tropical regions of the planet. tho' this plant typically blooms in the dead of night, it will need many daylight and it cannot survive in a very frosty or cold space. It grows best in sandy sol, damp and well-drained soil. It cannot grow in extremely saline soil. It's typically found in some regions of South Asia and Asia.

Benefits of Harsingar and its facet effects: It provides treatments for dengue fever, Chikunngunya, protozoal infection and inflammatory disease. It prevents gas, radical harm, treats cough, fights respiration issues, etc. in addition it's anti-bacterial, anti-viral and anti-fungal properties that build it fight varied infections within the body. It conjointly acts as a laxative in most cases.

Nutritional worth of Harsingar: The leaves of Harsingar contain carboxylic acid, fructose, glucose, carotene, amorphous rosin, vitamin C, salicylate, tannin, oleanolic acid and flavanol glycosides. The flowers square measure terribly useful because it contains essential oils and glycosides. The seeds contain palmitic, oleic and myristic acids. The bark of this plant is beneficial because of its alkaloids and glycosides content. The extracts of this flower posses antifungal and antiviral properties.

Uses of Harsingar: Harsingar is packed with useful uses such as; it helps treat dandruff, lice, lightheadedness and anxiety symptoms, scurvy and acidity. in addition it conjointly treats high pressure level, sciatica, relieves expelling cramps and is an remedy to snake bites in some cases. This herb ought to be consumed if you're perpetually restless and sometimes get panic attacks. in step with studies, Harsingar conjointly alleviates piles to a particular extent.

Reduces Pain and Inflammation: Parijat makes wonderful essential oils that square measure nice to cut back the pain, injury and therefore the inflammation. Not solely this, it reduces the pain of inflammatory disease, stress, muscle tension, rheumatism and sore muscles too. So, it's simple to grasp however useful parijat is in treating pain. Hence, what you have got to try and do is, combine the copra oil and 5-6 drops of parijat oil in a very bowl. Then, heat up the answer and massage on your vainglorious space.

It is bactericide, antiviral, and anti-allergic: night Jessamine could be a powerful bactericide and antiviral herb. Doctors swear by this herb once it involves anti-bacterial and antiviral properties. It cures varied forms of skin infections, allergies and rashes. It not solely fights against bacterium; however it conjointly helps to fight against the Semliki Forest Virus, and Cardio virus that causes encephalomyocarditis. So, what you have got to try and do is, combine 2 drops of parijat oil and copra oil in a very bowl. After that, don't forget to heat the oil. currently the remedy is prepared to use on your infected space.

Provides relief from Chikungunya and dengue fever: though Chikungunya and Dengue square measure serious and folks littered with it have to be compelled to be admitted within the hospital at once, however intense Harsingar will give some facilitate and cut back symptoms of those diseases. throughout such diseases, the thrombocyte count of the patient deteriorates chop-chop. In such cases this herb will be used as a remedial live to extend the thrombocyte count as quickly as potential. Harsingar alongside different herbs ought to be taken as a simmering or within the crude type to supply the simplest results. in step with analysis, distinction in dengue fever and Chikungunya patients will be seen as shortly as three days. However, this herb ought to be consumed often while not fail to form a large distinction.

Can treat inflammatory disease: Arthritis isn't solely common among recent aged individuals however it conjointly affects young adults currently days. It will be terribly annoying and may build someone deviate from his daily activities. In severe cases, it conjointly disrupts sleep to a particular extent. In such conditions, Harsingar ought to be consumed because of its anti-arthritic properties to cut back inflammation and pain. it's counseled to boil the powder extracted from Harsingar in a very cup of water and consume it directly for immediate relief. Folks that consumed it often typically expertise relief once a protracted usage of this herb.

Cures protozoal infection and different fevers: The leaves of Harsingar square measure accustomed treat the fever that happens throughout chronic protozoal infection. It also can be used as a remedy for top blood heat, symptom and nausea caused because of dipterous insect bites. The leaves contain useful soothing and healing properties that build it ideal to urge obviate protozoal infection parasites.

Prevents radical hurt to the body: Health issues and aging area unit generally caused attributable to radical hurt to the cells of our body. Typically this can be often known as aerobic hurt. To prevent such hurt, antioxidants area unit required. Therefore, Harsingar has durable antioxidants which could merely get obviate the harmful effects of free radicals. Other than this, Harsingar can also be accustomed forestall the event of cancer cells and fights early signs of aging. The essential oils extracted from its flowers can also be massaged on the body to remain it healthy and powerful.

Anti-allergic, antiviral and bactericide properties: Harsingar oil are accustomed fight bacteria like *E.coli*, eubacterium infection and fungal infection. Additionally it assists in combating encephalomyocarditis, cardio virus and semliki forest virus. It can also be accustomed treat skin issues like blackheads and

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pimples. Can treat cough: Persistent coughing are often caused thanks to loads of reasons like smoking, bronchitis, respiratory organ issues or infection. It is often terribly annoying and hampers our ability to speak and socially act with folks. In most cases, coughing may also build one unable to urge sound sleep and result in fatigue and stress. Harsingar sometimes helps in relieving cough and if consumed daily it will cut back the symptoms to a good extent.

Combats respiration problems: Regular consumption of Harsingar will relieve respiratory illness symptoms. Though it doesn't cure respiratory illness, however it will cut back the symptoms and makes it easier for an individual to breathe with none hurdle. Harsingar contains useful and healthful properties to produce relief from respiratory illness symptoms.

Prevents gas: Gas is often extraordinarily irritating and might cause weakness, abdomen ache and even symptom. Regular consumption of Harsingar treats gas connected issues simply. Other health advantages of bush or parijat: there's no limit once it involves talking concerning the health advantages of parijat or bush. Except the higher than ones, here ar another health advantages too:

- It helps in treating treat anxiety and dizziness. It cures dandruff and prevents hair from turning gray. Night bush helps in dominant the aldohexose levels within the body. It provides relieve in emission cramps.

Side-Effects & Allergies of Harsingar: Harsingar doesn't have loads of fatal facet effects, however something consumed in excess are often terribly harmful for health. Harsingar has a very bitter tastes, thus for those that ar terribly sensitive with style, will expertise slight nausea if they can't bear the style. It shouldn't be taken in excessive quantity to cure cough because it will prove fatal to the throat, it ought to be taken solely once the steering of associate degree Ayurvedic doctor for cough connected problems.


Tree of Harsingar

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Mycodiplosis larva feeding on rust fungi

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Aeciospores and urediniospores of rust fungi are a food source for the larval stage of members of the fly genus Mycodiplosis, hence these could be of interest as potential biological control agents. Larvae of Mycodiplosis melampsorae (Diptera: Cecidomyiidae) are reported for the first time in Italy as occurring on the crown of tree spurge (= Euphorbia dendroides), and feeding on the urediniospores of the rust fungus Melampsora gelmii.

INTRODUCTION

Mycodiplosis (Rübsaamen, 1885) (Diptera: Cecidomyiidae) is a well-known genus of gall midges, so far including about 50 worldwide-distributed species (Nelsen 2013). Their larvae are furthermore mycophagous, feeding on the spores of plant pathogenic fungi causing rusts (Basidiomycota, ord. Pucciniales) and powdery mildews (Ascomycota, ord. Erysiphales) on the crown of numerous plant species (Henk, Farr & Aime 2011). Plant-pathogen-insect interactions are therefore of a major interest for plant-disease biological control in agriculture (Kluth, Kruess & Tscharntke 2001) besides for more general meaningful ecological implications and consequences. For these reasons the interaction between the gall midge M. melampsorae (Rübsaamen, 1889), tree spurge (= Euphorbia dendroides L., Fam. Euphorbiaceae Juss., subgenus Esula Pers.) and the rust fungus Melampsora gelmii Bres. (Fam. Melampsoraceae Cast.) is reported for the first time in Italy. *M. melampsorae* is a polyphagous species and the larvae develop on various host plants after feeding on the urediniospores of rust fungi (ord. Pucciniales) (Skuhravá, personal communication). It occurs in Germany, in many countries of Europe and in Central Siberia (Skuhravá database of Cecidomyiidae). Finally, M. melampsorae is reported from several localities in northern Italy at altitudes ranging from 1245 and 2300 m a.s.l. (Skuhravá & Skuhravý 2010).Melampsora gelmii is a rust fungus, i.e. one of those biotrophic obligate fungal pathogens producing up to five different kinds of spores: basidiospores, spermatia/spermogonia, aeciospores, urediniospores, teliospores (Vialle, Frei, Hambleton et al. 2011).

Mycodiolosis larva feeding on rust fungi

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History of mycodiplosis

Mycodiplosis is a poorly studied genus of flies in the family Cecidomyiidae. Members of this genus are described using morphology of adult males to distinguish species. There are 49 accepted species, with five species deposited in the entomological collections of the National Museum of Natural History from Jamaica and the United States, and four additional described species from the Neotropical region (Gagné 2004). The earliest records of *Mycodiplosis* are two species collected in Germany and identified in 1853 by Johann Winnertz, *M. ceomatis* and *M. coniophaga*. The possibility of hidden biodiversity and many more undescribed species in the genus was recently raised (Henk, et al. 2011). Herbarium collections of rust-infected plant material have been found to contain *Mycodiplosis* larvae (Henk, et al. 2011). The life cycle stages of a representative species of *Mycodiplosis* from India have been described, and the possible use of the insect as a biological control agent of rust fungi suggested (Kaushal, et al. 2001).

Management aspects of *mycodiplosis*

The larvae of *Mycodiplosis* species are often obligate feeders on urediniospores and aeciospores of Pucciniales while some species share the galling habit common to other genera within Cecidomyiidae. Twenty one of the 49 described species were found on rust-infected plant material (Gagné 2004). In one study examining *Mycodiplosis* feeding on rust in India, the *Mycodiplosis* life cycle coincides with the secondary infection cycle of its rust food source, lasting approximately 15 days (Kaushal, et al. 2001). The fly larvae of this *Mycodiplosis* species fed on spores and reduced the quantity of secondary inoculum that would otherwise produce additional disease cycles (Kaushal, et al. 2001). The possibility of *Mycodiplosis* species larvae being used as a biological control agent for phytopathogenic Pucciniales is a practical consideration for exploring the diversity of these organisms and their ecological relationship with the rust fungi. Little else is known about the relationship between these fly larvae and their fungal food source. By examining the evolutionary history of this ecologically intimate relationship, it is possible to understand more about both Pucciniales and *Mycodiplosis.* Many insects and mammals feed on fungal fruiting bodies and reproductive propagules (Pirozynski and Hawksworth 1988; Wheeler and Blackwell 1984; Wilding, et al. 1989). The larvae of *Mycodiplosis* flies are thought to feed extensively on the spores of rust fungi and powdery mildew, while adults have been found feeding in nectaries of cacao flowers and on the termite prey of spiders (Gagné 1994; Kaushal, et al. 2001; Powell 1971). Among the described species of *Mycodiplosis* are larval stages that were discovered feeding upon Erysiphales (powdery mildews, five spp. of *Mycodiplosis*), Peronosporales (downy mildews, *M. inimica*), and even a saprotrophic Russulales, *Peniophora cinerea* (*M. gloeopeniophorae*). Of the 49 described species, 27 are known to be mycophagous in the larval stage, with 21 occurring on rust. Several other species were described from adults reared in a laboratory from larvae found in plant galls (Gagné 2004). Rust-feeding species in this fly genus are thought to be limited in range and dispersal, commonly colonizing rust infected plants within a small geographic range (Kaushal, et al. 2001; Powell 1971). The somewhat selective mycophagous habit of *Mycodiplosis* larvae is an ecological specialization that has had little exploration to determine its evolutionary significance with regard to either flies or fungi.

Host specialization and coevolution

The feeding niche of an organism can be that of a generalist, which exploits all locally available food sources that are physiologically compatible, or a specialist, exploiting food sources more narrowly defined by species, genus, or family groupings (Fox and Morrow 1981). Specialization is described in

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terms of behavior, physiology, and genetics (Jaenike 1990). There is a possibility of a range of specialization within *Mycodiplosis*, Henk, et al. (2011) found molecular evidence for possible feeding specialization among several potential species. Although *M. coniophaga, M. melampsorae* and *M. pucciniae* have been found on many rust species, and *M. rubida* was described twice by E. P. Felt, once on *Uromyces pisi* and once on a *Puccinia* sp., there are still 16 described *Mycodiplosis* species that have only been associated with a single rust species (Gagné 2004).

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Precision farming in vegetable crops

Article id: 21691
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INTRODUCTION

Today's technological advancement has reached a level where a farmer can have access to information and tools 'to manage his mechanized field operations. They can now measure, evaluate and deal variability with infield (e.g. soil fertility, water availability and yield) that was known to exist previously but was not manageable, to his advantage. The ability to handle variations in productivity within a field and maximize financial return, reduce waste and minimize impact on the environment has always been the objective of an enterprising farmer, especially those with limited land resources and those who advocate sound agriculture practice.

This concept is not new. What is new is the ability to automate data collection and documentation and the utilisation of this information for strategic farm management decision in the field operations through mechanisation, sensing and communication technology. Such an approach in agriculture production management gives rise to what is now termed as Precision Farming (PF), Precision Agriculture (PA), Prescription Farming (Precision farming), Site Specific Agriculture (SSA), Soil Specific Crop Management (SSCM), Spatially Variable Crop Production (SVCP) *etc.*

History of precision farming:

The term precision agriculture or precision farming appears to have been first used in 1990 as the title of a workshop held in great falls, Montana sponsored by Montana state University. Before this, in 1980's the terms site-specific crop management or site-specific agriculture.

Definition and concepts

The term means different aspects to different people. To some, precision farming means using satellite, sensors and field or thematic maps. Precision farming is in fact a comprehensive system designed to optimize agriculture production by carefully tailoring soil and crop management to fit the different conditions found in each field while maintaining environmental quality (Blackmore *et al.,* 1994). Precision farming also refereed as Hi-tech farming, Variable rate application farming, Site specific farming, Prescription farming

In other words, it is 'Digital Agriculture' involving very large scale farm level mapping, comprehensive database creation on required resources generated through space based inputs and field observations and making a detailed plan of work for maximizing the yield and reducing the cost on inputs using the decision support system.

Precision farming generally includes:

- Crop characteristics like, stage of the crop, crop health, nutrient requirement.
- Detailed soil layer with physico-chemical properties, depth, texture, nutrient status, salinity and toxicity, soil temperature, productivity potential *etc.*
- Microclimatic data (seasonal and daily) about the canopy temperature, wind direction and speed, humidity *etc.*
- Surface and subsurface drainage conditions, Irrigation facilities, water availability and other planning inputs of interest.

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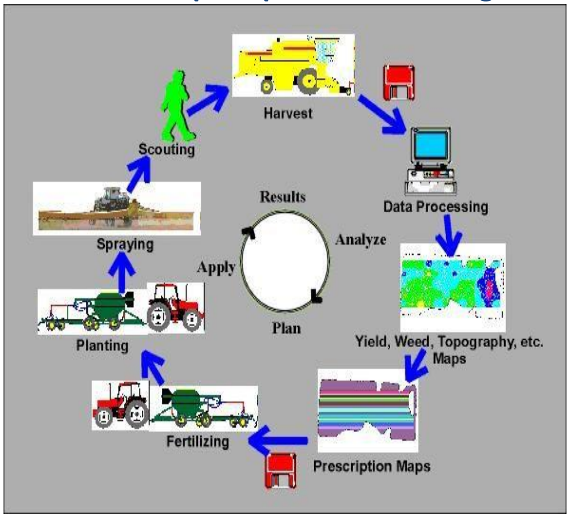
General concept of precision farming



Aims of precision farming:

Precision farming aims to optimize field-level management with regard to:

- Crop science (e.g. fertilizer inputs)
- Environmental protection (e.g. limiting leaching of nitrogen)
- Economics (e.g. improved management of fertilizer usage and other inputs)

Why Precision farming?

- In India after green revolution, farmers and scientists realized the fact that the soil is contaminated by excessive use of fertilizers and pesticides. The natural fertility of soil is lost by the excessive usage of chemicals.
- The effective usage of water is not happening in the farming method used during Green revolution.
- Majority of water is wasted and the result is less efficient resource management
- Eliminate the wastage of resources and thus the pollution to soil and water can be reduced significantly. Even though various modern farming techniques like drip irrigation, integrated pest management, planning of farm land, Soil fertility checking etc may come as part of precision farming the real concept of precision farming is outside these domains.
- The real concept of precision farming is based on GPS. The Global Positioning System enables the farmers to be precise in terms of Time and Space

Need for precision farming in india:

- Increased land degradation
- Depletion of water resources**,** Socio economic need for enhance productivity unit of land, water and time**.**
- Environmental pollution because of increased and indiscriminate use of fertilizers and chemicals.
- Precision farming is essential in order to address poverty alleviation, enhance quality of life and food security.

Types of precision farming:

1. **Map based farming:** which involves grid sampling a field, laboratory analysis of the samples, generation of site-specific map of the properties and finally using them in making managerial decisions.
2. **Real-time sensor based farming:** utilizes real-time sensors and feedback control to measure desired properties (like fertilizer/plant chemical requirement) and immediately use this signal to control these operations.

This precision farming concept yield better management decisions that will lead to higher productivity, high profit by reduced cost of cultivation and reduced environmental impact because of the reduced the input addition to the soil. This concept is picking up very fast in developed countries due to the larger farm holding, mechanization and technological developments. In India, the scenario is different. Largely we have fragmented land holding with labour intensive horticultural operations.

The socio-economic conditions of the Indian farmers, slow percolation of new technology are

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the additional hurdles. However, with the present day technological developments and future availability of high resolution multispectral sensor data the situation can be re-examined and there is a scope for adopting precision farming in India.

Initially it can be experimented on a pilot mode in Agricultural Universities or Research Stations with the kind of exposure we have and later it can be operationalised at larger scale. This is feasible in areas where farming is carried out in cooperative system.

Principles

1. Ability to generate yield maps.
2. Control and selective delivery of materials to crops.
3. Ability to control equipment applying materials selectively in response to information.
4. Detailed knowledge about crop growth and protection management.

Components of precision farming

1. Remote sensing (RS)
2. Geographical Information System (GIS)
3. Differential Global Positioning System (DGPS)
4. Variable Rate Applicator (VRA)

Comparison between traditional and precision farming

Operations	Tools implements and equipments	
	Traditional farming	Precision farming
Land development and leveling	Bullock or tractor operated scrappers and levelers	Laser guided precision land leveler
Tillage	Mould board plough Disc harrow	Vegetable transplanter machine, Potato planter
Irrigation	Centrifugal submersible pump	Sprinkler and drip irrigation systems
Plant protection	Manual, engine operated sprayer ,Duster	Power tiller sprayer, electrostatic and air assisted spraying
Harvesting and threshing	Sickles	High capacity multicrop threshers, potato diggers etc.

CONCLUSION

- Precision agriculture gives farmers the ability to more effectively use crop inputs including fertilizers, pesticides, tillage and irrigation water. More effective use of inputs means greater crop yield and (or) quality, without polluting the environment. Precision agriculture can address both economic and environmental issues that surround production agriculture today.
- Questions remain about cost-effectiveness and the most effective ways to use the technological tools we now have, but the concept of "doing the right thing in the right place at the right time" has a strong intuitive appeal. Ultimately, the success of precision agriculture depends largely on how well and how quickly the knowledge needed to guide the new technologies can be found and also the status of the Indian progressive farmers.

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Seed Priming: A tool for abiotic stress management

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Plants are suffering from many numbers of adverse environmental circumstances such as drought, water deficit, extreme temperature, submergence, high salinity etc. These abiotic stresses severely affect the plant growth and productivity by biochemical, physiological and metabolic changes, which may result in oxidative stress. A number of strategies are working to generate plants that can survive in these stresses condition. In these methods, seed priming is one of the most important physiological seed enhancement methods. Seed priming is a hydration treatment that allows controlled imbibition and induction of the pre germinative metabolism, but radicle emergence is prohibited. The hydration treatment is stopped before desiccations tolerance is lost. Priming solutions can be supplemented with plant hormones, different salts or beneficial microorganisms. After priming the seeds can be dried back for storage, distribution and planting. Germination speed and synchronicity of primed seeds are enhanced and can be interpreted in the way that priming increases seed vigour. Additionally, the overall growth of plants is enhanced due to the seed-priming treatments. In respect to plant defence, priming is defined as a physiological process by which a plant prepares to respond to imminent abiotic stress more quickly or aggressively that leads to better crop stands and higher yields. Primed seeds generally exhibit in increased germination rate, greater germination uniformity, and at times, greater total germination percentage under adverse germination conditions.

Priming has several methods according to needs we can use anyone to improve in such needful condition. The various methods include hydropriming, osmopriming, chemical priming, hormonal priming, biological priming, redox priming, solid matrix priming, etc. The efficiency of different priming agents varies under different stress condition and with different crop species.

Hydro-priming (drum priming) is attained by continuous addition of a limited amount of water to the seeds. In this priming method, the seeds are immersed in sterilized distilled water kept at the appropriate temperature and the duration of hydro-priming is determined by controlling seed imbibition during germination. It is absolutely necessary to dry the seeds after soaking as storing of improperly dried seeds will do more harm than good. After soaking, seeds were re-dried to their original weight with forced air under shade.

Osmo-priming is the soaking of seeds in low-water-potential solutions. The low water potential of the solutions can be achieved by adding osmotica like mannitol, polyethylene glycol (PEG) or salts like KCl, K_3PO_4, KH_2PO_4, $MgSO_4$, $CaCl_2$, NaCl etc.

Matrix priming (matrix conditioning) is the incubation of seeds in a solid, insoluble matrix such as vermiculite, diatomaceous earth, cross-linked highly water-absorbent polymers. In solid matrix priming (SMP) or matric conditioning, the solid or semi-solid medium is used as an alternative to the liquid medium.

Nutrient priming: In nutrient priming, seeds are primed in solutions containing the limiting nutrients instead of being soaked just in water. Increasing evidence suggests that mineral-nutrient status of plants plays a critical role in increasing plant resistance to environmental stress factors. The mineral nutrients play a particular role in contributing to the survival of crop plants under environmental stress conditions. Seed priming with micronutrient solutions improves germination related performance, growth of plants and grain yield of wheat, rice, maize, gram, pea etc.

Hormonal priming: Seed performance of various crops can be improved by the inclusion of plant growth regulators and hormones during priming and other pre-sowing treatments. IAA, Kinetin, Abscisic acid and other hormones use for seed priming. Abscisic acid (ABA) is a phytohormone extensively involved in responses to abiotic stresses such as drought, low temperature, and osmotic stress. ABA priming showed an increased rate of germination as compared to nonprime seeds in Indian mustard.

Chemical priming: Several chemicals used to bring about priming in various crops. Plants can acquire resistance to abiotic stress after treatment with several natural or synthetic compounds such as $Mg(NO_3)_2$, $Ca(NO_3)_2$, H_3BO_3, $CuSO_4$, $ZnSO_4$, KH_2PO_4, selenium, ethanol, putrescine, paclobutrazol, choline, and chitosan.

Biopriming: Use of beneficial microorganisms to the seed during priming may improve the establishment of the crop. Biopriming involves coating seed with a bacterial biocontrol agent such as *Pseudomonas species*, *Trichoderma harzianum, P. fluorescens, B. subtilis, Streptomyces sp., and Gliocladium virens* and hydrating for 20 h under warm conditions (23^0C) in moist vermiculite or on moist germination blotters in a self-sealing plastic bag and the seeds are taken out before radicle emergence. Two or more microorganism may also apply together with a ground crop such as carrot, onion etc. as seed priming. Rhizobacteria are used as inoculants to enhance crop yield and for biological control of fungal pathogens. Certain strains of rhizosphere bacteria stimulate plant growth, so-called plant growth-promoting rhizobacteria (PGPR). It integrates a biological and physiological aspect of disease control. Recent time, to control soil and seed borne disease mainly depend upon fungicidal and other chemical use which are harmful to human and environmental health. In the roots of many crops such as rice and tomato plants, mycorrhizal fungi were shown to encourage the accumulation of a number of transcripts and proteins, respectively, many of which with a predicted function in plant defense.

In present days, to increase crop yield, many types of chemical fertilizers are used in a vast amount, which are waste and hazard to human as well as environmental health. Seed priming agents use inadequate amount which is sufficient to enhance seed performance in a different stress situation. Seed priming agents also able to protect from pathogen attack during seed germination and induce disease resistance via physiological and biochemical changes. Seed priming is the best method to provide a particular nutrient to seed in nutrient deficient conditions by which seed performance and yield are enhanced without any harmful effects on the environment. It improves germination, germination speed, seedling vigor, root length, seedling dry weight, dry matter production, photosynthetic activity, and many other plant growth traits. Seed priming also improves the biochemical status of the plant by improving α-amylase activity and soluble sugar contents during seed germination and nitrate reductase activity and nitrogen content in growing seedlings. Seed priming improves the stress memory and antioxidant system by improving the activity of SOD, catalase, MDA, glutathione reductase, ascorbic acid, and stress protein like late embryogenesis abundant (LEA), dehydrin and aquaporin (AQP) proteins. Crop yield and quality of grain like nutrient content are also improved by seed priming.

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Biosensors: A fruit ripening detector

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1, 2, 3 Ph. D. Scholar, MPKV, Rahuri.

INTRODUCTION

There are several developmental phases through which the fruit passes and fruit ripening is one of them. In fact, ripening begins moment the growth of the fruit is completed. Fruit maturity is a stage of fruit harvesting while fruit ripening is a stage of fruit consumption.

The fruit ripening is associated with many visible changes in the colour, the flavour and the aroma. Thus, the fruit is ready for eating purposes. Fruit ripening is a type of ageing and many people prefer to call it "fruit ageing" than fruit ripening. In many fruits the ripening occurs after picking or the process is hastened after picking. Ripening processes are of degradative nature. Ripening is the process by which fruits attain their desirable flavour, quality, colour, palatable nature and other textural properties. Ripening is associated with change in composition i.e. conversion of starch to sugar. As fruit matures, it releases a gas known as ethylene,that causes the ripening process to begin. Once that process is under way, more ethylene is released, kicking the ripening into high gear. Currently, produce warehouses use expensive technologies such as gas chromatography or mass spectroscopy to measure ethylene levels, in order to gauge the ripeness of fruits that are in storage. A scientist from MIT, however, is developing small, inexpensive ethylene sensors that could be used in places such as supermarkets. There, they could let shopkeepers know which batches of fruit need to sold the soonest, in order to minimize spoilage.

Biosensors are analytical devices that convert a biological response into an electrical signal. Quintessentially biosensors must be highly specific, independent of physical parameters such as pH and temperature and should be reusable. The term "biosensor" was coined by Cammann, and its definition was introduced by IUPAC. Fruit quality monitoring is one of the major concerns within the food industry (Kriz *et al*., 2002). In particular, there is a growing need to develop analytical instruments which can provide quality monitoring for the entire food processing operation, including starting materials and final products (Whitaker, 1994). Biosensors are highly selective analytical instruments, due to the high selectivity of the biological recognition element employed which have been applied in an array of disciplines including medicine, industry, environmental analysis, food technology, and military (Wang, 2001). Each sensor utilizes an array of tens of thousands of carbon nanotubes, which have had copper atoms attached to them. While electrons ordinarily flow freely through the nanotubes, any ethylene molecules present in the vicinity will bond with the copper atoms, obstructing the flow of those electrons. Tiny beads of polystyrene are also used, which absorb ethylene and concentrate it near the nanotubes.

By measuring how much the electron flow has been slowed, the sensors are able to determine ethylene levels. As a result, the sensors can reportedly measure concentrations as low as 0.5 parts per million – for context, a concentration of between 0.1 and one part per million is what is generally required for most types of fruit to ripen.

The sensors were tested on bananas, avocados, apples, pears and oranges, and were able to accurately gauge the ripeness of all of them. Swager now envisions the sensors being built into the cardboard boxes used to store fruit, and equipped with radio-frequency identification

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chips that would allow them to transmit ripeness data to handheld reading devices used by shopkeepers.

Optimal ripening conditions for fruit ripening

Temperature- 18 to 25o C

Relative humidity- 90 to 95%

Ethylene concentration- 10 to 100 ppm

Biosensor is a compact analytical device incorporating a biological or biologically derived sensing element either associated or integrated within a physicochemical transducer (Fig.1). The usual aim of such a device is to produce either a discrete or continuous digital electronic signal that is proportional to a single analyte or a related group of analytes present in a sample (Compagnone *et al*., 1995).

Principle of Biosensor

Usually, a specific enzyme or preferred biological material is deactivated by some of the usual methods, and the deactivated biological material is in near contact to the transducer. The analyte connects to the biological object to shape a clear analyte which in turn gives the electronic reaction that can be calculated. In some examples, the analyte is changed to a device which may be connected to the discharge of gas, heat, electron ions or hydrogen ions. In this, the transducer can alter the device linked converts into electrical signals which can be changed and calculated.

Analytical chemistry (Compagnone *et al*., 1995) plays an important role in food quality parameters because almost every sector of industry and public service relies on quality control. A food quality biosensor is a device, which can respond to some property or properties of food and transform the response(s) into a detectable signal, often an electric signal. This signal may provide direct information about the quality factor(s) to be measured or may have a known relation to the quality factor (Finn, 2003).

Description

The application of biosensors in the medical diagnostics market has been highly successful. However, their potential success in the food, agriculture, veterinary diagnosis and environmental market is still to be established. Biosensor systems which are relatively small, portable instruments, have an on-site application and relatively inexpensive are desirable in the agro/food analysis. A vast amount of research is being undertaken in diagnostics companies and research institutions to develop biosensor technologies for the agricultural diagnosis sector.

However, moving the technology to the market place faces many challenges. For a developed biosensor to be successful it must compete with the fairly well established chemical, DNA and immunoassays techniques. The future holds much promise, but lies in addressing niche markets and changing requirements in complex systems. Fruit maturity at harvest is the most important factor that determines shelf life and final fruit quality. If harvested immature then fruits are more subject to shrivelling and mechanical damage, and are of inferior quality when ripe, whereas overripe fruits are liable to become soft and mealy with bland flavor soon after harvest (Kader, 1999; 1992). Therefore, fruits harvested either too early or too late in their season are more susceptible to post harvest physiological disorders than fruits harvested at proper maturity. Fruits can be divided into two groups:

1. Fruit that are incapable of enduring their ripening process once picked from the plant like berries, cheery, citrus fruits, grapes, lychee, pineapple, pomegranate, and tamarillo.

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2. Fruits that can be harvested mature and ripped off the plant like apple, apricot, avocado, banana, cherimoya, guava, kiwifruit, mango, nectarine, papaya, passion fruit, pear, peach, persimmon, plum, quince, sapodilla, sapote (Kader, 1999;1992). Volatile compounds are responsible for the characteristic aroma of fruits and are present in extremely small quantities (<100< g/g fresh wt.). The major volatile formed is ethylene. Scientists are trying to develop portable instruments with sensors that detect volatile production by fruits and hence detecting maturity and quality. Other strategies include the removal of a very small amount of fruit tissue and measurement of total sugar or organic acid content (Seymour *et al*., 1993).

Biosensors in plant biology

Revolutionary new technologies in the areas of DNA sequencing and molecular imaging, have led to advancements in plant science. Traditional methods of mass spectroscopy for gauging insights into cellular and subcellular localization, and measure of ion and metabolite levels had unprecedented precision but lacked the key information regarding location and dynamics of enzyme substrates, receptors and transporters. However, this information can be easily successfully tapped using biosensors. To measure a dynamic process under physiological conditions, we need to device tactics to visualize the actual process, for instance, the conversion of one metabolite into another or triggering of signalling events. This visualization can be done by sensors which respond dynamically.

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Paradigm shift of youngsters outlook enhancing agricultural revenues

Article id: 21694

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Youth man in agriculture
Is going to help us to fight against hunger
A country's health depends large on farming
Development also depends on farming
Food we eat come from farming so let us rise up, the business of farming
The business of farming
Here me all youth I say……………….
Youth man in agriculture
Is going to help us to fight against hunger
If all people were to work in offices and guess what; none of us in farming
If all people were to live in big cities where will the food we eat come from??
Here me all youth I say…………………
Youth man in agriculture
Is going to help us to fight against hunger

An appealing song written and performed by the Mega Fame Foundation from Ghana rightly describes the need of agriculture worldwide. With the advancement of technologies, though we can know the whole universe, our man made satellites may count more than the natural ones, we can travel in space, trains can run at the speed of bullets, can make virtual projections of a distant person and many more, but still to fulfill hunger of tummy we need food only.

It's miserable to imagine that in India, an agricultural country, the image of agriculture among people is not good. Agriculture is the biggest sector in India but still the sector and its workforce are not valued. When it comes to selecting livelihood sources, agriculture is disrated to the last position. Agriculture is considered as a back- breaking labor with little room for career advancement and so an unattractive way of employment. Farmer wants to educate their children so that they can break free from the family occupation and choose other careers. According to census 2011, everyday 2000 farmers give up farming. The present situation raises big questions- who will farm tomorrow?? Who will carry forward the primary livelihood activity?? The 2015, UNO report says by 2050 world population will become 9.1 billion and to feed the extra people we will require 70% extra food. So what will satisfy the hunger of 9.1 billion humans?? Is the supreme creation of God going to die due to starvation???

The average age of Indian farmers is 50.1 (Agriculture Census Division 2016). Increasing age of farmers affects agricultural growth by making it uncertain and unpredictable and leading to a phenomenon called as persistence of "uneconomic cultivators". Nearly half of India's population works in agriculture. But it contributes less than a fifth of India's GDP. In other words, it has very poor operational efficiency. Ironically, the youth of this country have high energy levels—we comprise 65 per cent of the population. The ever increasing unemployment in the country keeps the brilliant brain unused. When used in a right way agriculture can be proved as a goldmine for

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entrepreneurs as the young brain-power can do better application of innovations.

The educated, tech friendly and pre-visionary youth of India upon having the understanding of prevailing conditions- soil health, rainfall patterns, cropping cultures, water harvesting, post harvest management, value additions, market savvy etc can take agriculture many levels higher. Time needs white-collar farmers with good management strategy, risk assessment skills and proper knowledge of agri-business so making agriculture more than cultivation and advancing it to the industrial level. The globalization and Google era provides youth the opportunity to be more integrated with foreign techniques of production.

The changing climate alarms towards change in agriculture system too. We need to select crops according to the weather and soil health conditions. It is difficult to be understood by the aged and uneducated farmers who from generations to generations are cultivating the same crop and practicing the same age old agriculture pattern. Lot has been done by extension workers to bring inventions from lab to field but still the rate of adoption is very slow among farmers. Hence, we need innovation acceptable batches in farm. At the time when agriculture sector has ability to provide job for people from different fields like engineering, management, etc, the agriculture students are diverting from their mother field and searching job in other sectors is quite disappointing.

But there is another side of coin also where agriculture students, from Maharashtra and Punjab, have taken up farming as profession and are using proper seeds, machinery and agro-management techniques. It's a big responsibility of agriculture students to contribute their knowledge, brain and hard work with positive spirit to improve the dwindling condition of agriculture.

New generation agriculture- more than subsistence farming

Agriculture in the 21st century means more than subsistence farming. Today, young people can explore career options in permaculture design, biodynamic farming, communication technologies, forecasting, marketing, logistics, quality assurance, urban agriculture projects, food preparation, environmental sciences, and much more. Permaculture designing is gaining popularity in abroad and it id demand of time also when we need a balanced equation with the Mother Nature.

Terrace farming can be practiced even in big cities and forced cultivation of vegetables in off-season under protected cultivation can be much economic too.

Lots of fruit, vegetables and grains get destroyed in lack of proper storage and market accessibility. So, managing cold storage is also a profitable business.

Increased access to education and new forms of agriculture-based enterprise has ability to empower the youth to be a vital force for innovation in family farming, increasing incomes and well-being for both farmers and local communities.

Role of research industries towards attracting youth in agriculture

The agricultural sector offers enormous prospective for employment creation and communicating this to youth can radically change their image of agriculture. The research industries are playing key role in attracting youngsters. Companies like Monsanto of Bayer group, working in agriculture field, are hiring agriculture students and providing handsome remunerative too. The companies are doing

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their best to tie the knot between agriculture and technology. Mathematical revolution in agriculture is paving its way to boost farm productivity by enriching the farmers with the knowledge of the best time to plant crops by looking at historical data and using simulation models to make informed choices based on current conditions, right time to take plant protection measures .This mathematical revolution can give power to the whole agriculture supply chain to make informed decision about the judicious and smart use of resources. The sensing revolution brings the advanced sensor technology in agriculture that can enable a real- time understanding of the field situation may it be amount of water required for irrigation for the current crop stand or the probable reasons behind the crop stress , even the fertilizer requirements and their fixation and solubilization rates. So on one note taking care of plant, soil health and judicious use of resources promotes environmental health too.

So we can say that researches are changing the format of agriculture and making it much smoother. Uplifting agriculture from the laborious, tedious but still marginal economic status to a level where putting science and technology into new generation agriculture can deliver a step change in yields and making agriculture a game of brain.

Role of government

Farmers, businesses, policymakers, and educators need to promote agriculture as an intellectually stimulating and economically sustainable career while making jobs in the agriculture and food system attractive to youth.

When we see the land holding statistics of post independence, we find ever increasing number of small and marginal farmers. Their reducing profit from farm and increasing debt are putting them in situation to either quit farming or to do suicide. So government's concern is highly needed towards the situation.

At present, only a few crops get a Minimum Support Price (MSP) guarantee from the government. This has created a vicious cycle. Farmers are growing the same crops every season to sustain their livelihoods. It is time to break this cycle and think beyond this stunted vision. The government must assure MSP for other crops as well. This will encourage the youth to take up farming without bothering about the market risks. Attractive loan schemes will go a long way in strengthening the hands of the farmer. Farmers must also be provided with proper insurance policies as we are already in the middle of a climate change era. Cutting edge agricultural machine technologies are expensive. Government agencies should enable the farmer to rent such equipment so that they save money in investment and increase productivity. Farmers need handholding to embrace digitalisation.

Inspiration from global initiatives

In Africa One Acre Fund is helping small scale farmers by distributing feed and fertilizer on credit, offering training, and facilitating market access. By 2020, they hope to not only represent Africa's largest network of smallholder farmers but to also provide services to at least 1 million farming families.

In Iowa, the Practical Farmers of Iowa's beginning farmers' program helps families transition their farm to beginning farmers by writing business plans, facilitating access to capital, providing marketing education, offering online seminars, on-farm field days, and more.

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The International Fund for Agricultural Development Rural Youth Talents Program in South America is working for establishing and strengthening networks of youth involved in food and agriculture.

U.S. Department of Agriculture has announced to redesign their policy and resources to improve the financial security of new and beginning farmers and ranchers, including a new online portal that will be a one-stop resource where farmers can explore the variety of USDA initiatives designed to help them succeed.
Such a motion has to be started in India also.

We have started but we need a long way to go

Young and educated brainpower who can put developmental research into practice to incentivize productive investment in small farm businesses. Such investment will foster benefits in a two-fold way. Firstly, with the presence of forward-looking young entrepreneurs, the system, otherwise characterized by declining number of supernormal profit earning middlemen, is bound to become more centralized. Secondly, with the decline of swindling middlemen, the incentive structure will favor the actual farm owners to put in more effort and thereby earn higher profits. Young entrepreneurs would also bring with them advanced knowledge of production, thereby striving to get closer to the frontiers of technological advancement.

Abhishek Singhania, an Iitian who left his money-spinning job abroad to become a natural farmer at a village near Kolkata, studied the shortfalls of farming, the reasons behind the poor production and himself got involved in farming to make a smoother road to success for our farmers.

Shashank kumar and manish kumar, two Iitians from bihar, left their white collar jobs to give worth to the muddy, laborious hands of farmer. They studied the gap between growers and consumers and to mitigate it They decided to focus on educating farmers about soil quality, crop selection and marketing of their products. the duo launched their pilot project in Chakdharia village in Vaishali district. the two formed an advisory team, which has scientists from IIT Kharagpur, Rajendra Agricultural University, Pusa, Bihar Agricultural University, Sabour (Bhagalpur) and thankfully it helped in convincing farmers. they convinced farmers to select crop baesd on soil condition and farmers profile. Their initiative of growing rajma instead of wheat turned to be 100% fruitful. Now their farm and farmers- a farming solution company is connected with more than 1000 farmers, growing crops of consumers choice and upto their quality standard and even exporting to other countries and fetching higher profit.
Various charitable societies like Pingalwada charitable society, Amritsar run agriculture farm and became source of income and inspiration for many.

Mr. Nitai Chandra Hazari, an agriculture officer, West Bengal, who not just studied agriculture but lived and worshiped it. After retirement from the job instead of living the rest of his life smoothly with pension money, he has dreams to do more in agriculture field. In collaboration of seed corporation he is working to grow certified seeds. He has also planned to open nursery and provide job to others. Late Pankaj Jha, district information officer, Munger understood the importance of role of youth in agriculture, learnt the new techniques and while doing his noble service, managed to do mushroom cultivation and veggies production under green house.
Such persons are really inspiration to us .They not just learn the technologies but imply themselves too.
Apps like 'Gramophone' developed by 4 IIT, IIM , passed outs are helping farmers by providing solutions related to agronomy and agriculture market.

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CONCLUSION

Government schemes and various advances in agriculture can only be successful when the young brains get involved in it with a positive attitude. Dairy Entrepreneurship Development Scheme, Capital Investment Subsidy Scheme for commercial production units for organic/ biological inputs, agriclinic and agribusiness centres scheme, national livestock mission etc are many governmental schemes that can be utilized properly to give our contribution to the noble occupation of agriculture.

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Birds damage and management

Article id: 21695
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INTRODUCTION:

Birds are known to play an important role in pollination, putting a check on pesky insects and rodents, could also be causing drastic decrease in crop yields by destroying them, is emerging concern in Indian agriculture. Wide varieties of arable crops attract granivorous birds which lead to significant damage to the crop yields globally [1,2]. However, there are few studies pertaining to the awareness of the problem among the farmers and the magnitude of crop damage caused by the birds in India [3]. The problem of crop damage by birds is faced by the farmers and the losses due to crop depredation by birds are significant in terms of the gross crop yield. Birds can inflict damage to the crops and a loss to the farmers in all the stages of crops right from sowing and planting till harvesting [4]. Birds are known to cause considerable economic damage to variety of crops during vulnerable stages in different agro-ecological regions of the country. The extent of bird damage to any crop depends on several factors like concentration of local bird population, total area under the crop, cropping pattern habitat of the area, season and physiological status of the birds. It was identified 63 bird species of birds, 1,364, from 19 families that caused damage to several crops. A whopping 52 bird species attacked cereals, pulses got attacked by 14 bird species, while oilseeds faced damage risk by 15 species and fruits by 23 species. They also caused damage to the crops of smaller grains such as pearl millet and sorghum as well as maize. Among these, the Grey Partridge, Blue Rock Pigeon and House Sparrow were found to inflict most damage to crops. Other species include the Rose ringed parakeet, weavers, munias and doves that manage to nest in close proximity to agricultural fields. Moreover, bird damage was found to be more in isolated, early or late maturing fields, varied between regions, seasons, number of species, their density, concentration of migrants and their food habits.

Nature of Damage

- The pigeons and crows inflict the damage at the germination and seedling stages.
- The birds pick up the seed from the field after the post sowing irrigation and feed on the soaked seeds which were in the process of germination.
- They also pluck out on the developing young seedlings.
- At the flowering stage, the Rose ringed parakeets infest the inflorescence and feed on the anthers and pollen grains
- At milky stage when they split and strip away the covering bracts thereby exposing the grain for easy feeding and further damage
- This type of feeding is continued till the panicles/spikes/head reach dough stage. Damage by crows starts at this stage and they completely remove the spathes and eat the grains

Lethal methods

Lethal methods involve killing of birds, shooting, trapping, fumigation, poison baiting, egg and nest destruction, etc. In past, lethal methods were extensively used to control bird pests in India and elsewhere because killing

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was considered to be the surest way of getting rid of harmful birds. Killing of any bird species is now illegal in India and also not approved by the public. In view of the above facts, lethal methods of bird management are not recommended these days.

In India, as a common remedy to the problem, attempts are regularly being made by the famers to reduce crop losses from birds by deploying measures for control of birds either through traditional means or by using bird scaring techniques, devices, and pesticides.

Table 1: Traditional and conventional bird scaring techniques deployed by farmers in India.

Techniques	Reference
The white cloth banging	Kiruba et al. (2006) [5]
Chemical bird repellents are like trimethacarb, methiocarb, and curb	Bruggers et al. (1986) [6]
Killing and catching of birds	Singh and Dungan (1955) [7]
Methiocarb (4 methylthio) 3,5-xylyl-N-methyl carbamate, and Thiram	Sandhu (1987) [8]
Poisonous chemical	Bhatnagar (1976) [9]

Most of the farmers were not satisfied with the conventional bird scaring techniques being used by them due to their less effectiveness and non-reliable nature and as it requires continues hard work and more man power. The techniques like use of chemical repellent, net, spike guards, shooting the birds with gunshot, and making loud noise by bursting fire crackers in order to scare birds are either costly or lethal. Farmers believed that present traditional techniques are not effective enough to control this loss and they also expressed the need for sustainable techniques which can replace the traditional bird scaring techniques and help them to reduce their loss more effectively in a sustainable way. Traditional methods are like "trial and error method," and bird species become habitual for such techniques and hence they did experience "scaring" from such techniques for longer time. It was also observed during field visits that birds were not afraid of bird scaring devices and it was also a common experience of farmers. Lethal techniques may be an effective solution to the problem but by killing birds we may be destroying one of the important bio-indicators in the nature.

(a) (b) (c)

Fig 1. (a)House Crow (b) Baya Weaver (c) Rose-ringed Parakeet feeding on sorghum millets

More damage was inflicted in interior as compared to edges in the sorghum and pearl millet crops, as birds like the longer crop plants for secure feeding .The foraging activities of cropland bird species like House Crow have caused more damage to wheat, while pigeons and doves cause damage to pearl millet and sunflower. Also, the parakeets and crows were found to inflict more damage to the crops than what they actually consumed. They carried parts of kernels of the Jowar with them and then fed on the grains. But, while feeding on the grains in this way, a major portion of the kernel with the grains falls down. A maximum loss is recorded to the sorghum crops by sparrows, weaver birds, and parakeets that accounts to 52% (Figure 1). Pigeons damaged 42% of the peas crop (chick peas and pigeon peas) while sparrows and weaver birds damaged the groundnut crop by 26% in the sampling plots. ([10] . The maximum damage to the pearl millet and sunflower was caused by sparrows and weaver birds.

CONCLUSION:

Actual damage assessments of common crops indicate that Sorghum was the most affected crop due to depredation followed by pearl millet and combined chick peas and pigeon peas crops. The sustainable solution for reducing loss of crop is a need of the farmers and also such techniques will help to avoid direct or indirect effects of use of lethal bird control techniques on avian species. Though the area for this study was limited, it reveals the trends of agricultural loss due to birds. The problem of crop depredation should be study in larger agricultural area of the country and more concrete damage estimation should be done. Future work should focus on designing a sustainable solution by developing ecofriendly bird crop-specific and bird-specific scaring techniques to minimize crop depredation due to birds for improving the crop yields.

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Role of siderophores in biological control

Article id: 21696

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INTRODUCTION

Biological control of plant pathogens has been the subject of much research in recent years. It can potentially help us limit the use of chemical pesticides that are harmful to the environment. The use of plant growth-promoting rhizobacteria (PGPR), such as siderophore-producing bacteria, represents a potentially attractive alternative disease management approach, since they have the capacity to increase yield and protect crops simultaneously. Few organisms like *Pseudomonas fluorescens*, *P. putida* are a special group of organisms which are widely used as bio control agents.

Siderophores is a Greek word means "iron carrier”. They are small, high-affinity iron chelating compounds secreted by micro organisms such as bacteria, fungi and grasses . Siderophores are amongst the strongest soluble Fe^{3+} binding agents known.Siderophores usually form a stable, hexadentate, octahedral complex with Fe^{3+} . Kloepper et al.(1980) were the first to demonstrate the importance of Siderophores.

The scarcity of soluble iron

Iron is essential for almost all life for processes such as respiration and DNA synthesis. Despite being one of the most abundant elements in the Earth’s crust, the bioavailability of iron in many environments such as the soil or sea is limited by the very low solubility of the Fe3+ ion. This is the predominant state of iron in aqueous, non-acidic, oxygenated environments. It accumulates in common mineral phases such as iron oxides and hydroxides (the minerals that are responsible for red and yellow soil colours) hence cannot be readily used by organisms. Microbes release siderophores to scavenge iron from these mineral phases by formation of soluble Fe3+ complexes that can be taken up by active transport mechanisms. Many siderophores are nonribosomal peptides, although several are biosynthesized independently. Siderophores are also important for some pathogenic bacteria for their acquisition of iron. In mammalian hosts, iron is tightly bound to proteins such as hemoglobin, transferrin, lactoferrin and ferritin. The strict homeostasis of iron leads to a free concentration of about 10^{-24} mol L^{-1},hence there are great evolutionary pressures put on pathogenic bacteria to obtain this metal. For example, the anthrax pathogen *Bacillus anthracis* releases two siderophores, bacillibactin and petrobactin, to scavenge ferric iron from iron proteins. While bacillibactin has been shown to bind to the immune system protein siderocalin, petrobactin is assumed to evade the immune system and has been shown to be important for virulence in mice. Siderophores are amongst the strongest binders to Fe3+ known, with enterobactin being one of the strongest of these. Because of this property, they have attracted interest from medical science in metal chelation therapy, with the siderophore desferrioxamine B gaining widespread use in treatments for iron poisoning and thalassemia. Besides siderophores, some pathogenic bacteria produce *hemophores* (heme binding scavenging proteins) or have receptors that bind directly to iron/heme proteins. In eukaryotes, other strategies to enhance iron solubility and uptake are the acidification of the surroundings (e.g. used

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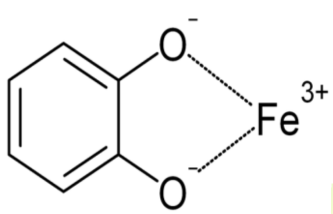
by plant roots) or the extracellular reduction of Fe3+ into the more soluble Fe2+ ions.

History of Siderophores

- The role of microbial siderophores in virulence to plant hosts was first demonstrated for the bacterial pathogen *Erwinia chysanthemi which produces the* catecholate chrysobactin and the carboxylate achromobactin
- *Erwinia amylovora synthesizes* the hydroxamate desferrioxamine and mutants defective in desferrioxamine biosynthesis show tissue-specific reduced virulence.

Structure

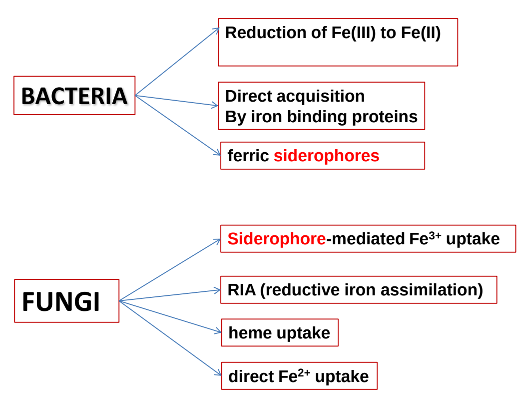


Siderophores usually form a stable, hexadentate, octahedral complex preferentially with Fe3+ compared to other naturally occurring abundant metal ions, although
if there are fewer than six donor atoms water can also coordinate. The most effective siderophores are those that have three bidentate ligands per molecule, forming a hexadentate complex and causing a smaller entropic change than that caused by chelating a single ferric ion with separate ligandsFe3+ is a hard Lewis acid, preferring hard Lewis bases such as anionic or neutral oxygen atoms to coordinate with. Microbes usually release the iron from the siderophore by reduction to Fe2+ which has little affinity to these ligands. Siderophores are usually classified by the ligands used to chelate the ferric iron. The major groups of siderophores include the catecholates (phenolates), hydroxamates and carboxylates (e.g. derivatives of citric acid). Citric acid can also act as a siderophore.The wide variety of siderophores may be due to evolutionary pressures placed on microbes to produce structurally different siderophores which cannot be transported by other microbes' specific active transport systems, or in the case of pathogens deactivated by the host organism.

Role of siderophores in controlling plant pathogens

To satisfy nutritional requirements of iron, microorganisms have evolved highly specific pathways that employ low molecular weight iron chelators termed siderophores._Siderophores are secreted to solubilize iron from their surrounding environments forming a complex ferric-siderophore that can move by diffusion and be returned to the cell surface. Siderophores can chelate ferric ion with high affinity its solubilization and extraction from most mineral or organic complexes.__In aerobic conditions at physiological pH, the reduced ferrous (Fe^{2+}) form is unstable._Fe^{2+} is readily oxidized to the oxidized ferric (Fe^{3+}) form.Fe^{3+} occurs as a poorly soluble iron hydroxide basically unavailable to biological systems.

MECHANISM OF IRON ACQUISTION



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Types of siderophores

- Hydroxamate,
- Catecholate and
- Carboxylate

Hydroxamate

Hydroxamate group-bearing siderophores are mainly synthesized by fungi and Gram-positive filament-forming bacteria (streptomycetes). In fungal systems the hydroxamic acid chelating group is commonly derived from acylated *N*δ-acyl-*N*δ-hydroxy-L-ornithine.

Catecholate

Each catecholate group provides two oxygen atoms for chelation with iron so that a hexadentate octahedral complex is formed as in the case of the hydroxamate siderophores. Linear catecholate siderophore are also produced in certain species.

Agrobactin and parabactin are produced by *Agrobacterium tumefaciens* and *Paracoccus denitrificans* respectively.

Carboxylate

The best characterized carboxylate type siderophore with a novel structure is rhizobactin. Rhizobactin is produced by *Rhizobium meliloti* strain DM4 and is an amino poly (carboxylic acid) with ethylenediaminedicarboxyl and hydroxycarboxyl moieties as ironchelating groups. Staphyloferrin A, produced by *Staphylococcus hyicus* DSM20459, is another member of this class of complexon siderophores.

Mechanism of siderophores in bio control of plant pathogens

- Siderophores produced by a microorganism can bind iron with high specificity and affinity, making the iron unavailable for other microorganisms; thereby limiting their growth.
- Competition for iron by siderophore production is an important antagonistic trait found in many of the bacterial bio control agents against plant pathogens.
- Microbial siderophores may stimulate plant growth directly by increasing the availability of iron in the soil surrounding the roots or indirectly by competitively inhibiting the growth of plant pathogens with less efficient iron-uptake systems.

CONCLUSION: Siderophore system constitutes a key position in Iron- homeostasis in many plant pathogens. The role of siderophores in Iron homeostasis depends largely on the pathogen-host system. Siderophore system affects growth, oxidative stress resistance as well as asexual and sexual development. Common virulence determinant, at least in some plant pathogenic fungi and bacteria. Modulates plant defense through an antagonistic mechanism between SA & JA signaling cascade.

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Plant nutrients, deficiency symptoms and control measures for increasing the productivity in pulses: approach towards doubling the farm income for small farmer's

Article id: 21697

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INTRODUCTION

Plants need the right combination of nutrients for growth, and as an external supply for its internal metabolism. Plant nutrients or nutritional elements can be any mineral taken up by the plants. Plant nutrition is not only essential for plant growth and survival, but a balanced nutrient solution also aids for maximizing the yield, improving crop quality and the nutritional value of the plant itself. The rocks and minerals on weathering release nutrients into the soil. The most important part of the soil with respect to plant nutrition is the colloidal fraction which consists of inorganic colloids (clay) and organic colloids (Humic substances). Nutrient toxicity is less common than deficiency and most likely occurs as a result of over-application of fertilizer or manure. Nutrient deficiency occurs when an essential nutrient is not available in sufficient quantity to meet the requirements of a growing plant. The nutrient supply is gradually depleted by absorption of nutrient ions by plant roots and continuously replenished by desorption of exchangeable ions on the clay-humus complex and break down of readily decomposable organic debris. Plant contains more than 90 elements in which, 17 elements are known to be essential which are classified as macronutrients and micronutrients, based on their relative abundance in plants. The following nutrients which are essential for plant growth and reproduction are; Carbon (C), Hydrogen (H), Oxygen (O_2), Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulphur (S), Iron (Fe), Manganese (Mn), Molybdenum (Mo), Copper (Cu), Chlorine (Cl), Boron (B), Zinc (Zn) and Nickel (Ni). Although there are eight trace elements considered to be essential for higher plants, Fe, Zn, Mn, Cu, Ni, B, Mo, and Cl. Possibly, other elements will be discovered to be essential because of recent advances in nutrient solution culture techniques and in the commercial availability of highly sensitive analytical instrumentation for elemental analysis. Common nutrient deficiencies in India are nitrogen (N), phosphorus (P), with some deficiencies of potassium (K), sulfur (S), boron (B), chloride (Cl), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn). Micronutrient deficiencies are fairly uncommon with deficiencies of B, Cl, Fe and Zn occurring most often. The present article will be a valuable source of information for students engaged in various applications of nutrient deficiency and its management.

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Objectives

- Identify and diagnose common plant nutrient deficiency and toxicity symptoms and to know potential limitations of visual diagnosis.
- Understand how to use a key for identifying deficiency symptoms.
- Distinguish between mobile and immobile nutrient deficiencies.

Plant Nutrient Deficiency Terminology

1. **Burning:** Severe localized yellowing; scorched appearance.
2. **Chlorosis:** General yellowing of the plant tissue; lack of chlorophyll.
3. **Generalized:** Symptoms not limited to one area, rather spread over the entire plant.
4. **Immobile nutrient:** Not able to be move from one part to another part.
5. **Interveinal Chlorosis:** Yellowing in between leaf veins, yet veins remain green.
6. **Localized:** Symptoms limited to one leaf or one section of the leaf.
7. **Mobile nutrient:** Able to be moved from one plant part to another.
8. **Mottling:** Spotted, irregular, inconsistent pattern.
9. **Necrosis:** Death of plant tissue; tissue browns and dies.
10. **Stunting:** Decreased growth; shorter height of the affected plants.

Table.1 Nutrients and Function in Plants

S.No	Functions	Nutrients
1.	Essential Nutrients	Carbon (C), Hydrogen (H), Oxygen (O_2), Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulphur (S), Iron (Fe), Manganese (Mn), Molybdenum (Mo), Copper (Cu), Chlorine (Cl), Boron (B), Zinc (Zn) & Nickel (Ni).
2.	Primary Nutrients	Nitrogen (N), Phosphorus (P) and Potassium (K).
3.	Secondary Nutrients	Calcium (Ca), Magnesium (Mg) and Sulphur (S).
4.	Macro Nutrients	Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg) and Sulphur (S).
5.	Micro Nutrients	Iron (Fe), Manganese (Mn), Molybdenum (Mo), Copper (Cu), Chlorine (Cl), Boron (B), Zinc (Zn) and Nickel (Ni).
6.	Functional Nutrients	Essential Nutrients + Cobalt (Co), Vanadium (V), Silicon (Si) and Sodium (Na).
7.	Beneficial Nutrients	Ruthenium (Ru), Strontium (Sr), Nickel (Ni), Chromium (Cr) and Arsenic (As).
8.	Energy Exchange	Hydrogen (H) and Oxygen (O_2).
9.	Translocation Regulator	Calcium (Ca), Magnesium (Mg), Potassium (K) & Sodium (Na).
10.	Oxidation Reduction	Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Boron (B) and Cobalt (Co).

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Table.2 Symptoms Caused Due to Deficiency of Nutrients in Plant

S.No	Deficiency of Nutrients	Causes/Symptoms
1.	Nitrogen (N)	Buttoning in Cauliflower.
2.	Calcium (Ca)	Cavity spots in carrot.
3.	Copper (Cu)	Dieback and little leaf in citrus, Reclamation disease in cereals.
4.	Boron (B)	Internal necrosis in aonla, jackfruit, Browning in cauliflower.
5.	Zinc (Zn)	Little leaf in brinjal, Bronzing in guava, Bunchy disease in peacan nut, White bud in maize, Khaira disease in paddy.
6.	Manganese (Mn)	Water core in Brassica, Marsh spot in pea, Spotted yellow disease in sugarbeet.
7.	Molybdenum (Mo)	Yellow spot disorder in citrus, Whip tail in cauliflower.

Table.3 Antagonistic Effect of Different Nutrients

S.No	Excess of Nutrients	Causes Deficiency
1.	N, P & K	Cu
2.	P	Fe, Zn & Cu
3.	N, K & Ca	B
4.	K & NH_4	Mg
5.	Ca	P
6.	Ca & Mg	K
7.	Fe & SO_4	Mo
8.	Zn & Al	Cu
9.	Zn, Mo, Cu & No_3	Fe
10.	B	Mo

Table.4 Indicator Crop Species for Various Deficiencies

S.No	Deficient Elements	Indicator Crop
1.	Nitrogen	Maize, Mustard and Minor Millets
2.	Phosphorus	Maize and Barley
3.	Potassium	Maize, Potato, Tobacco, Lucerne and Beans
4.	Calcium	Lucerne and Legumes
5.	Magnesium	Potato, Maize, Oats, Wheat, Peas and Beans
6.	Sulphur	Lucerne, Raya
7.	Iron	Sorghum and Barley
8.	Boron	Sunflower and Lucerne
9.	Molybdenum	Oats and Brassica spp.
10.	Cobalt	Oats, Maize and Tobacco
11.	Sodium	Sugarbeet

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I. Pulses

1. Pigeon Pea/Red Gram (*Cajanus cajan*)

a. Nitrogen (N) Deficiency

Visible Symptoms:

The deficient plants appear stunted, thin, spindle, grain head size and numbers of pods per plant are severely reduced. Young leaves uniformly become pale-green, greenish-yellow or pale yellow. Old leaves show an inter-veinal chlorosis and only veins remain green, leaves soon shed.

Control Measures/Remedies

Apply organic manures, nitrogenous fertilizers and apply (2% urea) as foliar spray.

b. Phosphorus (P) Deficiency

Visible Symptoms:

Phosphorous deficiency is difficult to diagnose, deficient plants appear dark green, stunted, thin and have delayed maturity and plants are stunted, foliage remains dark-green, shedding of old leaves and delays flowering.

Control Measures/Remedies

Apply organic manures, Phosphatic fertilizers and apply soluble P fertilizers such as ammonium phosphate with irrigation water.

c. Potassium (K) Deficiency

Visible Symptoms:

Potassium deficiency causes dwarfing of plants, reduced branching and loss of healthy, green growth. Leaf tips turn yellow to brown. The yellowing spreads from the tip outward along the margin and leaf tip becomes scorched as symptoms become severe.

Control Measures/Remedies

Apply KCl and K_2SO_4 to the soil before sowing according to soil test recommendations.

d. Calcium (Ca) Deficiency

Visible Symptoms:

Deficient plants appear stunted, with short stems; seed yields are drastically reduced. Light-green patches, irregular in outline, appear randomly around the leaf margin. Patches may turn brown, particularly on young and severely affected leaves; such leaves are shed and weak.

Control Measures/Remedies

Apply Calcium containing fertilizers before planting, use soluble nutrient amendment and fertilizer sources such as gypsum ($CaSO_4$-$2H_2O$), Ca $(NO_3)_2$.

e. Sulphur (S) Deficiency

Visible Symptoms:

Symptoms appear before flowering stage. At the further stage old leaves turn yellow and necrotic which suppress branching, leaf size and flowering. Flowers lack normal pigmentation and abort prematurely, which finally leads to poor pod formation and poor development of seeds.

Control Measures/Remedies

Application of 20 kg ha^{-1} sulphur in coarse and 40 kg ha^{-1} in fine soils.

f. Zinc (Zn) Deficiency

Visible Symptoms:

Stunted growth, narrow leaves with pale green to yellow with inter-veinal chlorosis starting from tip of leaflets and spreading to

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the remaining area except midribs of the leaves.

Control Measures/Remedies

Deficiency can be corrected by application of materials containing Zinc. Foliar application of zinc sulphate (0.5% + 0.25% lime) is advised. Apply zinc sulphate 25 kg ha^{-1} for good results.

2. Chickpea/Bengal Gram (*Cicer aeritinum*)

a. Sulphur (S) Deficiency

Visible Symptoms:

Sulphur deficiency are seen when crops are grown in calcareous soils. Young plants first turn pale and then chlorotic. Chlorosis starts from the leaf margins and spread towards the midrib. Tips of young leaves become necrotic and flowers lack normal pigmentation and abort prematurely.

Control Measures/Remedies

Sulphur deficiency can be reduced by the addition of 10 kg elemental sulphur per hectare in sandy loan soils. The increased in uptake of nitrogen and phosphorus leads to higher seed yield of chickpea.

b. Zinc (Zn) Deficiency

Visible Symptoms:

The zinc deficiency symptoms include yellowing of upper one third parts of the leaflets and turn light yellow colour. Gradually turn pinkish to reddish brown colour. Bronzing and necrosis are observed, Leaflet size decreases and plants are stunted with less branches.

Control Measures/Remedies

The deficiency can be corrected by applying zinc sulphate to the foliage or soil. Apply 25 kg zinc sulphate in light soils once in 5 years.

c. Manganese (Mn) Deficiency

Visible Symptoms:

Manganese deficiency develops 2 months after germination in deficient soils. Symptoms are chlorosis on the apical margin of leaflets and curling inwards. The size of leaf is reduced and young leaves may develop purpl discoloration.

Control Measures/Remedies

Apply manganese sulphate @ 5-15 kg ha^{-1}.

3. Greengram (*Vigna radiata*)

a. Sulphur (S) Deficiency

Visible Symptoms:

Short internodes, stunted growth, and lateral branches look bushy appearance. The length of petiole is reduced; leaf margins curl inward and turn necrotic.

Control Measures/Remedies

In sulphur deficient soils use SSP. Apply 20-40 kg sulphur ha^{-1} for better results.

b. Zinc (Zn) Deficiency

Visible Symptoms:

Symptoms appear 2 weeks after germination. Necrotic spots (brown) at the tip of cotyledon leaves appear. The brown spots appear on older leaves and later affect entire leaves get shed.

Control Measures/Remedies

If zinc deficiency is noticed in standing crop then 0.5% foliar spray of $ZnSo_4$ is recommended thrice at an interval of 10-15 days. Apply $ZnSo_4$ @ 25 kg ha^{-1} in light soils and 50 kg ha^{-1} in heavy soils once in 3-4 years for getting better results.

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c. Boron (B) Deficiency

Visible Symptoms:

The symptoms are very similar to Zinc deficiency. Symptoms are dull yellow colour develops in the interveinal portions of older leaves.

Control Measures/Remedies

Boron tolerant varieties should selected. Apply borax @ 5 kg ha^{-1}. If deficiency is noticed in standing crop then 0.5% foliar spray of borax is recommended twice at an interval of 10-15 days.

4. Blackgram (*Vigna mungo*)

a. Calcium (Ca) Deficiency

Visible Symptoms:

Light-green patches, irregular lines on the leaf, appear randomly around the leaf margin. Patches may turn brown, particularly on young leaves and severely affect leaves; such leaves are week and finally die.

Control Measures/Remedies

Apply Ca-containing fertilizers well before planting using soluble nutrient amendment and fertilizer sources such as gypsum ($CaSO_4 \bullet 2H_2O$).

b. Sulphur (S) Deficiency

Visible Symptoms:

Stem is thin and woody, elongation of internodes is limited, leaf size is small, paling and chlorosis of young leaves, Chlorosis starts from tip of leaves and spread to margins.

Control Measures/Remedies

Apply 20-40 kg Sulphur per hectare depending upon the soil type and for light soils 20 kg ha^{-1}. Apply Sulphur in the form of Gypsum and SSP.

c. Zinc (Zn) Deficiency

Visible Symptoms:

Mature trifoliate leaves develop irregular light pinkish white tissue in between the veins after 25-30 days. Margins turning upward forming a cup shape and followed by brown-orange chlorosis on the leaves often show necrotic spots. Leaf size is reduced, thick and brittle.

Control Measures/Remedies

If zinc deficiency is noticed in standing crop then 0.5% foliar spray of $ZnSo_4$ is recommended thrice at an interval of 10-15 days. Apply $ZnSo_4$ @ 25 kg ha^{-1} in light soils and 50 kg ha^{-1} in heavy soils once in 3-4 years.

d. Boron (B) Deficiency

Visible Symptoms:

The symptoms are very similar to Zn deficiency symptoms. Light yellow colour develops in the interveins of older leaves.

Control Measures/Remedies

Apply borax @ 5 kg ha^{-1}. If deficiency is noticed in standing crop then 0.5% foliar spray of borax is recommended twice at an interval of 10-15 days during pre flowering and pod filling stage for good seed set.

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CONCLUSION

Nutrient deficiencies confirmed that reduced crop growth, improper crop health and productivity to be decreased and may result in the appearance of unusual visual symptoms. Understanding each essential nutrient's role and mobility in the plant can help determine which nutrient is responsible for a deficiency symptom. As a diagnostic tool, visual observation can be limited by various factors, including hidden hunger and pseudo deficiencies, therefore soil or plant testing will be required to identify nutrient stress in the plant. This article will be helpful to researcher, students and farmers to understand the nutrient deficiency symptoms and its adverse effect on growth, yield and quality of the crops. It will also give the information regarding preventive and control measure for various deficiencies in major cereals, pulses and oilseeds Similarly it also helps to increase the crop production by proper nutrient management to meet the daily food requirement & to supply adequate amount of carbohydrates, protein, vitamin & minerals requirement in terms of nutritional security to farming community. Since the findings are based on the research done by various researchers in different scope. Still advanced research has to be carried out for further improvement in the results.

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Nutrients deficiency symptoms and control measures in oilseed crops: an approach towards increasing the productivity for doubling the farm income of small and marginal farmer's

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INTRODUCTION

Plant contains more than 90 elements in which, 17 elements are known to be essential which are classified as macronutrients and micronutrients, based on their relative abundance in plants. The following nutrients which are essential for plant growth and reproduction are; Carbon (C), Hydrogen (H), Oxygen (O_2), Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulphur (S), Iron (Fe), Manganese (Mn), Molybdenum (Mo), Copper (Cu), Chlorine (Cl), Boron (B), Zinc (Zn) and Nickel (Ni). Although there are eight trace elements considered to be essential for higher plants, Fe, Zn, Mn, Cu, Ni, B, Mo, and Cl. Possibly, other elements will be discovered to be essential because of recent advances in nutrient solution culture techniques and in the commercial availability of highly sensitive analytical instrumentation for elemental analysis. Common nutrient deficiencies in India are nitrogen (N), phosphorus (P), with some deficiencies of potassium (K), sulfur (S), boron (B), chloride (Cl), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn). Micronutrient deficiencies are fairly uncommon with deficiencies of B, Cl, Fe and Zn occurring most often. Plant nutrition is not only essential for plant growth and survival, but a balanced nutrient solution also aids for maximizing the yield, improving crop quality and the nutritional value of the plant itself. The rocks and minerals on weathering release nutrients into the soil. The most important part of the soil with respect to plant nutrition is the colloidal fraction which consists of inorganic colloids (clay) and organic colloids (Humic substances). Nutrient toxicity is less common than deficiency and most likely occurs as a result of over-application of fertilizer or manure. Nutrient deficiency occurs when an essential nutrient is not available in sufficient quantity to meet the requirements of a growing plant. The nutrient supply is gradually depleted by absorption of nutrient ions by plant roots and continuously replenished by desorption of exchangeable ions on the clay-humus complex and break down of readily decomposable organic debris. The present article will be a valuable source of information for students engaged in various applications of nutrient deficiency and its management.

Objectives

Identify and diagnose common plant nutrient deficiency. Understand how to use a key for

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identifying deficiency symptoms and control measures for the deficiency symptoms.

Oilseeds

1. Groundnut (*Arachis hypogea*)

a. Potassium (K) Deficiency

Visible Symptoms:

The deficiency occurs in light soils especially when N and P alone are applied without FYM. Leaves of deficient plants do not grow normally and appear irregular in shape and in matured leaves instead of normal uniform green colour, there is yellowish green colour, spreading from the leaf apex along the leaf margins to middle of the leaf. But the vein remains normal.

Control Measures/Remedies

Apply muriate of potash equivalent to 40-60 kg K_2O ha^{-1}

b. Calcium (Ca) Deficiency

Visible Symptoms:

Tender parts of stem and roots are damaged and growth remains stunted. Depressions can be observed on tender leaves and on under surface of the leaves and tender leaves are curled up.

Control Measures/Remedies

Apply 500 kg of gypsum ha^{-1} at peg formation stage, which can correct both calcium & sulphur deficiency.

c. Sulphur (S) Deficiency

Visible Symptoms:

Young plants are smaller than normal. Young leaves appear small and yellowish-green. Due to erectness of the petiole, the leaflets are seen in the form of 'V'. Reduction in number of root nodules lowers the N fixation leading to chlorotic appearance of leaves. Plant growth is also stunted.

Control Measures/Remedies

Apply super phosphate @ 500 kg ha^{-1} at planting or pegging stage.

d. Iron (Fe) Deficiency

Visible Symptoms:

The deficiency mostly occurs in calcareous soil or when water containing high bicarbonate and carbonates are used for irrigation. Interveinal chlorosis occurs initially due to deficiency of iron.

Control Measures/Remedies

Spray 5g ferrous sulphate along with 1g citric acid per litre of water, at weekly intervals till deficiency symptoms disappear.

e. Zinc (Zn) Deficiency

Visible Symptoms:

The deficiency occurs in light and calcareous soil with water containing high bicarbonate and carbonate ions. Zinc deficient leaves appear small with short internodes and rosette.

Control Measures/Remedies

Soil application of $ZnSO_4$ @ 50 kg ha^{-1} to prevent deficiency. Spray $ZnSO_4$ 2 g/lit of water, 2-3 times at weekly intervals.

2. Sunflower (*Helianthus annus*)

a. Sulphur (S) Deficiency

Visible Symptoms:

The plants show yellowing of leaves. Overall growth of the plant is retarded. Number and size of leaves is reduced. Size of capitulum is severely restricted and Maturity of flower is delayed.

Control Measures/Remedies

Application of 25 kg S ha^{-1} increases seed yield by

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38%. An average increase of 3.8 % in the oil content of seeds due to S application. Sulphur 10 kg ha^{-1} increase seed yield and oil content.

b. Manganese (Mn) Deficiency

Visible Symptoms:

The deficiency symptoms are entire lamina become mottled and the interveinal chlorotic areas develop light brown irregular necrotic patches.

Control Measures/Remedies

Application of manganese sulphate at the rate of 5-15 kg ha^{-1}.

c. Copper (Cu) Deficiency

Visible Symptoms:

Copper deficiency symptoms appear as inter-veinal chlorosis on older leaves starting from the tip of the leaf. Chlorotic areas develop dark brown necrotic, which spreads along the margins towards the base of the leaf.

Control Measures/Remedies

Application of copper sulphate at the @ 10-20 kg ha^{-1}.

d. Boron (B) Deficiency

Visible Symptoms:

The symptoms are very similar to zinc deficiency symptoms. Light yellow colour develops in the interveins of older leaves. Poor development of head and size of the seeds are reduced.

Control Measures/Remedies

Apply borax should be applied at the rate of 3-8 kg ha^{-1}.

e. Molybdenum (Mo) Deficiency

Visible Symptoms:

Molybdenum deficiency in sunflower is characterized by pale green foliage, interveinal and marginal chlorosis of old leaves and inward curling of leaf margins of the young leaves giving them a "cupped" appearance.

Control Measures/Remedies

Application of sodium molybdate at the rate of 300-800 g ha^{-1}.

3. Sesamum (*Sesamum indicum*)

a. Sulphur (S) Deficiency

Visible Symptoms:

The growth of the plant is stoped; leaf size is reduced and fully emerged young leaves turn pale yellow. If severe deficiency continues, the young leaves and flowers shed prematurely.

Control Measures/Remedies

Apply fertilizers containing sulphur to the soil. In case of sulphur deficient soils an application of 40-60kg ha^{-1} sulphur is recommended.

b. Zinc (Zn) Deficiency

Visible Symptoms:

Middle leaves show inter-veinal discoloration of the basal part and necrosis along the apical margins followed by the appearance of small buff coloured irregular areas. Leaves may also show curling of margins and reddish brown pigmentation in the inter-veinal areas.

Control Measures/Remedies

Spray 0.2 % zinc sulphate solution 2-3 times at weekly intervals.

c. Copper (Cu) Deficiency

Visible Symptoms:

Growth of plant is depressed from the seedling stage. Apical part of the young and middle leaves of plants turns chlorotic. Chlorosis on the apical part of the leaves becomes severe and spreads to

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the interveinal areas, which later develop light brown pigmentation.

Control Measures/Remedies

Spray 0.2% copper sulphate solution 2-3 times at weekly intervals.

d. Boron (B) Deficiency

Visible Symptoms:

Boron deficient plants appear severely stunted within two weeks. Later, depression due to boron deficiency becomes very marked and plants show death of the apical bud of the shoot which leads to development of several auxiliary branches. Leaves are thick and brittle and the size of the leaves is reduced. Pod formation and seed development are severely reduced.

Control Measures/Remedies

Spray 0.1-0.2 % borax or boric acid solution at weekly intervals.

e. Molybdenum (Mo) Deficiency

Visible Symptoms:

Plants develop yellowing and scorching of margins of old leaves. Yellowing gradually spreads to the interveinal areas which become dry and papery. Leaves show downward curling. Symptoms gradually spread to middle and young leaves. Deficient plants do not bear pods.

Control Measures/Remedies

Application of sodium molybdate at the rate of 300-800 g ha^{-1}.

4. Mustard & Rapeseed (*Brassica spp*)

a. Sulphur (S) Deficiency

Visible Symptoms:

Leaves show paling that starts the margins and spreads inward. As deficiency persists, leaves become yellow (Chlorotic) and/or develop purple pigmentation. The lamina of young leaves also curls inward giving these leaves a cupped appearance. Eventually, the lamina becomes scorched and withered. Flowering is delayed, symptoms spread from young to middle leaves, flowers lack normal pigmentation, pods are borne on short peduncle and their development is restricted.

Control Measures/Remedies

Apply fertilizers containing sulphur to the soil. In case of sulphur deficient soils an application of 40-60 kg ha^{-1} sulphur is recommended.

b. Iron (Fe) Deficiency

Visible Symptoms:

Deficient plants may develop chlorosis of young leaves at four leaf stage. Chlorosis starts from the base and spreads towards the apical part of the lamina. In case of severe deficiency, leaves become bleached and puckered. Flowering, pod number and size of pods is reduced.

Control Measures/Remedies

In case of iron deficiency, 0.5% ferrous sulphate as foliar sprays as 3-4 times at weekly intervals.

c. Zinc (Zn) Deficiency

Visible Symptoms:

Deficiency symptoms appear after 20 days of sowing, the first true leaf is also affected. Leaves are small in size with pinkish margin. Interveinal tissues turn yellowish to papery white, while veins remaining green and stunted. Upward or downward cupping of leaves are observed.

Control Measures/Remedies

Application of 20-25 kg ha^{-1} of zinc sulphate overcomes zinc deficiency. Zinc deficiency can be

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corrected by foliar application of 0.5 per cent zinc sulphate with staked lime (0.25 per cent).

d. Manganese (Mn) Deficiency

Visible Symptoms:

Apical part of the middle leaves of manganese deficient plants develop chlorosis, which later extends towards the base covering the entire inter veinal area. Eventually, severely chlorotic areas develop small grayish-brown spots which coalesce to form large necrotic lesions.

Control Measures/Remedies

Spray 0.2-0.3 % manganese sulphate 2-3 times at weekly intervals.

e. Copper (Cu) Deficiency

Visible Symptoms:

Young leaves develop interveinal chlorosis. Chlorotic areas later turn papery and necrotic. Growth of plants is also reduced which is more pronounced at the time of flowering and thereafter. Inflorescence is very poorly developed and large percentage of the floral buds of the plants withers before opening. Pod formation and seed setting are also reduced.

Control Measures/Remedies

Spray 0.2 % copper sulphate solution 2-3 times at weekly intervals.

f. Molybdenum (Mo) Deficiency

Visible Symptoms:

Mustard is very susceptible to molybdenum deficiency. Growth is markedly reduced and plants develop foliar symptoms like cupping, marginal scorching and loss of lamina.

Control Measures/Remedies

Apply Molybdenum based fertilizers like Sodium Molybdate. Application of ammonium molybdate @ 500 g ha^{-1}.

CONCLUSION

Understanding each essential nutrient's role and mobility in the plant can help determine which nutrient is responsible for a deficiency symptom. As a diagnostic tool, visual observation can be limited by various factors, including hidden hunger and pseudo deficiencies, therefore soil or plant testing will be required to identify nutrient stress in the plant. This article will be helpful to researcher, students and farmers to understand the nutrient deficiency symptoms and its adverse effect on growth, yield and quality of the crops. It will also give the information regarding preventive and control measure for various deficiencies in major cereals, pulses and oilseeds.

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Some physiological disorders of Apple (*Malus spp.*) and their management

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INTRODUCTION

Physiological or a-biotic disorders are mainly caused by changing environmental conditions such as temperature, moisture, unbalanced soil moisture, inadequate or excess of certain soil minerals, extremes of soil pH and poor drainage. The distinction between physiological or abiotic disorders from other disorders is that they are not caused by living organisms (viruses, bacteria, fungi, insects, etc.), but they are the result of abiotic situations (inanimate)i.e. their agents are non living in nature which causes deviation from normal growth. They results in physical or chemical changes in a plant which is far away from what is normal and is generally caused by an external factor. Non-infectious disorders in some cases are easy to identify, but others are difficult or even impossible to recognize.

1) Scald

Symptoms: Light mottling on greener surface of fruits are initial symptoms of scald. Irregular brown patches of dead skin develop within 3-7days due to warming of the fruit after removal from the cold storage. Scald usually affects the skin only but in severe cases it may extend to fruit flesh.

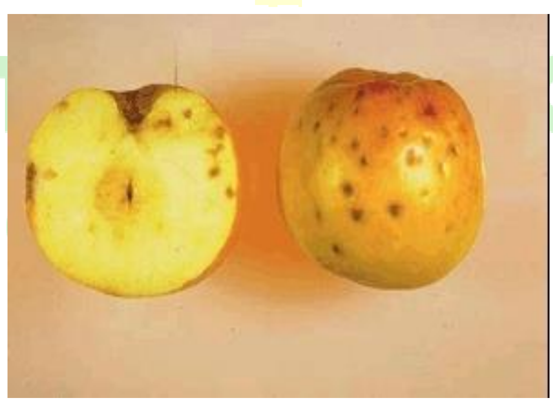
Causes

- Hot and dry weather before harvest.
- Immature fruit at harvest.
- High N and low Ca concentrations in the fruit.
- Inadequate ventilation in storage rooms or in packaging boxes.

Control

- Application of an antioxidant immediately after harvest.
- Spray of $CaCl_2$ (2-3%) two weeks before harvest is very effective.
- Harvesting at proper maturity and ventilation in cold storage helps in reducing the scald.

Scald



Bitter pit

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2) Bitter pit

Symptoms: Small brown lesions of 2-10mm in diameter (depending upon the cultivar) develop in the flesh of the fruit. Bitter pit is characterized by small sunken spots on the fruit surface which are more prevalent near the blossom end. The tissue below the skin becomes dark and corky. At the initial stage small water soaked areas appears which after loss of water shrink and turn brown and ultimately become brown and corky due to the dead tissue.

Causes

- Nutrient imbalance particularly low level of Ca which impairs the selective permeability of cell membranes leading to cell injury and necrosis.
- Heavy dose nitrogenous fertilizers as it results in lowering the soil pH or inducing excessive vigour.
- Earle and over thinning of fruits increases bitter pit.
- Irregular water supply.
- Harvesting of immature fruit, as early picked fruit tends to develop more bitter pit.
- Excessive shedding and heavy pruning as severe dormant pruning would result in a light crop and large fruit.
- **Control**
- Avoiding excessive doses of nitrogenous fertilizers.
- Thinning of fruits should be done judiciously.
- Annual bearing.
- Harvesting mature fruits.
- Maintaining moderate tree vigour and smaller fruit size.

3) Internal browning (Brown heart)

Symptoms: Internal browning is characterized by brownish streaks radiating into flesh from the core. These brown areas have well defined margins and may include dry cavities resulting from desiccation. Symptoms can range from a small spot of brown flesh to nearly the entire flesh being affected in severe cases.

Causes

- Large and over mature harvested fruits generally have greater susceptibility to internal browning.
- Injury incidence and severity increase with increasing concentration of CO2 in the storage atmosphere.

Control

- Avoid harvesting over mature fruit.
- Harvest at the optimum maturity, especially for controlled atmosphere storage.
- Maintain CO2 concentrations below 1% in controlled atmosphere storage and air storage.
- Assure good air circulation in storage rooms to prevent formation of higher CO2 concentration pockets.
- Avoid heavy coatings and thoroughly and rapidly cool fruit after waxing and packaging.

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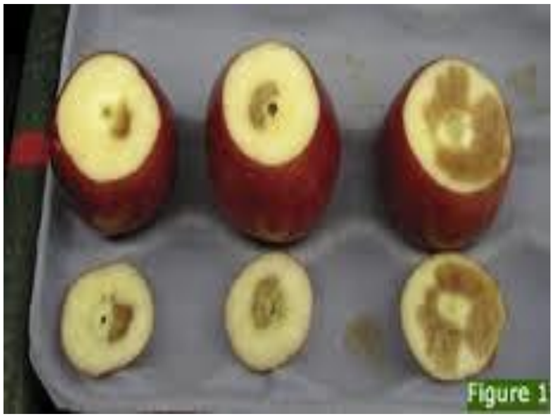

Internal browning (Brown heart)


Fruit drop

4) Sunburn

Symptoms: Initial symptoms are white, tan or yellow patches on the fruits exposed to the sun. With severe skin damage, injured areas of the fruit can turn dark brown before harvest. These areas may become spongy and sunken.

Causes

- Sunburn occurs when air temperature and the number of sunny hours are high during the ripening period.
- Sunburn also occurs when cool or mild weather is abruptly followed by hot, sunny weather.
- Sudden exposure of fruit to high temperatures and intense sunlight promotes sunburn.
- A gradual increase in temperature and solar radiation is another reason.
- Water stress can increase the incidence of sunburn.

Control

- Proper tree training and pruning practices should be followed.
- Summer pruning must be carefully done to avoid excessive sunburn.
- Pruned orchards should be regularly irrigated to reduce heat stress.
- Careful sorting to remove affected fruit upon packing is the only solution once the injury has occurred.

5) Fruit drop

Symptoms: Fruit drop is a complex phenomenon which occurs due to large number of factors like variety, tree aspect, environmental conditions, nutritional condition of the plant, number of developing fruits, number of seeds in the developing fruits and hormonal imbalance particularly auxin. In apple it is a very serious problem and the magnitude of the problem can be realized by the fact that in apple hardly 1% flowers take their fruits to maturity and others drop at different stages.

Control

- The soil condition and disturbed water relations can be checked by maintaining soil moisture through irrigation and mulching.
- The pre harvest fruit drop can be checked conveniently with the application of 10ppm NAA before the expected fruit drop or 20-25days before harvest. Application of 2, 4-D has also been found to reduce pre-harvest fruit drop effectively.

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CONCLUSION:

Physiological disorders are often caused by the deficiency or excess of something that supports life or by the presence of something that interferes with life. Factors responsible for physiological disorders such as relative humidity, atmospheric conditions, wind injury, chemical injury, physical soil problem, nutrient deficiency or excess, etc.

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Agriculture investment and outcome in India

Article id: 21700

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INTRODUCTION

Agricultural science has always played a critical role in economic progress in both developed and developing economies. Through agricultural R&D, welfare improvement has been realized in the form of lower food prices to domestic population, improved nutrition, expansion in rural employment, agricultural exports and enhanced level of foreign exchange, competitiveness of agricultural commodities in the world markets and strong growth linkages with rest of the economy. During the green revolution period, adoption of new technologies has helped to improve the income distribution across income classes. Governments in response to Montague–Chelmsford Reform (1919). When the country got independence, in the efforts to develop country's agriculture, promotion of agricultural R&D was considered as the most important one. The agricultural review team chaired by Dr M.W. Parker of USDA (1963) suggested far-reaching changes in organization and management of agricultural research in the country.

Constant policy assumptions are used through the forecast period. This includes meeting current U.S. ethanol and biodiesel mandates. EU biofuel targets are not reached despite the European Commissions insistence that penalties will be assessed on countries which do not reach the 10 percent target. The experience of the EU biofuel industry, current subsidies, and barriers to higher biodiesel and ethanol blends make reaching the target extremely difficult even if generation 2 feedstock technologies were economical.

All these efforts culminated in the development of agriculture as a modern sector along with rest of the economy and agriculture emerged as key sector. This paper highlights the research, confronts faced and the benefits that was taken place in Indian agriculture.

Indian Agriculture- A Brief

Over 55 per cent of the rural households depend on agriculture as their principal means of livelihood. Agriculture, along with fisheries and forestry, is one of the largest contributors to the Gross Domestic Product (GDP). Indian policymakers have created one of the largest agricultural R&D systems in the world. The knowledge and technologies generated by investment in R&D was primarily responsible for the green revolution and achieving food security for the huge population. Despite success of green revolution, India still houses one-fourth of the world's hungry and poor and 40 per cent of the world's malnourished children and women. India is the largest producer, consumer and exporter of spices and spice products. India's fruit production has grown faster than vegetables, making it the second largest fruit producer in the world. India's horticulture output, is estimated to be 287.3 million tonnes (MT) in 2016-17 after the first advance estimate. It ranks third in farm and agriculture outputs. Agricultural export constitutes 10 per cent of the country's exports and is the fourth-largest exported principal commodity. The agro industry in India is divided into several sub segments such as canned, dairy, processed, frozen food to fisheries, meat, poultry, and food grains.

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The Department of Agriculture and Cooperation under the Ministry of Agriculture is responsible for the development of the agriculture sector in India. It manages several other bodies, such as the National Dairy Development Board (NDDB), to develop other allied agricultural sectors.

Market Size:

India's GDP is expected to grow at 7.1 per cent in FY 2016-17, led by growth in private consumption, while agriculture GDP is expected to grow above-trend at 4.1 per cent to Rs 1.11 trillion (US$ 1,640 billion).$ As per the 2nd Advance. Estimates, India's food grain production is expected to be 271.98 MT in 2016-17. Production of pulses is estimated at 22.14 MT. India's exports of basmati rice may rise to Rs 22,000-22,500 crore (US$ 3.42-3.49 billion), with volume to around 4.09 MT in 2017-18, backed by a rise in average realizations. Wheat production in India is expected to touch an all-time high of 96.6 MT during 2016-17.and 152 MT Aprox during 2017-18. Groundnut exports from India are expected to cross 700,000 tonnes during FY 2016-17 as compared to 537,888 tonnes during FY 2015-16, owing to the expected 70 per cent increase in the crop size due to good monsoons. India's groundnut exports rose to 653,240 MT during April 2016-February 2017.@ India's export of grapes to Europe and China are expected to increase by 10 to 20 per cent this year on back of higher production on account of good monsoon and higher demand due to competitors such as Chile shifting focus to US market. Spices exports from India grew by 9 per cent in volume and 5 per cent in value year-on-year to 660,975 tonnes and US$ 1.87 billion respectively, during April-December 2016.

Investment:

According to the Department of Industrial Policy and Promotion (DIPP), and ICAR datas the Indian agricultural services and agricultural machinery sectors have cumulatively attracted Foreign Direct Investment (FDI) equity inflow of about US$ 2,315.33 million from April 2000 to December 2016-17.

Some major investments and developments in agriculture are as follows:

A. India and Brazil have signed a bilateral investment agreement, aimed at enhancing cooperation in areas of agriculture, cattle genomics, ship building, pharmaceuticals, defence production, ethanol production and oil and gas, between the countries.
B. Zephyr Peacock, the India-focused private equity fund of US-based Zephyr Management, has invested an undisclosed amount in Bengaluru-based potato seeds firm Utkal Tubers India Pvt Ltd, which will be used to produce high-quality mini-tubers in a tissue culture laboratory and multiply them in its own development farms and through supervised contract farming in different regions of the country.
C. Mahindra Agri Solutions Ltd (MASL), a unit of Mahindra & Mahindra Ltd, has agreed to purchase 60 per cent stake in OFD Holding BV, a Netherlands-based fruit distribution company, for Rs 36 crore (EUR 5 million), which will provide MASL access to European and Chinese markets for Indian grapes.

Government Initiatives

Given the importance of the agriculture sector, the Government of India, in its Budget 2017–18, planned several steps for the sustainable development of agriculture-

The participation of women in Mahatma Gandhi National Rural Employment Gurantee Act

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(MGNREGA) has increased to 55 per cent and allocation to the scheme has been increased to a record Rs 48,000 crore (US$ 7.2 billion) for FY2017-18. Short-term crop loans up to Rs 300,000 (US$ 4,500) at subsidised interest rate of 7 per cent per annum would be provided to the farmers. An additional incentive of 3 per cent is provided to farmers for prompt repayment of loans within due date, making an effective interest rate for them at 4 per cent.

Some of the recent major government initiatives in the sector are as follows:

A. The Government of Karnataka plans to invest around Rs 1 trillion (US$ 15.1 billion) for developing irrigation projects across the state to mitigate the impact of deficient rainfall and resulting drought on agriculture in recent years.

B. The Government of India and the Government of Israel have expressed their commitment to further strengthen bilateral relations in the field of agriculture and allied sectors, as well as enhance cooperation at the government-to-government and business-to-business levels between the two countries, in a bid to further enhance the relationship.

According to the Agriculture Ministry, 50,000 hectares of area is available for coconut cultivation in Bihar, and some other state the Coconut Development Board plans to equip the farmers thus making India the world leader in production, productivity, processing for value addition and export of coconut.

CONCLUSION

The agriculture sector in India is expected to generate better momentum in the next few years due to increased investments in agricultural infrastructure such as irrigation facilities, warehousing and cold storage. Factors such as India is expected to be self-sufficient in pulses in the coming few years due to concerted efforts of scientists to get early-maturing varieties of pulses and the increase in minimum support price.

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Karonda: Low cost cultivation fruit crop

Article id: **21701**

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Botanical name: *Carissa carandas* L,
Common name: Karonda, Karmada, Karvanda; Kaunda, Kalivi; Natal plum.
Family: Apocynaceae

General description:

Karonda is a small to big shrub usually 2-4 m tall. The stem is rich in white latex and the branches contain sharp spines.Its flowers are white and the smell of flowers is similar to a juvenile, with white colour. Its fruits are rounded, with small raw white flashy on ripe and red. The fruit is globose to broad ovoid in shape and contains many seeds. The crude fruits, white and red, are elliptical and violet and red in color, and when the cutting of beautiful and raw fruits is found, the milk substance comes out. At maturity fruit color vary from white, green and pinkish. red depending on the genotype.

Important uses

- Pickled crude gooseberry is very good. It's used to burn wood.
- There is also luxurious granite, which is found in Indian gardens. Its fruit is a bit bigger and beautiful in seeing. There are some headlines on this. This is done more in the work of pickle and chutney.
- Eating of fruit powder gives relief in stomachache. Karonda increases hunger, relaxes bile, stops thirst and closes diarrhea. Especially for the petty squads, it is very beneficial.
- Drinking dry juice of Karonda leaves is beneficial for dry cough.
- In Patalkot crushing the roots of tribal Karonda with water and coating on the body after fever and in the summer it is found in the lungs and after having diarrhea or diarrhea, its fruit juice is cooked and given instant relief.
- The powder of the fruit of korunde is very beneficial for the complaint of sour dakar and acid bile; According to the tribals, this powder increases appetite, calms the bile.

Table – 1 Food and nutritional value of *Carissa carandas* fruit

Components	values
Total acids	9 to 11 mg per 100 g.
Total Protein	0.39-0.66 g %
Total crude fat	2.57-4.63 g %
Fibers	0.62-1.81 g %
Carbohydrate	0.51-0.94 g %
Sugar	7.35-11.58 g %;
Iron	150 mg %
Calcium	115 mg %
Phosphorus	66 mg %
Energy (kcal/g)	338-342/lb calories (745-753/kg)
Ash	0.66-0.78 g %
Moisture	83.17-83.24 g %

Origin and distribution:

There are many species of karonda in the world, like *C. carandas* and *C. spinarum* are native to India while *C. grandiflora* is native to South Africa. *C. carandus* is also grown in Sri Lanka, Myanmar, Thailand and Peninsular Malaysia. In India it is found wild in the Western Ghats, Konkan area of Maharashtra and throughout the semi-arid regions. It is widely cultivated in the home gardens, farmer's fields and orchards as hedge plant and occasionally few plants are grown for commercial purpose.

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Carissa species has been of much socio-economic importance in the tribal area of Gujarat, Maharashtra, Rajasthan, and Madhya Pradesh.

Soil and Climate:

- It is a drought tolerant plant, thrives well throughout the tropical and sub tropical climates.
- Heavy rainfall and water logged conditions are not desirable.
- It can be grown in a wide range of soils including saline and sodic soils
- It can be grown also pH range from between 7.5 to 9.5.

Cultivars/selections:

In karonda no known cultivars have been developed, however, few selections based on location and quality of fruits has been identified. Some of the known selections are

PK-3- from Horticultural Research Station, GBPUAT, Regional Station Patharchatta

PK-4- from Horticultural Research Station, GBPUAT, Regional Station Patharchatta

Pant Manohar - This variety is developed from GB PUA&T Pantnagar (Uttarakhand) in 2007. The plants of this variety are medium– sized dense bushes, fruits are dark pink blush on white background and yield 30 kg / plant.

Pant Sudarshan- This variety is developed from GB PUA&T Pantnagar (Uttarakhand) in 2007. The plants of this variety are medium– sized dense bushes. Fruits are pink blush on white background. Average fruit yield 29 kg / plant.

Pant Suvarna- This variety is developed from GB PUA&T Pantnagar (Uttarakhand) in 2007. Plants are upright growing and sparse. Fruits are colour dark brown blush on green background. yield 25 kg / plant.

Maroon colored blush – This variety is developed from NDUAT Kumarganj (Faizabad),

White pink blush- This variety is developed from NDUAT Kumarganj (Faizabad) have been identified.

Propagation:

Karonda is usually propagated by seeds and seeds are to be sown immediately after extraction as longevity of seeds is short. Vegetative propagation is attempted using air layering, One year old seedlings are transplanted and air layering is done in the beginning of the monsoon.

Planting of planting:

Karonda planted in June when First monsoon shower in coming. Planting keep is. pits are dug of the dimension of 60cm X 60cm X 60cm at the distance 2m X 2m and mix the organic manure (FYM) and soil in 1:1 ratio. Most of the crops are grown as the hedge crop. In case of the hedge crops then the distance would be 1 – 1.5m.

Training and Pruning:

Regular plantations can be trained in single or double stem. Hence additional unwanted or die shoots or side branches are removed from time to time to give a desired shape to the plant. The normal height bearing plants does not require any pruning.

Manuring and Fertilization:

Protective hedge plants are hardly manured or fertilized. Manuring is beneficial; therefore 10-15kg of FYM (well rotten) should apply per year per plant, otherwise the growth of plants become week.

Irrigation

Karonda plant is a slow growing plant. Once the plant settled down into the soil and attained proper growth then there is no further irrigation is required beside the karonda behave like other plant because it is hardy plant, so it requires less irrigation.

Intercultural operations:

Hoeing is essential for removing the weeds and Suckers from the underground must be removed. Some seasonal vegetables can be

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intercropped in first 2 years of regular plantation.

Fruiting

Karonda start the bearing fruits between 2.5 – 3 years after transplanting. The fruits are developed in the month of mid January to February and fruit ripened in the month of August.

Harvesting and Yield

Fruits are harvested in raw stage as well as ripening stage fruits can be harvested is impossible at one time because all fruits are not ripen in one time. The harvesting is done 2-3 times. The change of colour white to pink or blue or red is the symptom of ripening of the fruit. Generally 5-6 kg karonda fruits yield is obtained from one tree.

CONCLUSION

Karonda is a forested and trendy pendant tree and does not require much care. The advantage of low cost is the promise of Karonde. Farmers can make profits by cultivating it or planting them around the farm. There is also a benefit from planting around the farm that farmers can also save their crops from animals

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Yellow Stem borer is Manophagous Pest of Rice and their Mangement

Article id: 21702

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INTRODUCTION

Rice (*Oryza sativa* L.), is the most important food crop of the global importance and the staple food for nearly half of the world population. Rice is life and princess among the cereals, the staple food of 65% of the total population in India. It constitutes about 52% of the total food grain production and 55% of total cereal production. India is the largest rice growing country, while China is the largest producer of rice. It is the most important crop of India and it occupies 23.3 per cent of gross cropped area of country. Rice contributes 43 per cent of total food grain production and 46 per cent per cent of total cereal production in India. It continues to play vital role in national food grain supply. Among the various insect-pests damaging the rice crop stem borer, gall midge, brown plant hopper and leaf folder are major in India. In India, approximately 100 insect-pests have been reported as pests of rice and 20 of these are considered to be major pests causing 30 per cent yield loss from seedling to maturity.

Among them yellow stem borer (*Scirpophaga incertulas* Walker) is the most destructive and widely occurring insect-pests of rice at all stages of the crop due to its monophagy to rice. Newly emerged larva enters into the stem for feeding on inner tissues at vegetative and reproductive stage of the crop results in formation of deadheart (DH) and white earhead

Host range:

It is a monophagous pest. However, some recent studies have shown that wild rice viz., *Ozyza rufipogon, O. nivara, O glberrima* and a grass weed can well sustain the borer throughout its development and have been considered as potential alternate host plants of this insect.

Damage of nature:

This is dominant and most destructive stem borer species in India. The extent of crop losses varies in time and space. It may cause 1-19 per cent yield loss in planted and 38-80 per cent in late planted of this insect.

The newly emerged larvae show a strong tendency to disperse. They move downwards and wander about on the plant surface. They can also be seen hanging down by a silken thread to be carried by the wind to adjacent rice plants. The survivors inter between the stem and leaf sheath and feed on green tissues of the leaf sheath. The caterpillars start boring on the stem, often at the nodal region and feed on the inner tissues of the plant. Often they leave the first tiller after a week and move in search of other plants by making cylindrical cases of rolled leaf tips in which they drift on the irrigation water. After finding a suitable host plant, the larvae bore in, leaving their cases sticking to the stem at right angles. Often these larval cases are confused with that of case worm. At vegetative stage, damage caused by the larvae produce dead heart which can be pulled out easily. In mature rice plants the caterpillars bore into the stalk at the top just below the earhead and cause white ear.

Mark of identification:

Adult moths often exhibit sexual dimorphism. The females are bigger than males and her fore wings are bright yellowish brown with a distinct

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black spot in the centre. The abdomen is wide, the tip being covered with tufts of yellowish hairs. the male moth is plae yellow with slender abdomen and anal end dorsally covered with thin hairs. Spots on the fore wings are not conspicuous. The eggs are creamy white, flattened, oval and scale like and covered with a tuft of anal hairs. They become darken to purplish tinge before hatching. Neonate larvae are pale yellow with dark brown prothoracic shield and orange head. The full grown sixth instar larvae are 25 mm long white or yellowish white and with a well divided prothoracic shield

Life cycle :

Female lay eggs in 2-3 days of her life span. The incubation period varies between 5-8 days. There are six instars which completed in about 30 days. Pupation takes place inside the stem after making an exit hole through which the adults emerges in 5-10 days. Life cycle is completed in 41-70 days and there are 4-6 generations in a year.

Natural enemies:

Trichogramma japonicum, Tetrastichus schoenobii and *Telenomus dignus* are important egg parasitoid of yellow stem borer.

Management:

- Summer ploughing and destruction of crop residues.
- Grow tolerant / resistant varieties like Mahsuri, Saket-4, Ratna, IR 36, IR 72 etc.
- Clipping of the tips of the seedling before planting helps in reducing the carry over of pest in eggs stage.
- Blaance use of fertilizers.
- Collection and destruction of moth during 5:30-7:0AM.
- Collection of egg masses and putting them to a bamboo cage cum percher.
- Release *Trichogramma spp.* @ 5000/ha/week for 6 week starting from 30days after transplanting.
- Spray Azadirachchtin 300ppm liquid 2% or / and Bt2.0 kg /ha at 5% dead or white ear appearance.
- Apply Fipronil 5 SC 50g/a.i./ha or cartap 4G 25 kg in 3-5 cm standing water or spray 2.5 litre chlorpyriphos 20 EC as and when either 5% dead heart or 1 egg mass at vegetative stage and 1 moth/ m square at panicle emergence to flowering stage is observed.

CONCLUSION

It is most dominant and destructive insect –pest. The extent of crop losses varies in time and space. It may cause 1-19 per cent yield loss in planted and 38-80 per cent in late planted of this insect. We can manage this pest use different types of steerage.

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King in the market of sweetener

Article id: 21703

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Most of High Intensity-Sweeteners (HIS) of distinct chemical structures are known to occur naturally. Consumer interest in natural HIS has grown dramatically in last decade, fuelled by concerns about the use of artificial additives in foods. Sweeteners (HIS) are sugar substitutes or sugar alternatives that provide sweetness without calories, since HIS entire are zero calorie and a hundred times sweeter than sucrose (table sugar). The use of HIS in foods, beverages, dietary supplements and pharmaceutical products is growing worldwide due to their many advantages, such as helping people to lose weight or prevent obesity, as well as assisting diabetics to control blood sugar levels. The sweeteners steviol, the diterpene glycoside (SGs) from Stevia rebaudiana Bertoni become the first in the race of natural HIS after Thaumatin, a protein from Thaumatococcus daniellii and Lo han guo a Glycoside from Siratia grosvenorii etc.

Stevia rebaudiana is commonly known as sugar leaf, belong to asteraceae family. The sweet herb Stevia is rapidly replacing the chemical sweetener like Splenda, Saccharine and Aspartame As these SGs are generally 150–400 times sweeter than sucrose. A total of more than 30 SGs are currently known to be produced in Stevia. SGs are synthesized from the glycosylation of steviol aglycone, which is derived from the methylerythritol phosphate (MEP) pathway. In stevia leaves there are two compounds viz. Stevioside(10%-20%) and Rebaudioside-A(1-3%). The extract of stevia Rebaudioside-A is around 300-400 times sweeter than normal sugar. The sweetness of stevia also felt for long time. The Stevioside is stable at 100 °C this is main advantage of Steviocide over other sweetener. A research report suggests rebaudioside A is less sweet than stevioside that may be a significant of the methodologies employed or due to the actual materials evaluated being mixtures of steviol glycosides rather

Fig.1. *Stevia rebaudiana*

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Table.1. Sweetness potencies of steviol glycosides.

Sl. No.	Compound	Relative sweetness[a]
1	Stevioside	300
2	Rebaudioside A	250-450
3	Rebaudioside B	300-350
4	Rebaudioside C	50-120
5	Rebaudioside D	250-450
6	Rebaudioside E	150-300
7	Dulcoside A	50-120
8	Steviolbioside	100-125

[a] Sweetness potency measured relative to 0.4% (w/v) sucrose. * Adapted from (Kim and DuBois, 1991)

Stevia crop has good potential in India

Most of the studies on Stevia leaves are focused on the plant growing parameters and its adaptation to different edapho-climatic zones. The medicinal and functional properties, such as antiviral and antibacterial capacities or antioxidant activity have also attracted much attention and interest, so that in published data complete and extensive research works on the extraction methods by all available technologies can be found. The plant was introduced at the University of Agricultural Sciences, Bangalore, during the late 1990s, and studies on its adaptability were initiated. Research focused on cultivation rather than crop improvement. Later, the Institute of Himalayan Bioresource Technology (CSIR), Palampur, introduced two accessions for domestication and cultivation in Himachal Pradesh. Along with cultivation, research has now been aimed at crop improvement through conventional breeding and biotechnological approaches.There is low risk in this crop. The investment in stevia is also tax free as it is agricultural product. The return also starts to come early. As it is perennial and planted for five years, the cost of plantation also reduces to one time in five years. There is high potential of return as compared to traditional crop. Stevia is been successfully cultivated in the recent years at many areas of Rajasthan, Maharashtra, Kerala, Tamil Nadu and Orissa. The increasing demands for natural sweeteners have driven the farmers in India for Stevia cultivation on large scale. One Hectare of *Stevia rebaudiana* cultivation would be sweetener equivalent to 36 Hectares of Sugar Cane. MDS-13, 14 are cultivated in India which can tolerate aberrant weather condition.SRB-123,512 and 128 are the unique variety having high total glucoside which are suitable for both southern as well as north Indian climates. On an average 2500 to 2700 of dried stevia leaves per acre can be harvested with good management practice.

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Table 2. Botany of stevia and its cultivation practices

Botanical Description		Agronomic Practices	
Characters	**Description**	**Characters**	**Description**
Name	*Stevia rebaudiana*	Temperature and pH of the soil	$15^{O}C$ -$30^{O}C$ 6.5-7.5
Family	asteraceae	Land preparation	A well drain red soil or sandy loam soil is required. The land sites are plowed twice to prepare a fairly smooth and firm-planting surface. Around 50 MT of FYM/ha has to be applied as a basal dressing during the last ploughing to incorporate the manure with the soil.
Shoot	The stem is annual, subligneous, more or less pubescent, 65 - 80cm tall	Water requirements	1800 mm yearly, Generally, one applies irrigation if the stem tips are drooping at least once per week.
Root	Root is fibrous, filiform, and perennial, forming abundant stock	Propagation	Stem cutting. Planting should be done at Feb to march of the year
Leaf	Leaves are small, sessile, lanceolate to oblanceolate, oblong, serate	Spacing	Stevia plants are planted into the field on 53 cm or 61 cm row spacing with a total plant density in the order of 100,000 plants per hectare.
Flower Structure	paniculate with the heads appearing opposite the bracts in irregular sympodial cymes. Length:15-17 mm	Microclimate	A height difference of 200m in the same region can result in considerable variations in climatic behavior.
pollen viability	65%	Fertilization	The plant has low nutrient requirements; however a soil test should be conducted. Under average condition application of FYM at a rate of 50 t /ha and fertilizers N-60 kg, P_2O_5 30 kg/ha and K_2O 45 kg/ha is recommended
Stigma	bi-lobed/bifurcated from the middle and style is surrounded by anthers	Weed control	This crop also requires hand hoeing and weeding.
Pollination Behaviour	insect pollinated	Harvesting	The first harvest of the crop can be in four months after planting and subsequent

			harvest once every 3 months. Some times 40 to 60 days after harvest are sufficient for subsequent harvests.
Photoperiod	short-day plant, two inductive short-day cycles are necessary for flowering induction	Drying	24 to 48 hours to dry stevia at 40º to 50ºC.
Seed	3 mm in length. seeds weight 0.3-1.0 g Seed yields of up to 8.1 kg/ ha	Yield	21,500 kg /ha of fresh or 6,000 kg/ ha dried leaf yield can be obtained

Stevia Extraction

The first stage in processing of Stevia leaves is by far the drying operation, commonly performed using solar energy. However, solar drying due to an intrinsic lack of systematic process control, often presents multiple disadvantages related to dried product quality, especially those aspects related to a deficient microbiological safety. In consequence, conducting research on dehydration of Stevia leaves is highly recommended. Drying by hot air is a very common and appropriate postharvest technology to extend shelf life of a product, preserving its quality and stability through reduction of moisture content. Furthermore, drying process also add value to food products and a proper management of the drying process, seen from an operational and capital investment point of view, can lead to a higher yield of a high quality product. The undesirable effects of hot-air drying can be reduced to a minimum through proper monitoring of appropriate control variables, such as air drying temperature, which favors improvement of the nutritional value of the food product. After that it was crushed to powder form which is greenish in color and can be used in a wide variety of foods and beverages, including coffee, applesauce and hot cereals. You also can use it to make an herbal tea blend. Its distinctive flavor is reminiscent of licorice, which will blend very well with different aromatic spices, such as cinnamon and ginger. This white powder is an extract of the sweet glycosides (natural sweetening agents) in the stevia leaf. Not all stevia extract powders are the same. The taste, sweetness and cost of the various white stevia powders will likely depend on their degree of refinement and the quality of the stevia plant used.

Stevia is safe or having side effects

Stevia glycosides, such as Rebaudioside -A, are “generally recognized as safe.” There’s concern that raw stevia herb may harm your kidneys, reproductive system, and cardiovascular system. It may also drop blood pressure too low or interact with medications that lower blood sugar. Although stevia is considered safe for people with diabetes, brands that contain dextrose or maltodextrin should be treated with caution. In some people, stevia products made with sugar alcohols may cause digestive problems, such as bloating and diarrhea. There’s some evidence to suggest that stevia may help fight or prevent some types of cancer. The glycoside called stevioside found in stevia plants helps boost cancer cell death in a human breast cancer line. Stevioside may also help decrease some mitochondrial pathways that help cancer grow. Stevia products made with Reb-A are considered safe, even for people who are pregnant or who have diabetes. Major global regulatory organizations including JECFA, EFSA, FDA and FSANZ have determined that high purity stevia extract is safe for consumption by the general population, which includes pregnant women when consumed within the recommended levels. These products rarely cause side effects. However, more research needs to be done to provide conclusive evidence on weight management, diabetes and other health issues. Whole-leaf stevia isn't approved for commercial use, but you can still grow it for home use. Despite a lack of research, many people claim whole-leaf stevia is a safe alternative to its highly refined counterpart or table sugar. Until research determines whether whole-leaf stevia is safe for everyone, get your doctor's approval before using it regularly, especially if you have a serious medical condition such as diabetes, heart disease, or high blood pressure. Improved genotypes with a high content of rebaudioside-A with respect to other glycosides (like stevioside) need to be developed, as the Food and Drug Administration has approved rebaudioside-A with 95% purity. Further research and development need to be carried out to improve stevia's potential as a crop by developing improved varieties with higher yield and quality.

Constrains and scope

Different steps need to be properly arranged to exploit the natural sweetness of stevia. Commercial industries should start financing the farmer for cooperative as well as precision farming with actual awareness about this herb stevia, the high quality calorie free bio sweetener. The Company should conduct training and education with customers on topics from formulation development to consumer insights. Giving the Group's high touch solution selling approach it carefully segments markets to prioritise its services to the highest priority opportunities. Since first being approved for use as a food ingredient in 2008, high purity stevia has shown strong growth in commercial cultivation. However, despite the growth achieved to date, stevia currently represents only a very small part of the total sweetener and flavor markets (less than 0.002 per cent of the global market) which suggests there is scope for significant further growth. The major problem of large-scale cultivation is the lack of quality planting material. Stevia is a self-incompatible plant, and seed-grown plants vary in their growth, quality and quantity of diterpene glycosides and desirable ratio of rebaudioside-A and stevioside, which restrict its cultivation from seed. Generally, plants with desirable characteristics are propagated by stem cuttings and tissue culture practices, which limits the large-scale production of planting material. The emphasis in future research should be on the development of new seed varieties with wider adaptability to different climatic conditions, better germination and viable seed production, better leaf: stem ratio and with a high content of rebaudioside-A compared with other glycosides for successful cropping and higher diterpene glycoside production.

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Systemic acquired resistance

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The systemic acquired resistance (SAR) is a "whole-plant" resistance response that occurs following an earlier localized exposure to a pathogen. SAR is analogous to the innate immune system found in animals, and there is evidence that SAR in plants and innate immunity in animals may be evolutionarily conserved.[1] Plants use pattern-recognition receptors to recognize conserved microbial signatures. This recognition triggers an immune response.

Infection of plants with "necrotizing" pathogens (causing HR) often results in enhanced resistance to subsequent infections by a variety of fungal, bacterial and viral pathogens. This physiological immunity was termed systemic acquired resistance (SAR).

SAR is important for plants to resist disease, as well as to recover from disease once formed. SAR can be induced by a wide range of pathogens, especially (but not only) those that cause tissue necrosis, and the resistance observed following induction of SAR is effective against a wide range of pathogens, which is why SAR resistance is sometimes called "broad spectrum." SAR is associated with the induction of a wide range of genes (so called PR or "pathogenesis-related" genes), and the activation of SAR requires the accumulation of endogenous salicylic acid (SA).

- SAR resistance is sometimes called "broad spectrum".

SAR is also induced by certain synthetic chemicals-

1) Salicylic acid,
2) 2,6-dichloroisonicotinic acid(INA)
3) Benzo (1,2,3) thiadiazole-7-carbothioic acid-5-methyl ester.(BTH)
4) Arachidonic acid

Other chemicals:

- Jasmonic acid, primarily derived from oxidation of fatty acids, that leads to systemic acquired resistance, often in cooperation with salicylic acid and ethylene, leading to the production of defenses.
- Probenazole-Synthetic chemical used in Asia for the control of bacterial pathogen in tomato.. i.e.., *Pseudomonas syringae pv. tabaci* and *tobacco mosaic virus in tobacco.*
- Riboflavin- showed to induce systemic acquired resistance but it activates in a distinct manner not involving salicylic acid. Such chemicals may be effective in inducing resistance in plants when they are applied through roots, as a foliar spray, or by stem injection.

SAR Action:

Pathogen infection → SA → Pathogenesis related genes(PR-genes) → Defense genes → Pathogenesis related proteins (PR-proteins) → Disease resistance

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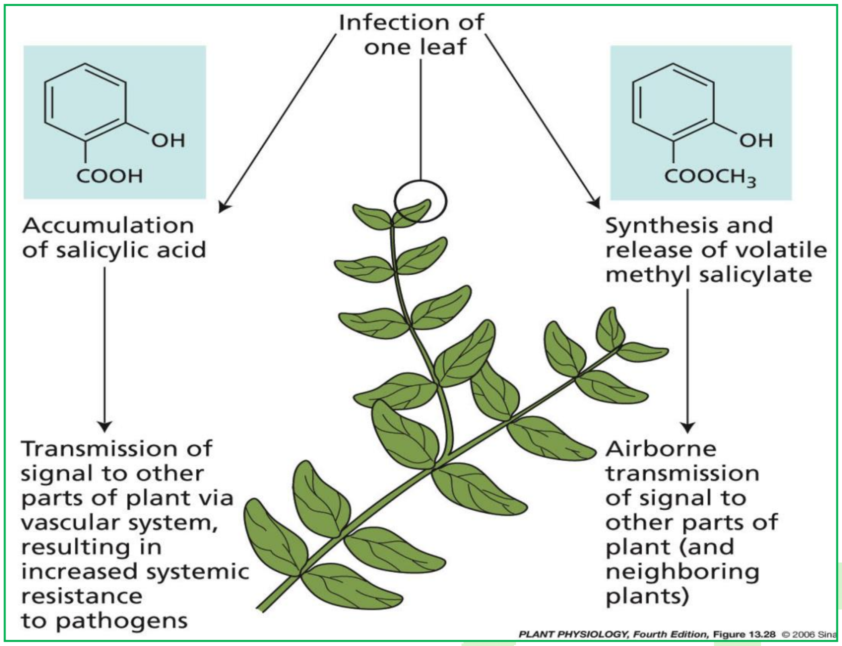
Process of systemic acquired resistance in plants:



Among PR-proteins,

PR-2 : beta-1,3-glucanase
PR-3 : chitinase
PR-5 : osmotin
PR-12: defensin.

} **Antimicrobial properties**

- Most of PR-proteins accumulate in extracellular space or in the vacuole.
- PR-proteins accumulate greater quantity at the site of infection and lesser quantity in non infected parts of infected plants.

History of SAR:

- The first systematic study of SAR was published by A. Frank Ross in 1961. Using TMV on local lesion hosts, Ross demonstrated that infections of TMV were restricted by a prior infection. This resistance was effective against not only TMV but also tobacco necrosis virus and certain bacterial pathogens.
- In 1982, Kees Van Loon showed that the accumulation of a group of extracellular proteins called PR proteins correlates with the onset of SAR.

- Systemic acquired resistance acts nonspecifically throughout the plant and reduces the severiy of disease caused by all classes of pathogens, including normally virylent ones. It has been observed in many dicot and monocot plants, but it has been studied most in cucurbits, solanaceous plants, legumes and graminaceous plants following infction with approoriate fungi, bacteria, and viruses.
- Systemic acquired resistance is certainly produced in plants following expression of the hypersensitive response.

- Localized infections of young plants.., e.g., cucumber with fungus (colletotrichum lagenarium), a bacterium (Pseudomonas lachrymans) or a virus (tobacco mosaic virus) , lead within a few days time to broad spectrum , systemic acquired resistance to at least 13 diseases caused by funfi, bacteria and viruses.
- A single inducing infection protects cucumber from all pathogens tested for 4-6 weeks; when a second booster inoculation is made 2-3 weeks after the primary infectin, the plants acquires season-long resistance to all tested pathogens.
- The degree ofsystemic acquired resisance seems to correlate well with the number of leisons produced on the induced leaf until a saturation point is reached.
- Systemic acquired resistance , however, cannot be inducced after the onset of folwering and fruiting in the host plant.
- Products of SAR genes , e.g,, β-1,3-glucanases, chitinases, cysteine rich proteins related to thaumatin, and PR-1 proteins have direct antimicrobial activity.
- The set of SAR genes that are induced in a plant may vary with the plant species. Although systemic acquired resistance does noe affect spore germination and appressorium formation , penetration is reduced drastically in systemacally induced resistance tissue

SA acts as a signal in the induction of acquired resistance

- Exogenously applied salicylic acid (SA) induces both acquired resistance and PRs in e.g. tobacco, tomato and *Arabidopsis,*
- plants expressing the *salicylate hydroxylase* gene *NahG from Pseudomonas putida do* not accumulate SA and are incapable of expressing PRs or SAR in response to pathogen infection, have provided proof that SA acts as a signal in the induction of acquired resistance.
- Moreover, NahG-containing plants are more susceptible to a variety of fungal, bacterial and viral pathogens (Delaney et al., 1994). Thus, SA is required for the expression of resistance, as well as for the enhanced defensive capacity of tissues with acquired resistance.
- Although accumulation of SA is required for the development of SAR, and it may be transported from infected leaves (Shulaev et al., 1995; M¨olders et al., 1996), it does not appear to be the primary long-distance signal for systemic induction .

Induced resistance in plants

- ONE: Production of PR proteins as result of pathogen attack.(Based on SA Pathway)
- SECOND: Production PR proteins as result of wounding. (Based on Jasmonic acid pathway)
- The compounds are analogues and induce similar response when applied exogeneosly.
- Jamonate induced pathway is designated as induced systemic resistance.
- THIRD: non pathogenic (based on root associated bacteria as rhizobacteria induced – systemic resistance)
- These are phenotypically same to that of SA, JA bue functionally very different– these do not producePR proteins and phytoalexins. But when pathogen attacks

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, plant response increases gradually and disease is reduced
- Thus. RISR gives potentiation of plant defence response

Properties of PGPR

- Stimulate growth
- N fixation
- Increase solubility of limiting nutrients (siderophores)
- Stimulate nutrient delivery and uptake
- Production of phytohormones
- Modulation of plant development (*e.g.* reduce ethylene enhances root growth)
- Plant-mediated disease suppression
- Non-pathogens antagonize pathogens (competition, antibiotics, lytic enzymes)
- Activating plant to better defend itself (ISR)
- Induced resistance observed on spatially separated parts of same plant

The nature of systemically induced resistance in plants

(A) Characteristics of induced systemic resistance

- The defensive capacity of the plant is enhanced through microbial stimulation or similar stresses
- The enhanced defensive capacity is expressed systemically throughout the plant
- Induced systemic resistance is active against fungi, bacteria, viruses and, sometimes, nematodes and insects
- Once induced, systemic resistance is maintained for prolonged periods

(B) Mechanisms of induced systemic resistance

- Developmental, escape: linked to growth promotion
- Physiological, tolerance: reduced symptom expression
- Environmental: associated with microbial antagonism in the rhizosphere; altered plant-insect interactions
- Biochemical, resistance: induction of cell wall reinforcement,
- Induction of phytoalexins
- Induction of pathogenesis-related proteins
- 'Priming' of defence responses (resistance)

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Flower infecting fungi: Special emphasis on *Ustilaginoidea virens*

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INTRODUCTION

There are different fungal pathogens which cause the diseases during the flowering stage of crop plants. These fungal pathogens are more dangerous than the other fungal pathogens because they infect the reproductive part of the plant ultimately causing the yield loss of the crop. Recently published example which cause economic yields to crop are Fusarium head blight (*Giberella zeae*) $3 billion to U.S. wheat and barley producers during the 1990s, chiefly due to mycotoxin production in infected inflorescences; sorghum ergot (caused by *Claviceps africana*), which has spread rapidly to and within previously unaffected sorghum production regions in the Americas and Australia during the past decade and Karnal bunt (caused by *Tilletia indica*), a smut disease that causes negligible yield losses but, as a quarantine disease, has major implications for international policy and trade. The new emerging disease of rice inflorescence is false smut (*Ustilaginoidea virens*) cause yield loss up to 20% to 80% depending on the severity of disease to the crop. Flower infecting fungi can be classified readily into three major groups: opportunistic, unspecialized pathogens causing necrotic symptoms such as blossom blights (group 1), and specialist flower pathogens which infect inflorescences either through the gynoecium or androecium (group 2) or systemically through the apical meristem (group 3) (Ngugi and Schrem, 2006). The false smut fungus (*Ustilaginoidea virens*) comes under the group 2 but less specified as infection on to ovary. The symptoms produce by the fungus clearly visible during the crop maturity time. The individual rice spikelet converts in to the charcoal sooty like mass of spores in later stage of development of disease. Smut balls consisted of dark-green chlamydospores and sometimes presence of sclerotia also observed. The colour of the smut balls was initially orange then changed to yellow, yellowish green and then greenish black at maturity.

The flower as an infection court

There is different flowering part which infected by the fungi for example calyx and corolla infected by many fungi *Botrytis cinerea*, *Venturia inaequalis*, *Mycosphaerella dianthi, S. sclerotiorum*, *Ovulinia azaleae.* The nectary infected by *B. cinerea,* the anther smut fungus *M. violaceum.* The pistil infected by *Ustilago nuda* f.sp. *hordei*, *B. cinerea, M. vaccinii-corymbosi* causing mummy berry disease of blueberry and *C. purpurea* causing ergot of rye. Pollen infecting fungi are *S. sclerotiorum, Verticillium albo-atrum, Coniothyrium minitans* and *Gliocladium catenulatum* and *U. virens. U. virens* shows special period of infecting pollen i.e. unipartile,

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bi-partile and the tri-partile stage of pollen development. Before this period and after this period of infection the *U. virens* does not show any infection to pollen (Chao et al., 2014).

Infection process in rice flowers (*U. virens*)

Infection process generally includes two Stages :

(i) **Epiphytic stage**: In this stage the pathogen spores goes inside the flowers from the small gap between the lemma and palea. Hyphae extends through the filaments, style and lodicules but no infection seen on these parts.

(ii) **Biotrophic stage**: In this stage *U. virens* mycelia starts covering the stigma, proliferate on anthers and infect style. Pathogen starts to take nutrients from the foot cells and the filler like cells (specialized hyphae function).

Infected Histological examinations revealed that *U. virens* infects the stamen filaments and occasionally attacks the stigma and lodicules; however, no infection of the ovary could be found (Tang et al., 2013). It was once believed that *U. virens* only infected fertilized spikelet's .However, recently, it is found that the rice male-sterile mutant abcg15 can be severely infected by *U. virens* (Qin et al., 2013).

Challenges in managing flower diseases

The all management strategy which is used against the foliar diseases could be useful for management of flowering diseases. The stages of the flower development also play a significant role to avoid the pathogen infection. Chemical control of flower diseases caused by fungi is complicated by the fact that diverse fungicidal active ingredients can damage sensitive flower organs such as the stigmatic surface and the anthers; however, only in a few cases has an associated reduction in seed set, fruit set, or yield been documented. In case of special pathogens such as *U. virens* (group 2) the application of fungicide is crucial as recommended in case of other foliage diseases i.e. just before the flowering and after the 50% of anthesis with the recommended dose. The group 1 and group 3 diseases caused by pathogen rely more time period with the flower while the group 2 pathogen have very less time of contact with the flowering part so the strategy for managing them become difficult. The studies have not been available that how much the residual toxicity of the fungicide on the rice plant when apply as recommended for the other flower infecting diseases.

CONCLUSION

The fungi which causing diseases in flower of crop plants are menace for the farming community. The loss caused by them is not negligible as cause social as well as economic loss. The different group i.e. group 1, group 2 and group 3 are made for the inflorescence diseases. Among these group the group 2 pathogen are more dangerous to crop inflorescence because of very specific time of infection. Under group 2 false smut also came which directly infect the pollen (uni-partile, bi-partile and tri-partile stage). The *U. virens* shows two stages of sign one is epiphytic and another one is biotrophic. The ovary of the flower was seen uninfected or less infected when the artificial inoculation has been done. Due to very less time of exposure of pathogen during flowering time *U. virens* is not easy to manage by any of the management practices. The time of application of fungicide also need to be short out with this pathogen.

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Amazing benefits of giloy on human health

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Wouldn't the planet be a wonderful place if there are no ailments and disorders? Wouldn't it build our lives a battier bit easier if we tend to aren't perpetually disturbed concerning falling sick? However, it doesn't seem like a chance within the close future, allow assisting during this task by enlightening a couple of wizard herb which will coping with these ailments with success.

To start off, the herb that we are talking about is Giloy that has been used traditionally as an Indian medication. This Ayurvedic herb once translated to Indo-Aryan, suggested that 'Amrita' which implies 'the root of immortality'. And, once prying its varied advantages, you'd undoubtedly conform to it.

Figure: Leaf and fruits of Giloy plant

Amazing advantages of Giloy:

I. Treating Diabetes:

Diabetic patients particularly people with two polygenic diseases will greatly enjoy Giloy treatment. They'll even have Giloy juice to scale back glucose levels. The purchase of Giloy juices and uses it as per the directions on the bottle will be beneficial.

II. Inflammatory disease Cure:

The wizard herb Giloy has been evidenced useful in treating inflammatory diseases and its symptoms. This is often doable because of its anti-arthritic and anti inflammatory properties. To cure arthritis, mix Giloy and ginger and for hardening joint pains, boil some milk with powdery Giloy stem in it and drink it.

III. **Immunity Booster:**

If you fall sick perpetually, then one reason might be that you simply have a weak system and this is often one thing you ought to address straight off. Your system need to be boosted up by purifying your blood, fighting microorganism, maintaining healthy cells, fighting free-radicals that causes harm to your body ,etc.

Rather than outlay time and cash on completely different remedies to repair these problems, all you would like to try is to use Giloy that could be a one stop remedy for all of those issues. A number of the opposite awe-inspiring advantages of Giloy – removal of poisons from the body, used as a treatment for physiological state and tract infections and fighting liver connected diseases.

IV. **Stress Relief:**

Do you suffer from severe bouts of tension and stress? Prepare a health tonic consisting of Giloy and different herbs and produce down your anxiety and stress levels. This tonic also flush out all the toxins, can calm your mind and body and provides your memory a way required boost.

V. **Cure For Jaundice:**

Here could be a fast formula that you can simply try if you or somebody you recognize is suffering of jaundice. Take 20-30 Giloy leaves and grind it up. Immediately take a glass of butter milk and add the grounded leaves in it. Mixed it up and strain it before giving it to the patient.

VI. **Stubborn Ear Wax:**

There are a unit times once removing ear wax becomes a tedious method additionally the ordinarily used ear buds also don't return to our rescue. For such instances, the use of Giloy could be a possibility. All you would like to try and do is grind some Giloy in water and heat it up use this as an ear drop and add few drops in your ear double on a daily basis. This can be used to eliminate stubborn ear wax.

VII. **Chronic Fever:**

For folks full of chronic fever or diseases, Giloy may be super useful because of its anti-pyretic nature. This helps in increasing the blood platelets, scale back symptoms of life threatening diseases and additionally take away the dandy fever symptoms. Combining a pinch of Giloy extract with honey may be used as a good treatment for protozoal infection.

VIII. **Treating Piles:**

Piles area unit quite painful and also the sooner you get eliminate it, the better. This remedy Giloy will cure all types of piles, thus make sure that you follow the directions totally. Take coriander leaves, Giloy and harad in equal measures. Take twenty grams of this mixture, add it to water and boil it. Once boiling, add some jaggary and have it twice on a daily basis.

IX. **Improves Digestion:**

Another good thing about Giloy is that it will facilitate in meliorative digestion yet as cure any viscus connected ailments. Use this formula – take equal amounts of herbs, Giloy and ginger root, simmering the 3 ingredients. Taking 20-30 grams of this simmering day after day will give relieve from viscus connected ailments.

X. **Treating Asthma:**

There has been an increase within individuals suffering from respiratory disease. If you're a respiratory disease patient, then recommendation for you, start chewing Giloy roots because it can facilitate in relieving from tightness of your chest, wheezing, coughing and respiration issues.

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XI. Health advantages of Mosambi

a) Higher Vision:

Eye disorders are quite common today and rather than firing cash on overpriced treatments, do that cost-efficient treatment which might cure disorders like tissue layer disorder, cataract, sclera, etc. Take 11.5 grams of Giloy juice and add one gram of honey and one gram of sodium chloride thereto and blend all of them totally and apply this mixture on your eyes.

b) Hypertrophy Cure:

When a person's body elements swell to large proportions, he or she is alleged to be plagued by hypertrophy and it's caused by the nematode worm. It is often simply cured by Giloy treatment. Take 10-20 grams of Giloy juice and add fifty milliliter of bitter oil in it. Have this stewing early morning on empty abdomen/stomach and you may be astonished with the positive results.

c) Treatment for Liver Disorders:

Use this remedy in liver disorders as a natural cure to treat it. You may require two grams celery seeds, two little pepper, a two branch sticks and eighteen grams of contemporary Giloy. Crush all of them along, place the crushed material in a pot and fill it with 250 milliliter of water. Leave this mixture overnight and next morning grind it, strain it before consumption. For effective results, this remedy needs to be followed over a course of 15-20 days.

d) Aphrodisiac:

Looking for ways to improve your sex life, you can boost it just by Giloy. It contains aphrodisiac properties which might play a significant role to improve sex life.

e) Signs of Aging:

Those wrinkles and fine lines are often thus plaguey, isn't it? Our look for the most effective remedy to get rid of all those wrinkles and dark spots is endless. Keeping that in mind, here is another natural remedy that one should attempt. It's been tested and tried that Giloy contains anti-aging properties that may take away dark spots, wrinkles, pimples and fine lines.

f) Metabolism Problems:

Respiratory issues like cold, tonsils, and cough simply cured by Giloy treatment because of its medication properties. These properties are helpful in dominant and fight against metabolism issues.

g) Cure For Vomiting:

This remedy is often used if you're plagued by expulsion, respiratory illness or asthma. To prepare this you need Giloy, yellow bacciferous night shade and bark of Malabar nut. Take equal quantities of those 3 ingredients and boil them in 1 liter of water. You can add some honey and drink it likewise.

h) Urinary Disorders:

For urinary disorders like burning sensation or painful micturition, Giloy could be a sensible cure. Make a stewing mistreatment; take 20-30 grams of Giloy take it twice a day daily. Instead you'll additionally attempt having one gram of Giloy exract mixed with three grams of honey. This could even be taken once in the morning and once in the evening.

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i) Treatment for Gout:

This natural herb is one amongst the most effective treatments for gouty arthritis. For a permanent relief from this continuous drawback, attempt mix physic with Giloy extract and apply it where needed. You may see visible results inside within couple of days.

j) Anemia:

Lack of spare red blood cells in your body ends up in anemia. You'll say sayonara to all or any type of anemia symptoms like lightheadedness, fatigue, short breath, etc., by consuming Giloy. You'll either use Giloy in its fine-grained kind or make a stew to treat anemia. Once probing this post you may undoubtedly agree that this magic herb stands faithful which means 'Amrita'.

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Role and importance of pollinators in agriculture

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What is a Pollinator?

The pollinators are living organism that play important role in plants to make fruit or seeds. The pollinators are moving pollen from male flower part to female flower part. This pollen then fertilizes the plant. Only and only fertilized flower can make fruit or seeds, and without them, the plants cannot reproduce. Various type of plants, such as soybeans do not require pollinators at all, and some can be pollinated by wind in the ecodome blowing on the plants. However other crops such as raspberries or alfalfa won't reproduce or raise fruit without pollination; various fruits and vegetable plants like strawberries reproduce more gradually and produce less fruit without pollinators around them.

Why are pollinators important?

Pollinators play vital role to production agriculture products. Near about 30% of the agriculture productions and fiber crops grown throughout the world depend upon pollinators. Roughly about one out of every four mouthfuls of food and drinks that we consume are mostly produced from pollination services provided by the pollinators.

Role of pollinators

Pollination refers to the transfer of anther to stigma in flowering plants for sexual reproduction Insects aid in cross-pollination in fruits, vegetable, ornamentals, cotton tobacco, sunflower and many other crops. Insect pollination helps in uniform seed set, improvement in quality and increase in crop yield. In the other subgroup are vegetables that are pollinated by insects. Some of the vegetables are self-pollinating in nature, but the fruit set will be greater if insects visit those flower. The pollinators are bees, honeybees or bumblebees. These vegetables include broccoli, collards, cauliflower, cucumber, cantaloupe, pumpkins and watermelon, okra, peppers and squash. Peppers are self-pollinating, but they set more fruit when pollinated by bees. Cucurbits and squash require insect pollination.

Honey bees

Honey bees travel from flower to flower, collection of nectar (later converted to honey), and pollen grains. The pollen store on the hind legs, in a structure referred to as a "pollen basket". As the bee flies from flower to flower, some of the pollen grains are transferred onto the stigma of other flowers. Nectar provides the energy for bee nutrition; pollen provides the protein. When bees are rearing huge quantity of brood (beekeepers say hives are "building"), bees on purpose gather pollen to meet the nutritional needs of the brood. High-quality pollination management seeks to have bees in a "building" state during the bloom period of the crop, thus requiring them to gather pollen, and making them more efficient pollinators. Millions of hives of honey bees are contracted out as pollinators by beekeepers, and honey bees are by far the very most important commercial pollinating agents. Other species of bees differ in various details of their behavior and pollen-gathering habits, and honey bees are not native to the Western Hemisphere; all pollination of native plants in the Americas historically has been performed by various native bees.

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Other insects

Several insects other than bees achieve pollination by visiting flowers for nectar and pollen. Several do so adventitiously, but the very important pollinators are specialists for at least parts of their life cycles for at least assured functions. For example, males of many species of Hymenoptera, including many hunting wasps, rely on freely flowering plants as sources of energy (in the form of nectar) and also as territories for meeting fertile females that visit the flowers.

Prominent examples are predatory wasps (especially Sphecidae, Vespidae, and Pompilidae). The term "pollen wasps", in particular, is widely applied to the Masarinae, a subfamily of the Vespidae; they are remarkable among solitary wasps in that they specialise in gathering pollen for feeding their larvae, carried internally and regurgitated into a mud chamber prior to oviposition. Various bee flies, and some Tabanidae and Nemestrinidae are particularly adapted to pollinating fynbos and Karoo plants with narrow, deep corolla tubes, such as Lapeirousia species. Part of the adaptation takes the form of remarkably long probosces.

Lepidoptera (butterflies and moths) also pollinate plants to various degrees. They are not major pollinators of food crops, but various moths are important pollinators of other commercial crops such as tobacco. Pollination by certain moths may be important, however, or even crucial, for some wildflowers mutually adapted to specialist pollinators.

The orchid species *Epipactis veratrifolia* mimics alarm pheromones of aphids to attract hover flies for pollination. Another plant, the slipper orchid in southwest China, also achieves pollination by deceit by exploiting the innate yellow colour preference of syrphide. Some male Bactrocera fruit flies are exclusive pollinators of some wild Bulbophyllum orchids.

Vertebrates

Bats are important pollinators of some tropical flowers. Birds, particularly hummingbirds, honeyeaters and sunbirds also accomplish much pollination, especially of deep-throated flowers. Other vertebrates, such as kinkajous, monkeys, lemurs, possums, rodents and lizards have been recorded pollinating some plants.

Tomato blossoms are self-fertile, but (with the exception of potato-leaf varieties) have the pollen inside the anther, and the flower requires shaking to release the pollen through pores. This can be done by wind, by humans, or by a sonicating bee (one that vibrates its wing muscles while perched on the flower), such as a bumblebee. Sonicating bees are extremely efficient pollinators of tomatoes, and colonies of bumblebees are quickly replacing humans as the primary pollinators for greenhouse tomatoes.

CONCLUSION

Pollinators are playing vital role for agriculture production. Approximately 30 percent of the food and fiber crops grown throughout the world depend upon pollinators for reproduction. In many crops So, in keeping view these facts, giving importance to these beneficial insects viz., bees, some butterflies, house flies, some aphids, ants and some beetles into the crop field shall increase the crop production.

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Microgreens

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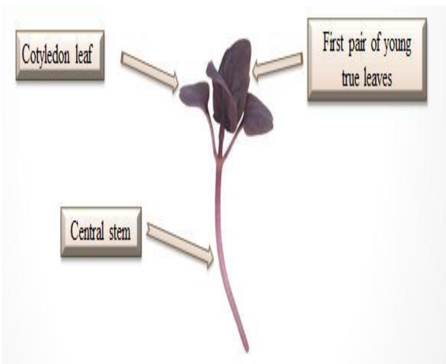
The spectrum of life in terms of income, life style and spending is changing rapidly with economic development. Diet related diseases such as obesity, diabetes, cardiovascular disease, hypertension, stroke and cancer are escalating both in developed and developing countries, in part due to imbalanced food consumption patterns. Vegetables are oftenly referred to as Protective Food in view of nutritive and medicinal values and serve as one of the important components of Indian agriculture towards nutritional security of people. India is the 2nd largest producer across the globe but national food security is becoming a matter of increasing concern and poverty is reflected in the nutritional status of the people. The present per capita availability of vegetables in India is only 210 g against the requirement of 300g/ capita / day for normal health as per the Recommended Daily Allowance (RDA). Households in large cities in low income countries like India spend 50-80 per cent of their incomes on food (Bakker *et al.,* 2000) and nutritional deficits in macronutrients and essential micronutrients are common.

Now-a days, non-availability of fresh and pesticide residue free vegetables for consumption is increasingly becoming major concern for vegetarian population of our country. So, Microgreens: a new class of edible vegetables with lots of potential in term of nutritional ability to cure various deficiencies (Pinto *et al.,* 2015) presents a homestead option towards nutritional security. As these can easily be grown in urban or peri-urban areas, where land is often a limiting factor, either by specialized vegetable farmers or the consumers themselves. Simultaneously, they also offer opportunities for rural population of our country to enhance dietary status of their food. Microgreens can easily be grown with and without soil organically in short period of span of 10-15 days around or inside residential areas. Moreover, microgreens are usually consumed raw, hence there is no loss or degradation of micronutrients through food processing. There are more than 25 microgreens commercially grown all over the world. Phytonutrient levels differ according to growth stages of the plant and often decrease from the seedling to the fully developed stage (Ebert *et al.,* 2014). Microgreens are 4-6 times more nutrient dense than their mature counterparts (Xiao *et al.,* 2012). So, microgreens can be termed as 'Functional Foods', which have health promoting or disease preventing properties. In recent years, consumption of microgreens has increased along with consumer awareness and appreciation for their tender texture, distinctive fresh flavours, vivid colours and concentrated bio-active compounds such as vitamins, minerals, antioxidants etc.

Microgreens: What are they?

Microgreens are young and tender edible seedlings produced using the seeds of different species of vegetables, herbaceous plants, aromatic herbs and wild edible plants. Depending on the species that has been used, they can be harvested 7-21 days after germination when the cotyledonary leaves have fully developed and the first true leaves have emerged (Xiao, 2012). Microgreens are harvested by cutting the single seedlings just above the soil line when their height is 3 to 9 cm without the rootlets. The edible portion is constituted by the single stem, the cotyledonary leaves and, often, by the emerging first true leaves. In some cases, when small and tender, also the integuments of the seeds that remain attached to the cotyledons may be considered edible. Microgreens contain three part central stem, cotyledon leaves and first pair of very young true leaves. Based on growth stages of plant, microgreens fall in the stage older than "Sprouts" and younger than "Babygreens"



Diagrammatic representation of a microgreen

There are 70-80 types of microgreens grown worldwide but, ones listed in Table 1 have gained importance for homestead and commercial utility.

Table 1. List of some of the important microgreens Source: Xiao *et al.,* (2012)

Commercial name	**Botanical Name**	**Family**	**Microgreen colour**
Arugula	*Eruca sativa Mill.*	Brassicaceae	Green
Bull's blood beet	*Beta vulgaris* L.	Chenopodiaceae	Reddish green
Celery	*Apium graveolens* L.	Apiaceae	Green
Cilantro	*Coriandrum sativum* L.	Apiaceae	Green
Garnet amaranth	*Amaranthus hypochondriacus* L.	Amaranthaceae	Red
Golden pea tendrils	*Pisum sativum* L.	Fabaceae	Yellow
Green basil	*Ocimum basilicum* L.	Lamiaceae	Green
Green daikon radish	*Raphanus sativus* L.	Brassicaceae	Green
Magenta spinach	Spinacia oleracea L.	Chenopodiaceae	Red
Mizuna	*Brassica rapa* L.	Brassicaceae	Green
Opal basil	*Ocimum basilicum* L.	Lamiaceae	Greenish purple
Opal radish	*Raphanus sativus* L.	Brassicaceae	Greenish purple
Pea tendrils	*Pisum sativum* L.	Fabaceae	Green
Pepper cress	*Lepidium bonariense* L.	Brassicaceae	Green
Popcorn shoots	*Zea mays* L.	Poaceae	Yellow
Purple kohlrabi	*Brassica oleracea* L.	Brassicaceae	Purplish green
Purple mustard	*Brassica juncea* L.	Brassicaceae	Purplish green
Red beet	Beta vulgaris L.	Chenopodiaceae	Reddish green
Red cabbage	Brassica oleracea L.	Brassicaceae	Purplish green
Red mustard	*Brassica juncea* L.	Brassicaceae	Purplish green
Red orach	*Atriplex hortensis* L.	Chenopodiaceae	Red Reddish
Red sorrel	*Rumex acetosa* L.	Polygonaceae	green
Tartary buckwheat	*Fagopyrum tataricum* L.	Poaceae	Green

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Microgreens: Growing process

Now-a-days people are becoming aware about importance of microgreens. So, inhabitants in rural, urban area and peri-urban locations can utilize nutritional potential of microgreens at home and market. Although, growing process of microgreens is very easy but commercial basic requirements of microgreens it need to be taken into confederation for successful cultivation of microgreens. Some important requirements of some of the microgreens are given in Table 2.

Table 2. Some Requirements for Growing Microgreens

Microgreen	Seed (g) / Tray (30 x 30 cm)	Soaking Time (h)	Depth of media Mix (cm)	Temp. (^{o}C)	Maturity (Days)
Amaranth	2.5	NA	2	>22	16-25
Purple Basil	2.5	NA	1	>24	16-25
Beet root	12.5	24	2	16-25	16-25
Buckwheat	12.5	8-12	2	20-25	5-6
Cress	8	NA	1	16-25	5-14
Dill	5	NA	1	15-23	16-25
Kale	5	4-8	2	16-28	16-25
Linseed	36	NA	2	16-25	6-8
Mustard	2.5	8	2	16-25	15-20
Pea shoots	100-150	8-12	2	15-25	10-14
Radish	5	6-12	3	16-28	12
Cabbage	5	4-8	2	16-25	3-6
Arugula	3	NA	2	16-25	16-25
Sunflower	50	8-12	2	20-25	8-12

Source: www.greenharvest.com.au

There are some of the vegetable crops which are gaining importance in some metro and big cities of India

Red amaranth

Beetroot

Broccoli

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Cress

Dill

Carrot

Fenugreek

Kale

Radish

Linseed/Flaxseed

Red cabbage

Mustard

Fennel

Onion

Red veined sorrel

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Pea

Gold corn

Source: www.greenharvest.com.au

Material and media

Microgreens cultivation is not much costly because as they do not require much tool and material to grow. Selection of growing trays for the commercial cultivation should have good drainage capacity. Size of growing trays can appropriately be chosen depending upon availability of space and ease in handling and transportation of living microgreens. As far homestead cultivation is concerned, one can even use deposable trays for successful cultivation. Media should preferably be inert one like cocopeat, vermiculite and cocopeat alone or in combination of 3:1:1. As the concept of microgreens cultivation relates to provide pesticide free and nutritional rich food, so treatment with any chemical pesticides should be avoided. Moreover looking to vulnerability of microgreens particularly to damping off disease, seeds can be treated with *Trichoderma harzianum* and *Trichoderma virens* alone or in combination (1 mg per seed ball). This practice is very important when trail is used as growing media (Pill *et al.,* 2011).

Growing tray with small hole for better

Tray filling by media

Desposable tray for homestead production

drainage

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High density sowing in media using reusable tray

High density sowing in media using deposable tray

Nutritional requirement

As microgreens cultivation is aimed at to provide organic edible for better health of people. Fertilizer requirement for microgreens production is very minimum, which can easily be achieved through organic sources. Otherwise, one can also spray solution of 10 mM $CaCl_2$ i.e. 1.10 g per 10 litres of water (Kou *et al.,* 2014).

Harvesting

Microgreens are harvested at the appearance of 1st set of true leaves. Most of the microgreens are ready for harvesting after the 10-15 days after sowing of seed. Microgreens cutting should be done above from media surface without roots. Some types of microgreens like coriander and fenugreek may regrow and can be cut several times. The media once used to growing the microgreens, can also be used successfully for another crop of microgreens.

Stage of Cutting and harvesting microgreens

Utility

In recent years, consumption of microgreens has increased along with consumer awareness and appreciation for their tender texture, distinctive fresh flavours and concentrated bioactive compounds such as vitamins, minerals, antioxidants as compared to mature leafy greens.

Homestead utility

Microgreens are vivid in colour, so can be used in plate presentation and garnishing, which introduce hidden tangy flavours dishes. A tiny pile of microgreens can also be used to add flavours in salad.

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India represent vide variety of eatables in daily diet, nutritional enrichment of which can be done with microgreens.

Blending of microgreens in different eatables

Some of the homestead utilities of microgreens are presented below:

Commercial Utility

Microgreens are highly perishable in nature and it can't be stored for a long time in open as well as refrigerator conditions. To overcome this problem and to fullfill commercial utility of microgreens, they are sold as living microgreens. Living Microgreens are the freshest and most nutritious greens and can be stored in the refrigerator for up to 14 days or at room temperature for 4-6 days with daily watering. They are sold in the market at rate of 100g/Rs. 200. However, branding of microgreens is very important to make commercial utility successful so, proper packaging of living microgreens is essential to attract masses particularly new generation towards this new class of edible vegetable. As is being done in developed countries like USA.

Living miccrogreens being sold in USA

Microgreen Troubleshooting

a) **Weak, skinny microgreens:** The plants need more light compared their mature counterparts, otherwise microgreens may become weak and skinny.
b) **Overcrowding:** Excessive dense sowing may cause damping off, however it can be easily overcome by treating the media by Trichoderma.
c) **Wrong sowing time:** Some seeds may not germinate at very high or very low temperatures. .
d) **Over soaking:** Over soaking of seeds may result in dead seeds.

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CONCLUSION:

A new class of edibles popularly termed as 'Microgreens', are concentrated with various bio-active compounds like vitamins, minerals, antioxidants *etc*. for health promotion and disease prevention. So, it can be inferred that higher level of antioxidant in microgreens may be helpful to deal with oxidative stress. The higher level of minerals in most of the microgreens can be used as health promoting strategy to meet the requirements for elementary dietary intake.

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Vermicomposting

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Indiscriminate uses of chemical fertilizers lead to imbalance in microorganisms which lead to decrease in organic carbon. So there is need to provide organic fertilizers which supplies more nutrients with less cost instead of inorganic fertilizers. Among organic fertilizers vermicomposting is the important one.

Materials required: Waste material, earthworms and cowdung

Types of earthworms:

Burrowing: Eats 90% soil and 10% waste material. Not suitable for vermicomposting

Eg: *Feritima asiatica*

Non-burrowing: Eats 10% soil and 90% waste material. Suitable for vermicomposting

Eg: *Eisenia foetida, Udrinus ujini, Lumbricus rubellus*

Procedure:

Construct a shed and then construct beds of 3feet width and 1.5 feet deep. Distance between two beds should be 2 feet.Spread sand and broken bricks at the base in order to protect from water infiltration. Spread 2-4 feet waste material and then farm yard manure. Continue the same procedure until it reaches 12 feet height and then sprinkle water. After 48 hours release 1000 earthworms per sq.m area. Protect the earthworms by placing gunnybags on it. Daily sprinkle water and compost will be ready in 6-8 weeks.

Is compost ready?

Compost will be in black colour and light in weight. Worms will come and stick to gunnybags. Then stop watering for 2-3 days so that worms will reach to bottom of the bed in search of water. Then we can harvest compost and sieved with 3 mm sieve.

Preventive measures

- Requires compact floor
- 15-20 days old cow dung should be used
- Should be free from Plastic, chemicals, pesticides and metals
- Provide good aeration for proper growth and multiplication
- Maintain 40-50% moisture, 18-25^{0} C temperature
- Sharp implements should be avoided
- Protect from wounds
- Protect from rats, ants and other enemies

Benefits

- Supplies all essential plant nutrients
- Contains more nutrients than other compost
- Supplies enzymes, hormones, immunity boosters
- Increase microbial population, Keeps crop healthy

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- Makes soil fragile- so called as jeevanagali
- Increase water retention capacity, colour, quality, shelf life and taste of food, yield- increases rate, soil physical properties
- Improves germination, root growth and structure, plant growth, new shoots/leaves
- Called as Farmers friends
- Free flowing, easy to apply, handle and store
- No bad odour
- Reduces Soil erosion
- Increase earthworms in soil
- Reduce Nutrient losses and improves nutrient use efficiency
- Free from pathogens, toxic elements and weed seeds
- Minimizes pest and diseases, decomposes organic matter

Disadvantages

- Requires 50 to 80 degrees F.
- Cannot digest inorganic materials, meat, dairy or greasy foods.

Nutrients

- 15-30 kg N, 10-20 kg P2O5, 11-18 kg K2O
- Zinc, iron, manganese, ragi, boron, calcium, magnesium and Sulphur

Table 1: Nutrient analysis of vermicompost

Parameters	Content	Parameters	Content
pH	6.8	Available N (%)	0.50
OC%	11.88	Available P (%)	0.30
OM%	20.46	Available K(%)	0.24
C/N ratio	11.64	Ca%	0.17
Total Nitrogen (%)	1.02	Mg%	0.06

Dose:

- 1-1.5 t/ac
- Fruit crops-5-25 kg per tree
- Flower pots-200 g
- Can mix with chemical fertilizers

Storage:

- One cow provides 3.5 t FYM
- 1.5 t FYM comprses of 20 kg N,P2O5, K2O
- 3.5 t FYM+7 t waste material+30 t soil gives 40 t vermicompost which supplies 500 kg N, P2O5, K2O

Cost:

- 1 tonne- Rs. 4000-5000
- If prepared in farmer fields it costs around Rs. 1200/t

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Different applications of solar energy in agriculture

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INTRODUCTION

Solar energy is created by light and heat which is emitted by the sun, in the form of electromagnetic radiation. With today's technology, we are able to capture this radiation and turn it into usable forms of solar energy - such as heating or electricity. Solar energy is the continuous energy generated by sun's nuclear fusion reactions. The average solar radiation intensity available at Earth's orbit is 1367 kW/m^2. Humans rely on solar energy to survive, including all other forms of renewable energy (except for geothermal resources). Although the total amount of solar energy resources is ten thousand times of the energy used by humans, but the solar energy density is low, and it is influenced by location, season, which is a major problem of development and utilization of solar energy.

Solar energy has always played a central role in agricultural production as the driving force behind the climate and weather, and as the energy source for crop plants to produce organic matter (e.g. fruits) through photosynthesis. But only in recent centuries humans learned to use additional energy to manipulate natural conditions. Using artificial irrigation or greenhouses, agricultural productivity could be increased and become less dependent on climate conditions. Furthermore, processing methods have evolved to allow higher productivity and longer food preservation, while also requiring more energy input. With the challenges to the agricultural sector, it is evidently necessary to deploy and further enhance the methods of raising productivity. This implies that energy becomes an increasingly significant factor.

Agricultural Applications of Solar Energy

Solar energy can supply or supplement many farm energy requirements. All the applications aim to increase agricultural productivity, i.e. maximizing yields, minimizing losses and speeding up the production. Secondly they allow better management of natural resources. The following is a brief discussion of a few applications of solar energy technologies in agriculture.

1. Solar Drying

Solar drying is one of the oldest and most simple methods of using solar energy. By drying crops or grain, they can be preserved for transport and storage. Laying them out on the ground is the most simple and cheapest method, but it bears the risk of contamination with dust or animal excreta and it is highly dependent on weather conditions.

More sophisticated solar dryers protect grain and fruit, reduce losses, dry faster and more uniformly and produce a better quality product than open air methods. The basic components of a solar dryer are an enclosure, drying trays or racks, and a solar collector. The collector can be as simple as a glazed box with a dark colored interior to absorb the solar energy that heats air. The air heated in the solar collector moves, either by natural convection or forced by a fan, up through the material being dried. The size of the collector and rate of

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airflow depends on the amount of material being dried, the moisture content of the material, the humidity in the air, and the average amount of solar radiation available during the drying season.

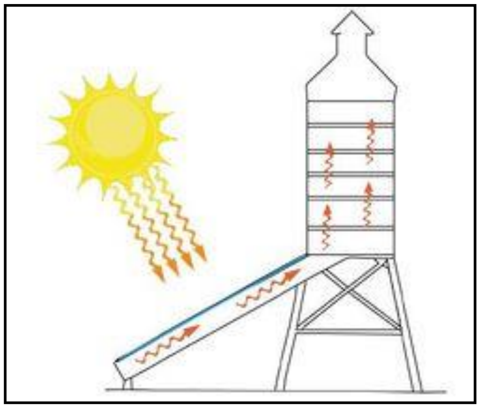

Fig. Conceptual design of solar dryer

2. Solar cooker

Two different types of solar cookers i.e. indirect and direct focusing type have been developed in the country. The indirect type solar cooker consists of an insulated box with transparent window through which sunlight enters into the box have been satisfactorily developed and commercially exploited for domestic cooking. Such solar cookers are being marketed on commercial scale in most of the states through State Energy Development Corporations or other nodal agencies of the Ministry of Non-conventional Energy Sources (MNES), Government of India.

Fig. Solar Cooker

3. Solar water heater

Water heating is one of the most common applications of solar energy for domestic and industrial applications. Similar to solar dryers, water heating systems are also available in natural convection and forced convection designs. Natural convection water heating system also known as thermo syphon water heating system consists of a flat plate solar collector, insulated water storage tank and necessary insulated pipe fittings.

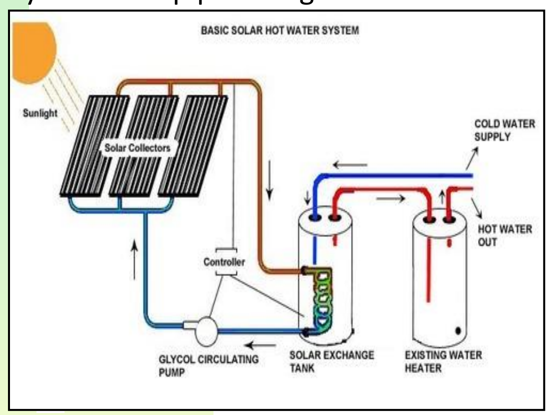

Fig. Workflow of solar water heater

4. Solar photovoltaic cell

In this technology, solar rays collected via small plates that are semiconductor photovoltaic, are converted into electricity. Photovoltaic cells can be built in two ways: concentrator and flat panel. Solar cells are the most common type of flat panels where the light is immediately brought to semiconductor and is converted to electricity. The solar cells are formed by solar modules. Power cells and solar modules may be enough only to charge the battery and to build a system with output significantly requires that modules that work together and at same time.

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Fig. Solar photovoltaic cell

5. Greenhouse heating

Another agricultural application of solar energy is greenhouse heating. Commercial green house typically rely on the sun to supply their lighting needs, but are not designed to use the sun for heating. They rely on gas or oil heaters to maintain the temperatures necessary to grow plants in the colder months. Solar greenhouse, however are designed to utilize solar energy both for heating and lighting. A solar greenhouse has thermal mass to collect and store solar heat energy, and insulation to retain this heat for use during the night and on cloudy days.

A solar green house is oriented to maximize southern glazing exposure. Its northern side has little or no glazing and is well insulated. To reduce heat loss, the glazing itself is also more efficient than single-pane glass, and various products are available ranging from double pane to cellular glazing. A solar greenhouse reduces the need for fossil fuels for heating. A gas or oil heater may serve as a back-up heater, or to increase carbon dioxide levels to induce higher plant growth.

Fig. Solar greenhouse

CONCLUSION

The solar energy can be found in the farthest corners of the world and it can be developed to electric power production and agriculture. Considering all the possibilities of applying solar energy in agriculture and the related advantages, it is absolutely desirable to further spread its use, but also elsewhere in global agriculture. As solar energy has entered the on-grid market in the last decade, agriculture is no longer limited to small off-grid applications. Many agricultural businesses are taking advantage of policy incentives for substituting part of their energy needs with fixed cost solar energy. Solar energy appeals to farmers and agricultural businesses because it helps them hedge the risk of future volatility of energy costs; it has low maintenance costs, and the fuel is free once the higher initial cost of the system is recovered.

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The wonderful health edges of Kantola (Spiny gourd)

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Spiny Gourd or Kantola could be a vegetable that generally seen in Indian markets during monsoon season. It has several health advantages that is the reason why now it's available all round the world besides Indian landmass. Fruit is covered with small spines everywhere that is why it named as "Spiny Gourd" also known as teasel gourd, Kakrol, Kankro, Kartoli, Kantoli and Bhat korola. Kantola primarily cultivated within the mountain regions of India on infertile soil and it is a vascular plant of solely three to four months generation.

Momordica charantia is the biological name of Kantola. It belongs to "Cucurbitaceous" family and genus "Momordica". Look wise Kantola is somewhat similar to bitter gourd. Vascular plant of burred gourd (Kantola) grows slowly. Burred gourd pods are dark in color and its color changes from light to yellow which indicats that they are overripen and bitterer in taste.

Figure: no.1 Spiny Gourd or Kantola

Local names of spine gourd in India:

- Spine gourd or Teasel gourd (English)
- Kantola (Hindi)
- Meluku-pakal or Palu-pakal (Tamil)
- Katwal or Kankoda (Gujarati)
- Bhat korola or Kankrol (Bengali)
- Kartoli (Marathi)
- Avandhya or Bhat-kerela (Assamese)
- Adavikakara (Telugu)
- Bara -karela or kankera or kankoda (Rajasthani)
- Ben-pavel or Erimapasel (Malayalam)
- Karchi-balli (Kannada)
- Phagil (Konkani) and some more.

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Only burred gourds of dark color are edible and it is suggested that, to prepare a dish first we have to peel the outer surface of it. It's delicate and easy to digest additionally used as drugs to cure completely different pathological state can be taken in the form of fine-grained or dried, burred gourd's has several health advantages.

Source of phytonutrients: each plant contains completely different chemical compounds. Kantola is low in calories as solely seventeen cal per 100g packed with completely different nutrients like dietary fiber, minerals, vitamins and anti-oxidants.

Useful for pregnant women: during pregnancy the physiological state, several essential things will arise. One among the issues is ectoblast defects. Contemporary pods of Kantola supply folates (Vitamin B, C), that is crucial for cell growth and replica. If pregnant mothers intake Kantola in their meals throughout their pregnancy then it reduces the possibility of ectoblast defects as Kantola has seventy two mcg/100g of folates.

Reduce glucose level in diabetic patients: Phyto-nutrient, polypeptide-P and plant hypoglycaemic agent helps to scale back the glucose levels. Kantola is made in Phyto-nutrient, polypeptide-P, plant hypoglycaemic agent and charantin that boosts the polyose synthesis within the cells of liver, muscle and animal tissue. Combined result of these compounds can facilitate to scale back the amount of glucose to treat type-2 polygenic disorder.

Reduce the probabilities of cancer: one of the causes of cancer is presence of excess poisonous free radicals in our body. Burred gourd supplies vitamin-C referred as superb natural inhibitor. Vitamin-C hunts down excess poisonous free radicals from our body to scale back the probabilities of cancer.

Work as anti-aging: Kantola additionally has completely different benefiting flavonoids like provitamin A, alpha-carotene, lutein, and zeaxanthins that square measure referred to as protecting scavengers against element-derived free radicals and reactive oxygen species of these compounds can assist you to appear younger by operating because the anti-aging compound. It helps you to stay your skin healthy.

Improve eyesight: It additionally contains A that is crucial for the great vision. Within the season of kantola, we can take it in our food to enhance your vision.

Treat fever and atrophy problem: Boil leaves of Kantola vascular plant in water. Add one tbsp of raw honey and drink it to induce relief from atrophy. You'll additionally drink this mixture to treat fever caused by microorganism.

Home remedy to cure piles: within the malady of hemorrhoids or piles, you'll use burred gourd as drugs to induce relief from piles. Prepare powder of kantola. Take five gms of kantola powder and five gms of sugar twice a day to cure piles.

Reduce excess sweating (Hyperhidrosis): If you're feeling embarrassed by downside of excess sweating then, you'll use kantola to induce relief from the sudation. Take tub with the fine-grained burred gourd. Use it as natural scrub. It'll scale back the formation of excess dangerous odor sweating additionally it offers you sleek skin.

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Treat Coughing: Coughing is that the common downside that seen within the kids and adults due to instant change in the climate or virus and bacteria. If you'll take three grams of fine-grained kantola thrice a day with water to manage the non-stop coughing.

Give relief in respiration problem: fog and pollution etc causes respiration issues in our day to day life for which if we will consume burred gourd it will cure respiration issues. Combine 250-500 milligrams of kantola's root powder with one tsp ginger juice and one tbsp of honey and consume it to induce instant relief in any kind of breathing downside.

Remove urinary organ stones: If any individual is suffering from urinary organ stones, then he/she will get relief from urinary organ stones by consuming kantola for which add ten grams of fine-grained kantola in one glass of milk or water and drink it daily to get rid of urinary organ stones of urinary organ and bladder.

Improve digestion: It contains fibers that may facilitate to stimulate the digestion. Burred gourd additionally helps to cure constipation.

How to use Kantola:

Only green colored kantola is edible and used as vegetable. The skin packs loads of nutrients and thus shouldn't be removed. Avoid the use of ripen kantola.

Nutritional values of Kantola:

Edible kantoal fruit contain 84.1% moisture, 7.7 g carbohydrate, 3.1 g protein, 3.1 g fat, 3.0 g fiber and 1.1 g minerals. It also contained small quantities of essential vitamins like ascorbic acid, carotene, thiamin, riboflavin and niacin. It also content protein in the leaves and dry weight of aerial plant parts remained higher in male as compared to female defruited, and monoecious plants. From Momordica dioica fruit isolated 6-methyl tritriacont-50on-28-of and 8- methyl hentracont-3-ene along with the known sterol pleuchiol. Momodicaursenol, an unidentified pentacylic triterpene isolated from the seeds, has been identified as urs-12, 18(19)-dien-3 beta-ol on. The presence of trace alkaloids and ascorbic acid in kantoal fruit is confirmed by phytochemical tests. Presence of glycosides, lectins, b-sitosterol, saponins, triterpenes of ursolic acid, hederagenin, oleanolic acid, aspiranosterol, stearic acid, gypsogenin, two novel aliphatic constituents. Three triterpenes and two steroidal compounds have been isolated from the dry root of Momordica dioica.

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The idea behind the development of Krishi Embassy for enhancing the farmer's income and satisfaction of the consumers

Article id: 21712

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INTRODUCTION:

The half of the Indian population is dependent upon agriculture and allied sectors like animal husbandry, fisheries etc. directly or indirectly. India is one of the leading producer and exporter of many agricultural commodities. The diversity in climatic conditions in India favours the growth and development of a huge range of agricultural and horticultural crops. India has become a food sufficient country post green revolution. As the agricultural sector is growing but the income returns to the farmers is not boosting concomitantly. The main problem is that the procuring policies, even though the minimum support prices are assured, but still farmer used to sells the product to their own trusted sources as they finance them during their needs. In this ways, the income which farmer fetches remains low and the real profit is earned by the middle handlers.

How a farmer can fetch more income?

The government should adopt strong procurement procedures for agricultural produce by studying consumer behaviour located at a farther distance from the source of the origin of a particular agricultural commodity.

Why study consumer behaviour?

The best example is just to analysis the market. The Kinnow, a type of Mandarin is grown highly in Punjab and an adjacent part of Rajasthan. The average price of Kinnow during the season remains nearer to 5 to 10 rupees per kg in that region. But the consumer located in Delhi is also having interest in Kinnow and paying the price nearer to 50 rupees per kg. But if you see it's an overnight journey from that region to Delhi but the increment in price is huge. So who is an advantage, neither the farmer nor the consumer but the middle handler? In the same way, the government should study the consumer behaviour throughout the country for particular famous commodities, whose consumption is favoured at distant locations.

An innovative idea of Krishi Embassy:

Firstly, I should take to you a tour of the famous agricultural commodities in India. Kinnow of Punjab and Northern Rajasthan, Litchi of Bihar, Tea of Darjeeling, Mango verities of Uttar Pradesh, Mangosteen of Tamil Nadu, Apples of Himachal Pradesh, Dry fruits of Jammu Kashmir, Saffron of Jammu Kashmir, Flowers from Hosur of Southern India, Basmati rice of Trans-Gangetic plains etc. are many examples of

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famous agriculture commodities whose consumer is located in the source of origin and also at distance from the source of origin. But what happens actually is, when you go to Muzaffarpur of Bihar, where you can buy 100 pieces of litchis in 10 rupees but when you to the parts of Rajasthan where people also love litchis, the cost is 100 rupees for 10 litchis. Excluding the transportation cost, the increment in price is huge. In this condition, the farmer is not satisfied as he got just 10 rupees, while the consumer is also not satisfied he paid 100 rupees, but the whole advantages are circumventing around middle handlers. So there is an immediate need to search for alternative routes, where farmers can fetch high income and consumer can pay the low but reasonable price for their produces.

Here I propose the idea of the development of Krishi Embassy in a particular state for the fair acquisition of the agriculture produce, and sending them to Krishi Embassy of another state for the circulation of the agriculture produces to the consumers. This idea can block the excess middle handlers which are the main reason behind the abrupt increment in the prices. The idea will provide the farmer with a good income, while at the same time the burden of the consumer will also reduce.

How to develop Krishi Embassy?

Like, if Bihar state is the best producer of litchi fruits, but the consumer of Rajasthan, Punjab and Haryana also favours this fruits, then these state can open their Krishi Embassy centres in Bihar, where the government official will directly buy these fruits through the farmer based on the consumption limits for their region. In this way, they will pay more to the farmers and will send their fruits to the Krishi Embassy centre of their own states, where from the traders will buy it for selling in the local markets.

SUMMARY:

The Krishi embassy idea will create the transparency in procurement, transportation and selling of agricultural produces with the same time blocks the interfere of the middle handler and stocking of the agricultural produces by the large traders.

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Climate change: Threat to agriculture

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INTRODUCTION

Climate change, periodic modification of Earth's climate brought about as a result of changes in the atmosphere as well as interactions between the atmosphere and various other geologic, chemical, biological, and geographic factors within the Earth system. Climate change is any significant long-term change in the expected patterns of average weather of region (or the whole Earth) over a significant period of time. It is about non-normal variations to the climate, and the effects of these variations on other parts of the Earth. These changes may take tens, hundreds or perhaps millions of year. But increased in anthropogenic activities such as industrialization, urbanization, deforestation, agriculture, change in land use pattern etc. leads to emission of green house gases due to which the rate of climate change is much faster.

The changes in climate parameters are being felt globally in the form of changes in temperature and rainfall pattern. The global atmospheric concentration of carbon dioxide, a greenhouse gas (GHG) largely responsible for global warming, has increased from a pre-industrial value of about 280 ppm to 387 ppm in 2010. There is also a global trend of an increased frequency of droughts as well as heavy precipitation events over many regions. Cold days, cold nights and frost events have become less frequent, while hot days, hot nights and heat waves have become more frequent. It is also likely that future tropical cyclones will become more intense with larger peak wind speeds and heavier precipitation. Overall, the temperature rise is likely to be much higher during the winter (*Rabi*) rather than in the rainy season (*Kharif*). It is projected that by the end of the 21st century, rainfall over India will increase by 10-12% and the mean annual temperature by 3-5°C.

Climate change scenarios include higher temperatures, changes in precipitation, and higher atmospheric CO_2 concentrations. There are three ways in which the Greenhouse Effect may be important for agriculture. First, increased atmospheric CO_2 concentrations can have a direct effect on the growth rate of crop plants and weeds. Secondly, CO_2 induced changes of climate may alter levels of temperature, rainfall and sunshine that can influence plant and animal productivity. Finally, rises in sea level may lead to loss of farmland by inundation and increasing salinity of groundwater in coastal areas.

1. Climate change impacts on water availability

It is known that water resources play a vital role in human prosperity and crop productivity. The world's agriculture, hydroelectric power and water supplies depend on different components of the hydrological cycle, including the natural replenishment of surface and groundwater resources (Cuculeanu, 2002).

2. The greenhouse effect and climatic extremes

Concentrations of carbon dioxide (CO_2) in the atmosphere have increased from pre-industrial levels of about 270 µmol mol^{-1} to current concentrations of 360 µmol mol^{-1}. Increases in greenhouse gases in the atmosphere, such as CO_2, methane and nitrous oxide, are predicted to result in a rise in mean

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temperatures of 2–3°C by the year 2050 and even by as much as 4.5°C by 2100 AD together with more frequent episodes of water deficit and higher temperature events.

In the future it is thought that the increase in CO_2 and other greenhouse gases will cause an increase in global mean temperature, with larger increases at high latitudes than elsewhere and larger increases during winter than summer.

2.1. The effect of elevated CO_2 and climatic extremes on plant growth

2.1.1. Plant structures: leaves and roots

CO_2 enrichment of the air in which crops grow usually stimulates their growth and yield. Plant structure and physiology are usually markedly altered; this includes increased leaf expansion and cell wall extensibility and often cell turgor pressure, leading to increased leaf and root growth. If increased turgor pressure is alone insufficient to account for increases in leaf growth under elevated CO_2, then cell wall relaxation (extensibility), cell division or both may also be affected.

Simplistically, scientists have suggested that increased leaf size, if associated with larger cells, suggests that cell expansion has been stimulated, whilst increased leaf size, if associated with more cells, suggests that cell division has been stimulated.

2.1.2. Seasonal growth

Contrasting seasonal growth responses to elevated CO_2 and temperature in certain species suggests that pasture management may change in the future.

The grazing season may be prolonged, but whole-season productivity may become more variable than today. This is shown by studies of perennial ryegrass where, in spring, increased leaf extension occurred in elevated CO_2 whilst in summer it was reduced. In high temperature it was reduced in both seasons.

In elevated $CO_2 \times$ temperature, leaf extension increased in spring, whilst in summer it decreased. Many organisms are near their tolerance limits and some may not be able to persist under hotter conditions. Higher temperatures in arid regions with cold winters may mean spring growth occurs earlier. Water reserves gained during the winter may, in some cases, be depleted earlier.

2.1.3. Change in Photosynthetic activity

Plant growth and crop yields depend on temperature and temperature extremes. The optimum range for C3 crops is 15–20°C and for C4 crops it is 25–30°C. The variation in temperature requirements and temperature extremes of different cultivars of the same species, and among species, is quite wide for most crops. C3 plants are sensitive to higher CO_2 and typically respond with an increase in photosynthesis and growth, whilst C4 plants don't respond so dramatically. Typically, field-grown crops, such as winter wheat, carrot, cauliflower and onion, have been shown to increase leaf area and biomass during early crop growth under elevated CO_2 conditions compared with ambient conditions.

2.1.4. Effects on yield and phenology

Crop yields were greater under elevated CO_2, but warmer temperatures reduced the duration of crop growth and, hence, the yield of determinate crops such as winter wheat and onion; but the yield of carrot, for example, an indeterminate crop, increased progressively with temperature (Wheeler *et al*., 1996).

2.1.5. High CO_2 makes crops less nutritious

Scientists generally predict that crop yields could fall in a warmer world though higher atmospheric CO2 by itself should raise yields, as

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plants find it easier to extract CO2 from the air to make carbohydrates. The effect climate change might have on the nutritional value of crops, as opposed to their yield, has been even murkier. Previous studies have given conflicting results. In the largest study yet, Samuel Myers of Harvard University and colleagues report that the CO2 levels expected in the second half of this century will likely reduce the levels of zinc, iron, and protein in wheat, rice, peas, and soybeans. Some two billion people, the researchers note, live in countries where citizens receive more than 60 percent of their zinc or iron from these types of crops. Deficiencies of these nutrients already cause an estimated loss of 63 million life-years annually.

3. Rise in global mean temperature

Through global warming, an anticipated increase in temperature can potentially have various effects, e.g. pikelet sterility in rice, reversal of vernalisation in wheat, reduced formation of tubers in potatoes, loss of pollen viability in maize. Yields can be severely affected if temperatures exceed critical limits for periods as short as 1 h during anthesis (flowering). Flowering is a very important event in crop development, as it is a phase which is particularly vulnerable to environmental stresses (Roberts *et al*., 1993). It is thought that extreme temperatures are more important than average temperatures in determining plant responses. Crop yields are affected by net primary productivity and also by the phenology of crop development. Increased temperature can speed phenological development, reducing the grain-filling period for crops and lowering yield. In terms of temperature, a 12-day period of high temperature stress close to anthesis reduced spring wheat root biomass from 141 to 63 g m^{-2} (Ferris *et al*., 1998) by the end of the elevated mean temperature period, whereas mean temperatures over the treatment period had no effect on either above-ground biomass or grain yield at maturity. Interestingly, it was increasing maximum temperatures over the mid-anthesis period which was related to a decline in the number of grains per ear at maturity. Grain yield and harvest index also declined sharply with maximum temperature. This study suggested that high temperature extremes may reduce yields considerably.

IMPACT OF CLIMATE CHANGE ON INDIA'S AGRICULTURE

India's agriculture is more dependent on monsoon from the ancient periods. Any change in monsoon trend drastically affects agriculture. Even the increasing temperature is affecting the Indian agriculture. Increase in CO2 to 550 ppm increases yields of rice, wheat, legumes and oilseeds by 10-20%. A 1oC increase in temperature may reduce yields of wheat, soybean, mustard, groundnut, and potato by 3-7%. Much higher losses at higher temperatures. Productivity of most crops to decrease only marginally by 2020 but by 10-40% by 2100 due to increases in temperature, rainfall variability, and decreases in irrigation water. The major impacts of climate change will be on rain fed or un-irrigated crops, which is cultivated in nearly 60% of cropland. A temperature rise by 0.5oC in winter temperature is projected to reduce rain fed wheat yield by 0.45 tonnes per hectare in India (Lal *et al*., 1998). Recent studies done at the Indian Agricultural Research Institute indicate the possibility of loss of 4-5 million tons in wheat production in future with every rise of 1°C temperature throughout the growing period. Rice production is slated to decrease by almost a tonne/hectare if the temperature goes up by 2°C. In Rajasthan, a 2°C rise in temperature was estimated to reduce production of Pearl Millet by 10-15%. If maximum and minimum temperature rises by 3°C and 3.5^{o}C respectively, then soybean yields in M.P will decline by 5.

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CONCLUSION

Climate change, the outcome of the "Global Warming" has now started showing its impacts worldwide. Climate is the primary determinant of agricultural productivity which directly impact on food production across the globe. Agriculture sector is the most sensitive sector to the climate changes because the climate of a region/country determines the nature and characteristics of vegetation and crops. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield. Food production systems are extremely sensitive to climate changes like changes in temperature and precipitation, which may lead to outbreaks of pests and diseases thereby reducing harvest ultimately affecting the food security of the country.

"Rising global CO2 increases yield and decreases water use by crops, and this is often presented as one positive of atmospheric change," Long says. But the Nature study's "significant" finding suggests that higher-CO_2 environments will mean less nutritional crops, so that "increased quantity is at the expense of quality."

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Adoption of mechanical soil conservation method: A key input to increases crop production and productivity in Arunachal Pradesh

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INTRODUCTION

Adoption of soil conservation measures is a prime necessity to protect the fertile soil from degradation as caused by adverse climatic condition and faulty agricultural practices in Arunachal Pradesh. One general practice observed throughout Arunachal Pradesh is *Jhum* cultivation occupying 1.1 lakh hectare geographical area. *Jhum* is a land-use system where forest and vegetative cover are slashed and burned down for growing crops from rice to wild medicinal plants. The cycle of *Jhum* spans for a period of 10-20 years. However, in the recent past the cycle has reduced to a span of 2-5 years which means deforestation is going to rise at an alarming rate. Land desertification in Arunachal Pradesh accounts for a total 10% of the total geographical area (Garg, 2016). However, this percentage is not constant and has possible change toward desertification due to vegetative degradation. A report states that 669.35 million ton of soil in Arunachal Pradesh is eroded annually at an average rate of 90.9 t ha^{-1} $year^{-1}$ indicating serious threats to soil resources (Pandey, 2016). The region is rich in soil organic carbon (SOC) ranging from 1.5% to 4.86% (Tasung and Ahmed, 2017; Debnath *et al*., 2015; Nadeem, 2015) and soil fertility status range from medium to high (Tasung and Ahmed, 2017: Debnath *et al*., 2015). However, the common observations of large boulder or pebbles deposits in the soil profile make the top fertile soil prone to runoff loss due to landslides and erosion. Arunachal Pradesh is located in the Eastern Himalayas in the Northeast of India. It is the largest state with 83.7 lakh hectares of geographical area. Agriculture is the mainstay of the general population. The area under permanent cultivation is 19 lakh hectares under having 1.97 lakh ha net sown area, gross sown area of 2.40 lakh ha and 122% cropping intensity. The state enjoys five different agro-ecological zones viz., Alpine Zone (34.1%), Mid tropical hill zone (7.8%), Mid tropical Plain zone (11.6%), Sub-tropical Hill zone (20.6%), Temperate Sub-Alpine zone (24.8%) (Bhagawati *et al*., 2011). A span of one decade shows that cereal production like rice increased from 134 MT in 2002 to 255 MT in 2012 while pulse production increased with meager inclination of 7.1 MT in 2002 to 10.5 MT in 2012 and fruit production showed a promising increase from 82.1 MT to 107 MT in 2012 (Roy *et al*., 2014). However, vegetables production across a decade in the state was stagnant at about 83.5 MT from 2002 to 2012 (Roy *et al*., 2014). Therefor, it can be concluded that low cereal, pulses and vegetables production and productivity will not sustain the constant growing population in Arunachal Pradesh in the near future.

Importance and methods of soil conservation

Soil conservation structure primarily hinders the runoff in steep slopes. These structures protection SOC against loss to environment, increase soil fertility and soil productivity, improve soil moisture status, increase crop production and productivity and reduces green house gas emission. Eventually, can double the farmer's income by increasing cropping intensity

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and low consumption of farm input with profitable outputs. Now that we have briefed the importance of taking up soil conservation methods in Arunachal Pradesh, the question arises how it can be done when 80-95% farmers are financially backward? Thus, government has supported many schemes and project to conserve the land and its productivity. However, the best measure to implement soil conservation measures for this region is through community approach as soil conservation structure constructions are labor intensive.

Figure 1: Images of land-use system in the mid hills of Arunachal Pradesh.. A) Pineapple cultivation along the slope. B) Wet land rice cultivation. C) Recently open *Jhum* land. D) Jhum Rice cultivated along the slope.

Though terracing is a tradition practice, it is reserved only to rice crop. Therefore, terracing is equally crucial for horticulture crops in steep slopes are yet to be realized by the farmers. Thus, the feasible and suitable soil conservation structures suitable are:

Contour Terrace: In terracing, a number of terraces are cut along the hill slope. These are made on the steep slopes so that flat surfaces are available to grow crops. They can reduce surface run-off and soil erosion.

Half moon terrace: These are semicircular beds of appropriate diameter with the shape resembling a half moon. These terraces are recommended for fruit trees and other plantation crops on steep slopes.

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Contour bunds: Contour bunds are mechanical barrier built across the slope for safe diversion of excess runoff and retention of eroded soil. It is recommended for all types of crops at 2-7% slope.

Bench terrace: They are flat beds constructed on hills of 16-33% slope across the slope. The height of the riser should not be more than 1 m and the width of the bench terrace depends on the degree of slope. On steep slopes, it is better to construct terraces on foothills for agricultural crops when soil depth is more than 1 m.

Water harvesting ponds: Water harvesting ponds are structures dug out along the slope for retaining runoff water on seasonal and perennial basis. It also checks the speed of water and save soil from erosion.

CONCLUSION

Fertile soils of Arunachal Pradesh need to be preserved and protected from degradation. The land is blessed with huge potential for cultivating temperate to tropical crop but is likely to face low production and productivity due to desertification from erosion and landslides. Therefore, soil conservation measures like building mechanical structures to prevent erosion is apt for the farmers of this region. To avoid the financial load the farmers can make these structures through community approach system which ultimately enhances crop production, productivity and cropping intensity.

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Incorporation of intercrops in sugarcane: "Principles, Opportunities and Methods"

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Our dependence on sugarcane cultivation for sweeteners is increasing day by day as contribution of sugarcane to total sugar production has increased to 75% from 60% during early nineties in India. In view of changing market scenario and consumers' preferences, new income generating opportunities need to be created through crop diversification in sugarcane "Produce to Product Chain". This would help for enhancing the land utilization efficiency, reducing the cost of production and cultivation, economizing the use costly inputs and making plant-ratoon system to ensure sustainability. This in turn raises the socio-economic conditions of small and marginal farmers and provides an opportunity for employment generation especially for rural women and youths. Intercropping, an important strategy of crop production refers to growing of two or more than two crops of generally dissimilar habits simultaneously on the same piece of land in a fixed ratio and definite row arrangement. The recommended optimum plant population of base crop is suitably combined with an appropriate additional plant density of the associated crop and there is crop intensification in both space and time dimensions.

Growth pattern of sugarcane

The initial growth of sugarcane is very slow generally takes about 30-35 days to germinate in spring season (February – March) and even more time in autumn (November). Thereafter, further 100 days are taken to develop full canopy of the plant covering entire inter-row spaces which provide an opportunity to take another crop (short duration like short duration pulses or potato) to utilize this inter row space without affecting the main crop i.e., sugarcane.

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Prospects and opportunities of intercropping in sugarcane system:

Intercropping usually permits more intensive cropping in a crop like sugarcane which have large lateral spread when fully grown, their optimum row spacing is usually 90 cm or more and this vacant space in between the rows can quickly be covered by weeds, which offer severe competition to the main crop. Instead of wastage of these available inter row spaces, intercropping would offer opportunity for profitable utilization of such space while cutting down on the direct cost of cultivation of the main crop by reducing the expenditure on weed control. Intercropping require raising a short duration, quick growing crop in the space left in between rows of sugarcane and the companion crop should require, only that much space which is left unoccupied by the sugarcane crop. Such a situation only could theoretically give an associated growth with zero competition. Sugarcane characteristically widely spaced, initially slow growing, long duration and one time income generating crop, offer ample scope for intercropping with any of the short duration, high value and mid-season income generating crops for nutrition and economic security especially of small and marginal cane growers.

Sugarcane based cropping system has a distinct advantage as it leaves large crop residues like trash, roots, stubble etc. which are heavily fertilized. Basically intercropping in sugarcane is a small farmer technology, whereby the farmer gets additional income for risk management. The intercropping in sugarcane is an additive series and not a replacement series.

There is tremendous scope of increasing area under pulses through intercropping in sugarcane under Indian tropics and subtropics (Table 1). Some of the important intercrops are given in Table 1.

Table 1: Crops suitable for intercrops in sugarcane

	Crops suitable
Tropical belt	Green gram (*Vigna radiata*) Groundnut(*Arachis hypogea*) Blackgram (*Vigna mungo*) Sesame (*Sesamum indicum*) Cowpea (*Vigna unguiculata*) Maize (*Zea mays*) Sunflower(*Helianthus annuus*) Fingermillet (*Eleusine coracana*) Soybean (*Glycine max)* Radish (Raphanus sativus) Coriander(*Coriandrum sativam*) Onion (*Allium cepa)* Okra (*Abelmoschus esculentus*)
Subtropics (Autumn planting)	Potato (*Solanum tuberosum*) Onion (*Allium cepa)* Radish (*Raphanus sativus)* Garlic *(Allium salivum*) Mustard (*Brassica campestris*.)

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	Coriander *(Coriandrum sativam)* Carrot (Daucus carota) Sugarbeet (*Beta vulgaris*) Lentil (*Lens esculentus*) Wheat (*Triticum aestivum*) Linseed (*Linum ustitatissimum*) French bean (*Phaseolus vulgaris*) Peas (*Pisum sativum*) Maize (*Zea mays*) Turnip (*Brassica rapa)* Toria(*Brassica spp.)* Grain amaranth (*Amaranthus* spp.)
Subtropics (Spring planting)	Green gram (*Vigna radiata*) Tomato(*Lycopersicum esculentum*) Blackgram (*Vigna mungo)* Cowpea (*Vigna unguiculata*) Brinjal (*Solanum melongena*) Dhaincha (*Sesbania sesban*)

Source: Verma and Yadav., (1986); Menhi Lal and Singh (2004)

Tips for successful intercropping in sugarcane

- Crop selected for intercropping in sugarcane should be of short duration, short stature, high value, mid-season income generating and eco- friendly
- Selection of the crop varieties should be on the basis of the recommendations for the region/areas.
- There should be sufficient moisture in the upper layer of the soil at sowing time of intercrops. If required, light irrigation should be given before sowing of intercrops.
- Irrigations in intercropping system should be as per the requirement of the intercrop.
- Before selecting an intercrop, scope of marketing the produce should be explored.

Intercropping with autumn planted sugarcane:

Autumn planted sugarcane have a wider spacing of 90 cm or more and bud sprouting is quite late and initial growth rate of crop is also very slow. In general autumn planted sugarcane provides 15-20 per cent more cane yield than spring planted cane but the area remains limited. However, companion cropping of winter pulses may promote autumn planting of sugarcane on account of higher returns and improved resource use efficiency.

Intercropping of sugarcane + potato produces higher yield of component crops over potato - cane system. Intercropping of two rows French bean shows distinct positive effect on sugarcane growth similar to potato in terms of shoot count at grand growth stage. The system appeared to be quite profitable as it promotes French bean yield. Autumn sugarcane intercropped with two rows of lentil receiving

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150 kg N/ha in combination with *Azospirillum* produced highest sugarcane equivalent yield which was however, comparable to sub-optimal dose of 112.5 kg N/ha. These observations indicate that intercropping sugarcane with two rows of lentil could effect a saving of 37.5 kg N/ha. The compatibility of pulses as intercrop in sugarcane for enhancing system productivity has also been documented.

Intercropping with potato

Among oilseed crops, intercropping of mustard (*Varuna*) in autumn sugarcane (1: 1ratio) enhances net return and cane equivalent yield. On the other hand, two rows of mustard *(Pusa Jaikisan*) intercropped with autumn sugarcane are also high yield providing system.

Intercropping with spring planted sugarcane:

It is estimated that about one million hectare additional area can be brought under pulses by intercropping green gram and blackgram in spring planted sugarcane especially in UP, North Bihar, Punjab and Haryana. Experiments conducted at Lucknow reveal that out of 5 genotypes of green gram, minimum loss of cane yield is due to genotype PDM-11 and PDM-84-139 (4-5%). Among dual purpose legumes, the highest net monetary return works out for sugarcane + green gram (K- 851 for grains) system followed by sugarcane + cowpea (*Pusa Komal* for green pods). After picking green pods for vegetable and/or mature pods for grains, the legume plants with longer leaf area duration are incorporated in the soil between the inter-row spaces of sugarcane as green manure. These systems effect nitrogen economy in sugarcane to the extent of 35-40 kg/ha besides producing bonus yield of pulses. The compatibility of intercrops varies with the row arrangements and genotypes selected as intercrop in the system.

Sugarcane based intercropping system involving *Sesbania sesban* at high density in spring planted cane effectively controls weed population and its *insitu* turning exhibits allelopathic effects on germination of *Cyperus rotundus* nuts, besides correcting nutritional imbalances.


Intercropping with green gram

Agro-techniques for wheat – sugarcane system (late planting)

Simultaneous planting of sugarcane + wheat compensates the crop yield over wheat-sugarcane sequence necessitating late planting of cane. Companion cropping involving sugarcane in furrows and wheat (3 rows) on ridges holds promise to increase the land use efficiency both in space and time.

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Sugarcane ratoon based intercropping systems:

Failure of subterranean bud sprouting in winter harvested plant cane is the major constraint in ratooning. The problem is more acute in high sugar early maturing varieties. The management strategy lies in keeping the metabolic activities of stubble buds alive till the commencement of favourable temperature regime. Introducing early bulking high density intercrops *(berseem, shaftal and senji)* may help to mitigate the problems associated with winter-initiated ratoon. Moreover, intercropped forage legumes serve as live much, regulate the rhizospheric thermal regime through root respiration, protect stubble buds from frost damage and encourage the sprouting of subterranean buds during spring.

Intercropping of sugarcane + wheat:

Wheat-Sugarcane–Ratoon–Wheat is the most important cropping system, which has attracted the attention of the scientists and development workers in recent years. It is estimated that approximately 3 Lakh hectares (14%) of sugarcane area in India is under this system. The importance of the system lies in the fact that more than 60% of the sugarcane area in western U.P. and 10- 14% in other states is covered by this system. A drastic reduction (30-50%) in sugarcane yield is a common feature when the sugarcane is planted late (summer-April end to May end) after the harvest of the wheat crop. High to very high temperature at planting and germination time, low humidity, over mature seed cane, little time for tillering, heavy infestation of weeds and insect-pests are the major factors responsible for poor cane yield. The recent approaches for the management of this system include simultaneous planting of sugarcane and wheat (taking wheat as reference crop) and Wheat + Sugarcane under Raised Beds.

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Entomopathogenic nematodes and it's potential as a suitable biocontrol agent of insect-pest of agricultural crops

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INTRODUCTION:

The Entomopathogenic nematodes (EPNs) are used enormously in various classical and augmentative biocontrol programs related to the management of insect pest of agricultural crops. In the world, the field success and failures of uses of entomopathogenic nematodes (EPNs) are documented. If used properly and in a suitable environment, these nematodes are the best choices to overcome the pest issues related to agricultural and horticultural crops. These nematodes carry the symbiotic bacteria in their gut and upon reaching to the insect's midgut, these bacteria are released. The bacteria is responsible for the death of the insect because of its toxins.

Entomopathogenic nematodes and its associated bacteria

Nematode vector	Associated Bacteria species
Heterorhabditis spp.	*Photorhabdus* spp.
Steinernema spp.	*Xenorhabdus* spp.

Role of nematode partner:

The infective juveniles of these nematodes act as a vector, which carries bacteria to the insect's midgut. In this way, the nematode provides shelter to the bacteria. The new generation of juveniles feeds of mother carcass and develop inside it, the term is commonly known as *endotokia matricida*.

Role of bacteria partner:

The bacteria partner perform three major tasks inside the host, firstly it releases the toxin to kill the host, then it produces the digestive enzymes to convert the host tissues into a growth medium and finally, it secrets antibiotic, which inhibit the growth of secondary soil pathogens on the dead cadaver.

Why choose entomopathogenic nematodes?

The major challenging issues i.e. advancement of pesticidal resistance in insects, the ill effect of pesticides on beneficial predator and parasitoid insects and the eco-safety concern are advocating the crop protectionist to search for alternative methods. In this perspective, the entomopathogenic nematodes found suitable as a natural insect's killer.

Status of entomopathogenic nematodes in India:

The research related to the entomopathogenic nematodes was initiated in the early 1960s, but the growth was boosted in the late 1990s. From India, two nematode species namely *Heterorhabditis indica* and *Steinernema thermophilum* was described in the year 1992 and 2000 respectively. Later on various trials were run against many various insect pests of agricultural crops.

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Broad-spectrum activity of entomopathogenic nematodes:

Unlike the *Bt* crystal gene which is species-specific in nature and has limited management activities, the entomopathogenic nematodes are found effective against almost 23 orders on insects, which clearly defines its broad-spectrum activity.

Potential of EPNs in insect management:

The EPNs have a wide potential in biocontrol management, as these are safe to the ecosystem and do not contaminate the aquatic and terrestrial ecosystem. These nematodes can be efficiently integrated with the other management technologies thus found to be a suitable component of IPM. Even the researcher has reported the compatibility of these nematodes with various nematicides. If needed it can be used with a piece of proper advice from the crop protectionist for it combines application doses and delivery methods.

The technical constraints related to entomopathogenic nematodes:

In spite of carrying the huge potential to become a chief biocontrol agent, the applications of these nematodes are still marginalized. The main reason behind that is lack of the skilled researcher and research infrastructure facilities, lack of effective products, improper way of delivery of nematodes in the field, lack of technical advisories and poor knowledge among farmers.

Role of extension worker:

The extension worker should be trained with the knowledge and skills related to the handling of entomopathogenic nematodes via method demonstration or via short term training. The crop protectionist and extension worker would have collaborated with each other for spreading the knowledge and beneficial role of entomopathogenic nematodes.

SUMMARY:

The entomopathogenic nematodes are the best example of successful biocontrol management approaches. The native strain of nematodes is found much effective against the pest of native region. These nematodes can be included in organic farming as a component or also can be integrated into IPM. The researchers are still limited, which has to be boosted for the development of stable EPNs products.

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Phytohormonal signaling and crosstalk mediated biotic stress responses in plant

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INTRODUCTION

Seed plants have evolved a set of sophisticated mechanisms to respond to diverse exogenous and endogenous stimuli to promote their survival under stress environment. As sessile organisms, plants have developed specific mechanisms that allow them to rapidly perceive and respond to stresses in their respective environments. Plants respond to this situation by a series of developmental and metabolic adaptations that are aimed at increasing the possession of vital nutrient from the soil, as well as to sustain plant growth and survival. Tolerances of plants to various biotic stresses are triggered by complex multicomponent signaling pathways to restore cellular homeostasis and promote fitness. The development of a comprehensive understanding of how plants sense deficiency and coordinate the responses via signaling pathways is of major interest, and a number of molecular players and networks have begun to surface for the regulation of the biotic stress response. Biotic stresses trigger many biochemical, molecular, and physiological changes and responses that influence various cellular and whole plant processes (Wang *et al*., 2003). In order to this, the article will emphasize the molecular mechanisms conserved among different hormone signaling pathways, and their cross-talks playing decisive role in plant defense.

Role of phytohormones in growth and development of plants

Plant growth and development involves the integration of many environmental and endogenous signals that, together with the intrinsic genetic program, determine growth and development of plants. Fundamental to this process are several growth regulators collectively called the plant hormones or phytohormones. This group includes auxin, gibberellins (GAs), cytokinin, abscisic acid (ABA), ethylene, brassinosteroids (BRs), and jasmonic acid (JA), each of which acts at low concentrations to regulate many aspects of plant growth and development. A single hormone can regulate an amazingly diverse array of cellular and developmental processes, while at the same time multiple hormones often influence a single process. Well-studied examples include the promotion of fruit ripening by ethylene, regulation of the cell cycle by auxin and cytokinin, induction of seed germination and stem elongation by GA, and the maintenance of seed dormancy by ABA. Historically, the effects of each hormone have been defined largely by the application of exogenous hormone. To elucidate the molecular mechanisms underlying phytohormone action, several researchers have utilized the genetically facile model plant *Arabidopsis thaliana* to isolate mutations that confer altered response to applied hormone. This has prompted investigation into molecular control of signal transduction, phytohormonal action, homeostasis and plant growth in response to developmental and environmental stimuli.

Regulatory role of phytohormones in response to biotic stress

Plants have developed defence signaling system to protect themselves from invading pathogens. Plant hormones such as SA, JA, and ethylene act as signals to trigger and mediate a diverse array of defense responses. The signaling pathways of ABA, SA, JA and ET are known to interact among themselves at various nodes, such as hormone-responsive transcription factors to regulate plant defense response (Lorenzo *et al*. 2003). Other hormones such as ABA, Auxin, GA, Cytokinins, and Brassinosteroids, also play vital roles in defense against pathogens. Fungal elicitors can activate a branch of the ABA signaling pathway in guard cells that regulates plasma membrane Ca^{2+} channels. Moreover, a battery of studies examining the induction of resistance by the non-protein amino acid *b*-aminobutyric acid revealed that ABA considerably enhances plant resistance to fungal pathogens through its positive effect on callose deposition

Hormonal crosstalk in plant defense during pathogen attack

Different plant hormones such as SA, JA, ethylene and ABA trigger the diverse array of defense responses. These hormone signaling pathways interconnect in an antagonistic or synergistic manner, providing plants with a vast regulatory potential to adapt rapidly to their biotic environment and to use their limited resources for growth and survival in a cost efficient manner. However, it is noteworthy that whole plant adaptation and sustained growth are the key features of a proper defense response under stress conditions. The defense responses activated in plants in response to different stresses depends on the type of crosstalk (positive or negative) between the hormone signaling pathways rather than solely on the individual contributions of each hormone (Figure: 01). However, the molecular details of such phytohormone interaction remain largely unknown till date. Understanding the crosstalk between phytohormonal and defense signaling pathways is thus important, as it may reveal new potential targets for the development of host resistance mechanisms and phytohormones.

Recent studies have implicated an important function of gibberellins (GAs) in mediating JA signaling in both stress responses and plant development. DELLAs, known as plant growth repressors whose degradation is promoted by GA, confer plants elevated resistance to necrotrophs via potentiating JA signaling, whereas they attenuate salicylic acid (SA) signaling to make plants more vulnerable to biotrophs, suggesting a role of DELLAs in modulating the balance of JA and SA signaling in response to pathogen stress (Navarro *et al*., 2008). In addition, GA has also been found to promote JA biosynthesis through DELLAs to control the expression of MYB genes.

Although these observations have suggested the crosstalk between GA and JA signaling in pathogen interaction and plant development, the detailed molecular mechanisms by which DELLAs modulate JA signaling still remain mysterious. As putative transcriptional regulators, DELLA proteins have been shown to interact with bHLH-type transcription factors to coordinate the effect of light and GA on plant development. The signaling pathways of SA and JA are known to intersect at various points because SA and JA regulate biotic stress responses antagonistically. This antagonistic relation was first reported in tomato, where JA-related wound response was inhibited by aspirin, an acetylsalicylic acid drug.

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Studies have shown NPR1 to be a key player in the antagonistic crosstalk of SA and JA. The SA-facilitated suppression of JA-responsive genes like LIPOXYGENASE 2 (LOX2), VEGETATIVE STORAGE PROTEIN (VSP), and PDF1.2 was abolished in npr1 mutant plants. Genetic studies had implicated ethylene and JA hormones as important regulators of pathogen defense responses, as well as of the wounding response and other stress-related pathways. The ERF1 transcription factor is found to be an intersection point for these two signaling pathways (Lorenzo *et al*. 2003). Like ethylene, JA rapidly induces ERF1 expression, and treatment with both hormones synergistically activates ERF1. Induction of ERF1 by both hormones alone or in combination is dependent upon both signaling pathways.

Molecular signaling during biotic stress response

While it has long been obvious that hormones do not function in discrete pathways, but rather exhibit extensive cross-talk and signal integration with each other and with environmental and developmental signaling pathways, the molecular basis for such coordinated regulation has been unclear. However, the overlap between hormone-regulated gene suites during the adaptive responses of plants to these stresses suggests the existence of a complex network with extensive cross-talk between the different hormone signaling pathways as shown in figure: 01. Phytohormones such as salicylic acid (SA), jasmonic acid (JA), ethylene (ET), and abscisic acid (ABA) are endogenous, low-molecular-weight molecules that primarily regulate the protective responses of plants against biotic stresses via synergistic and antagonistic actions, which are referred to as signaling crosstalk. Several recent findings have begun to elucidate the molecular details of some of these events. Auxin acts as a significant constituent engaged in defense responses via regulating the expression of a great number of genes and mediates molecular crosstalk during stress responses (Hagen and Guilfoyle, 2002). Moreover, the generation of reactive oxygen species (ROS) has been proposed as a key process that occurs during biotic stress responses.

- **ROS: A common signal to trigger downstream stress responses**

The tight regulation of the steady-state levels of ROS is involved in multiple cellular processes in plants. Some ROS species are toxic byproducts of aerobic metabolism, whereas ROS also function as signaling molecules. Rapid ROS production plays a pivotal role in both ABA signaling and disease resistance responses. ROS represent a significant point of convergence between pathways that respond to biotic stresses. Nevertheless, our current understanding of ROS participation in crosstalk between these pathways is very limited. Thus, dissecting the genetic network that regulates ROS signaling in response to biotic stress needed further extensive study.

- **Protein Kinase Phosphorylation cascades**

Different kinase cascades are involved as cross-talk points in hormonal networks during various stress conditions. These transduction cascades lead to the regulation of gene expression that directly affects the biosynthesis or action of other hormones. In plants, the MAPK cascade plays a crucial role in during biotic stress responses and in hormone responses that include ROS signaling. Major plant transcription factor families such as bZIP, NAC, AP2/ERF, and MYB coordinate regulatory networks underlying biotic stress tolerance. The WRKY 70 transcription factor is also a key component mediating the antagonistic interaction between the two hormones.

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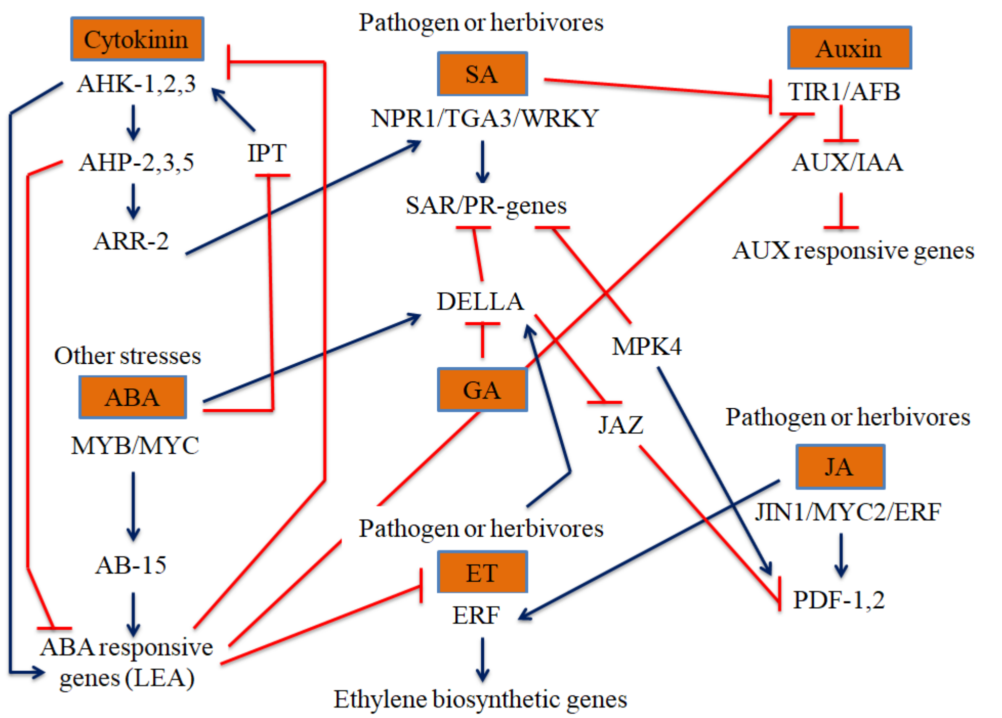

Figure 1: Phytohormonal signaling and cross talk occurs during biotic stress tolerance.

CONCLUSION

From the foregoing discussion it is clear that plants utilize elaborate signaling pathways in response to numerous biotic stresses. In addition to other small molecules such as Ca^{2+} and ROS, plant hormones trigger specific signal cascades upon stress perception. The fluctuations in several key hormone levels such as ABA, ET, SA and JA occur as early responses to stress. These affect metabolic processes that ultimately results in an altered growth pattern suitable for withstanding the biotic stress conditions. Recent research findings have helped to clarify the elaborate signaling networks and the sophisticated crosstalk occurring among the different hormone signaling pathways. Such crosstalk helps to integrate various stress signal inputs and allows plants to respond to them appropriately. The readjustment of growth, responses and acquisition of enhanced levels of tolerance to the stresses are keys to the survival of plants. At the molecular level, these are facilitated by the presence of multiple signal intermediates for each hormone and their ability to crosstalk at various signaling levels. Thus, the complex web of crosstalk among the often redundant multitudes of signaling intermediates is still emerging and expected to be better understood in near future.

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Sulphur & Zinc: Essential nutrients for quality production of oilseed crops

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INTRODUCTION

India is the fourth leading oilseeds producing country in the world, next only to the USA, China, and Brazil, harvesting about estimated at 32.10 million tonnes of oilseeds per annum, grown in an area of nearly 26.2 Mha with an annual average yield of 1225 kg ha^{-1}. in year of 2016-17 (Anonymous, 2018*).* India is rich in vegetable oil resources where oil is extracted from nine oilseed crops (groundnut, sesamum, rapeseed mustard, niger, castor, linseed, sunflower, soybean and safflower and several tree species. In the country, oilseed crops mostly growing in dry-land and rain-fed area. Therefore, yield and quality of oil are approximately low resulting by those areas and the deficiency of sulphur and zinc in soil. Aside from that low fertility, rainfed satuation and abnormal condition of weather are gives more adverse affects on the productivity of oilseed crops. So, sulphur is provides key role in the overcome or defeat of these satuation with high produce. Sulphur is one of the 17 essential plant nutrients, it is essential for growth and development of all oilseed crops as well as some cereals. Oils and fats are more essential parts of human diet, serves as important raw material for manufacture of lubricants, textiles, soap, hair oils, varnishes, paints, pharmaceuticals, etc. Oilcakes are used in animal feeds, fisheries and as manures.

Table.1 The crop wise average production of nine major oilseeds during (2016-17)

S. No.	Crops	Production in million tonnes
1.	Groundnut	7.56
2.	Castor	1.42
3.	Sesame	0.78
4.	Nigerseed	0.08
5.	Rapeseed & Mustard	7.98
6.	Linseed	0.15
7.	Safflower	0.08
8.	Sunflower	0.24
9.	Soybean	13.79
Total Oilseeds		32.10

Sources: Annual report (2017-18), Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare,Government of India.

Sulphur and Zinc Deficiency

The available Zn in Indian soils ranges from 0.01 to 52.9 mg kg^{-1}. It constitutes less than 1% of the total Zn content. Currently 36.5% of soil samples across the country are deficient in available Zn; about 8, 29 and 15% area of the country is suffering from acute deficiency, deficiency and latent deficiency of Zn, respectively. Acute Zn-deficient soils are intensively cultivated ones characterized by coarse texture (sandy/ loamy sand), high pH (> 8.5 or alkali/ sodic soils) and/or calcareousness, and low soil organic

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carbon (< 0.4%) content (Shukla *et al.,* 2014). Zinc deficiency witnessed a decline from 46% in 1967-1987 to 36.5% in 2011-2017 due to regular and higher use of Zn fertilizer in some parts of the country. Interestingly, based on periodic Zn deficiency data from 1967 to 2000, Singh (2009) had predicted that Zn deficiency would rise up to 63% by 2020-25. Zinc deficiency disorders are known by different nomenclatures like khaira disease in rice, rosetting in wheat, white bud in maize, little leaves and mottling in vegetables, and reduced fruit formation in citrus.

The continuous mining of nutrients from soils coupled with inadequate and imbalanced fertilizer use has resulted in emergence of multi-nutrient deficiencies. Mainly at least six nutrients (N, P, K, S, Zn and B) were observed deficient in Indian soils. Sulphur is the fourth essential nutrient after N, P, and K in oilseed crops. Zinc deficiency in oilseed crops causes typical symptoms; however, up to 50% reduction in crop growth can result due to Zn deficiency without the appearance of visual symptoms. Zinc deficiency symptoms common to many crops normally appear in four-week-old plants on older and emerging leaves. Sulphur and zinc deficiencies in oilseed crops are given below in Table 2 and Table 3, respectively.

Table 2: Sulphur Deficiency Symptoms on Major Oilseed Crops

Crops	Deficiency Symptoms
Rapeseed-Mustard	Deficiency symptoms first occur on younger leaves. Chlorosis of leaf margins, development of purple pigmentation. Inward curling of young leaf lamina giving rise to a cupped appearance followed by scorching and withering.
Groundnut	Stunted growth, and general yellowing of plants. Delay in maturity. Acute sulphur deficiency causes the entire plant turn to yellow.
Sunflower	Yellowing spreads from the base to the apex. Growth of plants is reduced. The size of capitulum is severely restricted. Inflorescence may remain covered within the bracts. Maturity of flowers is often delayed.
Sesame	Growth is retarded, leaves are smaller and fully emerged leaves first turn pale and then golden yellow. Number of flowers and pods are reduced; hence yield is reduced.
Canola	Younger leaves are lime-green, often with interveinal chlorotic mottles and pale leaf margins. Leaves are cupped or roll inwards and become thickened and crisp and brittle.

Table 3: Zinc Deficiency Symptoms on Major Oilseed Crops

Crops	Deficiency Symptoms
Rapeseed-Mustard	The interveinal areas of the sub-terminal leaves develop light brown necrotic patches.
Groundnut	Light green yellow or bleached spots in interveinal areas of older leaves. The emerging leaves become smaller in size and often termed as “little leaf”. Inter-nodal distance becomes too short so that all leaves appear to come out from the same point, and is termed as “rosetting” at early stage.
Sunflower	Deficiency symptoms first appear on middle leaves as loss of green

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	color, followed by development of brown spots, which grow between the veins.
Sesame	Deficiency symptoms first appear on middle leaves as loss of green color, followed by development of brown spots, which grow between the veins.
Soybean	Light green yellow or bleached spots in interveinal areas of older leaves. The emerging leaves become smaller in size and often termed as "little leaf". Inter-nodal distance becomes too short so that all leaves appear to come out from the same point, and is termed as "rosetting" at early stage.

Table 4: Composition and energy value of oilseeds

Oilseeds	Composition (%)					Energy (Cal/100 g kernel)
	Moisture	Protein	Oil	Fibre	Carbohydrate	
Groundnut	5.0	28.5	47.5	2.8	13.3	595
Mustard	8.5	20.0	39.7	1.8	23.8	541
Niger	4.2	23.9	39.0	10.9	17.1	515
Sunflower	5.5	19.8	52.1	1.0	17.9	620
Sesamum	5.3	18.3	43.3	2.9	25.0	563
Safflower	5.5	13.5	25.6	34.9	17.9	356
Soyabean	8.1	43.2	19.5	3.7	20.9	432

Role of sulphur in oilseed crops

An insufficient sulphur supply can affect yield and quality of the crops, caused by the S requirement for protein and enzyme synthesis (Scherer, 2009). Sulphur deficiencies have been reported from more than 70 countries worldwide and 120 districts throughout India (Tandon, 1991). As per latest available data, 41 percent soil samples tested were deficient in available S in India (Singh, 2008). Sulphur (S) helps in the synthesis of cystein, methionine, chlorophyll, vitamins (B, biotin and thiamine), metabolism of carbohydrates, especially by its effect on the protolytic enzymes (Najar *et. al.,* 2011). It is also necessary for chlorophyll formation and helps in biosynthesis of oil and metabolism of carbohydrates, proteins and fats and thus now-a-days sulphur is being considered as the fourth major nutrient element after NPK (Das *et. al.,* 2016). Important for formation of chlorophyll, resulting of photosynthesis , it is provides more source- sink in the form of starch, sugar, fats, oils, vitamins and other vital compound.

The oil content in seed at par with the increasing of NPK levels whereas; consecutive addition of sulphur and FYM increased oil content. Crop fertilized with 75% recommended dose of fertilizer with sulphur (40 kg ha^{-1}) and FYM (10 t $ha^{-1)}$ recorded higher oil content than control (*Kumar et. al., 2017* and *Kumar et. al., 2019*).

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Table 5: Effect of Sulphur on Protein content, Oil content, Straw yield and Grain yield of mustard.

Sulphur level	Protein content (%)	Oil content (%)	Straw yield (kg ha^{-1})	Grain yield (kg ha^{-1})
0 kg S ha^{-1}	21.20	41.76	3183.47	812.6
20 kg S ha^{-1}	22.53	43.99	4515.20	1356.3
40 kg S ha^{-1}	23.81	45.30	4912.53	1469.6
Source: Kumar et al., 2017.				

Role of Zinc in Oilseed Crops

Zinc is an essential micronutrient for higher plants especially oil crops, where it is required for activity of various types of enzymes (dehydrogenases and RNA and DNA polymerases), carbohydrate metabolism and protein synthesis. Zinc also plays an important role in the production of biomass (Cakmak, 2008). Furthermore, Zn may be required for chlorophyll production (Pandey *et al.,* 2006). Application of Zn had a significant effect on seed oil content (Cakmak, 2008). A seed oil content of 43.7% was obtained with the highest Zn application rate. The application of Zn had a significant effect on rapeseed oil. The oil content of seeds increased with Zn application (Ahmadi, 2010).

CONCLUSION

Sulphur and Zinc play key role in quantitative and qualitative production of oilseed crops enhancing through number of branches, grain yield, oil content, and cystein, methionine, vitamins (B, biotin and thiamine), and metabolism of carbohydrates. Ever increasing human's population creating pressure on demand and gap between demand and supply is increasing met this only left option to increase productivity as well as qualitative production of oil seed crop.

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Fruit Rot (Koleroga/Mahali) disease in arecanut (*Areca catechu* L.)

Article id: 21719

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INTRODUCTION

Arecanut (*Areca catechu* L.) also popular by the names betal nut and supari is used worldwide for consumption and chewing purpose. It is one of the important plantation crop, covers an area of about 1 lakh hectares distributed in parts of West Bengal, Assam, Maharashtra, Karnataka, Tamil Nadu and Kerala states . India contributes around 51% of world total production. It grows in well humid areas with high rainfall and up to about 1000 meter above sea level. Being a palm it grows up to a height of about 12 to 16 meter and lives for about 60 to 100 years. It comes to bear in 6 to 8 years after transplanting and an average about 5 kg of nuts can be harvested from a palm (Rangaswami and Mahadevan, 2012).Fruit rot of arecanut also known as Mahali in Malayalam and Koleroga in Kannada, caused by the fungus *Phytophthora meadii* McRae (McRae, 1918) is a serious disease that could leads to great economic losses . It was first reported from India in 1918 from infected rubber trees and later it was reported as a causal agent on cardamom. It occurs annually in many parts of peninsular India, causing severe damage. It also occurs in Srilanka and Indonesia.

ETIOLOGY

The severities, persistent and spread of fruit rot are related to the pattern of rain. The disease appears usually 15 to 20 days after the onset of regular monsoon rain and may continue up to the end of rainy season, fruit dropping is the first sign of its occurrence. The fallen nuts are discolored and covered with a whitish felt of fungal mycelium. The infection usually starts from the end of the nut due decay the pericarp is shriveled and the kernel destroyed (Rangaswami and Mahadevan, 2012).Continues heavy rainfall coupled with low temperature (20-23^{0}c) high relative humidity, intermittent rain and sunshine hours are factors that favor the occurrence of fruit rot. Disease spread is through heavy wind, rain splashes and flies. The fruit bunches infected towards the end of rainy season may remain mummified on the palm and such nuts provide inoculums for bud rot or crown rot or the occurrence of fruit rot in the next season.

Causal Organism

Phytophthora meadii McRae: (Kingdom: Chromista/straminipila, Phyla: Oomycota, Class: Oomycetes, Order: Pythiales, Family: Pythiaceae). The fungus produce spherical to ovoid, caduceus sporangia with medium length pedicels , formation of sporangium on sympodium , rare production of chlamydospores and formation of aplerotic oospores (Butler, 1907).

MANAGEMENT

Before the onset of monsoon

1. Removal of all dried and infected bunch of last season attached to the palm.
2. Use of polythene and kotte (coverings made from the 2 basel sheaths of areca palm leaves sewn together) and karada (dried wild grass which is dried bunched and spread on the fruit and tied at the tip of the bunch); systematic chemicals such as Aliette (aluminium phosethyl) and metallaxyl; Spraying the bunch and crown with 1% Bordeaux mixture. Covering the bunch with

polythene cover (125 to 200 gauge 24x30 inch) before start of heavy monsoon shower (Sastry and Hegde,1989).

During rainy season

1. Spraying 1 % Bordeaux mixture. The initial spray is to be done immediately after the onset of monsoon showers and the second spray after an interval of 40 to 45 days. If monsoon prolongs, third spray should be given (Butler, 1910).
2. Areca palms sprayed experimentally with Bordeaux mixture to which cheap local vegetable oils were added as spreaders remained almost free from koleroga (Narasimhan, 1934).
3. A fine spray will be needed for effective spread of spray fluid over the surface of nuts. Spraying operations are to undertaken on clear sunny days. Collect and destroy of all fallen and infected nuts to prevent the spread of disease.
4. Remove the infected tissue from the crown and treat the wound/cut end with 10% Bordeaux paste. Cover the treated bud with protective covering till the normal shoot emerges.

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Role of crop protection in doubling farmers' income

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INTRODUCTION

Agriculture is the backbone of the Indian economy, as it employs nearly half of India's workforce and contributes ~17% to the nation's GDP. The Green Revolution led India from a food deficient country to a food surplus economy. It has not only helped increase exports of agricultural products but has also helped satisfy the demands of India's huge population. Despite all its achievements, Indian agriculture is still grappling with challenges like high monsoon dependency, unpredictable weather patterns, reduction in arable land, low per hectare yield, increase in pest attacks, lower farmer incomes etc. Approximately 25% of the global crop output is lost due to attacks by pests, weeds and diseases and thus agrochemicals have an increasing role to play in enhancing crop productivity (Chand and Pavithra, 2015). Crop protection solutions play a vital role in two ways; protecting the crop and produce from pests and increasing the farm productivity. Integrated Pest Management (IPM) is one of the modern approaches to increase farmer income while protecting the environment. It provides a framework to undertake a step-by-step method in ensuring good crop health and higher productivity. IPM ensures reliable crop quality, decreased severity of pest infestations, reduced potential for problems of pest resistance or resurgence and increased consumer confidence leading to fair price of the yield.

Increasing farmer income: Role of Crop Protection Solutions:

Prevention

Several crop management features are designed to prevent outbreak of insects, diseases or weeds. Multiple strategies can be combined and optimized for an IPM program. The goal is to prevent pest populations from building up to economically damaging levels.

Location for Crops

Growing crops in locations where they are best suited to climate, soil and topography provides them with optimal conditions from the start. Appropriate land preparation builds on these conditions.

Selection of Crop variety

Choosing beneficial crop varieties, like those with disease and pest resistance, is the main feature of IPM. These varieties can be derived from traditional cross-breeding or modern biotechnology: pest-resistant and herbicide-tolerant varieties, for example, may reduce the need for other crop protection measures. GM crops can also facilitate reduced or no-till practices, thus maintaining soil health and preventing erosion.

Crop Planting & Rotation

Planting similar crops alongside each other can substantially increase pests and should be avoided if possible. Traditionally, some farmers sow different crops in alternate rows or under sow a crop like maize with a legume such as

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cowpea to help improve soil fertility and reduce weeds. Such systems can help reduce pests.

Soil Management

Mechanical, physical and cultural crop protection methods prevent or minimize pests as well as reduce their build-up and carryover from one crop to another.

Water management

Supplying water to crops is essential to plant health but it can greatly influence pest incidence and impact. Irrigation may be required, especially in dry areas or with crops that require a lot of moisture. But while flood irrigating some crops, such as lowland rice, can control weeds, it is wasteful of water and can adversely affect beneficial soil organisms. Methods to combat these risks and conserve water include drip irrigation or growing crops on ridges or raised beds.

Monitoring

Management of any crop requires routine inspections to assess how well plants are growing and what actions need to be taken from seeding to harvest. Walking through a field involves scouting for pests and distinguishing them from non-pests and beneficial insects. Tools like pheromone traps, diagnostics and forecasting systems can assist with such monitoring in a timely and accurate way. IPM often requires collaborative decisions within a specific geography to provide effective control of pests. Some of these decisions need to be taken by national governments in relation to quarantine regulations and legislation, provision and training of advisory services and strategies for control of highly mobile pests like locusts. Geographic information systems and remote-sensing techniques can also assist in areawide management.

Intervention

Reducing economically damaging pests to acceptable levels may involve cultural, physical, biological and chemical control measures individually or in combination. Costs, benefits, timing, labor force and equipment as well as economic, environmental and social impacts all must be taken into consideration.

Cultural and physical methods

These techniques, such as weed control by tractor cultivation or disease control by removing infected plant debris, should be assessed for their impact on plant roots and yields as well as their requirements for labor and energy Also, the possibility of integrating cultural techniques with the careful use of crop protection products should be explored. For example, instead of replacing manual weeding entirely with herbicides, hoeing may be used in conjunction with them.

Biological control

Research on nature's own methods of pest control is yielding new products and methods that can be used in IPM programs. Many of these require similar technical expertise as crop protection products in relation to formulation, field application and resistance management. Research on nature's own methods of pest control is yielding new products and methods that can be used in IPM programs. Using beneficial insects to control pests works best when crops are grown in controlled environments like greenhouses and plastic tunnels. There are cases when control techniques with living organisms are successful in open field conditions, such as using predatory mites against spider mites. However, biological control products are usually only efficient at low pest intensities and other interventions are often required. Bacteria, fungi, nematodes or

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viruses have also been mass produced to control some pests. The most common and successful is *Bacillus thuringiensis* (Bt), a naturally occurring bacterium, which has been used to control several important pests (e.g., caterpillar pests in vegetables, vineyards and orchards). With modern biotechnology, crops like corn and cotton can now express the insect toxin produced by this natural control agent, delivering it more effectively. Finally, the development and availability of insect sex pheromones and other behavior modifying chemicals offer farmers the possibility of:

- Selective trapping techniques to monitor the movement of pests or changes in their populations during the season
- "Lure and kill" strategies to attract the pest to insecticide deposits and reduce the need for overall crop spraying
- Mating disruption that slows population build-up to delay or reduce the need for control treatments

Biotechnology also has considerable potential to contribute to IPM. One focus of research has been on mass production of micro-organisms that cause disease in insect pests and weeds or compete with plant disease-causing organisms. The second and most rapidly expanding area of biotechnology for pest control has been the development of crop varieties resistant to pests and diseases and/or tolerant to herbicides. These varieties incorporate insect or disease resistance within the plant for accurate and timely delivery of an active ingredient.

Chemical control

Chemical crop protection products (pesticides) are biologically active chemicals that control a range of insect and vertebrate pests, diseases and weeds. They are often the most costeffective way of controlling infestations as part of an IPM strategy. Today's crop protection products are the result of more than 50 years of research, development and field experience around the world by the plant science industry. Before crop protection products are released in the market, they are thoroughly tested for their safety, usefulness and effectiveness. When sold, they are labeled with explicit use instructions. To get the most out of these products, they must be applied correctly. Responsible use and good handling practices limit potential pesticide residues in crops and the environment as well as help avoid pest resurgence and resistance. Improved application techniques and equipment, such as reduced drift nozzles and spot spraying, help farmers protect untreated refuges (e.g., hedgerows and field margins) and natural habitats for wildlife and pest enemies. The timing of treatment (season and time of day) as well as the types of products used is also critical factors.

CONCLUSION

In a nutshell, application of an Integrated Pest Management program offers following long-term benefits:

- Reduced amount of broad-spectrum pesticide used in the environment
- Reduced chance of pests developing resistance towards a specific pesticide
- Reduced health risk to humans
- Reduced health risk to pests and organisms that are not the target 3 less harmful to the environment

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Zero Budget Natural Farming (ZBNF)

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Zero Budget Natural Farming (ZBNF), which is a set of farming methods, and also a grassroots peasant movement, has spread to various states in India. It has attained wide success in southern India, especially the southern Indian state of Karnataka where it first evolved. A rough estimation for just Karnataka puts the figure there at around 100,000 farmer families, while at the national level, ZBNF leaders claim that numbers could run into millions. This has been achieved without any formal movement organization, paid staff or even a bank account. ZBNF inspires a spirit of volunteerism among its peasant farmer members, who are the main protagonists of the movement.

The *neoliberalization* of the Indian economy led to a deep agrarian crisis that is making small scale farming an unviable vocation. Privatized seeds, inputs, and markets are inaccessible and expensive for peasants. Indian farmers increasingly find themselves in a vicious cycle of debt, because of the high production costs, high interest rates for credit, the volatile market prices of crops, the rising costs of fossil fuel based inputs, and private seeds. More than a quarter of a million farmers have committed suicide in India in the last two decades. Various studies have linked farmer's suicides to debt. Debt is a problem for farmers of all sizes in India. Under such conditions, 'zero budget' farming promises to end a reliance on loans and drastically cut production costs, ending the debt cycle for desperate farmers. The word 'budget' refers to credit and expenses, thus the phrase 'Zero Budget' means without using any credit, and without spending any money on purchased inputs. 'Natural farming' means farming *with* Nature and *without* chemicals.

The four pillars of ZNBF

1. Jivamrita/jeevamrutha is a fermented microbial culture. It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity; During the 48 hour fermentation process, the aerobic and anaerobic bacteria present in the cow dung and urine multiply as they eat up organic ingredients (like pulse flour). A handful of undisturbed soil is also added to the preparation, as inoculate of native species of microbes and organisms. Jeevamrutha also helps to prevent fungal and bacterial plant diseases. Palekar suggests that Jeevamrutha is only needed for the first 3 years of the transition, after which the system becomes self-sustaining.

How to prepare jeevamrutha?

Put 200 liters of water in a barrel; Add 10 Kg fresh local cow dung and 5 to 10 liters aged cow urine; Add 2 Kg of Jaggery (a local type of brown sugar), 2 Kg of pulse flour and a handful of soil from the bund of the farm. Stir the solution well and let it ferment for 48 hours in the shade. Now jeevamrutha is ready for application. 200 liters of jeevamruta is sufficient for one acre of land.

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Jeevamrutha Application

Apply the jeevamrutha to the crops twice a month in the irrigation water or as a 10% foliar spray.

2. Bijamrita/beejamrutha is a treatment used for seeds, seedlings or any planting material. Bijamrita is effective in protecting young roots from fungus as well as from soil-borne and seed-borne diseases that commonly affect plants after the monsoon period. It is composed of similar ingredients as jeevamrutha - local cow dung, a powerful natural fungicide, and cow urine, a strong anti-bacterial liquid, lime, soil.

Bijamrita Application as a seed treatment

Add Bijamrita to the seeds of any crop: coat them, mixing by hand; dry them well and use them for sowing. For leguminous seeds, just dip them quickly and let them dry.

3. Acchadana - Mulching. According to Palekar, there are three types of mulching:

a. Soil Mulch: This protects topsoil during cultivation and does not destroy it by tilling. It promotes aeration and water retention in the soil. Palekar suggests avoiding deep ploughing.

b. Straw Mulch: Straw material usually refers to the dried biomass waste of previous crops, but as Palekar suggests, it can be composed of the dead material of any living being (plants, animals, etc). Palekar's approach to soil fertility is very simple – provide dry organic material which will decompose and form humus through the activity of the soil biota which is activated by microbial cultures.

c. Live Mulch (symbiotic intercrops and mixed crops): According to Palekar, it is essential to develop multiple cropping patterns of monocotyledons (monocots; Monocotyledons seedlings have one seed leaf) and dicotyledons (dicots; Dicotyledons seedlings have two seed leaves) grown in the same field, to supply all essential elements to the soil and crops. For instance, legumes are of the dicot group and are nitrogen-fixing plants. Monocots such as rice and wheat supply other elements like potash, phosphate and sulphur.

4. Whapasa - moisture: Palekar challenges the idea that plant roots need a lot of water, thus countering the over reliance on irrigation in green revolution farming. According to him, what roots need is water vapor. *Whapasa* is the condition where there are both air molecules and water molecules present in the soil, and he encourages reducing irrigation, irrigating only at noon.

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Conservation tillage practices in soil management

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INTRODUCTION

Soil is one of the most precious natural resources on the Earth. Proper soil management is a key to sustainable agricultural production. Soil management involves six essential practices: proper amount and type of tillage, maintenance of soil organic matter, maintenance of a proper nutrient supply for plants, avoidance of soil contamination, maintenance of the correct soil acidity, and control of soil loss (erosion). In India, the greatest concern for soil degradation is erosion caused by water. All of these practices depend on soil type, soil texture, and slope as well as on the crops that are grown.

The potential for erosion of a specific soil type largely depends on the severity of the slope, the crops grown, and the number and types of tillage operations. Several techniques are available to reduce soil erosion, including residue management, crop rotation, contour tillage, grassed waterways, terraces, and conservation structures. The techniques adopted must ensure the long-term productivity of the land, be environmentally sound, and, of course, be profitable. Conservation tillage and crop residue management are recognized as cost-effective ways to reduce soil erosion and maintain productivity.

Conservation Tillage

The objective of conservation tillage is to provide a means of profitable crop production while minimizing soil erosion due to wind and water. The emphasis is on soil conservation, but conserving soil moisture, energy, labor, and even equipment provides additional benefits. To be considered conservation tillage, the system must provide conditions that resist erosion by wind, rain, and flowing water. Such resistance is achieved either by protecting the soil surface with crop residues or growing plants or by maintaining sufficient surface roughness or soil permeability to increase water filtration and thus reduce soil erosion.

Conservation tillage is often defined as any crop production system that provides either a residue cover of at least 30 per cent after planting to reduce soil erosion due to water or small-grain residues on the soil surface during the critical erosion period to reduce soil erosion due to wind. The term conservation tillage represents a broad spectrum of tillage systems. However, maintaining an effective amount of plant residue on the soil surface is the crucial issue, which is why the Natural Resources Conservation Service (NRCS) has replaced conservation tillage with the term crop residue management. Some of the conservation tillage systems are described here.

a. No-Till

With no-till, the soil is left undisturbed from harvest to seeding and from seeding to harvest. The only "tillage" is the soil disturbance in a narrow band created by a row cleaner, coulter, seed furrow opener, or other device attached to the planter or drill. Many no-till planters are now equipped with row cleaners to clear row areas of residue. No-till planters and drills must be able to cut residue and penetrate undisturbed soil. In practice, a tillage system that leaves more than 70 per cent of the surface covered by crop residue is considered to be a no-till system.

Fig. No-Till Planter

b. Strip-Till

On some soils, including poorly drained ones, the no-till system is sometimes modified by the use of a strip tillage operation, typically in the fall, to aid soil drying and warming in the spring. This system is called strip-till. It is considered a category of no-till, as long as it leaves the necessary amount of surface residue after planting. Strip-till is sometimes done along with the fall application of anhydrous ammonia, dry fertilizer, or both. This usually involves using a mole knife, which is designed to shatter and lift soil as it places fertilizer. One benefit of strip-till, compared to no-till, is accelerated soil warming that result from removing residue and disturbing the soil in the berm.

c. Ridge-Till

Ridge-till is also known as ridge-plant or till-plant. With ridge-till, the soil is left undisturbed from harvest to planting except for possible fertilizer application. Crops are planted and grown on ridges formed in the previous growing season. A planter equipped with sweeps, disk row cleaners, coulters, or horizontal discs is used in most ridge-till systems. Ideally, this process leaves a residue free strip of moist soil on top of the ridges into which the seed is planted. Special heavy-duty row cultivators are used to reform the ridges. Corn and grain sorghum stalks are sometimes shredded before planting. The use of ridge-till has decreased considerably in the past decade, and it is currently practiced on small acreage.

d. Mulch-Till

Mulch-till includes any conservation tillage system other than no-till and ridge-till. Deep tillage might be performed with a subsoiler or chisel plow; tillage before planting might include one or more passes with a disk harrow, field cultivator, or combination tool. Herbicides and row cultivation control weeds. The tillage tools must be equipped, adjusted, and operated to ensure that adequate residue cover remains for erosion control, and the number of operations must also be limited. At least 30% of the soil surface must be covered with plant residue after planting.

Effect of tillage on soil erosion

The primary advantage of conservation tillage systems, particularly no-till, are less soil erosion due to water on sloping soils and conservation of soil water for later crop use. Residue absorbs the impact of raindrops, thereby reducing the amount of soil dislodged. It also intercepts water as it moves down the slope, which allows soil particles to settle. Although wind erosion in India is not as great a problem as water erosion, the residue left on the surface by conservation tillage systems slows the wind near the soil surface, thereby reducing the movement of soil particles into the air.

Surface residues effectively reduce soil erosion. A residue cover of 20 per cent to 30 per cent after planting reduces soil erosion by approximately 50 per cent compared to a bare field. A residue cover of 70 per cent after planting reduces soil erosion more than 90 per cent compared to a bare field. On long, steep slopes, even conservation tillage may not adequately control soil erosion. Other practices may be required on such fields, such as contouring, grassed waterways, terraces, or structures.

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Crop production with conservation tillage

Crop germination, emergence, and growth are largely regulated by soil temperature, aeration, and moisture content, by nutrient availability to roots, and by mechanical impedance to root growth. All of these factors are affected by tillage.

i. Soil temperature

Crop residue on the soil surface insulates the soil from the sun's energy. The amount of residue influences soil temperature. Residues from corn, wheat, and grass sod maintain cooler soil than residue from soybeans and other crops that produce less residue or residue that decomposes rapidly.

ii. Moisture

A soil surface reside cover of 30 per cent or more decreases the amount of water evaporated from the soil surface and increases water infiltration rates, leading to more water stored in the soil. More stored water is usually advantageous in dry summer periods, but it may be disadvantageous at planting time and during early growth, especially on soils with poor internal drainage.

iii. Organic matter

Soil organic matter tends to stabilize at a certain level for a specific tillage system used in fields with a particular soil texture. Mould board plowing buries essentially all residues and increases oxidation of organic matter. With conservation tillage systems, especially no-till and ridge-till, residue is left on the soil surface where decomposition is slow, which then causes organic matter in the upper few inches to increase after several years. Crop roots decompose more slowly than above ground residue, and so tend to contribute relatively more to soil organic matter than does above ground residue.

iv. Soil density and compaction

The loss of air-filled pore volume in soils caused by mechanical compression results in an increase in soil density, referred to as soil compaction. Excessive compaction restricts plant root growth, impedes drainage, reduces soil aeration, increases injury potential of some herbicides, and reduces uptake of potassium and nitrogen. Untilled soil usually has a greater density than freshly tilled soil. However, after soil is loosened by tillage, density increases over time as a result of wetting and drying, wheel traffic, and secondary tillage operations.

v. Planting depth

Uniform planting depth, good contact between the seed and moist soil, and enough loose soil to cover the seed are necessary to consistently produce uniform stands. Planting shallower than normal in the cool, moist soil common to many conservation tillage seedbeds may partially offset the disadvantage of lower soil temperatures. However, if dry, windy weather follows planting, germination may be poor, and shallow-planted seedlings may be stressed for moisture.

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Weed management in sugarcane through herbicides

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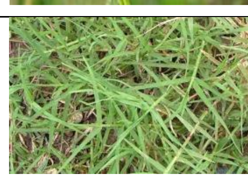
Weeds are those plants which grow out of place & time and compete with crop plants for space, light, water, nutrients and other resources needed for growth and development. Crop-weed competition in sugarcane has long been recognised as one of the major causes of growth and yield reduction resulting in lesser production & productivity. Sugarcane is generally planted at wider row spacing ranging from 60-100 cm and takes a longer period of time usually more than one month (30-40 days) for emergence in the field. Growth of the sugarcane is also slow during early stages of crop cycle. All these factors provide enough space and time for weed emergence resulting in their vigorous growth. As a result, weeds occupy field much earlier than sugarcane and offer strong competition for different resources. Therefore adoption of proper Weed management strategies must be incorporated to reduce the yield losses and provide more number of millable canes so as to increase the yield and productivity of sugarcane.

Predominant Weed flora found in sugarcane fields

Sugarcane is generally infested with a variety of weeds and in India, nearly 150 species of weeds have been observed in sugarcane fields. Major weed species found in the sugarcane are *Cyperus rotundus, Cynodon dactylon, Brachiaria ramose, Commelina benghalensis, Dactyloctenium aegyptium, Digitaria sanguinalis, Echinoicloa* sp., *Eleusine indica, Panicum* sp., *Convolvulus arvensis, Ageratum conyzoides, Amaranthus* sp., *Digera arvensis, Eclipta alba, Portulaca* sp., *Trianthema* sp. *etc.* In order to adopt an effective weed control measure it is important to have knowledge about ecological and biological characteristics of weeds.

Losses caused by weeds to sugarcane

Reduction in yield of cane due to weed infestation in the fields has been recorded under various ecological situations of the sugarcane growing regions of India. It ranged from 10.7 to 73.7 % depending upon the nature, intensity and the period of occurrence of weeds.

Name of the weed	Photo	Name of the weed	Photo
Cyperus rotundus		*Convolvulus arvensis*	
Cynodon dactylon		*Ageratum conyzoides*	

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Commelina benghalensis		*Amaranthus* sp	
Dactyloctenium aegyptium		*Euphorbia sp*	
Digitaria sanguinalis		*Argemone maxicana*	
Echinoicloa sp		*Trianthema* sp	
Eleusine indica		*Annagalis arvensis*	

Critical period of crop-weed competition

Sugarcane shows different responses to weed competition during the growing season. The period during which presence of weeds causes maximum yield reduction is considered to be the critical period for crop-weed competition. Weeds also accumulate maximum dry matter during this period. For high yields weeds must be controlled during this period. Critical period varies with the time of planting and nature of the crop (Plant cane or ratoon cane). In subtropical India, in spring planted cane, this period is between 60 to 120 days after planting while in late planted cane it is from 45-75 days. The period starts from April/May (depending upon the date of planting) and ends in July with the onset of monsoon when crop reaches 'close in' stage. In ratoon cane, critical period of crop-weed competition is generally between 30 and 90 days after ratoon initiation.

Chemical weed management practises

Suitable herbicides for controlling weeds in sugarcane are classified below:

- Herbicides
  - Selective
    - **Contact**
    - **Translocated**: Simazine, Atrazine, Metribuzin, Diuron, 2,4-D, Asulam, Dicamba, Trifluralin, Fluchloralin, Alachlor, Nitrofen
  - Non selective
    - **Contact**: Paraquat
    - **Translocated**: Glyphosate

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Application of herbicides

Success in weed control by using herbicides requires a good knowledge of application technology with respect to appropriate time, method and dose of herbicide to be applied.

Time of application

Herbicides may be applied as pre-or post-emergence treatments depending upon their mode of action.

Pre-emergence application

Soil active herbicides like simazine, atrazine, diuron and metribuzin are commonly applied on the surface of the soil in sugarcane fields. Herbicide moves within the soil through diffusion or mass flow in the liquid or vapour phases in the presence of adequate moisture. Success of a pre-emergence treatment depends, largely on the presence of herbicide in 2-3 cm upper layer of the soil. This is where most annual weed seeds germinate. The extent of mobility of herbicide determines the extents of weed control. The absorption of herbicides by the soil is usually associated with the germinating seeds or developing roots of the weed plants which also require sufficient soil moisture. Herbicides absorbed by the roots are carried upwards in the xylem along with the transpiration stream and are translocated to all parts of the plant.

Post-emergence application

Some of the weeds like *Cyperus rotundus* and *Cynodon dactylon* are not controlled effectively through the application of pre-emergence type herbicides. It requires post-emergence treatment with foliage absorbed herbicides. One or two post-emergence sprays at an interval of 30 and 60 days after planting the sugarcane can effectively check the infestation of such weeds. The commonly applied post-emergence herbicide in sugarcane are 2, 4-D, paraquat, glyphosate, dicamba, and asulam + actril-D.

Method of application

In pre-emergence treatment, blanket application of herbicides is done to an entire area. For post-emergence treatment, when both sugarcane and weeds have already emerged, application of non-selective herbicides like paraquat or glyphosate should be done as directed inter-row spray avoiding spray drift to crop foliage. For spraying under low drooping leaves of sugarcane invert spray lance and project spray fan almost horizontally. The technique is especially useful when the weeds are not too tall. If there are scattered patches of weeds, the post-emergence spot treatment is needed.

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Marketing strategies of milk in India

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INTRODUCTION

At present time the world, marketing is more important than of production. Because Production is often considered as the more important function. However, this practice is gradually losing ground and it is being recognized that "unless you can sell a product, you should not manufacture it". Marketing, the process by which a product or service originates and is then priced, promoted, and distributed to consumers, begins when production ends. Marketing concentrates primarily on the consumers. After determining the customers' needs and desires, marketers develop strategies to educate customers about a product's most important features, persuading them to buy it, and then to enhance their satisfaction with the purchase. All business activities facilitating the exchange are included in marketing.

Amul is a name we have all grown up hearing. That utterly bitterly delicious smell of it has sometimes even made us leave our beds and run to the kitchen. Anand Milk Producers Union Limited or Amul, based at Anand in Gujarat is an Indian dairy cooperative. The Gujarat Co-operative Milk Marketing Federation Ltd. (GCMMF) is India’s largest food product marketing organization and Amul is a brand managed by them. And India is having first rank in milk production in world.

Definition

The term ‘Market milk’ refers to fluid whole milk that is sold to individual usually for direct consumption. It excludes milk consumed on that farm and that used for the manufacture of dairy products.

Definition of Market milk

Whitish nutritious fluid produced and secreted by the mammary glands of mature female mammals and used for feeding their Calf until weaned. Or The **milk** of cows, Buffalo, goats, sheep used by man as a food or in the production of butter, cheese, Khoa, Dahi, Sweets etc.

The Market milk industry in India

Although a beginning in organized milk handling was made in india with the establishment of military dairy farms. India is the world's largest producer and consumer of dairy sector. The dairy industry in India was worth INR about 5,000 billion in 2016. India is also globally the largest milk producing country since 1997. In India, the co-operatives and private dairies have access to only 21% of the milk produced. Approximately, 34% of the milk is sold in the unorganized market while 45% is consumed locally.

1. Handling of milk in co-operative milk unions established all over the country on a small scale in the early stages.
2. Long distance refrigerated rail tank used for milk transport from Anand to Bombay.
3. for organized distribution pasteurization of milk and packing in bottles.

White Revolution-

The White revolution, popularly known as operation flood, was a dairy development program that was launched by the Indian Government to increase the production of milk in India.

Salient features-

1. The program was started in 1970 with the help of World Food Program (WFP).
2. The program was implemented in three phase-1 (1970-1981), Phase-2 (1981-1985) and Phase-3 (1985-1996).

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3. It created a national milk grid linking producers throughout India with consumers in over 700 towns and cities.
4. In this program new methods were adopted in the case of cattle in animal husbandry.
5. A small farmer-controlled network was created through the dairy cooperatives.
6. The entire procedure from procurement to marketing was sole and exclusive domain of the farmer.
7. Changing the composition of cattle feed ingredients and nutrients in different proportions.
8. Fixing the different producer costs on a sliding scale.

Composition of milk of different types of animals

Type of animals	Water	Fat	Protein	Lactose	Ash	Specific gravity	SNF	T.S.
cow	86.05	4.5	3.4	4.6	0.4	1.028	8.5	13.2
Buffalo	82.00	6.5	3.7	4.8	0.4	1.030	9.0	16.2
Goat	87.00	4.00	3.7	4.6	0.6	1.028-1.030	9.0	13.0
Sheep	80.00	8.5-9.0	4.6	4.6	0.7	1.030-1.033	9.5	18.5

Factor affecting composition of milk

In general, the proportional increases in fat, protein and lactose yields are approximately the same as the proportional increase in milk volume. Milk composition changes little. Milk differs widely in composition. All milk contains the same kind of constituents, but in varying amount.

1. Species
2. Breeds
3. Individually
4. Interval between two milking
5. Complete milking
6. Frequency of milking
7. Method of milking
8. Feeds
9. Age of milch animal

CONCLUSION:-

The art of marketing in India is more important than the art of production. Production is often considered as the more important function of Marketing. After determining the customers' needs and required, marketers develop strategies to educated customers about a product's most important features, persuading them to buy it, and then to enhance their satisfaction with the purchase. All business activities facilitating the exchange are included in marketing. All business activities facilitating the exchange are included in marketing.

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Some medicinal and aromatic plants cultivation in Garhwal Himalaya region

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Uttarakhand situated in Northern part of India and in the heart of Himalayas. Medicinal plants have played an important role of primary health care system among the local people of Himalayan region. Uttarakhand is a hill state in the Indian Himalayan region. Due to its unique geographical location and different climatic conditions, it has rich biodiversity and variety of plant species. In Uttarakhand, enough possibilities exist for their processing of medicinal and aromatic plants. This may built a network of rural enterprise, thereby increasing the employment and income for the rural peoples of the state.

INTRODUCTION

Medicinal and aromatic plants play a very important role in the human health. In the world, herbalism flourishes as the method of rehabilitation of choice in many European and Asian continents (Al-Quran 2005). It is estimated that traditional knowledge, mostly plant based, medicinal treatment systems continue to provide health care to more than three-quarters of world's population of the earth(Prakash 2015). Mostly plant based medicinal system isused in developing countries. The reliance of majority of the population on these systems, is because of, the arranged remedies have been historical acceptanceand easily availability, economical less expensive and highly effective (Azaizeh *et al.,* 2003). The peoples of different developed countries, were increased the use of plant based medicine for self-medication, that indicated the increasing the medicinal plant imports by these countries. Thus, there are evidences of positive attitudes towards herbal drugs and preparations. Mostly the medicinal and some aromatic plants are collected from the forests in the different forms like, fruits, roots, seeds, leaves, corms, tubers, rhizome and flowers (Edwards 1996). The collection of these medicinal and aromatic plants from the forestsare not rewardingour requirements. In order to ensure the continuous supply of the medicinal and aromatic plants of standard quality, it is necessary to cultivate these plants in a systemic way for meeting the demands.

Uttarakhand is the place of temples, holly rivers and importantly place of gods. The god blasé his grace to give the plenty of miracle medicinal plants and also aromatic plants (Gaur 1999). Large number of economically important medical and aromatic plant has been not exploited; someone exploited ruthlessly, as a result of many species has been extinct or are at the verge of extinction. Over the several years, different medical species are shrinking and there is growing concern to preserve them for mankind (Anthwala *et al.,* 2010 and Bentley and Trimen 1980). There are some plant species that are presently under human cultivation, but due to the continuous increasing demands of these plants, they are in scarcity and sometimes even adulterated material is made. While on the other hand, vast potential of cultivated lands are laying unutilized. Hence, keeping in view the demands of medical and aromatic plant; as well as agro-climatic conditions of the state, commercial cultivation of economic plants may be undertaken (Joshi and Joshi 2014).

Climatic condition of Uttarakhand

Uttarakhand situated in Northern part of India and in the heart of Himalayas. Uttarakhand is the mixture of valley, hills and plains. It has high mountains and fertile lands and valleys. There are several rivers and streams in this area. Uttarakhand showed the different agro-climatic condition like, tropical and temperate, which is the reason, here maximum diversity is observed for different herb plants (Prakash, 2014). The only limiting factors is the area is irrigation, which is relatively less, but by use of the hi-tech techniques of cultivation and crop specific managements fulfill the requirements. These hi-tech techniques will ensures the maximum utilization of resources resulting into optimum

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profit margins and also provide the employment for peoples. During the period of July to September lies the monsoon season of Uttarakhand. The temperature ranges from 15 to 25 degrees Celsius at most of the places, during this time. The state receives approximately 90% of its annual rainfall in this season. It is also one of the most pleasant seasons of Uttarakhand.

Suitable Medicinal and Aromatic Plant Species

Depending upon the agro-climatic conditions and the existing demands in the domestic as well as in the world market, the cultivation of following economically important crops may be highly remunerative. The selection of crops has been done, keeping in view, the overall conditions of the state, but all the crops cannot be successfully cultivated in all the areas. The selection of economic crops for large scale cultivation may be done from among the following crops.

Sarpagandha (*Rauwolfia serpentina*) or 'snakeroot' is a species of flowering plant in the family Apocynaceae. It is native to South and East Asia. Humid climate increases the quality of its products. Generally crop is propagated by seed. Its plants are ready for harvesting 18 months after planting. Average root yield varies from 1500 to 2500 kg/ha. Sarpagandha choornam is a unique Ayurvedic herbal powder solely for hypertension. It also relieves stress, anxiety and insomnia which are usually found associated with hypertension. Sarpagandha is an Ayurvedic plant which has been used for its medicinal properties. This plant has been used by Ayurveda for thousands of years as a remedy for various diseases such as hypertension, insomnia and even insanity. The plant has been mentioned by sage Charaka in his work, Charaka

Senna (*Cassia angustifolia*)

Senna is one among the top ranked export oriented medicinal plants from India. The sennosides present in its plants is used as laxative. The drive leaves, pods and flowers and herbal concentrates are exported. In European market it is sold as herbal tea. It is cultivated as a annual crop in different states, usually in marginal soils requiring warm and dry weather throughout growing period. Three picking are generally practiced. Well dried material maintains light green to greenish yellow colour. An average dry leaf yield of 600-700 kg/ha under rainfed conditions and 1500-2000 kg/ha under irrigated condition is harvested.

Ashwagandha (*Withaniasomnifera*)

Ashwagandha is popularly known as Indian ginseng. Plant is an erect, branching, perennial, under-shrub up to 1.5m in height. The plant is cultivated in soils that are unsuited for the other crops and requires little care. Dried roots are medicinally important, which are used for preparation of general tonics. Alkaloids present in its roots are active principles. It is a medicinal plant of repute due to its extensive use in Indian system of medicine. The various preparation and forms of 'Ashwagandha' *viz.,* powder, decoction, oil, smoke, poultice *etc.,* have been suggested for the cure of various diseases such as leprosy, nervous disorders, intestinal infections, veneral diseases, rheumatism and as a tonic for all kinds of weakness and also to promote vigour and stamina. Yield of fresh roots is about 500kg/ha whereas that of dry roots is about 150kg/ha.

Aloe (*Aloe barbadensis*)

Aloe is a dry land crop, requiring low input. Leaf is economically important which contains gel that is used as skin tonics and in different herbal cosmetic preparations. Recently the crop attained high demand in international market and it will have more export demand in future. Leaf sap is also medicinally useful. Its plants grow well in a wide range of soils. An average yield of about 100tonnes/ ha of fresh leaves can be expected.

Safed musli (*Chlorophytum borivilianum*)

Safed musli is a major Indian medicinal plants used for the preparation of vital tonics. Dried fleshy root power is medicinal important. Saponins present in its fleshy roots are active ingredient. It is a new addition to cultivation. It has a vast potential in the international market because of its aphrodisiac property. It is a kharif sown crop, requiring well drained organic rich soil. Sowing is done after first shower. The crop is ready for harvesting within 120-150 days. Average fresh root yield is about 3000-5000 kg/ha.

Green Chirata (*Andrographis paniculata*)

Green chirata is commonly known as king of bitters. Its herbage contains andrographoloide, which is used for the therapeutic purpose. The plant is well-known for its hepatoprotective, immunomodulant, antinalarial and antipyretic actions. A kharif sown crop, its plants are transplanted in July and harvested in October/ November. An average dry herbage yield of 3500 kg/ha.

Kuth (*Saussurea lappa*)

Kuth is a perennial herb with 1-2 m height. The most useful part of the plant is its roots, which contains the alkaloids *saussurine*. It is commonly given in spasmodic diseases as a stomachache and tonic; it is given in advance stages of typhus fever, as a stimulant in cholera and as an alternative in chronic skin diseases and rheumatism. The root also contains 1.5% essential oil, which is used in perfumery and cosmetics. The roots are in demand in local as well as world markets.

Saffron (*Crocus sativus*)

Saffron is a small bulbous perennial, 15-25cm high plant, cultivated for its large, scented blue or lavender flowers. The stigma of the flowers, the saffron of commerce, is of medicinal value. Saffron thrives well in cold regions with warm or sub-tropical climates. They contain the bitter principle *picrocrocin*. Saffron is a mild stimulant, stomachache, carminative, antispasmodic, nerve sedative *etc*.It is a popular remedy for promoting menstruation or for soothing lumber pains. The maximum yield of saffron per hectare per year is around 15 Ib.

Indian Belladona (*Atropa acuminata*)

Plants of Indian belladonna are tall errect perennial upto 2 m in height. This plant has the same medicinal properties as the European *Atropa belladonna*. It contains two alkaloid *hyoscyamine* and *atropine*. The leaves and roots are used as a sedative, antispasmodic, narcotic and antihidrotics. They are a valuable antidote in opium and muscarine poisoning. The yield of leaves from a uniform belladonna crop varies between 500-600kg/ha and reaches upto 750kg/ha in subsequent years.

Worm Wood (*Artemisia annua*)

It is an aromatic and bitter shrubby plant. The leaf of the plant contain an active constituent namely *artemisinin*. The drug is in very high demand because of its anti-malarial properties. It is also main source of the drug “Afsanteen” used in India in chronic fever, swelling and inflammation of the liver. The yield of oil varies between 0.12 to 0.50%, which is known as “Wormwood Oil”. Fresh wormwood oil is the best source of azulene (40 to70%).

Tagara (*Valeriana wallicii*)

The most economical part of the plant is root, leaf and rhizome. The active constituent is monoterpene derivatives called *valepotraits*. They are 0.5% in European valerian and 2% in Indian valerian. It is used as stimulant, carminative, antiseptic useful in hysteria *etc*.

Patees (*Aconitum heterophyllum*)

Patees is a tall herb commonly found in western Himalayas. The plant thrives best in elevated environments. The dried tuberous root of the plant is used as antipyretic, aphrodisiac, anti-fertility and tonic. The main active constituent of this plant root is *aconitine*.

Katuka (*Picrorhiza kurroa*)

Katuka is a perennial herb with an elongate stout, creeping rootstock. Plants may be cultivated at higher altitudes in the Himalayas. *Picroside* I and II and *kutkoside* are the bitter compounds found in the plant. It is also contains *apocyanin.* The drug is popularly used in India as a bitter tonic, cathartic, stomachic and febrifuge including anti-malerial. It is also useful in cure of different types of jaundice and especially useful in hepatits.

Gloriosa (*Gloriosa superba*)

Gloriosa is a beautiful herbaceous, tall glabrous, branching leaf tip climber about 1 to 3 m tall. The useful part of the plant is tuberous rootstock and seeds. It contains *superbine, gloriosine* and 1.3% *colchine*. Flowers also contain *luteolin*. The tuber is useful in chronic ulcers, leprosy, inflammation piles, thirst etc. The leaf juice is used for killing lice in hair, root powder is given in rheumatic fever.

Jatamansi (*Nardostachys jatamansi*)

This is an erect perennial herb, 10 to 60cm high. The plant is propagated by cutting of under gourd parts and sometimes by seeds. It is valued for its rhizome. The roots of jatamansi contain *valeranone*, which is also known as *jatamansone* and it possess sedative properties. It can be used as substitute for *valeran*, useful in intestinal colic, weak antibacterial and anti-protozal hypotensive conditions.

Isabgol (*Plantago ovata*)

The husk of seed contains colloidal mucilage mainly consisting of *xylose, arabinose*, *galacturenic acid* with *rhamnose* from the mucilage. The mucilage is approximately 30% by weight of whole seed. In addition, the seed also contains some oil and small amount of *glycoside, aucubin* and *tannin*. It is used to control chronic constipation, diarrhea and dysentery. In addition to its medicinal use psyllium seed mucilage is employed as a stabilizer in ice creams and as an ingredient of chocolates and other food materials.

Galanga (*Kaempferia galanga*)

Galanga is used for both medicinal and aromatic purposes. Its rhizome contains essential oils, which are used in flavouring and perfumery. They are also diuretic, expectorant and carminative. Galanga grown in well drained, humus rich soil is suitable for its cultivation. Its plants are propagated by rhizomes. The rhizomes are ready for harvesting after 6 months. Rhizomes yield may vary from 3000 to 4000 kg/ha.

Palmarose (*Cymbopogon martiivar. motia*)

Palmarose is popularly known as Roshagrass, which yields palmarosa oil and has high demand in international market. The essential oil is erutracted mainly from its inflorescence and used in perfumeries and cosmetics. Oil yield is about 0.2 to 0.3%.

CONCLUSION

Large number of economically important medical and aromatic plant has been not exploited; someone exploited ruthlessly, as a result of many species has been extinct or are at the verge of extinction. These hi-tech techniques will ensures the maximum utilization of resources resulting into optimum profit margins and also provide the employment for peoples.

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Potential uses of high erucic acid type rapeseed mustard

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INTRODUCTION

The market value of rapeseed mustard is primarily by its demands for human consumption in the form of cooking oils, margarines and salad. Apart, from human consumption rapeseed oil has various kinds other industrial applications. Members of oilseed brassica are known to have a unique fatty acid called as erucic acid, which traditionally is considered as antinutrional factor for human consumption. Therefore, its level was minimized by breeding methods to and finally develop Canola- or '00'-quality (Lühs and Friedt 1994, Przybylski and Mag 2002, Yadava et al. 2018). Oils with high erucic acid have been recently been recoginized to have various industrial applications. Since then, erucic acid (cis-13-docosenoic acid, 22:1) a very long chain fatty acid having 22 carbon atoms with one double bond at the cis-13 position of the carbon chain has emerged into an important fatty acid in the oleochemical industry. It is a naturally occurring fatty acid in seed storage triglycerides of the Cruciferae family. The current, major industrial source of erucic acid is rapeseed oil. Rapeseed oil contains more than 40% erucic acid. Table 1. below showing the available source of erucic acid in different oilseed brassica species which could be exploited for industrial purposes either directly or after processing. Benefits of rapeseed mustard lines having high proportions of erucic acid would significantly reduce the production cost and time.

The present scenario industries should look beyond petroleum based products due to the rapid depletion of fossil fuel reserves. As the cost of petroleum-derived products increases, the need to switch to a more eco-friendly and economicalsource that can reduce environmental pollution.

Table 1: Different cultivated species of Brassica and their corresponding range of Erucic acid content

Brassica species	Erucic acid content (%)	References
Crambe (*Crambe abyssinica* Hochst. ex. R.E. Fries)	52-59	Vargas-lopeza et al. 1999
Indian mustard (*Brassica juncea*)	33-55	Chauhan and Kumar (2011), All India coordinated project (2016, 2017)
Karan rai (*Brassica carinata*)	28-38	Chauhan et al. (2010), Chauhan and Kumar (2011)
Toria (*Brassica rapa*)	30-52	-do-
Brown sarson(*Brassica rapa)*	26-32	-do-
Yellow sarson(*Brassica rapa*)	32-57	-do-
Taramira (*Eruca sativa*)	26-52	Yadava et al. (1998)

Uses of High Erucic Acid oils

High erucic acid oil can be used without processing or it may undergo chemical modifications to obtain its derivatives that have various applications as listed below (Table 2.). Oils high in erucic acid have special attributes that make them useful in manufacturing industries. These attributes include high smoke and flash points, oiliness and stability at high temperatures, ability to remain fluid at low temperatures, and durability (USDA, 1989).One of the major derivative is erucamide.

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Table 2: Potential products from High Erucic acid lines of Rapeseed Mustard

Derivatives of Erucic acid	Characteristics		Commercial Products
Erucamide (Amide of Erucic acid)	Slip agent critical to manufacture and use of polyolefin films such as Polyethylene an Lubricants	Polyethylene	Bread wrappers, shopping and garbage bag, shrink wraps, plastic sheeting.
		Lubricants	Spinning lubricants in textile, steel, shipping industry. Metal forming, rolling, fabricating and drilling oils, marine lubes, high temperature lubricants.
vulcanized oil (High Erucic oil with sulfur or sulfur derivatives)	Vulcanized oil are blended with natural and synthetic rubber in high proportion to aid in giving soft, elastic and resistant to light and ozone.	Rubber smother	Rubber hoses, shoe soles, tires, bowling balls, bouncing balls, hockey pucks, toys, erasers, and instrument mouthpieces.
Brassylic acid (Product formed by oxidation of Erucic acid)	Brassylic acid it is used as a substitute for natural musk to enhance the odor of fragrant components in perfume formulations.	Fixative	Perfume industry.
	Diesters of brassylic acid. Various other di-esters of brassylic acid (a derivative of erucic acid), with alkyl parts ranging in size from methyl to decyl, also have been incorporated into PVC and evaluated as plasticizers that are excellent in low temperature conditions, giving the product a light stability.	plasticizers	PVC (poly vinly chloride).
	Ammonification of brassylic acid to produce euriconitrile. Used for production of nylon 13 and 13-13.The technical advantages of nylons 13 and 13-13 are their tensile strength, percent elongation at break, and impact strength.	polyesters	Nylon 13 and Nylon 13-13- lower mold shrinkage, good flow properties for molding applications, and excellent resistance to chemicals.
Behanic acid (product derived from hydrogenation of erucic acid)	The hydrogenation of oil yields a glyceride, which contains saturated fatty acids. This triglyceride has a glossy surface and about the same melting point as beeswax (63 to 65° C) but is much harder.	Glossy agent	Manufacture of shoe and floor polishes

Advantages

1. High erucic acid lines will definitely reduce the processing cost
2. Natural product is always preferable because they are environmental friendly and have ability to naturally degrade compared to its counter parts petroleum based products.

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3. In terms of physical properties, rapeseed mustard oil including canola oil has excellent lubricity than mineral oil.
4. Rapeseed oil has viscosity index of 145-158 and is better than mineral oils that have viscosoty only 100 (Kinaway 2004).
5. Canola oil has Fash point of 326°C while that of mineral oil is 200 °C this makes canola oil safer.

Disadvantage

Breeding for high erucic lines is difficult as in rapeseed and related brassica species erucic acid is inserted only in the *sn1* and *sn3* position of the glycerol backbone. This limits the erucic acid content due to specificity of the *sn2* acyltransferace in brassica species.

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PGPR: A key player in sustainable agriculture

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Plant growth promoting rhizobacteria constitutes a group of rhizosphere bacteria that colonize roots in rhizosphere soil and exert a beneficial to crops on plant growth. The PGPR inoculants promote growth by serving as Bioprotectants (suppression of plant disease), biofertilizers (improved nutrient acquisition) and Biostimulants (phytohormone production). These are soil bacteria inhabiting around root surface and are directly or indirectly involved in promoting plant growth and development via secretion of various regulatory substances in the rhizosphere. Generally, these organism facilitate the plant growth through various ways e.g. modulating plant hormone levels, by either assisting in resource acquisition (phosphorus, nitrogen and essential minerals) and by decreasing the inhibitory effects of various pathogens on plant growth and development in the forms of biocontrol agents. The increased health and productivity of different plant species by the application of plant growth promoting rhizobacteria under both normal and stressed conditions has been very well documented

PGPR as biofertilizers are well recognized as efficient soil microbes for sustainable agriculture and hold great promise in the improvement of agriculture yields. Agriculture contributes to a major share of national income and export earnings in many developing countries, while ensuring food security and employment. Sustainable agriculture is vitally important in today's world because it offers the potential to meet our future agricultural needs and maintain the soil fertility and getting toxic free foods hence, peoples Nowadays shown interest in eco-friendly and sustainable agriculture system. PGPR are known to improve plant growth in many ways compared to synthetic fertilizers, insecticides and pesticides. They enhance crop growth and can help in sustainability of safe environment and crop productivity. The rhizospheric soil contains diverse types of PGPR communities, which will exhibit beneficial effects on crop productivity. Several research investigations are conducted on the understanding of the diversity, dynamics and importance of soil PGPR and their beneficial and cooperative roles in agricultural productivity. Some common examples of PGPR exhibiting plant growth promoting activity are: *Pseudomonas*, *Azospirillum, Azotobacter, PSB, Bacillus, Rhizobium, Erwinia and Mycobacterium*

Mechanisms of Plant Growth Promotion by PGPR

Rhizobium and phosphorus solubilizing bacteria are important to plant nutrition. These microbes play a significant role in secretion of organic acids thus lowering the pH in the rhizosphere and consequently release the bound forms of phosphates in the calcareous soils. Utilization of these microorganisms as environment-friendly.Phosphorus biofertilizers could help increase the availability of accumulated phosphate(by solubilization), increase the efficiency of biological nitrogen fixation and render availability of Fe, Zn, etc., through production of plant growth promoting substances.

Further, these soil bacteriumare reported as to secrete some extracellular metabolites called siderophores are commonly referred to as microbial Fe-chelating low molecular weight compounds. The presence of these compounds in rhizosphere of soil ienhance the rateof Fe supply to plants and inhibits the activity of competitive microbe thereby increases the plant growth and productivity of crop.

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There are three major ways of applying PGPR

1. Seed treatment

One packet of the inoculant is mixed with 200 ml of rice kanji to make a slurry. The seeds required for an acre are mixed in the slurry so as to have a uniform coating of the inoculant over the seeds and then shade dried for 30 minutes. The shade dried seeds should be sown within 24 hours. One packet of the inoculant (200 g) is sufficient to treat 10 kg of seeds.

2. Seedling root dip

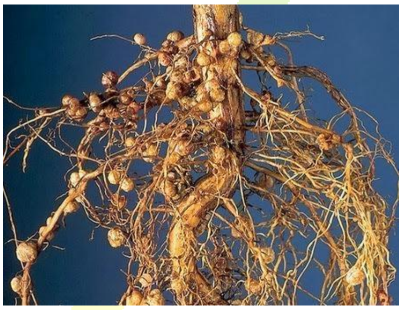
This method is used for transplanted crops. Two packets of the inoculant is mixed in 40 litres of water. The root portion of the seedlings required for an acre is dipped in the mixture for 5 to 10 minutes and then transplanted.

3. Main field application

Four packets of the inoculant is mixed with 20 kgs of dried and powdered farm yard manure and then broadcasted in one acre of main field just before transplanting.

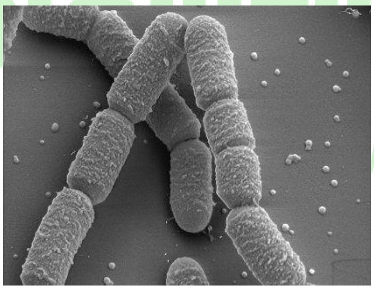
CONCLUSION

The modern and intensive agriculture necessitates for the heavy dependence on fertilizers and chemicals, which cause the pollution and environmental hazards by neglecting the traditional good agricultural practices. In many areas, health and productivity of soil have declined to the extent that, they cannot sustain profitable farming any more. To avoid the above mentioned problems, emphasis is now focused on use of PGPR are excellent model systems which can provide the bioactive compounds enriching the soil fertility, agriculture yield and act as a ecofriendly having diverse uses in agriculture. Current and future progress in our understanding of PGPR diversity, colonization ability, mechanisms of action, formulation, and application could facilitate their development as reliable components in the management of sustainable agricultural systems.



1. *Rhizobium*

2 pseudomonas



3. PSB

4 *Bacillus,*

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Role of medicinal herbs in cancer treatment

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Medicinal plants are the important source of medicine ever since the dawn of human civilization and in spite of tremendous developments in the field of allopathy during the 20th century. Plants are considered as a repository of various bioactive compounds and used for long time due to its therapeutic properties and their derived product has benefits over synthetic medicine which increased the utilization of medicinal plants in the healthcare sector and shows potential role against cancer treatment.

Cancer is one of the life-threatening diseases which creates major problem in both the developing and developed countries and is one of the deadly diseases which are characterized by the irregular cell proliferation. The most common reason behind the cancer is lifestyle changes and therefore an urgent need to find a better treatment for the disease is required so here we have listed some important medicinal herbs for management of caner

1. Periwinkle (*Catharanthus roseus:* F: Apocynaceae) an herbaceous perennial plant popularly know as Madagascar periwinkle and rosyperiwinkle. The plant originated from Madagascar. Widely distributed in India, Indonesia, Isarel, Madagascar and South Africa and mainly grown for its leaves and roots having medicinal properties contains vinca alkaloids like vinblastine, vincristine (leucocrystine), alstonine, ajmalicine and reserpine. Vinca alkaloids execute anticancer effect by binding to the tubulin (microtubule protein in cancer cells) thereby breaking down the microtubules, thus, inhibiting formation of mitotic spindle in the metaphase that arrests division of the cancerous cells.

2. Aloe vera (*Aloe barbadensis* F: Liliaceae) an important medicinal herb popularly know as Indian aloe and first aid medicinal plant. The leaves of aloe contains aloe-emodin compound which activates the macrophages to fight against cancer. Aloe vera also contains acemannan, which enhances activity of the immune cells against cancer and stimulates immune system response of the body by activating macrophages and releasing cytokines such as interferon, interleukin and tumor necrosis factor.

3. Liquorice *(Glycyrrhiza glabra* F: Legumunoceae*)* a herbaceous perennial legume native to the Middle East, southern Europe, and parts of Asia and widely distributed in India, north Africa, france and germany. Flavonoids are derived from root and whole plant of Liquorice posses a strong anticancer, antioxidant, antiulcer and anti HIV properties. Glycyrrizin and glabranin compound are isolated from Liquorice wich will inhibites the growth and spread of lung cancer and the licorice extracts prepared from the dried roots and stems of *Glycyrriza* has been used for cancer treatment.

4.Kalmegh (*Andrographis paniculata* F: Acanthaceae) Andrographolide compound isolated from leaves of the plant enhancing anticancer activity against cancers of breast, ovary, stomach, colon and compound also responsible for production of white blood cells in order to releases interferon and thereby arresting G-0/G-1 phase of cell- cycle and inducing apoptosis. The chemoprotective potential of *A. paniculata* against chemotoxicity, including carcinogenicity was observed in mice. Thus, *it* possesses anticancer immune stimulant, antioxidant, antiinflammatory and antihepatotoxic properties.

5. Babchi (Psoralea corylifolia Linn.; F: Papilionaceae/Fabaceae) Bavachinin, corylfolinin and psoralen, isolated from babchi possess strong anticancer activity against lung and liver cancer. Psoralen enhances immunity of the body by stimulating natural killer cell activity and prevents the growth and spread of stomach and prostate cancers by inhibiting G2/M phase of cell cycle. The compound also possesses strong antioxidant, immunomo enhancing and hepatoprotective properties.

6. Makoi (*Solanum nigrum* Linn.; F: *Solanaceae*)
The fruit of the plant contains a major phytoconstituents like Flavonoids (quercetin) and alkaloids (solasodine, solanine and solamargine) which have been reported to inhibit growth and spread of various cancers cells. Apart from these compounds the Solanine and solamergine are have been very strong anticancer actions against murine tumours and the Steroidal glycosides of this plant such as spirostane, furostane, spirosolane and pregnane are capable to inhibit growth and spread of colon, breast and cervical cancers cells. Higher doses of solanum nigrum induce apoptotic cell death, while lower doses lead to auto phagocytic death of cancer cells.

CONCLUSION

Due to the increased adverse affect caused by the chemotherapy in treatment of cancer with the common drugs like alkylating agents, antibiotic, steroid analogue obtained from medicinal herbs shows a lesser toxicity and better effectiveness in numbers of ontological conditions for example in breast cancer, testicular cancer, leukaemia, brain tumour etc. With the enhancement in the technology for the study of effectiveness, quality control and rationale based approach for the disease treatment it seems that in future use of medicines obtained from the herbal source will be a potentials means of treating the disease and will also be economical and cost effective.

1.Periwinkle

2. Aloe vera

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3. **Liquorice**

4.Kalmegh

5. Babchi

6. Makoi

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Secondary agriculture for doubling farmer's income

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The current scenario of farmer's distress in our country is taking a toll on farmer's lives as well as agricultural economy of India. To cope with this situation, government has set a goal of doubling farmer's income by various approaches, secondary agriculture being one of them. Secondary agriculture is a broad term which refers to value addition to the primary produce, adoption of alternative enterprises and utilisation of crop residues. Various alternative enterprises that are gaining more popularity nowadays include mushroom culture, agroforestry, sericulture, lac-culture, bamboo cultivation, bee-keeping, agri-tourism etc. Adoption of secondary agriculture can drive the growth of primary agriculture by adding two to three fold value, thus strengthening the economy. It will increase the income generation of the farmers as well as better management of agricultural wastes is also possible.

INTRODUCTION:

Indian agriculture is one of the most significant contributors to the Indian economy with a substantial share in the national GDP. Also, it is the largest livelihood provider as about 60% of the country's total population (mostly rural) depends on agriculture. Currently, a decline in the share of agriculture in the rural income has been observed. This may be due to the lack of sufficient employment and income generation in the rural areas which is resulting in the exodus of rural youth to the urban areas in search of better employment opportunities. But, as the other industrial sectors do not have similar absorbing power, the problem of unemployment remains as such. Considering this scenario of agrarian distress, Government of India's Ministry on Agriculture and Farmer's welfare has setup a committee on doubling farmer's income (DFI Committee). According to a report published by this committee, presently, 44% of the agriculture dependent rural households have found employment in the non-farm sector and only 26% remain purely dependent on agriculture.

To meet the goal of doubling farmer's income, various approaches have been proposed by this committee, secondary agriculture being one of them. Agriculture is normally considered as a primary sector. When we add the prefix 'secondary' to anything, it represents the next or the higher level of that particular thing. There is no clear definition of secondary agriculture, but it is a very broad term which includes all types of agro-processing enterprises as well as agro-allied enterprises. Even, management of agricultural wastes like crop residues is considered as one of the avenues of secondary agriculture. But, each and every agro-based industry cannot be included in secondary agriculture. The focus is primarily on the micro enterprises or small-scale units at village level. So, according to the DFI committee, any venture can be considered as a secondary agriculture practice when:

- It utilises only the locally available resources and agricultural by-products as raw material.
- It deploys only the locally available skills and expertise *i. e.,* rural manpower.

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- It can be categorised appropriately under the Micro, Small or Medium Enterprises Development (MSMED) Act, 2006.

For example, a locally setup cotton ginning unit near the cotton growing field, a cottage scale unit to prepare jam, jelly, pickles etc. or a jaggery making setup near the sugarcane field.

All the secondary agriculture practices can be broadly divided into following three categories:

- Value addition to primary produce
- Utilisation of crop residues and agricultural wastes
- Alternative enterprises

Why we need secondary agriculture?

It can drive the growth of primary agriculture by adding two to three fold value, thus strengthening the rural economy. Both on-farm and near-farm activities will lead to creation of new value-added products with better market demand which will increase the income generation of the farmers as well as better management of agricultural wastes. Secondary agriculture activities also help in the reduction of gap between the agricultural and industrial sectors.

Table 1: Classification of various secondary agriculture avenues

Value addition to primary produce	Utilisation of crop residues and agricultural wastes	Alternative enterprises
A. Processing of primary agricultural produce into pickles, chutney, jam, jelly, candy, spices powder etc. B. Pre-cooling and packaging of horticultural crops (flowers, vegetables, fruits) C. Preparation of dyes, flavours, extracts, essential oils, nutraceuticals etc. D. Biopesticides, biofertilizers, vermicompost and animal feed production	A. Bio gas production B. Compost preparation C. Cereal straw utilisation for packaging, fibre board production D. Banana/Agave fibre extraction E. Leather products F. Cutlery plates from arecanut and other palm leaves	A. Bee keeping B. Mushroom culture C. Bamboo cultivation D. Lac culture E. Sericulture F. Agroforestry G. Integrated farming system H. Agri-tourism

Among the various options available for secondary agriculture, some activities are found to be more promising and popular among the Indian farmers. These include enterprises like mushroom culture, agroforestry, sericulture, lac-culture, bamboo cultivation, bee-keeping etc. Other than these more popular practices, agri-tourism is one newly developed concept to promote extra income generation to the farmers. The details of these activities have been discussed further.

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- **Mushroom cultivation:**
  Cultivation of mushrooms is one of the most popular secondary agriculture practices especially for the educated section of farmers. It requires less land, is not capital-intensive, utilises waste from other farming activities and provides great potential to enhance farming income. Farmers who follow the conventional rice-wheat cropping system can easily adopt mushroom cultivation as a secondary practice as the crop residues or straw serves as an excellent substrate for mushroom growth. This will enhance both, income of farmers as well as protein yield per unit area.
- **Agroforestry:**
  This refers to the growing together of field crops and forest tree species. Agroforestry provides multiple benefits to the farmers in addition to the generation of extra income through the tree products (timber, fibre, fuel-wood, feed and fodder). Trees act as wind breaks for the field crops, enriches soil health by adding organic matter through leaf litter and even regulates micro climate around the crops. There are some nitrogen fixing tree species (NFTS) like *Leucocaena leucocephala* too which fixes atmospheric nitrogen into the soil.
- **Sericulture:**
  It is the practice of rearing silkworms on host tree species for obtaining raw silk fibres. There are mainly four types of silkworms – mulberry, eri, tasar and muga silkworms. Each of them prefers different species of trees as their host. Most common of these is the mulberry silkworm (*Bombyx mori*), which is reared on mulberry trees. Cultivation of mulberry plants is referred to as moriculture. Sericulture is one of the most profitable activities for farmers as the demand of silk fibres is always high in the textile and fashion industries.
- **Lac culture:**
  Lac is a natural resinous substance secreted by lac insects (most common insect species is *Kerria lacca*). The important tree species preferred by these insects are kusum, palas, ber, *Ficus spp. etc.* Recently, *Flemingia semialata* – a bushy lac-host has been found to be very promising for intensive lac cultivation. Lac cultivation provides sustained & higher economic returns, generates employment opportunities and supports various lac based rural cottage industries.
- **Bamboo cultivation:**
  Bamboos have multiple utility that include food, fibre, fuel, construction material, medicinal products, paper, etc. and is also a source of some nutraceuticals which can be extracted from bamboo culm and leaves. Thus, cultivation of bamboo can meet various requirements of farmers and provide them with good income and it is eco-friendly too. Nowadays, extraction of fibre from bamboo is also done. Processed products like pickles, chutney and candies can also be prepared from bamboo shoots.
- **Bee-keeping:**
  Rearing of honey bees or apiculture is a very profitable activity that can be taken up by the farmers along with their main crop. Requiring very little land and fewer inputs, this is feasible for the small farmers as a part of the Integrated Farming System (IFS). Other than honey, other products like bees wax, royal jelly, bee venom and bee pollen also has market demand. Bees pollinate the nearby crops, thus increasing total yield and productivity.
- **Agri-tourism:**
  This is a relatively new concept which refers to development of agricultural farms as tourism spots where tourists can connect with the rural life, local cuisine and familiarity with various farming

landscapes. Agri- tourism ensures cash flow during the off season and also creates opportunity to sell products grown and harvested through agricultural operations. It generates employment to a part of rural population as well as helps in conserving and communicating the values of rural life and agriculture.

Considering the present situation of farmer's distress in our country, we need a more feasible and reliable solution to their problems. Adoption of secondary agriculture is one such solution and so, there is a need to promote it more and more. This will not only help in better income and employment generation for the farmers but will also make primary agriculture more sustainable.

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STEVIA: A nature's sweetener

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India is the largest producer of medicinal herbs and known as the botanical garden of the world. Officially, over 3000 plants were recognized in India for their medicinal value and about 200 native plant species are in wide use for their curative properties. Plants are the important source of drugs in modern as well as traditional systems of medicine across the world. Among such medicinal plants stevia also play a major role in curing various diseases.

Stevia (*Stevia rebaudiana* L.) is an herbaceous perennial plant belongs to the Astaraceae family popularly know as natural sweetener, honey plant, sweet herb of Paraguay and Sweet Leaf. The plant originated from South America and distributed widely in Uruguay, Paraguay, Brazil, Thailand, Central America, China, and Israel. The Leaves of Stevia produce diterpene glycosides compounds called as stevioside and Rebaudioside and they can be more than 200 times sweeter than table sugar and may substitute sucrose as well as other synthetic sweeteners apart from these believed to have antiglycemic, antiseptic antibacterial, antimicrobial, anticancer activity & also be used in stomach upset, indigestion, weight loss and heart burn.

Botany

The plant is a slender perennial herb growing upto a height of 60 to 70 cm tall with sessile, opposite to oblanceolate leaves, serrated above the middle. The flowers are small, white and arranged in an irregular cyme.

Medicinal Uses

- It is used for the preparation of biscuits, chocolates, ice creams and candies and also in Indian dishes like sakkare pongal, payasam, ravaladdoo, jam, juice, tea, coffee
- It can be used in herbal medicine and tonics for diabetic Patients.
- Wet stevia leaf bag placed over eyes for a few minutes effectively tighten skin and smoothes out wrinkles.
- Stevia has a healing effect on blemishes, wounds, cuts and scratches
- Used as aid in body weight management and weight losses.
- It also tends to lower the elevated blood pressure, incidents of colds and flu.
- Kaempferol compound present in stevia reduce the risk of pancreatic cancer

CULTIVATION PRACTICES

Soil & Climate

The plant is a semi-humid sub-tropical crop can be grow in the temperature of 11-38^{O}C with a rainfall of 140 cm for its successful cultivation and it comes up well in sandy loam soil with ample supply of water and prefers acidic to neutral soil (pH 6.5 – 7.5) for its better growth.

Propagation

The plant can be propagated through cuttings or seed or by tissue culture. Commercially it is propagated through cuttings because the seed germination is very poor and establishment of seedlings is very slow. The cuttings of 15 cm

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length taken from leaf axils of current years growth and treat with Paclobutrazol @ 100 ppm/ IBA @ 500 ppm to obtain better root initiation. Cuttings will be ready for transplanting after 25-30 days of rooting. The best month for propagation is February – March.

Field preparation and Sowing

Land should be initially ploughed 1-2 times with disc plough and harrowed to break clods and brought to a fine tilth. The required quantity of FYM is incorporated into the soil at the time of last ploughing.

Spacing: 45 x 22 cm

Fertilizer dose: 60:30:45 NPK/ha

Irrigation : crop should be irrigated once at every eight days intervals and Sprinkler irrigation has been found to be very effective.

Deflowering

An important intercultural operation followed in stevia by removal of flowers at different growth stages in order to facilitate more vegetative growth along with increasing the accumulation of photosynthates (steviosides).

Harvesting

The crop attains first harvest after three months of planting. It should be harvested by leaving 5-8 cm of stem from the ground level to facilitate the regeneration. The subsequent harvests can also be taken at 90 days interval. A minimum of four harvests can be obtained in one year. After harvest the leaves have to be stripped off from the branches and spread in a thin layer for drying

CONCLUSION:

India is a meadow of medicinal plants where most of the plant species are exploited for traditional system of medicine. Stevia is one such upcoming medicinal plant with plenty of medicinal properties. However, its cultivation is only confined to parts of South and Central America. Hence, there is a need to expand the area under this valuable medicinal crop, with good agricultural practices.

Stevia plant

Stevia flower

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Stevia popular products


Stevia powder

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The effects of climate change on Indian agriculture

Article id:
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INTRODUCTION:

Climate change is a phenomena which indicates significant changes in global temperature, precipitation, wind patterns and other measures of climate which occur over decades or longer. It includes rise in the temperature, melting of snow that leads to rise in see level, changes in precipitation pattern; high intensity and low frequency of rainfall which leading to drought and flood situation during crop season and increased frequency of extreme weather events such as hailstorms etc., (IPCC 2014). The Indian Agriculture is mainly dependent on monsoon and therefore highly prone to climatic risk. In India about two third area of cultivation comes under rainfed agriculture. The different parts of the country face different type of climatic risk such as frosts events in North West, floods in the north eastern, cyclones in the eastern parts and heat waves in the north western parts which adversely affect the crop production. (Pathak and Chakrabarty, 2015).

Climate change and its impact on Agriculture:

Climate change affects agriculture either directly or indirectly by impacting crops, soils, livestock and pest. The direct impact include rise in atmospheric concentration of carbon dioxide (CO_2) and temperature. The increase in CO_2 concentration has fertilization effects particularly on the C_3 plants thereby promote their growth and productivity. Rise in temperature leads to increase in respiration, increase in evapotranspiration, shortening of crop duration, alteration in the photosynthetic capacity, higher incidence of insect pest and diseases, enhanced nutrient mineralization in soil and decline in fertilizers use efficiency. Climate change also has indirect impact on the land use system in India through availability of irrigation water, frequency of floods and droughts, organic matter decomposition in soil, soil erosion and changes in pest incidence and distribution. Some of the considerable impact of climate change on Indian agriculture is mention below:

1. Crops:

Carbon dioxide fertilization:

- Increased CO_2 concentration in atmosphere proved to be beneficial in C_3 crops such as Rice and Wheat, as it enhances the photosynthetic efficiency in these crops.

Photorespiration:

- If there is increase in temperature and light intensity without significant rise in CO_2 concentration then it will lead to photorespiration.
- Photorespiration is the process of light-dependent uptake of molecular oxygen (O_2) which leads to release of carbon dioxide (CO_2) from organic compounds.
- The effect of photorespiration is mainly observed in C_3 plants.

Reduction in yield:

- A rise in temperature leads to increased respiration, decreased crop growth duration and reduction in the availability of irrigation water which ultimately reduce the yields of major cereal crops.
- The productivity of major crops will be adversely affected due to increased frequency of extreme weather events (floods, droughts, cyclones and heat waves).

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Higher incidence of pest and disease:

- Significant rise in temperature and humid conditions leads to higher incidence and distribution of pest and diseases.

2. Water:

Uneven distribution of rainfall:

- The rise in temperature and higher evapotranspiration leads to higher demands for irrigation water.
- Uneven distribution of rainfall leads to excess or shortage of irrigation water which ultimately affect the crop production and productivity.

Decline in water table:

- The melting of snow in the Himalayas may lead to increased water flows in the rivers like the Ganges and Brahmaputra and leads to a decline in the water availability in long run.

Extreme weather conditions:

- The high frequency and intensity of rainfall during monsoon season leads to considerable runoff, floods and soil erosion in several parts of the country, however this excess water can be effectively utilized for crop production through water harvesting techniques.

3. Soil:

Organic matter:

- The rise in temperature and atmospheric concentration of CO_2 will affect the organic matter (OM) thereby affecting the soil quality.
- Indian soils are low in organic matter and further rise in temperature will fasten the OM decomposition process which will further leads to Low soil OM.

C: N ratio:

- Higher CO_2 concentration will increase the C: N ratio of crops which will lead to slow decomposing of the crop residue.
- Nitrogen (N) mineralization rate will hasten due to rise in temperature, it will cause loss of N through volatilization and denitrification process thereby lead to reduction to the plant available N in soil.

Soil erosion:

- High intensity rainfall and wind may cause soil erosion.
- A significant increase in sea level may lead to the ingression of sea water in coastal lands which make them less suitable for cultivation.

4. Livestock:

Reduction in production of quality fodder:

- Climate change will affect the livestock by impacting production and nutritional property of feed and fodder.
- High temperature generally cause lignification of crop residues; thereby decrease its digestibility.

Water requirement for livestock:

- Global warming may lead to scarcity of water resources for livestock and may further increase the water, shelter and energy requirements of livestock.

Reduction in milk production:

- Climate change is likely to increase the heat stress in dairy animals which may lead to adverse effect on their reproduction and milk producing ability.

Application of Climate resilient technology for climate change mitigation in agriculture:

- To mitigate the adverse impact of climate change on Indian agriculture, several potential technologies has been employed, some of them are mentioned below;
- Development of climate smart (heat, flood, drought and salinity tolerant) crop varieties.
- Development of early maturing crop varieties.
- Development of Water harvesting infrastructures (e.g. construction of check dams and farm ponds).
- Use of Micro-irrigation technologies e.g. Drip and sprinkler irrigation for efficient utilization of water in crop production.

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- Adoption of Conservation Agriculture (CA) with Resource conservation technologies (RCTs) at farmer's field. Adjustments in sowing date of field crops to avoid the terminal heat stress type of situations.
- Adoption of intercropping and crop diversification models in order to prevent complete crop failure due to floods and droughts.
- Integrated farming systems (IFS), Integrated Nutrient management system) and Integrated Pest and disease management practices (IPM) must be followed.
- Government support such as Crop insurance scheme and supply of credit to small and marginal farmers may enhance the climate risk bearing capacity of farmers.
- Improved weather based crop advisory and short term weather forecast could be boon for farmers in overcoming the ill effects of extreme weather events and its associated hazards.

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Biofortification in Wheat: A new solution to hidden hunger

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INTRODUCTION

Hidden hunger is one of the most subtle types of deficiencies which are commonly expressed as Micronutrient Deficiency caused by eating food that fills stomach but lacks in essential vitamins and micronutrient. These types of deficiencies are more often ignored or are unnoticed in our society which leads it to be called as 'hidden hunger'. Globally, 800 million people are suffering from chronic hunger that means they are undernourished in terms of calories (FAO *et al.,* 2017). It is estimated that approximately every one-in-three individual suffer from micronutrient deficiencies globally (FAO, 2013). With this situation, it is challenging to accomplish Sustainable Development Goal (SDG) 2 which aims to end hunger, ensure food security and improved nutrition, and promote sustainable agriculture, by 2030. The popular saying "Health can be improved by food, not medicine" is prime goal of breeding wheat with improved micronutrients to combat hunger.

Wheat is the staple food crop of world, being most grown and consumed crop and is key crop in terms of food security. The hunger plight was tried to sort out during Green Revolution era 1965-67 through development of short statured wheat varieties, adoption of intensive irrigation practices and heavy application of nitrogenous fertilizers. However, during the same time, the nutritional perspective was remained neglected which arisen the problem of hidden hunger.

Biofortification

- Biofortification is the process of increasing micronutrient bioavailability of crops with conventional breeding or genetic engineering based techniques.
- It is favored over fortification as it enhances nutritional level in plants during development phase.
- Biofortification is a multi-disciplinary approach involving role of breeders, geneticist, nutritionist and economist.
- Wheat is one of the important crops in terms of nutritional value and consumed in processed form such as flour, bread and other food stuffs.
- However, wheat contains suboptimal quantities of micronutrients, especially iron (Fe) and zinc (Zn) and most of these micronutrients are removed by milling. Deficiencies in micronutrients are mostly prevailing in regions where the human diet consists mainly of cereals.
- Cereals such as wheat are mostly lacking in mechanism of zinc absorption as compared to pulses which realized the deficiency of zinc in plants and thus human diet.
- National Health Survey (NFHS-4, 2015-2016) report indicated that 58.5% children are anemic at national level (International Institute for Population Sciences, 2016) and iron deficiency anemia led to the loss of more than 46,000 disability adjusted life years (DALYs) in 2010 (Murray and Lopez, 2013).

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- Globally, more than 17 percent people lack sufficient zinc in their diets. It is estimated that 1/3 of world population is affected by Zn deficiency which is associated with low dietary intake and Zn-deficiency leads to estimated annual deaths of 4,33,000 children under the age of five (WHO, 2009).
- It was reported in different studies that a wide variation in grain Fe and Zn concentrations was found in wild relatives of modern wheat and the concentrations was even higher than those found in modern elite cultivars (Cakmak *et al.,* 2000).

Advancement in studies for improving Fe and Zn content in wheat:

Wheat ploidy and evolution has been a determinant factor with respect to iron and zinc content. The A and D genome of wheat is found to be more contributing in terms of zinc efficiency. Researchers have found that wild wheat relatives possess more zinc and iron content as compared to modern cultivars. Breeding programmes have been designed to involve potential wheat germplasm like emmer wheat to transfer a high micronutrient trait to selected genotypes making it more effective for quality consumption. Substantial progress had been made through recent technological advancement like molecular markers, gene tagging, marker assisted selection, quantitative trait loci (QTL) mapping and next generation sequencing to escalate research in wheat iron, zinc and protein content. These recent advances in wheat research will allow characterization of gene responsible and would help in deploying the knowledge to improved cultivars. Some of these advances are discussed below:

1. Genome availability

Large genome size and complexity in wheat genome has led to some level of difficulty in designing research methodology for improving Fe and Zn content. The molecular advance that involves genome assembly and accessibility to wide genome is enabling identification of single nucleotide polymorphism and development of genome specific markers. These tools should be used for precise mapping and deployment of grain Fe and Zn traits through marker assisted selection.

2. Reverse Genetics

The major advancement in sequencing technology has been helpful for rapid discovery of mutants in specific genes. This would assist researchers to order mutants in their gene of interest and allow faster characterization of function of desired gene in wheat and will provide valuable alleles for breeding.

3. Transgenic Methods

Transgenic wheat production is a major bottleneck as efficiency of wheat transformation still lags behind the efficiency of barley transformation but it is constantly improving and different promoters are available to target transgene expression at particular tissue level or at developmental stages. The transformation into elite lines should be cost effective and this would speed up breeding programs.

Conclusions & Future Directions

Involving modern techniques like molecular biology and conventional breeding in biofortification has achieved considerable success in combating malnutrition. However, the use of wild sources would be rewarding in terms of increasing nutritional content and bioavailability of micronutrients. Climate change in near future will also lead to reduced grain micronutrient content. There is an equal need to increase social

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awareness as well so that farmers can use these biofortified varieties for production.

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Molecular genetics of plant cell wall-degrading enzymes produced by plant pathogenic fungi

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INTRODUCTION

The establishment of the pathogen in the host and subsequent development of disease involves chemical interaction between the host and the pathogen. The pathogen employs offensive chemical weapons to breach host barrier, which the host resist with all its might. Parasitism and disease resistance run parallel and are inseparable. A biochemical tug of war ensues between the host and pathogen, in which one tries to outwit the other. Enzymes, toxins, growth regulators and polysaccharides are the important chemical weapons of the pathogen. Both saprophytic and plant parasitic fungi produce extracellular enzymes which can degrade the cell wall components of plants. These fungi not only secrete enzyme for obtain the important nutrient but they also use these enzyme for degrading cell wall polymer for development of penetration peg for establishing the colony inside the tissue of host. DeBary (1886) was the first to suggest that extracellular enzymes may be involved in the infection process of plant pathogenic fungi. Of the numerous cell wall degrading enzymes produced by plant pathogenic fungi, most research has concentrated on the pectin degrading enzymes. This is because the pectinases are typically produced first, in the largest amounts, and are the only cell wall degrading enzyme capable of macerating plant tissue and killing plant cells on their own. The pectin matrix of plants is found throughout the primary cell wall but is most concentrated in the middle lamella between cells. The pectin matrix is thought to stabilize cellulose microfibrils, other neutral sugar polymers and proteins in the primary cell wall. The pectin matrix consists of homogalacturonan and rhamnogalacturonan with various degrees of methylesterification of the carboxyl group of the galacturonate residues. Two types of pectinases have been differentiated by their cleavage pattern: an endo form that cleaves internal regions of pectin chains randomly and an exo form that removes terminal residues. Other fungal cell wall degrading enzyme may also be important in the breakdown of plant cell walls and colonization of plant tissue. It has been proposed that xyloglucans are interlaced with cellulose microfibrils and act as a network providing tensile strength to the cell wall. Breakdown of the xyloglucan spanning the space between cellulose microfibrils by fungal cellulases and xylosidases could weaken the wall and provide increased access for fungal cellulases to degrade the cellulose microfibrils. Cellulose microfibrils are considered to provide the structure and support for all the other components of plant cell walls, and their degradation by fungal cellulases may contribute to the weakening of the cell wall. Enzymes involved in cellulose degradation include endo-1, 4-glucanase which cleaves internal bonds, and cellobiohydrolase which cleaves the disaccharide cellobiose from the end of the polymer Polysaccharides also provide inter-

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connections between the main components of the cell wall. Xylans in dicot cell walls provide interconnections between rhamnogalacturonan and other cell wall components Arabinogalactans and arabinans are probably attached to many of the rhamnosyl residues on rhamnogalacturonan and therefore have a role in determining the spacing between pectin polymers and limiting the size of pores in the pectin matrix. Fungal arabinases arabinogalactanases, xylanases, and glycosidases may act in concert to increase access to the main polymers by degrading their respective substrates.

Genes encoding fungal pectinases:

Several PG genes have been cloned from saprophytic and phytopathogenic fungi. All of the fungal PG genes cloned thus far are between 1100 and 1350 bp long and most of the genes have one to four introns of 50 to 81 bp with at least one intron approximately 55 bp in length, except for a *Sclerotinia sclerotiorum* gene which has no introns. At the amino acid level, fungal PG genes are approximately 60 to 65% similar to each other, except for the *F. moniliforme* gene which is approximately 40% similar to the *S. sclerotiorumpg1* and the *Colletotrichum lindemuthianum Clpg1* genes, and the fungal PG genes are approximately only 20% similar to PG genes from bacteria and plants. A region of approximately 80 residues in PGs from fungi, bacteria and plants has many highly conserved amino acids and may contain the active site and/or be involved in binding of the substrate. Based on the DNA sequences, all of the PG proteins have a single peptide of 20-40 amino acids long, mature proteins of 360-380 amino acids, and calculated sizes between 33 and 38 kDa. However, because so many of the fungal PGs that have been cloned thus far are from *Aspergillus* species, the range of variation in PG genes may be underestimated.

Role of cell wall degrading enzyme in pathogenicity:

The importance of cell wall degrading enzyme to the pathogenicity (the ability to cause disease) or virulence (the level of disease induced) of phytopathogenic fungi is not clear. Studies attempting to correlate cell wall degrading enzyme production to virulence or pathogenicity in phytopathogenic fungi have been complicated by the multiple isozymes of each cell wall degrading enzyme produced by most fungi. Different isozymes of each cell wall degrading enzyme may have different functions, including providing nutrients during saprophytic growth, and may be produced at different stages during infection of plant tissue. Both classical genetic studies utilizing mutants and much more precise molecular genetic techniques have been employed to address this question. Mutants of the wilt pathogens *viz., Fusarium oxysporum* f.sp. *lycopersici*, *Verticillium albo-atrum*, and the brown rot fungus *Sclerotinia fructigena* that have reduced PG and PME activities were created by treatment with irradiation or mutagenic chemicals, and these mutants were reported to have similar virulence or slightly less virulence than wild types on their host plants. This suggests that these enzymes may be minor virulence factors but are not pathogenicity determinants. However, these studies had at least one of the following deficiencies; the mutants still produced pectinase enzymes, the assays used to screen for PG activity could not measure low levels of endo or exo-activity, and the mutants were wound inoculated into the plants so any role of the enzymes in initial infection could not be determined. Most significantly, many of the mutants used in these studies also had abnormalities in growth or production of other enzymes demonstrating the imprecision of using mutagenic agents which can disrupt many genes in addition to the ones of interest.

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CONCLUSION

The main mode of action through which plant pathogenic fungus acts is through disrupting cell wall components not just for obtaining nutrient but also to establish a colony through penetration peg. These mechanisms have been researched so far and many genes and protein encoding those enzymes have been studied to have an insight for the molecular mechanism involved. Recent advances in molecular genetics and genomic studies have begun to unravel cell wall–degrading enzyme families that are specifically present or enhanced in plant-pathogenic fungi.

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Management strategies for storage pests of agricultural crops

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"Storage pests are of serious problem as it render the cereals and pulses totally in-edible. Storage pests affect the crop at the highest point just before it reaches the market, so it causes havoc economic loss for the farmers or seller. Hence it is of utmost importance to manage these pests. It is important to identify the pest at right stage and formulate the best management practice possible. But effective measure of controlling a pest should be economical and should not induce and residual toxicity on the crops."

1. Control strategies for storage pest

Pests are very detrimental for crops at any stage of its life cycle. The damage is of more concern particularly when it occurs during the penultimate stage of its life cycle. Crops which are being destroyed at post harvest stage or during storage render maximum economic loss to the growers or farmers. Hence proper strategies are needed to be adopted to ensure that crops are not damaged at storage. It is also needed to ensure that the damage by pest should not be such that it causes huge loss. The crops generally lose consumer acceptability if there is some damage particularly at the later stage. Control strategies or management techniques are adopted when all precautionary measures fail to control pest infestation in stored crop.

1.1. Chemical control

Chemical control basically is the chemical management of any storage grain pest or post harvest pest of horticultural crops. Chemical control is the fast method, economically efficient and best in terms of pest mortality. But it has severe consequences on human health because of toxicity that stays as a residue and because of the ill-effects as a result of it.

1.1.1. Fumigation

Fumigation with suitable fumigant is done in case of stored-product insects when storage is done in bulk containers, warehouses and other large storage structures. This is best suited when any large area requires fumigation. Fumigants effectively kill the insect population which is hiddenin places beyond our observation. Sometimes resting structures, spores, eggs and pupas are also affected due to fumigation. The structure or place which is to be fumigated is usually sealed tightly so that the fumes could not escape outside. Methyl bromide is one such fumigant which has effectively managed many pathogens of cereals, pulses and vegetables effectively within 48 hours of exposure. Formaldehyde fumigation also sterilizes many structural equipments and grains to kill fungal pathogens. Carbondioxide however a very less lethal gas can effectively suffocate the pest population and cause death of the species.

Gaseous phosphine and aluminum phosphide when used as fumigant in corn, wheat, sorghum and soybeans can effectively destroy all prevailing insect pests (either adult or juvenile).

1.1.2. Dusting and spraying

When insecticides are applied to stored grains and food products the insecticides act upon the particular target insects and kill them. Basically there

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are two types of insecticides, residual type (insecticides which leave active residues on grain for several months to more than a year) and non-residual type (substances that kill rapidly due to high vapor pressure and high lethality of residues). Residual insecticides usually contain organophosphates, pyrethroids and insect growth regulators (IGRs) as the active ingredients. The non-residual pesticide group contains only dichlorvos (also an organophosphate). These chemical costs are very nominal and hence commercially feasible but the biggest concern are the residual side effects.

1.1.3. Insect-pest growth regulators

Insect growth regulators (IGR's) are also known as biorationals have deleterious effects on growth, development and metabolic process of the insects. Generally these chemicals are very slow in action and have slow efficacy but are safer than any other chemicals used. Methoprene is a IGR which damages surface feeding caterpillars of barley, oats, cereals, peanut, rice, wheat sorghum and peanut.

2. Physical method of control

Physical methods of pest control are those strategies in which the pests are managed by either manipulation of physical environment or by applying physical treatment to the crops. Physical treatments are the treatments by the help of which the pest are killed, removed or setting up barriers. Usually physical methods of pest control are usually practiced in insects and small rodents (Fields and Muir, 1995). Physical methods for managing storage pests include the techniques discussed below:

2.1.1. Physical removal

This is literally the simplest method of pest management in which the pests are mechanically being removed from the stored crops. The crops are subjected to mechanical observations and the pests are removed naturally from the crop system. This is an excellent strategy when the amount of crop is lesser or the labour is cheap. Since there is hardly any technical know-how, so this is very nice strategy in underdeveloped and developing countries. This is also excellent in case when crop quantity is less. But this is not feasible if crop quantity is huge enough.

2.1.2. Mechanical impact

This physical separation of pest or pest debris from grains is being done by mechanical impact techniques. Generally cereals and pulses are given mechanical impact such that the pest or its cocoon floats out at the top of the grains and are physically separated after that.

In industrial or commercial scale this technique is used quite effectively. It is being done using pneumatic conveying machine. During pneumatic conveying of grains, usually the high-speed impact of grains against the walls of the vessels eliminates a significant proportion of adults and well-developed hidden stages of primary feeders. Adults cannot survive the shock of the high speed rotating grains. This machine has potential to successfully eliminate broken or distorted grains and their insect debris by forced aspiration.

2.1.3. Abrasive and inert dust

Inert dust are basically chemically unreactive but have insecticidal properties. Inert and abrasive dusts like diatomaceous earth (DE) and silica aerogels (SA) which are used in several countries as an alternative to chemical protectants. Diatomaceous earth (DE) provides worthy protection against insect infestation in dry grain storage. In this system the insects once comes in contact gets desiccated and dies (Mahdi and Khalequzzaman, 2006).

2.1.4. Ionizing radiation

Ionization at a low dosage is a very effective way of managing stored grain pests. Ionization or irradiation represents either the exposure to x-rays (accelerated electrons) or gamma radiations (radioactive isotopes). The insects which are subjected to these radiation treatments are not immediately exterminated, but they slowly collapse due to gene abrasion. The radiated gamma rays have potential to penetrate deep into the grains or food products. The accelerated electrons have a limited depth of penetration to 2–5 cm but have tremendous sterilization potential. Irradiation is widely being used in disinfection and sterilization of fresh horticultural produces. The radiation unit is expensive and huge investment cost. This is the reason why high value crops are only irradiated.

2.1.5. Light

Many insect pests get attracted to light. If light is set along with a trap, the insects (nocturnal ones) would get attracted to it and can get trapped into it. Similarly some fungal spores are known to get destroyed in absence of light. These fungal spores won't be able to germinate and a cause rot disease if light is present.

Sheribha *et. al*., (2010) evaluated the effects of red coloured light on *T. castaneum* population and observed that red coloured light is not preferred by *T. castaneum* adults. So it can be concluded that if storage areas were lit red, *T. castaneum* beetles could be managed without the use of chemical pesticides.

2.1.6. Thermal control strategies

Insects and pests are very thermosensitive. They can barely reproduce if the temperature is too high or too low. Hence either high or low temperature could manage these pests effectively.

A. Low temperature – A low temperature can be very lethal for pests that cannot tolerate cold temperature. When temperature is maintained below 4^{O}C, it results in lysis of the immature stages of almost all insect pests. The pest mortality rate is even higher when freezing temperature is provided to the pests. *Oryzaephilus mercator* and *T.castaneum* are very susceptible to low temperature. *Trogoderma* spp., *Plodia interpunctella* and *Ephestia* spp. are cold-tolerant species. Cooling of stored cereals and pulses below a temperature of 20^{O}C significantly reduces the reproduction rate of primary feeders like *Sitophilus* sp., *R. dominica* and *Prostephanustruncatus* and *Sitotroga cerealella*. The main principle is suspending the reproduction potential at temperature below 10^{O}C.

B. High temperature – A slight elevation in temperature is enough to stop multiplication or reproduction of any pest. Most of the stored-grain insect pests die at a temperature of 50–60^{O}C after a treatment time of 10–20 min. Even exposure to a temperature only 5^{O}C above the optimum tolerant temperature for the species will stop all sort of development. This is mainly effective against insects which are from cold regions. An exposure for 50^{O}C for 2 hours successfully eliminates most persisting insect pests. Grain heating in domestic scale is carried out in open sun whereas in commercial scale it is being carried out using implements like infrared radiation, high frequency dielectric, hot-air fluidized belt and microwave heating. Unlike sun heating, these help to ensure a uniform and constant high temperature. The biggest demerit of this system is that fresh fruits and vegetables which are prone to moisture loss cannot be subjected to high temperature.

i. **RF heating**: When grains are subjected to a frequency of 3 and 300 MHz and wavelength between 100 and 1 m, it is known as RF heating. The main advantage is its depth of penetration of waves inside dry grains.
ii. **MW heating**: MW heating involves a higher frequency range than RF. The frequency ranges from 300 MHz to 50 GHz.

2.1.7. Controlled Atmosphere Storage

Technically controlled atmosphere storage is nothing but subjecting the harvested crop produce in controlled condition of gases, temperature and pressure. Application of controlled atmosphere for storage of grain involves the use of higher concentration of CO_2 (9.0– 9.5%) and low concentration of O_2 (2–4%). This situation is very lethal to all insects and even microbes. Due to lack of oxygen, the aerobic microbes and living insects cannot survive. This technology is obviously very expensive as compared to the former points discussed. So it is mainly used for high value horticultural crops mainly.

2.1.8. Ozonation

Ozonation is a process of subjecting and stored product to ozone. Ozone chemically is allotrope of Oxygen (O_3) which can be produced by corona discharge or UV-light treatment of air. After ozone is

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produced, it remains in the same form for 20-30 minutes before it changes to oxygen. The technique is very safe and does not contain residual effects. A dose of 45ppm or less can be very effective against prevailing insect pest population. However it can cause metal corrosion, amino acid oxidation and lipid oxidation.

3. Biological control

Biological control of storage grain pest is an important component as this is an organic practice and does not involve application of any sort of chemicals. Biological methods are safest option when question comes to residual toxicity and human health.

3.1.Botanicals

Botanicals are those plant entities that produce chemicals which repel insect pest. Botanicals are known to disturb the feeding environment of the pest, disrupt the behaviour and physiology of insects and affect its oviposition (Verma and Dubey, 1999)

Neem based botanicals possess anti-feeding, repellent and feeding deterrent propertiesagainst storage insect pests. Neem seedkernel powder at 4.0% (w/w), neem seed oilat 1.0% (v/w) and mahua oil at 1% (v/w)proved repulsive and a potent ovipositioninhibitor in checking damage by the pulsebeetle, *C. chinensis* for up to 8 months inpigeon pea (Singal and Chouhan, 1997)

Wheat grains when mixed with neem and dharek(*Melia azedarach*) at a concentration of 4% (w/w) werefound to be less damaged by storage insect pest.Even the role of essential oils from plants has been widely used asbactericidal, fungicidal,anti-parasitic, antivirus and insecticidal agents. Pérez *etal.* (2010) reviewed the activity of essentialoils as a bio rational alternative to controlcoleopteran insects in stored grains(Pérez and Cárdenas-Ortega, 2010)

Rice grains which were treated with turmeric powder 3.25% (w/w) were found to be least infestedby rice weevil. 0.2% (v/w) ginger grass oil when applied to red gram prohibitedthe oviposition and appearance of*C. chinensis* (L.) for a significant time period(Kirubal and Das, 2008). *Cymbopogon citratus* (Stapf) and *Cymbopogon nardus* (Rendle) based essential oil when applied on rice, the overall incidence of storage pest was negligible (Paranagama*et. al.*, 2003).Crude application of *Citrus sinensis* and *Citrus aurantium* plant extracts in the same concentrations, caused 89 and 76% mortality to *S. oryzae* and *R. dominica* respectively.

The ovipositional and anti-feeding activities of essential oils obtained from *Vitex negundo* (0.062–0.5%) were effective against both *C. chinensis* and *S. oryzae*(Rana *et. al.*, 2005). Essential oil extracted from *Cymbopogon martini* was found to be an effective repellent againstthe beetles *C. chinensis* and *T. castaneum*.The oil also affected oviposition, adultdevelopment and led to huge mortality of *C. chinensis*in cowpeas (Rajesh *et. al.*, 2007).

Table 1: Effect of botanicals on storage pest

Common name	Utilization	Reference
Black pepper	Significantly retard the reproduction potential of *Callosobruchus chinensis*	Morallo-Rejesus*et. al.*, (1990)
Turmeric	Effectively repels a number of stored insects. 2%powder mixed with rice and wheat can protect from attack by storage pests	Jilani and Su, (1983)
Star anise	*T.castaneum* adults and eggs are damaged	Ho, (1995)

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Pongam oil tree	Leaves have insecticidal property against stored-grain pests	Ahmed and Koppel, (1987)
Garlic	The oil is known to kill*T.castaneum* and *Sitophilus zeamais*.	Mohiuddin and Qureshi, (1987)
Clove	Repels *T. castaneum*. and many other insects	Grainge and Ahmed, (1988)
Ginger	Causes adult mortality in *C. chinensis* and repels *T. castaneum*	Ho (1995)
Sweet flag	Rhizome powder showed efficiency to reduce storage pest upto 8 months of storage. Oil is also toxic to *Sitophilus oryzae* and *Sitotrogacerealella.*	Teotia and Tewari, (1971)
Neem	Almost every part of the tree is insecticidal but the seed kernel has maximum efficacy. *Trogoderma granarium* is very susceptible to neem extract	Ketkar, (1987)
Meliaazedarach	Leaf and drupe powders (1 and 4%) protect wheat against *S. cerealella*	Teotia and Tewari, (1971)
Lac tree	Oilsare used as surface protectant against pulses weevils. Lac tree extract is known to kill adults of *S.zeamais* and eggs of *T. castaneum*.	Ketkar, (1987)
American aloe	Leaves are used against stored-grain pests	Grainge and Ahmed, (1988)
Indian privet	Leaves have insecticidal property against many stored-grain pests	Ahmed and Koppel, (1987)
Himalayan cedar	Wood oil @1000 ppm is effective as grain protectantagainst rice weevil for a month duration.	Singh *et. al.*, (1989)
Bullock's heart & custard apple	Seedspossesses insecticidal against*C. chinensis*. Leaf extract is known to inhibitthe growth of *S. cerealella*	Grainge and Ahmed, (1988)
Artemisia absinthium	Leaf have insecticidal properties against *Sitophilus granariusS.cerealella,* and *Tinea granella*	Grainge and Ahmed, (1988)
Undi	Oil can be effectively utilized as surface protectant against pulse weevils	Ketkar, (1987)
Vasaka	The resin and the plant extract is toxic to stored-grain insects. Leafpowder effective against *R. dominica*and *S. oryzae*	Dastur, (1951); Chellappa and Chelliah, (1976)

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3.2. Pheromones

Pheromones are technically sex hormone that attracts the other gender of the insect. Pheromones are installed in traps due to which the insects gets lured into the trap. Pheromones are commercially available for specific insects (Phillips *et. al.*, 2000).

Table 2: Pheromone trade names for storage grain pests

Storage pest	Pheromone trade name
Cigarette beetle - *Lasiodermaserricorne*	Anobiidae
T. castaneum	The red
Triboliumconfusum	Jacquelin du Val
Warehouse beetle - *Trogoderma variabile*	Ballion

3.3. Natural enemies of pest

Natural enemies of pest are those living organisms that either feed on the major pest or inhibit its growth and development at any stage of the life cycle.Several species of parasitoid wasps from the family of Pteromalidae, Ichneumonidae and Braconidae managesLepidopteran pests in stored-product. Some species of free-living predatory beetles, true bugs (Heteroptera: Anthocoridae), and mites prey on any life stage of numerous species of stored-product insect pests that they can subdue and consume the natural enemies can be categorized into predators and parasitoids.Several insect predators and parasiticwasps attack insect pests of stored grain andcan be used effectively if applied in overwhelmingnumbers. Insect parasitoids havebeen shown to be effective in suppressing alimited number of pest species both in bulkgrain storages and in food processingfacilities and warehouses. One of the more effective parasitoids is *Theocolax elegans* which is a small pteromalid wasp(1–2 mm long) that attacks primary grainpests like *Sitophilus* sp., lesser grain borer (*R. dominic*), drugstore beetle (*Stegobium paniceum* L.), cowpea weevils(*Callosobruchus* spp.) andAngoumois grain moth (*C. cerealella*) (Flin *et. al.*, 2006)

Trichogramma sp. was found to be managing a variety of stored-product moths in bulk groundnut storage, bulkwheat storage and bakeries, as well as inwarehouses and retail stores in Europe (Grieshop et. al., 2007). Stored-productmoths commonly oviposit on packages andon shelves holding stored-product packages.*Dinarmus* sp. is alarval/pupal parasitoid of *Callosobruchus* sp., *Bruchus* sp., *Bruchidius atrolineatus* and *Acanthos celidesobtectus* in legumes seed.

3.4. Microbial pesticides

Microbial pesticides are specialized form of microbes in applicable form which when applied to any product can cause ailment and death of the microbe. The microbial pesticide can be either in bacterial or fungal form. Spinosad is a commercial bacterialinsecticide derived from metabolites of the actinomycete bacterium *Saccharopolyspora spinosa* which is effective in controlling insects associated with stored wheat (Flinn et. al., 2004).

In farm bins which are not exposed to sunlight, spinosad can be very effective as it degrades slowly over 12 monthsof storage. Spinosad is very effective against borer pest like

(*Rhyzopertha dominica* F.) and the red flour beetle (*T. castaneum*) (Fang et. al., 2002).

Bacillus thuringiensis (Bt) is another registered protectant which can be used in stored grains. The dried currant moth (*Ephestia cautella*) and the larvae of *P. interpunctella* exhibits a high susceptibility to Bt. Nuclear polyhedrosis virus, granulosis virus and cytoplasmic polyhedrosis virus.

7. Finding ideal control method with increasing concern of residual toxicity and environmental hazards

It is undoubtedly very important task to ensure that the pest count is near to nil when question comes to post harvest storage of cereal, pulses, oil seeds, fresh fruits and vegetables. But it is also necessary to understand that to achieve such a situation, there should not be any compromise with the health of the consumer. Chemical methods of sterilization of harvested produces are the easiest, fast, cost effective method. But the chemicals which would be used can be very much deadly if any residues are remaining. Hence we need to shift our attention towards physical methods and biological methods. The application of these techniques might be slow but can prove out to be very effective against the microbes and ensure risk free food to the consumer. Moreover several chemicals which belongs to organophosphate groups (chlorpyrifos-methyl, pirimiphos-methyl, Malathion, etc) have now developed resistance due to continuous application. Hence adoption of biological and physical techniques to manage storage grain pest is of utmost importance.

8. CONCLUSION

Storage pests are of serious problem as it render the cereals and pulses totally in-edible. Storage pests affect the crop at the highest point just before it reaches the market, so it causes havoc economic loss for the farmers or seller. Hence it is of utmost importance to manage these pests. It is important to identify the pest at right stage and formulate the best management practice possible. But effective measure of controlling a pest should be economical and should not induce and residual toxicity on the crops.

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Human Environmental Interaction: An impact of changing era

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Human continuously interact with the environment to sustain their daily life. The human social system and the different components of the ecosystem interact continuously to develop a life support system. The humans interact with environment in a complex adaptive manner. Humans continuously strive to adapt the complex network of the various ecosystems. Humans along with other organisms and the non-living components form the base of the strong ecosystem. Ecosystem provides basic supporting services like water, food, medicines, fuel and other useful substances. The use of technology further helped the human beings to exploit the natural resources to gain maximum benefit from them. But this interaction led to serious environmental implications and has caused a great deal of environmental damage. The environmental problems is adversely affecting the human existence and life sustenance other living creatures.

Human Social System

The social system of the humans dynamically affects the total environmental conditions. The behavior and attitude of the people directly or indirectly affect the environment. The different factors that influence the environment are human population size, values, attitudes, technological advancement, social status, educational background and environmental awareness. The humans obtain various environmental services in order to sustain their lives and improve the quality of life. Various governmental and non-governmental organizations continuously aim to protect the environment and maintain the ecological balance.

The increasing population and advancement in the technology has put a great amount of strain in the environmental resources. Since 18th century women have played an important role to protect the environmental resources and their conservation. The environmentalists like Rachel Carson (Silent Spring, harmful impacts of DDT), Amrita Devi (protect khejri trees), Bachni Devi and Gaura Devi (Chipko movement), Medha Patkar (Narmada Bachao Andolan), Vandana Shiva (Navdanya movement), Menaka Gandhi (Animal Rights Activist), etc. have contributed to the welfare of the environment.

The environment provides various ecosystem services like supportive, provisioning, regulation and cultural. The supporting services involve recycling of the nutrients, soil formation, primary production, transfer of energy from one trophic level to other, etc. The provisioning services involve providing food, water, wood, fuel, fiber, etc. the regulation services involve regulation of climatic conditions, flood, disease, water purification, ecological succession, etc. The cultural services provided by the ecosystem are aesthetic beauty, spirituality, education, recreation, tourism, etc. These services are essential to sustain life on earth and support the well being of the living organisms. Together, these ecological services help to provide food security, access to resources, security from disasters, basic materials for good quality of life, shelter, healthy life, access to clean air, food and water, good social relations, mutual respect among various organisms and further impart freedom of choice an action to achieve their desired goal.

Coevolution and Coadaptation

The continuous unending process of acclimatizing and evolving to the changes in the environment and the human social system is called the process of coevolution and coadaptation. The changing environment affects the human activities and vice versa. The environmental processes like landslides, floods, forest fire, storms, tornadoes, tsunami, etc. cause the climatic conditions to change and affect the lives of the people, forcing them to respond to the changed situation.

Drivers-Pressures-State-Impact-Response

The model was developed by European Environmental Agency to assess the environmental problems and the human activities leading to the degradation. The model constitutes of indicators to depict the change in environment due to anthropogenic activities. The social, cultural and technological activities increase the pressure on the environment. The driving forces like the industrial development, agricultural practices generate pressure on the natural resources to fulfill the needs of the increasing population. The pressure is generated in the form of harmful emissions and changing the constituent of air, water and soil. The pressures influence and modify the natural state of the resources i.e., temperature change, soil quality, air quality, etc. Furthermore, the environmental components lead to negative impacts on the human health, living conditions, etc. These impacts stimulate the need for changes in the anthropogenic activities to prevent further damage to the environment. The changed responses in turn reduce the impact of the driving forces and provide solution to the environmental problems.

CONCLUSION

The human activities pose greater risk to environmental sustainability. The changes in climatic stability, biodiversity loss, physiological and biological processes, resource degradation like loss of flora and fauna, etc. would lead to collapse of the ecological system in the near future. Thus, there is a great need to protect and conserve the natural resources and make them available for future generation. The interaction of humans with the environment should be positive and development should be made with least harm to the environment and its resources.

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Seed treatment for the management of soil borne insect & pathogens in plant

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Seed treatment is probably the cheapest and often the safest method of direct plant disease control. Seed treatments are used to prevent or reduce losses from diseases caused by organisms associated with seeds or present in the soil. Treating infested seeds with chemicals or heat greatly reduces the incidence of many seed-borne pathogens. Seed treatment is used also to protect healthy seed against soil-borne organisms, such as Pythium, Fusarium, and Rhizoctonia, which cause seed rots, pre emergent damping off, and seedling blights of many crops.

INTRODUCTION

Seed treatment refers to the application of fungicide, insecticide or combination of both to seed so as to disinfect them from seed borne or soil borne pathogens, organism and storage insect. The seed may be infected during harvesting threshing or processing as the machine used for these operations may be contaminated. More over, these machine may cause injury to the seed, making them more susceptible to insect pest and disease or producing weak seedling, which may be attacked by soil borne pathogen easily at in early stage. Some seeds fail to germinate due to dormancy or presence by germination inhibitors and some seeds creates difficulty in sowing or are dirty and discolored.

The seed treatment in physical and chemical operation is performed with the seed between processing and storage or sowing time to overcome these problems, which are known as seed treatment. The seeds require solar energy or water exposures immersion in condition water.

Methods of seeds treatment

(A) Mechanical treatment :

1. **Proper cleaning**: Infected seed become tough, deformed discolored and lighter in weight. Surface texture and colour removed by hand by proper cleaning inert matter and chaffy materials.
2. **Reducing mechanical injury**: Harvesting, threshing and processing machine are not in good condition and moisture content in the sed. So by reducing seed injury or insect disease can be minimized.

(B) Physical treatment :

1. **Safe moisture content** : Drying of the seeds to safe moisture leaves is the most effective method of preventing infection in seeds micro-organism (Fungi bacteria) 12 percent for cereals, 10 percent for cotton and soybean 9 percent for legumes 8-10 percent for vegetable seeds.
2. **Safe storage of seeds:** Some seed borne disease have very short life cycle and stored for some time under proper condition (low moisture and low temperature) for example - ergot of Bajra is eliminated in 5-8 months. (before sowing time).
3. **Solar treatment:** This treatment is very important in pathogens and insect pest. During summer (May-June) when the day temperature rise to 40-50^{0}C. The seeds are soaked for 2 hours in the

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morning and sun dried for the whole day on cemented floor. Loose smut of wheat and barley and pink boll worm of cotton can be killed by this treatment.

4. **Hot water treatment**: The soaking of seed in hot water for some time kills seed borne pathogen without affecting the germination of seeds. If the seeds of cauli-flower are soaked in hot water at 50^0C for 50 minute. Xanthomonas compestris (a bacterium) is killed. Cabbage carrot, cucumber, onion, lettuce spinach, chillies and radish.

Fungicide insecticide formulation: The insecticide mostly use for treating seeds are DDT, Aldern, Linden Dieldrin, Heptptachlor. Dosage is very important (Table 1). There seems to be a narrow range between the amount of insecticide that can be used without injuring the seeds. It will effectively protect seeds from insect in the soil.

Table 1: Seed treatment of specific crops

Dosage of 100 K.g. of Seed				
Crop	**Name of Chemical and its Formulation**	**Qty. of Chemical (gms)**	**Nature of treatment**	**Qty. of Water in the Case of Slurry (liters)**
Cereals and Millets				
Paddy	Ceresan wet 205%	60	W	To immerse seed completely
	Organo-mercurial 1%	250	D	-
Wheat Barley	Thiram 75% WP	100	S	1/2
	Mancozeb	200	S	1/2
	Organo-mercurial 1%	250	D	-
	Vitavax	250	D	-
	Carbendazim	250		
Sorghum	Thiram 75%	85	S	1/2
	Difolatan	200	S	1/2
Pearl-millet (Bajra)	Thiram 75% WP	75	S	1/2
	Thiram 75% WP	300	D	-
	Caotan 75% WP	300	D	-
	Organo-mercurial 1%	250	D	-
Brine 5% Solution to completely immerse seed				
Greengram	Thiram 75% WP	75	S	-
	Difolatan	250	D	-
	Carbendazim 50% WP	100	D	-
Cotton	Thiram 75% WP	110	S	1/2
Ceresan wet 2.5% Dip seed for 6 hours in 0.2% solution to immerse seed				
Jute	Caotan 75% WP	80	S	1/2
	Carbendazim 50% WP	200	D	-

Sugarbeet	Thiram 75% WP	250	D	-
	Carbendazim 50% WP	100	S	-
Vegetable :-				
BEans, Cowpea, Pea	Caotan 75% WP	100	S	1/2
	Thiram 75% WP	250	D	-
Clusterbean	Thiram 75% WP	75	S	1/2
Bhindi	Thiram 75% WP	100	S	1/2
	Caotan 75% WP	250	D	-
Brinjal	Thiram 75% WP	250	D	-
	Caotan 75% WP	250	D	-
Tomato	Thiram 75% WP	335	D	-
Chilli & Capsicum	Thiram 75% WP			
	Caotan 75% WP	250	D	-

Advantage of seed treatment

1. **Controlling seed borne disease**: Proper seed treatment is effective against seed borne pest and disease.
2. **Protecting seeds:** The chemicals used for seed treatment produces time protecting coating around the seed, which may rot the seed before germination or the seeding immediately after their emergence.
3. **Improving germination:** The seed treatment after controlling seed surface moulds (which may infect the seed following moisture harvesting or storage conditions) affect the viability of the seeds. Germination can also be improved by breaking dormancy, removing germination inhibitors and treating the seed with germination promoters.
4. ***Protection against storage insects:*** Even some fungicide, such as thiram and mercurial have insect repellen properties. Insecticide, such as malathion have proven effectiveness.
5. **Controlling soil insects:** Certain fungicide and insecticide in combination protect the seed and seedling against soil insect, wire worm and seed corn maggot.
6. **Reducing the cost of seed producing:** By sowing treated seeds, the expenditure towards spraying and dusting of insecticide and fungicide for crops protection is minimized.
7. **Producing good quality seeds:** A healthy crop can be raised and the seed produced from such a crop are of good quality.

Type of seed treatment

(A) Protection :

1. **Seed disinfestations :** Seed disinfestations refers to the destruction of surface borne organism that have contaminated the seed surface but not infected the seed surface, chemical dip soaks, fungicide applied as dust. Slurry or liquid.
2. **Seed disinfection:** Seed disinfection refers to the eradication of fungus spores that have become established with in the seed coat, or in more deep seated tissue.

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3. **Seed protection:** Seeds and young seedling can be protection from micro-organism in soil which can cause decay of seed or seedling.
4. **Protection:** Treatment includes surface treatment with insecticide/ fungicide/ pesticide.

Seed treatment products

(A) Mercurials :

1. **Organomer curials :** The recommended dose for the treatment of small grains, flax, cotton and safflower, proper dose is critical.

2. In organic mercurial: The treatment of seeds is practically limited to mercuric chlorides, mercurous chlorides and mercuric oxide, rook, tubers garden and vegetable crops.

(B) Non mercurial: Involve use of organic non mercurial such as thiram and caption. They are less effective than the organic mercurial but causes less damage to the seed and less dangerous to persons handling the seed.

1. **Inorganic non mercurial:** Copper carbonate, copper sulphare, cuprous oxide constitute the major inorganic non mercurial compound which are used to treat the seeds.

Formulation of fungicide materials

Seeds treatment materials are available in the from of dusts, wettable powders and liquids.

1. **Dust:** Fungicide is usually applied at rates of 200 to 250 grams. Per quintal of seeds.
2. **Slurry:** This type of fungicide is applied to the seed in soup like water suspension.
3. **Liquid:** The use of liquid solution known as quick wet methods.

Coloring of seeds

Most of seed treatment dyes and some companies add their own colour brand dye to seed treatment.

1. As a warning that the seeds have been treated to prevent in advertent contamination of food or feed.
2. As a visible mean of evaluation the completeness of treatment cover the dyes. If used for treatment formation or dry seeds are mixed with fungicide and insecticide treatment.

Precaution of seed treatment

1. Treated seeds must be clearly labeled and never be used for food, feed or edible oil.
2. Seed treatment should be carried out in well aerated area.
3. Contact with chemical through breathing or skin must be avoided.
4. Empty and used containers of the chemicals should never be reused in the house or in farm.

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Cultivation practices and economical importance Long Melon

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Botanical name : *Cucumis melo*
Family : Cucurbitaceae
Origin. : India
Chromosome no. : 2n = 24

Economical importants:

- They are used in the form of salad cooked as vegetable, and preserved in the form of sweets.
- Fruits which are eaten raw along with salt and pepper.
- If it is taken without salt ,it is not easily digested.

Soil:

- Well drained soil.
- Well fertile soil.
- Sandy loam soil is suitable of the cultivation of long melon.
- Soil pH 5.8 to 7.5.

Climate:

- It is warm season crop grown mainly in tropical & sub-tropical region.
- Average temp. 25 –30℃
- It tolerates cool climate better than musk melon.

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Improved varieties :

- Arka sheetal
- Kernel selection
- Punjab long melon

Seed rate: 2 to 2.5 kg / ha

Sowing time:

Nov – Mar.

Spacing :

1) Spacing channels – 200cm × 250cm

2) Spacing hills - 60cm × 90cm

Irrigation:

- Irrigate the crop once in 4 to 5 days during summer depending upon the soil and weather condition.
- In rainy season irrigation depends upon the rains.

Manures and Fertilizers:

Required dose for long melon crop is 100:50:50 NPK / ha . Half dose of nitrogen at the time of sowing and full dose of p & k . Remaining dose of nitrogen apply after 45 days of planting .

Harvesting :

Harvest has to be done when the fruit stalk becomes brown and dried, and as the fruits have the complete ashy coating .The first and last one or two harvest should be done from other harvests for seed extraction. For seed purpose generally harvest will be done 7 –10 days after the maturity of vegetable.

Yield :

350– 400 Q / ha.

Plant Protection :

Pest:

- Fruit fly
- Aphids
- Jassids

Disease:

- Powdery mildew
- Downy mildew
- Anthracnose
- Fusarium wilt
- Bacterial leaf spots

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Nano-pesticides and its physiological effects in crop plants

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INTRODUCTION:

The use of agrochemicals is associated with some risks for human and environmental health (e.g., contamination of water resources, residues on food products). Many reports supported that nanotechnology will allow the development of high-tech agricultural fields, equipped with a range of intelligent nano tools that allow for the precise management and control of inputs, including pesticides, fertilizers, and water. Activities by governments and regulatory bodies looking at developing pieces of legislation that are adapted to nano agrochemicals that might emerge vary considerably (FAO/WHO, 2013; APVMA, 2014). The extent to which nano agrochemicals develop will be strongly influenced by the regulatory system that controls their entry into the market. There are, at present, great geographical discrepancies, which may eventually shape applications emerging in a given market (Watson *et al.,* 2011). In the EU for instance, some companies are currently facing great challenges derived from the definition of nanomaterials that has been proposed (EU, 2011). Companies are thus unlikely to choose the EU to introduce a new nanoagrochemical onto the market. Ten years ago, expectations regarding nanotechnology were considerable and often associated with the names of big players: "Monsanto, Syngenta and BASF are developing pesticides enclosed in nanocapsules or made up of nanoparticles.

Nanopesticides in plant disease management:

Plant pests and pathogens cause significant reductions in crop production, with estimated global losses of 20%–40% per year. Current pest management relies heavily on the application of pesticides, such as insecticides, fungicides, and herbicides. In spite of many advantages, like high availability, fast action, and reliability, pesticides have harmful side effects towards non-target organisms, the resurgence of the pest population, and the development of resistance (Feng *et al.,* 2012). Furthermore, it is estimated that 90% of applied pesticides are lost during or after application. As a result, there is an increased motivation to develop cost-efficient, high-performing pesticides, that are less harmful to the environment. The use of nanoparticles to protect plants can occur via two different mechanisms: (a) nanoparticles themselves providing crop protection, or (b) nanoparticles as carriers for existing pesticides or other actives, such as double-stranded RNA (dsRNA), and can be applied by spray application or drenching/soaking onto seeds, foliar tissue, or roots (Zhang *et al.,* 2013).

Nanoparticles act as carrier for insecticides:

Loading insecticides into nanoparticles first started in the early 2000s. Since then, conventional insecticides (27 studies) and bioactive compounds with insecticidal properties (13 studies) have been conducted with a range of nanoparticles . These studies have explored eight different MoA and a range of essential oils (not included in Insecticide Resistance Action

Committee (IRAC) classification). The most commonly investigated nanoparticle carriers were silica (8 studies), chitosan (11 studies), and lipids (4 studies). Spodoptera litura (5 studies), Tetranychus urticae (4 studies), and Helicoverpa armigera (4 studies) were the most popular target pests (Yang et al., 2009). In these studies, the researchers aimed to improve low water-solubility, decrease volatilization, improve stability, and provide slow release of the active molecules. Evaporation or volatilization of the active is another common issue associated with the loss of insecticide post application. Essential oils are known for inducing insecticidal effects, but rapidly evaporate due to their chemical instability in the presence of air, light, moisture, and high temperatures (Nguyen *et al.,* 2012).

Nanoparticles act as Carriers for Herbicides:

To reduce the toxicity of herbicides imazapic and imazapyr, both were loaded onto chitosan nanoparticles. Similar effectiveness between nanoparticle-loaded and free herbicides was observed against the target weed *Bidens pilosa*. Toxicity was reduced in *Allium cepa* assays and Chinese hamster ovary cell cultures, compared to free herbicides. Both nanoparticle-encapsulated and free herbicides did not affect the number of bacteria in the soil (Li *et al.,* 2007). However, the authors observed differences in the ratio of bacteria associated with the nitrogen cycle, and the nanoparticle-loaded herbicide group had the least impact. Chidambaram converted rice husk waste into nanosized particles, and loaded them with 2, 4-D.

Nanoparticles mediated RNAi for Plant Protection:

Topical application of dsRNA has emerged as a highly appealing alternative. This method of application faces similar issues to pesticides, such as short longevity due to environmental degradation, and difficulties with site-specific uptake by the targeted pest. To date, nanoparticles acting as carriers of RNAi-inducing molecules have been targeted against viruses , used with honeybees as a model organism for DNA methylation and alternative splicing , and targeted against aphids and mosquitoes (Mitter *et al.* 2017). Scientist successfully afforded viral protection against cucumber mosaic virus (CMV) and pepper mild mottle virus (PMMoV) using plants sprayed with dsRNA loaded onto LDH nanoparticles, called BioClay. Significantly, a single spray of BioClay protected plants for 20 days after application on sprayed, and on newly emerged, unsprayed leaves, while plants sprayed with naked dsRNA succumbed to viral infection. Jiang *et al.* (2014) made the only other report of nanoparticle-facilitated plant uptake of dsRNA through the root tip to induce gene silencing of two endogenous Arabidopsis genes. Further research is limited to targeting mosquitoes for human disease control.

Conclusions and future prospectus:

Nanotechnology can provide solutions for agricultural applications and has the potential to revolutionize the existing technologies used in pest management. Development of nanopesticides can offer unprecedented advantages like (i) improved solubility of poorly water-soluble pesticides, (ii) increased bioavailability and efficacy of pesticides when loaded onto nanoparticles and reduced pesticide toxicity, (iii) enhanced shelf-life and controlled delivery of actives, (iv) target-specific delivery of the active molecules and pH dependent release, (v) smart delivery of RNAi molecules for disease management, (vi) nanoparticles as carriers to slow down degradation of active molecules and improve the formulations' UV stability and rain-fastness, (vii) nanopesticides to improve the selective toxicity and overcome pesticide resistance.

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Medicinal uses of Drooping Fig (*Ficus semicordata* Buch.-Ham. Ex. Sm.)

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Ficus semicordata Buch.- Ham. Ex. Sm. commonly known as Drooping fig or Wedgeleaf fig is one of the most popular edible wild fig found in the North-Eastern region of India. it belongs to the family Moraceae and it is widely distributed in India, south China, Bangladesh, Myanmar, Bhutan, Nepal, Malaysia, Vietnam and Thailand. They are locally known as Heirit (Manipuri), Bhui Goolar, Khaina, Khunia (Hindi), Theitis, Theitil, Theipui (Mizo), Bainchi (Bengal), Khaniyo, Khanyu (Nepal), and Thaijang (Tripura).

Drooping Fig is a small to medium sized tree which can grow upto a height of 10 – 15 m with trunk diameter upto 2m in circumference. The bark is usually dark-grey in color and the young twigs generally covered with white or pale-brownish short hairs. Leaves are mostly elliptic to oblong, lanceshaped and broad, the base are highly unequal-sided with a rounded large lower lobe overlapping the leaf stalk. Fruits are spherical to pear-shaped with1.2-2 cm in diameter, usually pink or dull reddish brown with white marks, hairy, on leafless branches. The branches are pendulous in nature and are often prostrate on the ground.


Medicinal uses:

Drooping Fig are known to have various medicinal values in traditional medicine for the treating various ailments. Almost all the parts of the plants are useful with fruits and root parts being most dominant in medicinal uses.

1. **Fruits** : Raw fruits are known to have antidiarrheal properties. Boiled unripe fruits are eaten to lower down blood sugar. Fruits are also used to treat leprosy, abdominal ailments, ulcers, jaundice, constipation, indigestion, marasmus and hepatitis. Fruit juice are generally used to treat headache.
2. **Roots** : Juice from crushing the root are used to treat bladder problems, liver diseases, abdominal ailment, hyperthermia, visceral obstructions, fever and also for menstrual disorders. Other than

that roots are also used to treat constipations, indigestions, colic pain, ulcers and to heal the wounds.

3. **Bark** : The soup of the bark after boiling is used to treat dysentry and liver problem. A mixture of the bark and fruits are incorporated in the bathing water to treat against leprosy. It is also used for treating boils. Bark is also used to treat baldness, toothache, diarrhoea and bladder complains. Mixture of Myrica esculenta and bark of Ficus semicordata is used for traeating menstrual disorders.
4. **Leaves** : Decoction of leaves are taken orally to cure jaundice. The juice from the leasves are applied to skin to treat against skin diseases and scabies. It is also used to cure indigestion, liver disorders and healing of th wounds.
5. **Latex** : latex is generally used to cure fever, boil, wound, leprosy, ulcers and mumps. The milky latex is applied on the head to avoid baldness.
6. **Other parts such as seeds, twig, and aerial parts** : The fumes from burning the twigs is used to cure earache. Young twigs when fed to the cattle facilitates the discharge of placenta. The milky sap obtain from the aerial parts of the plants is diluted and is given to typhoid patient to treat typhoid fever. Mixture of leaves and seeds of F. semicordata, onion and basil leaves are used to treat stomach disorders.

Other than these, F. semicordata is also consumed because of its rich source of nutritional values. The fruits are rich source of moisture (89.10%) and has higher acid contents (3.70) than the other fig species. The total sugar content of this fruit is 10.11%, also they contains protein 1.24%, fat 0.79%, starch 15.11% and vitamin C 7.77mg/100g.

CONCLUSION

Drooping fig (*F. semicordata)* is an important underutilized fruit crop which has certain medicinal properties that has been used ethnically by certain group of people in the eastern Himalayan region for treating various illness. It would be of great importance to us in the near future if these wildly grown species is conserved and propagated for further studies and medicine usage.

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Cultivation practices and economical importance Faba Bean

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Botanical name :-*Vicia faba*
Family :-leguminaceae
Origin :-anhuri,bakia,kavin.

Importance:-

Faba bean, being a legume, is a nitrogen-fixing plant.It is a "break" crop which enhances cereal yield because it decreases the occurrence of take-all and cereal cyst nematode (CCN) which affect cereals.Faba bean tolerates water logging better than other grain legumes such as chickpeas, field peas, lupins and lentils. It also tolerates acid soil types better than other grain legumes.Many operations can be undertaken using cereal equipment.Stubble residue is a valuable nutrition source for stock feed.

Soil type:-

The crop is bested suited to red-brown earths, black earths, grey clays and alluvial loams.It prefers types of soil with pH ranging from neutral to alkaline (pH of 7.0 to 9.0). However, good yields have been achieved on paddocks with pH as low as 4.6 where aluminium and manganese levels are low (aluminium below 20ug/g and/or manganese below 50ug/g).If soil pH is below 5.0 the application of lime is strongly recommended.Deep loams are the first choice of soils. The crop may suffer moisture stress in soils that dry quickly. Faba bean tends to have shallow roots.Faba bean is tolerant of waterlogging.

Climate:-

The optimal temperature for plant growth is 15-20°C, especially during the reproductive phases of flower and pod development. Faba bean tolerance of frost is better compared to other grain legumes.Faba bean flowers will abort if temperatures exceed 27°C and are also particularly sensitive to hot, dry conditions during podding.

Rainfall

The crop requires an average annual rainfall of 400 mm or areas with irrigation. Faba bean has been grown in drier areas (350mm); however there are yield penalties if grown in lower rainfall areas.Prolonged cool weather in spring is ideal for development of pods.

Seedbed preparation:-

The previous crop stubble should be heavily grazed, slashed or burnt in order to obtain a flat seed bed.Rolling after seeding should be considered on stony or extremely cloddy soil, because pods set low on the plant may cause harvest difficulties.

Variety:-

As with all crops, choice of variety requires achieving a balance between adaptability to environment, disease reaction, agronomic performance and marketability. Local advisors are a good source of information on all aspects of growing faba bean.

Time of seeding:-

The best time for sowing is from late April to late June. Later sowing markedly reduces yield potential. Flowers and pods abort if flowering is during a period of high temperatures. Sowing too early can promote disease development.

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Seeding rate:-

When a seed size of 55-60 g/100 seeds with a germination of 80 percent is used, sow 130 kg of seed per hectare for cultivars Fiesta, Farah, and Nura.

Seed should be weighed and germination tested before sowing.

Seeding rate (kg/ha) = Plant density (plants/m^2) x 100 seed weight (g) x 10 ÷ Germination percentage

Seeding depth:-

Sow the seed 20-50 mm deep.

Seed treatment:-

Faba and broad beans can be inoculated with either the rhizobium of the Acid Tolerance faba bean inoculum Group F or the rhizobium for field pea strain of inoculum (Group E). If sowing on areas that have not grown beans before, inoculation of seed before sowing is considered cheap insurance to maximize nodulation and therefore increase nitrogen fixation.It is recommended to use seed from a healthy crop in preference to a fungicide to treat seed borne diseases. If seed has been inoculated it must not be treated with a fungicide.

Fertiliser requirement:-

Add 6 kg/ha of phosphorus for every tonne per hectare of grain expected to be harvested.

Weed control:-

Faba bean and broad bean are excellent competitors with weeds due to the vigorous early growth of both crops. Well managed crops are normally very clean at harvest time. However, beans should not be sown in paddocks with moderate-high levels of broad leaf weeds, as there are few chemical control options. Grass weeds can be readily controlled in beans.

Irrigation:-

Faba bean responds well to irrigation as plants are not particularly susceptible to water logging. Laser levelled bays are suitable if well drained. If drainage is not good, then beds should be considered. Irrigation times should be kept as short as possible as water logging will cause temporary growth reductions and will affect yield.

Drainage is a combination of surface and internal drainage. Surface drainage can be improved with large capacity drains with good outfall, laser-levelled and smoothed bays and beds or spinner cuts. Internal drainage is related to soil structure and can be improved with gypsum where appropriate, and with pasture rotations. Minimising cultivation, particularly of dry soil, can help to preserve soil structure and internal drainage.

If drainage is less than ideal, rains following irrigation can lead to prolonged water logging and subsequently reduce yield. Pre-irrigation and sowing into moisture is a strategy successfully employed on many farms. The alternative is to rely on rainfall. Dry sowing can be successful by ensuring that the earliest rain is used to germinate the crop.

Don't leave the first spring irrigation too late as this may hasten the end of flowering and severely affect yield. The first spring irrigation will commonly coincide with the period of maximum flowering and some pod filling, so any delay will be costly. As soon as water is available, begin inspecting the soil in the root zone and plan the first irrigation to ensure that no stress occurs. Note that irrigated crops often lodge. It is not usually severe enough to affect yield but requires care in harvesting.

Pests:-

Red-legged earthmite (*Halotydeus destructor*) is a black-bodied mite with red legs; it damages

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seedlings as they emerge. Symptoms include leaves that turn silvery, then brown and shrivel.

Cowpea aphid (*Aphis craccivora*). Moisture stressed crops are susceptible to aphid infestation, especially when the atmosphere is dry and when warm weather occurs in autumn and spring. Minimal damage occurs from direct feeding of aphids. However, heavy or prolonged periods of infestation can cause stress on plants, resulting in yield loss. Aphids may also transmit viruses.

Lucerne flea (*Sminthurusviridis*) is a small (2.5 mm), wingless, light green hopping insect. It chews through leaves in layers resulting in "window-pane" like holes. The crop shrivels and becomes stunted.

Native budworm (*Helicoverpa punctigera*). The caterpillar damages maturing seed in pods. The newly hatched caterpillars are small (1-2 mm) and therefore are easily missed when crops are being inspected. When mature (40-50 mm long) they have a yellow-white stripe down each side of the body and a dark stripe down the centre of the back.

Diseases:-

Ascochyta blight on leaf, stem and pod is a major problem. It is caused by the fungus *Ascochytafabae*. Grey-brown spots form on leaves. Small fruiting bodies may appear on leaves after rain. Dark coloured spots also appear on stems and pods, which may spread to the seed. Stems may collapse if symptoms are severe.

Chocolate spot is another major problem. It is caused by *Botrytis fabae*. The symptoms are reddish or chocolate brown spots on leaves and reddening of stems. The spots may enlarge and merge, forming a black mass on the leaves (blighting), which is followed by defoliation and lodging. Chocolate spot and *Ascochytafabae* usually require a minimum of two sprays for control.

Dense crops, waterlogging and wet weather favour outbreaks of these diseases.

Rust (*Uromycesviciae-fabae*) in beans has only been an occasional problem in south-eastern Australia. It occurs late in the season during podding, resulting in premature leaf drop which may reduce seed weight and size. Humid and warm (more than 20ºC) conditions late in the season promote its spread. Rust can be identified by numerous small, orange-brown pustules, which appear on the leaves of infected plants and are surrounded by a light yellow halo. As the disease develops to an advanced stage infected leaves wither and drop off. Rust pustules on stems are similar but often larger than those on leaves. Isolated rust pustules may also appear on pods.

Cercospora (*Cercospora zonata*) This disease mainly affects leaves, but may also affect stems and pods of faba bean. Lesions (1-5mm dia.) first appear on the lower leaves early in the growing season (approximately seven weeks after sowing) and can expand rapidly to 15mm and coalesce with adjacent lesions if conditions favour disease development. The result is serve blighting of large portions of the leaf. Severe infection can result in extensive defoliation of plants.

Symptoms of this disease can be easily confused with those of ascochyta leaf spot (*Ascochytafabae*) or chocolate spot (*Botrytis fabae*). This has been causing some confusion in accurate diagnosis by many growers and consultants in recent years, resulting in application of inappropriate fungicides. The severity of cercospora leaf spot appears to be strongly linked to close faba bean rotation. It is anticipated that resistant cultivars will be released within five years.

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Alternaria (*Alternaria alternata*) causes dark brown leaf spots, which often have a zoned pattern of concentric brown rings with dark margins. Symptoms can be confused with chocolate spot. Infection often follows insect damage or other leaf spots caused by rust or chocolate spot.

Alternaria spots can be distinguished from ascochyta blight as the spots have a brown margin containing obvious concentric rings but do not produce black fruiting bodies (pycnidia) on a grey centre.

Harvesting:-

When the hilum on the seed of faba bean turns dark brown-black, the seed is at full physiological maturity. Therefore the seed will not grow any larger. For paddock management issues these crops can be prepared for windrowing in order to be harvested.

It is strongly recommended to harvest faba bean when the plant is black, the crop is mature and seed moisture content is below 12 percent to meet export specifications for grain storage.

Open front headers give the best results for harvesting of faba bean and harvest should begin while stems are still a slightly green colour.

A dense or early sown crop will have pods higher off the ground than a late sown or thin crop. If sowing time is late, quiet often seed pods are set on stems near the soil surface, therefore the harvest comb needs to be set close to the ground to avoid grain loss.

Avoid leaving harvest until beans are too dry because this will result in pod shattering. Reduce shattering by harvesting under conditions of higher humidity or mid morning.

Yields:-

The average yield in south-eastern Australia is 1.8 – 2.0 t/ha.

Yields may range from 1 to 3 t/ha depending on spring rainfall.

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Groundwater Recharge Techniques

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INTRODUCTION

Ground water is a precious and the most widely distributed resource of the earth and unlike any other mineral resource, it gets its annual replenishment from the meteoric precipitation. At present nearly one fifth of all the water used in the world is obtained from ground water resources. Agriculture is the greatest user of water accounting for 80% of all consumption. Due to rapid urbanization, infiltration of rainwater into sub-soil has drastically decreased, and recharging of groundwater has diminished over the years.

This creates serious impact on socio-economic and environmental degradation of the area. It has therefore, become imperative to promote in-situ water harvesting to augment groundwater recharge. Ground water recharge is the process whereby the amount of water present in or flowing through the interstices of the sub-soil increases by natural or artificial means.

Rainfall is the principal source for replenishment of recharge of ground water. Other sources include recharge from rivers, streams, irrigation water etc. An unconfined aquifer is recharged directly by local rainfall, rivers, and lakes, and the rate of recharge will be influenced by the permeability of overlying rocks and soils. A confined aquifer, on the other hand, is characterized by an overlying bed that is impermeable, and local rainfall does not influence the aquifer. It is normally recharged from lakes, rivers, and rainfall that may occur at distances ranging from a few kilometers to thousands of kilometers.

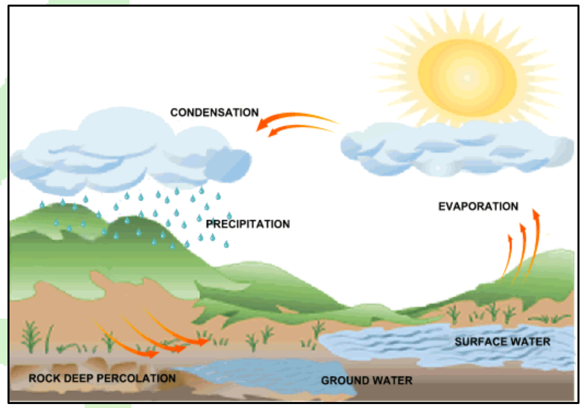

Figure 1: Groundwater in Hydrologic cycle

Ground water recharges techniques in surface methods

Spreading basins

This method involves surface flooding of water in basins that are excavated in the existing terrain. For effective recharge highly permeable soils are suitable and maintenance of a layer of water over the highly permeable soil is necessary. When direct discharge is practiced the amount of water entering the aquifer depends on three factors i.e. the infiltration rate, the percolation rate, and the capacity for horizontal water movement. At the surface of aquifer, however, clogging occurs by deposition of particles carried by water in suspension or in solution, by algae growth, colloidal swelling and soil dispersion, microbial activity, etc. Recharge by spreading basins is most effective where there are layer below the land surface and the aquifer and where clear water is available for recharge.

Percolation Tanks

Series of earthen dams are constructed on suitable sites for storing of adequate quantity of surface water. The tank area should be selected in such a way that significant amount of water infiltrates through the bed of the tank and reaches the groundwater table. These tanks are effective in alluvial areas and hard rock area. These are useful in continuous recharge after monsoon. The size of the tank depends on the percolation capacity of strata.

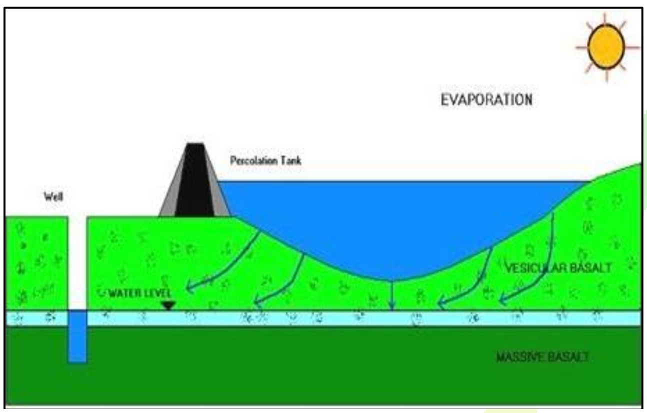

Figure 2: Percolation tanks.

Stream Augmentation

Stream flow augmentation with recycled water has the potential to improve stream habitat and increase potable water supply. Successful stream flow augmentation with recycled water requires that the lead agency clearly articulate a strong project rationale and identify key benefits. Seepage from natural stream or river is artificially increased by putting some series of check dams across the river or stream. The placing of check dams spread the water in a larger area which eventually increases groundwater recharge. The sites for the check dams should be selected in such a way that sufficient thickness of permeable bed or weathered bed is available for quick recharging the stored water.

Ditch and furrow system

A ditch is described as a long narrow trench, with its bottom width less than its depth. A ditch system is designed to suit topographic and geological condition that exists at the given site. A layout for a ditch and flooding recharge project could include a series of trenches running down the topographic slope. The ditches could terminate in a collection ditch designed to carry away the water that does not infiltrate in order to avoid ponding and to reduce the accumulation of fine materials. This system provides more opportunity to percolate the water into the ground.

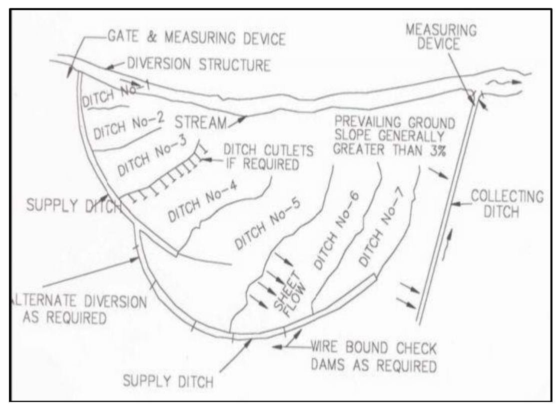

Figure 3: Ditch and Furrow system

Ground water recharges techniques in subsurface methods

Recharge wells

Recharge or injection wells are used to directly recharge the deep-water bearing strata. Recharge wells could be dug through the material overlaying the aquifer and if the earth materials are unconsolidated, a screen can be placed in the well in zone of injection. Recharge wells are suitable only in areas where thick impervious layer exists between the surface of the soil and the aquifer to be replenished. They are also advantageous in areas where land is scarce. A relatively high rate of recharge can be attained by this method. Clogging of the well screen or aquifer

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may lead to excessive buildup of water level in the recharge well.

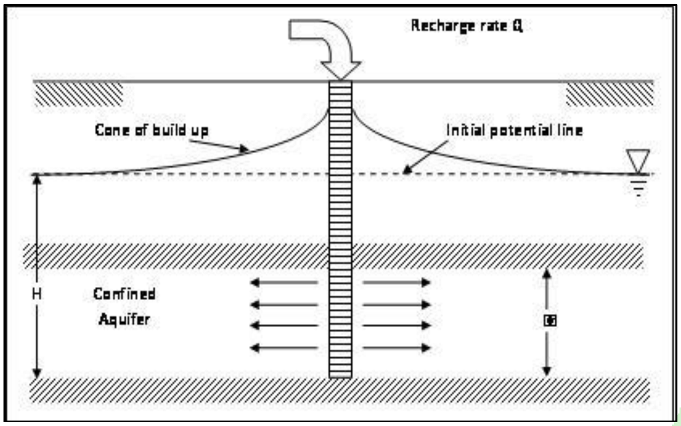

Figure: Recharge well

Recharge pits

Conditions that permit surface flooding methods for artificial recharge are relatively rare. Often lenses of low permeability lie between the land surface and water table. In such situation artificial recharge systems such as pits and shafts could be effective in order to access the dewatered aquifer. The rate of recharge has been being found to increase as the side slope of the pits increased. Unfiltered runoff water leaves a thin film of sediments on the sides and bottom of the pits, which require maintenance in order to sustain the high recharge rates. Shafts may be circular, rectangular or square cross-section and may be back filled by porous materials. Excavation may be terminating above the water table. Recharge rates in both shafts and pits may decrease with time due to accumulation of fine grained materials and the plugging effect brought by microbial activity.

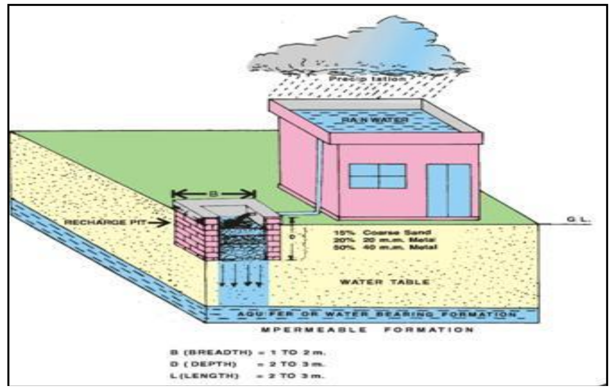

Figure: Recharge pits

Dug wells

Existing and abandoned dug wells may be utilized as recharge structure after cleaning and desilting the same. The recharge water is guided through a pipe from desilting chamber to the bottom of well or below the water level to avoid scouring of bottom and entrapment of air bubbles in the aquifer. The dug wells can be used as recharge structure storm water and other surplus water from canal etc. can be diverted into this structure to directly recharge the dried aquifer. The water for recharge should be guided through a pipes to the bottom of well to avoid entrapment of bubbles in the aquifer.

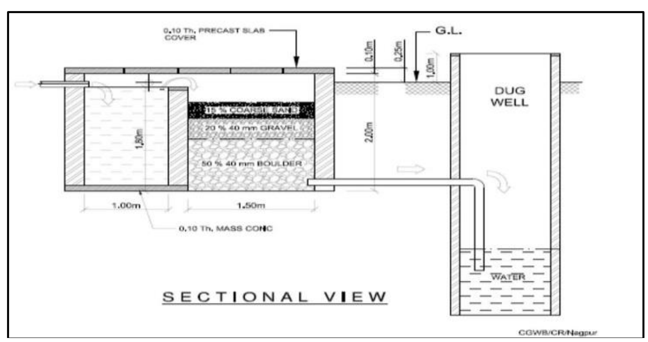

Figure: Dug well

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CONCLUSION

Ground water recharge includes recharge as a natural part of the hydrologic cycle and human-induced recharge, either directly through spreading basins or injection wells, or as a consequence of human activities such as irrigation and waste disposal. Artificial recharge with excess surface water or reclaimed waste water is increasing in many areas, thus becoming a more important component of the hydrologic cycle. The groundwater recharge through surface methods is the cheapest and the most suitable in many areas. Ground water recharge give the reduction of runoff, increased availability of groundwater especially in summer month, increase in irrigation, revival of springs, and improvement of groundwater quality.

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Spiny coriander (*Eryngium foetidum L.*): A potential herb for multi-purpose application

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INTRODUCTION

Eryngium foetidum L. is a biennial herbs which are mostly grown in tropical Africa, South Asia and southern parts of Europe (Hossain et al., 2017; Shavandi et al., 2012). In India, it is mostly grown and consumed as culinary purposes by indigenous people of north-eastern regions. The leaves are oblanceolate (8-20 cm long) with serrated margins and grows best in moist wet or moist conditions (Paul et al., 2011). The herb is still underutilized (Singh et al., 2013) and mostly used the fresh leaves for consumption by small section of population. This herb is known by several local names such as *Mexican coriander, Bahkhawr* (Mizo, India); *Awa phadigom* (Manipuri, India); *Dunia* (Naga, India); *African malli* (Malyalam, India); *Bandhania* (Hindi); *Bangladhonia, Bilatidhonia* (Bangla); *Andu kola* (Sri Lanka); *Japanese long coriander* (Japan) etc. (Singh et al.,2014). This herb contains essential nutrients and antioxidant compound that attracts for potential application in food, medicine and cosmetic industries.

(a) (b)

Fig. 1. (a) Spiny coriander at field (b) Plant after harvest

Chemical composition

The aerial parts of spiny coriander are rich source of calcium, carotene, riboflavin, iron, essential oils and Vitamin A, B and C (Singh et al., 2014). The proximate analysis indicated that the presence of moisture (85%), protein (3.3%), fat (0.6%) carbohydrate (6.5%), ash (1.7%), phosphorous (0.06%) and iron (0.02%) respectively in fresh leaves (Paul et. al., 2011; Shavandi et al., 2012). The variation of vitamin C and polyphenols content of spiny coriander of different ecotypes from India has been reported (Bhavana et al., 2013). Also, there are significant variation of identified compounds of essential oils which may be due to cultivar variation, geographical

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origin, age of herbs and different analysis methods used (Shavandi et al.,2012; Thi et al.,2008). It has been reported the contain of high amount of acyclic aldehydes and aromatic compounds in the Nigerian *E. foetidum* volatile oils which is a potential source of natural antioxidant (Thomas et al.,2017). The chemical compositions of flavour and essential oil are complex containing several constituents of hydrocarbons and oxygenated compounds, but the foremost compound of essential oil is aldehydes (Shavandi et al., 2012).

Potential application

The spiny coriander is being used in culinary purpose, medicine and perfumery industries. It is a potential pharmaceutical crops based on their phytochemical constituents and pharmacological potential (Wang et al., 2012).Traditionally, the herb is mostly used for etho-medicinal purpose. It is used to treat fever, cold, flu, hypertension, rheumatism, asthma, vomiting, burns, stomachache, arthritis, worms, infertility complications, snake bites, diarrhea, earache, menstrual pain etc. (Paul et. al., 2011 and Singh et al., 2013). Spiny coriander is known for its unique pungent aroma and essential oil. As a culinary purpose, the leaves are added to curries, chutneys, stews, sauces, noodles, meat dishes and soups for garnishing, flavouring, marinating and seasoning of cuisines (Paul et. al., 2011; Singh et al., 2014). Presence of essential oil drag the potential application in perfumery, pharmaceutical and cosmetic industries beside culinary purpose. The essential oil is of high economical value in international trade markets (Shavandi et al., 2012; Hossain et al., 2017). Plant extract with selective activity against certain plant pathogenic bacteria (*Erwinia genus*) indicates the potential in agricultural industry for used as pest control agent. A unit of CSIR, North East Institute of Science and Technology (NEIST) at Jorhat has developed formulation of a drug from essential oil of spiny coriander as the main components for treatment of arthritis and skin disease (Singh et al., 2014).

The spiny coriander has potential for multi-applications such as food, medicine, perfumery and cosmetics. The marketable product of this herb are plants and seeds. It has a great potential and economic importance because of its culinary use, nutritional value and medicinal ingredients (Hossain et al., 2017). Most of the investigation had been done for extraction and identification of essential oil compounds (Shavandi et al., 2012) which are mostly for application in pharmaceutical and cosmetic purposes. However, fresh leaves are mostly used for culinary purpose. The indigenous plants and its utilization techniques are diminishing gradually due to modernization and development trends. Thus, exploring the potential of underutilized crop such as spiny coriander may offer a sustainable alternative than conventional trend of cultivating common crops (Altieri et al., 2012; kahane et al., 2013). This can generate huge income to the indigenous smallholder communities. Processing of spiny coriander with adequate retention of its quality would also be a challenge for food engineering.

CONCLUSION

Spiny coriander is a high value underutilized crop that has huge market potential for alleviating farmer's income. The demand for this herb is also increasing day by day not only because of its nutritional/medicinal importance and increasing of health awareness but also its potential application in medicinal, pharmaceutical and perfumery industries. Therefore, further studies need to be done for wide spread cultivation of this herb to fetch better income of farmers by deviating from subsistence method of cultivation.

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Origin, area, production, varieties, package of practices for bottle gourd

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INTRODUCTION

Bottle Gourd - *Lagenaria siceraria* (Mol.) Standl. (2n = 22) (Hindi: Lauki) The name bottle gourd is due to bottle like shape of fruit and its use as a container in the past. Fruits at tender stage are used as a cooked vegetable and for preparation of sweets and pickles. Hard shells of mature fruits are used as water jugs, domestic utensils, floats for fishing nets, etc. As a vegetable it is easily digestible. It has cooling effect and has diuretic and cardiotonic properties. Fruit pulp is used as an antidote against certain poisons and is good for controlling constipation, night blindness and cough. A decoction made out of leaf is taken for curing jaundice. Seeds are used in dropsy. Origin Originated in tropical Africa, the crop is domesticated in Asia, Africa and New World. Botany Bottle gourd is a climbing annual with a duration of 3 ½ to 4 months. Flowers are solitary, chalky white in colour and open at night. Fruits are fleshy and vary in shape and size.

Botany

Bottle gourd is a climbing annual with a duration of 3 ½ to 4 months. Flowers are solitary, chalky white in colour and open at night. Fruits are fleshy and vary in shape and size.

Improved Varieties

Punjab Komal (PAU, Ludhiana)

It is developed from the cross between local collections LC 11 and LC 5. The fruits are pear shaped, medium sized each weighing about 625 g, light green and pubescent. First picking is possible 70 days after sowing. Average yield is 500 quintals per hectare. It is tolerant to CMV

Punjab Barkat (PAU, Ludhiana)

It is developed by selection from a local material collected from Khanna in Ludhiana district. Its plants are vigorous and profusely branched. Fruits are about 27 cm long, shining light green, cylindrical and tender. First fruit picking is possible 40 days after transplanting. Fruits are suitable for packaging and distant transportation. It is moderately resistant to mosaic disease. Average fruit yield is 565 quintals per hectare.

Pusa Naveen (IARI, New Delhi)

It is developed by selection from a local material. The fruits are cylindrical, 30-35 cm long, medium thick (6.0-7.0 cm diameter) and straight. It takes about 60 days from sowing to first harvest. Average fruit weight is 850 g and yields about 300 quintals per hectare.

Pusa Summer Prolific Long (IARI, New Delhi)

It is developed by selection from a local material. The fruits are cylindrical, 40-50 cm long, pale green in colour and are suitable for both spring-summer and rainy seasons. Average yield is 150 quintals per hectare.

Arka Bahar (IIHR, Bangalore)

It is developed by selection from a local material. The fruits are cylindrical, straight, medium long and light green. Average fruit weight is 1.0 kg and yield 400 quintals per hectare.

Kalyanpur Long Green (CSAUAT, Kalyanpur)

It is developed by selection from a local material. The fruits are long with tapering blossom end. Average yield is 300 quintals per hectare.

Azad Nutan (CSAUA&T, Kanpur)

The fruits are attractive, shining light green and medium long. It is recommended for

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cultivation in both spring-summer and rainy seasons. First picking is possible 55-60 days after sowing. Average fruit weight is 1.0-1.5 kg.
Samrat (MPKV, Rahuri) It is developed by selection from a local material. The fruits are green, pubescent, 30-40 cm long and cylindrical. Average yield is 400 quintals per hectare.

Pusa Hybrid 3 (IARI, New Delhi)

It is suitable for cultivation in both spring-summer and kharif seasons. The fruits are cylindrical, attractive green, long and straight. First picking is possible 55-60 days after sowing. Average fruit weight is 1.0 kg and yield is 425 quintals per hectare in spring-summer season and 470 quintals per hectare in kharif season.

Heterosis

A good number of F1 hybrids, Pusa Meghdoot, Pusa Manjari, Pusa Hybrid 3 and Pant Sankar Lauki 1 were developed in public sector in bottle gourd. F1 hybrid Varad (MGH 4) developed by Mahyco, Jalna yields 60-65 t/ha. It has cylindrical bright green, 40-45 cm long fruits weighing 600-750 g.

Climate

Bottle gourd is a typical warm season vegetable. Though crop tolerates cool climate better than musk melon and water melon, it cannot tolerate frost. Well drained fertile silt loam is ideal for cultivation of bottle gourd. Crop is quite suitable for river bed cultivation because of its deep tap root system. A deep soil supports vines for a long period.

Season

Crop is grown during summer and rainy season. In places where water is not scarce, it is grown throughout the year.

Land preparation and sowing

Land is ploughed to a fine tilth and furrows are made at a distance of 2.0-3.0 m. After incorporating farmyard manure, seeds are sown in furrows at a distance of 1.0-1.5 m between plants. When bottle gourd is trained on bower, follow a spacing of 3.0 x 1.0 m. In sloppy land, sowing is done in pits with 2-3 plants / pit. Soaking seeds 12-24 hours in water or in succinic acid (600 ppm) for 12 hours improves germination. Seed rate recommended is 3-6 kg/ha.

Irrigation

Bottle gourd requires good soil moisture conditions to promote vegetative growth and to produce attractive, shining green, tender fruits of regular shape. First irrigation is given immediately after sowing to enhance proper seed germination. Subsequent irrigations are given at 3-4 day intervals in summer months. In rainy season, irrigation is required only during the prolonged dry spell.

Weed Control

In early stages of plant growth the weeds are kept under check by shallow cultivation with tractor drawn tillers or manual hand hoe. When vines start spreading on beds, one weeding is done manually. Pre-sowing application of fluchloralin (Basalin) 2.0-3.0 litres per hectare or butachlor @ 2.5 litres per hectare are also effective in controlling weeds in bottle gourd. Incorporate Basalin into the soil by raking to prevent its photo-degradation.

Training and pruning

As bottle gourd puts forth good vegetative growth, proper training and pruning are advantageous. Training plants to bower helps to tap sunlight more effectively and yield as high as 80 t/ha was obtained. Axillary buds of growing vines should be removed till vines reach the bower height. When vine reaches bower, apical bud is removed at 10-15 cm below bower to allow 2 or 3 branches to spread on bower. After formation of 4-5 fruits, vines are again pruned allowing 2-3 axillary buds only to grow on primary vines. It is also advisable to remove all yellow and pale coloured older leaves near bottom portion.

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Interculture

Bottle gourd is highly responsive to heavy application of manures and fertilizers. Follow fertilizer package and interculture operations as that of ash gourd and bitter gourd.

Harvesting

Fruits are harvested at tender stage when it grows to one third to half. Fruits attain edible maturity 10-12 days after anthesis and are judged by pressing on fruit skin and noting pubescence persisting on skin. At edible maturity seeds are soft. Seeds become hard and flesh turn coarse and dry during aging. Tender fruits with cylindrical shape are preferred in market. Harvesting starts 55-60 days after sowing and is done at 3-4 days intervals. While harvesting, care should be taken to avoid injury to vines as well as to fruits. Plucking of individual fruits is done with sharp knives by keeping a small part of fruit stalk along with fruit. Average yield is 20-25 t/ha for open pollinated varieties and 40-50 t/ha for F1 hybrids.

Fruits can be stored for 3-5 days under cool and moist condition. For export purpose, fruits are packed in polythene bags and bags are kept in boxes of 50-100 kg capacity.

Post-Harvest Handling

Uniform fruit shape, size, tenderness and colour are important for fetching premium in the market. The fruits are soft-skinned and are easily bruised during post-harvest handling. Bruised parts turn blackish and spoil the look of the whole lot. Therefore, the bruised or damaged fruits are culled before packing in the appropriate boxes. Bottle gourd fruits can be stored for about two weeks at 10°C and 60-70 per cent relative humidity.

Export

Bottle gourd is becoming an important export commodity of India. It has potential for export to Southeast Asia, Middle East and Europe. For export purposes, harvesting is done during cooler part of the day. Fruits are pre-cooled immediately after harvest. The fruits that are uniformly green, cylindrical, straight, 30-40 cm long and free from blemishes are suitable for export. Before packing, the individual fruits are wrapped in paper bags. The other shapes are not preferred due to inconvenience in packing.

Seed Production

For seed production the fruits are allowed to ripen on vines. Isolation and monitoring requirements for quality seed production are the same as for other gourds. At seed maturity the fruits dry and seeds rattle inside the shell. The fruit colour turns brown or tan with thick and hard shell. The shells are broken, seeds extracted, dried to 7 per cent moisture level or less, cleaned and stored. Average seed yield is 5.0-6.0 quintals per hectare.

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Impact of climate change on insect pests population development

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Environmental change is the term used to portray a slow increment in the normal temperature of the Earth's air and its seas, a change that is accepted to change the Earth's atmosphere until the end of time. The worldwide temperature has been consistently ascending since 1900 with an expansion of about 1°C from that point forward. The best increment has been in northwestern North America, however, India's temperature has expanded somewhere in the range of 0.2°C and 1°C. In addition, the rate of an unnatural weather change is expanding; temperature expanded twice as quick during the most recent 50 years as it did over the most recent 100 years. The mean temperature in India is anticipated to increment up to 1.7ºC in *Kharif* (July to October) and up to 3.2º C during *Rabi* (November to March) season, while the mean precipitation is relied upon to increment by 10 percent by 2070 (Gupta, 2011).

Effect of climate change on insect pests

Insects are cold-blooded organisms - the temperature of their bodies is around equivalent to that of nature. In this way, the temperature is likely the absolute most significant natural factor affecting insect behaviour, dissemination, improvement, survival, and multiplication. Anthropogenic CO_2 is twice more significant for temperature increment than other seemingly perpetual ozone harming substances joined. Albeit expanded CO_2 should not legitimately maliciously influence insect pests, the temperature increments driven by the expansion in anthropogenic CO_2 as of now influence on pests in significant ways including their circulation, nourishment, phenology and as a vectors.

Impacts of elevated CO_2 on insect pests

All in all, have plants developed under elevated CO_2 are less nutritious to insects herbivores, which can influence their conduct and execution. Phenotypic host-plant interactions changes normally make leaf material eaten by the pests are less nutritious. As an outcome, pests have a progressively troublesome time changing over the sustenance they eat into biomass. To moderate the impacts of less nutritious sustenance, insect pests herbivores frequently expend more. Insect herbivore performance is positively correlated with leaf nitrogen fixations. Zvereva and Kozlov (2010) reported that the leaf nitrogen substance diminished for mustard and collard developed under raised CO2.

Plants can likewise shield themselves precisely, either by having extreme leaves or by structures, for example, leaf trichomes. Levels of mechanical protection are adversely associated with herbivore execution. Elevated CO_2 expanded trichome densities on radish. A few examinations, for the most part considering leaf durability, leaf thickness, and explicit leaf weight, have likewise watched increments in mechanical protection because of elevated CO_2. This is likely to some extent because of higher death rates because of both parasitoids and other natural enemies. The natural enemies are thought to have better accomplishment under Elevated CO_2 because their prey is progressively evident. Insects are regularly take more time to create, making them progressively obvious to natural enemies. Higher utilization rates additionally cause expanded leaf harm and expanded frass generation, the two signals to natural enemies.

Hamilton *et al.* (2005) estimated levels of herbivory in soybean developed in encompassing air and air improved with CO_2 or O_3 utilizing Free Air gas Focus Enhancement (FACE). Under outside conditions and introduction to the full pests network, raised CO2 expanded the vulnerability of soybeans to herbivory from the get-go in the season, while presentation to Elevated CO_2 appeared to have no impact. In the locale of the shelter presented to abnormal amounts of herbivory, the level of leaf region expelled expanded from 5 to over 11% at Elevated CO_2. They found no proof for compensatory sustaining at Elevated CO_2 where leaf nitrogen substance and C: N proportion was unaltered in plants encountering expanded herbivory. Be that as it may, levels of leaf sugars were expanded by 31% at Elevated $CO_2$and agreed with a critical increment in the thickness of the obtrusive species *Popillia japonica* (Japanese bug).

Impacts of elevated temperature on insect pests

A large number of the impacts of expanded temperature on insect performance have to do with the immediate impacts of temperature on insect's pests. Since insects are exothermic, they will, in general, be increasingly dynamic under wormer conditions. A run of the mill impact of raised temperature is thusly to expand utilization rates and along these lines decline the opportunity to pupation, making them less evident to natural enemies and at times expanding the potential number of pages per season. It has been assessed that with a 2^{o}C temperature raise insects may encounter one to five extra life cycles for every season (Yamamura and Kiritani, 1998). Elevated temperatures increment rover moth execution, both diminishing its improvement time and expanding its survival rate (Williams *et al.,* 2003). Anyway, the survival rate of another individual from its family, the pious devotee moth, is altogether different under expanded temperatures. If wanderer moths respond more positively to future situations than contenders, they may turn out to be progressively inclined to flare-up.

The temperature may change sex proportions of some insect species, for example, thrips (Lewis, 1997) possibly influencing generation rates. Insect pests that spend significant pieces of their life accounts in the soil might be more slowly influenced by temperature changes than those that are over the ground essentially because soil gives a protecting medium that will in general cradle temperature changes more than the air (Bale *et al.,* 2002). Lower winter mortality of insects because of hotter winter temperatures could be significant in expanding insects population (Harrington *et al.,* 2001).

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Impact of changes in precipitation pattern on insect pests

Early and opportune planting becomes progressively dubious under environmental change. During the 2009 blustery season, delay in the beginning of rainstorm by 45 days brought about deferred plantings of pigeonpea that are inclined to harm by *Helicoverpa armigera* and caused overwhelming harm (Sharma, 2010). Likewise, with temperature, precipitation changes can affect insect pests, predators, parasites, and diseases, bringing about an intricate dynamic. Contagious pathogens of insects are supported by high stickiness and their rate would be expanded by atmosphere changes that extend times of high moistness and diminished by those that outcome in drier conditions.

CONCLUSION

Species life history (transformative) adjustments may cloud our capacity to distinguish species reaction to environmental change - in like manner, species react contrastingly to changes in warm conditions. There are numerous communications and it is very hard to anticipate the effect of environmental change on insect pests later on, yet we may anticipate an expansion of certain essential vermin just as optional insects and intrusive species. The best financial procedure for ranchers to pursue is to utilize coordinated vermin the executives' practices to intently screen insects and illness event. Keeping nuisance and harvest the executives' records after some time will enable ranchers to assess the financial matters and ecological effect of vermin control and decide the achievability of utilizing certain irritation the executives' procedures or developing specific yields. A portion of the potential adjustment procedures could be creating IPM with more accentuation on organic control and changes in social practices, insects determining to utilize ongoing systems, for example, recreation demonstrating and substitute generation methods

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Impact of climate changes on agriculture and food security in India

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Why climate change vulnerable to Agriculture?

Agriculture represents a core part of the Indian economy and provides food and livelihood activities to much of the Indian population. The agricultural sector represents 35% of India's Gross National Product (GNP) and as such plays a crucial role in the country's development. Food grain production quadrupled during the post-independence era; this growth is projected to continue. The effect of climate on agriculture is related to variabilities in local climates rather than in global climate patterns. While the magnitude of climate change impact varies greatly by region. Climate change is expected to impact on agricultural productivity and shifting crop patterns.

What is Climate change?

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer. Climate change has adverse impacts on agriculture, hydropower, forest management and biodiversity. In the long run, the climatic change could affect agriculture in several ways such as quantity and quality of crops in terms of productivity, growth rates, photosynthesis and transpiration rates, moisture availability etc. Climate change directly affects food production across the globe.

Current Issues in Agriculture

Indian agriculture is inundated by several problems; some of them are natural and some others are manmade. Some of them are overproduction in short-term, yet food insecurity for a large population, Declination of yields in the country. This is because of the few issues like less irrigation facilities, improper environment, climate changes etc. Crop diversification is one of the major issues in agriculture. Groundwater irrigation plays an important role in diversification as it facilitates controlled water release, which is one of the factors for growing crops. Therefore, districts with greater dependence on groundwater have a higher potential for crop diversification. The quality and quantity of water resources also brings the changes in the agriculture.

In some parts of the country, too much food is grown. Such overproduction is expensive economically and ecologically. Heavily subsidized surpluses depress market prices of commodities and thus create severe problems for developing countries whose economies are based on agriculture. They also tend to reduce the incentives for domestic food production. Subsidized disposal of the surpluses depresses markets for commodities such as rice and sugar, and undermines the economies of the developing countries that depend on them.

Agriculture & Climate Change:

In the decades, climate change and other global trends will endanger agriculture, food security, and rural livelihoods coming. Agriculture and climate change which is a three-fold relationship. Agriculture as a contributor to climate change. Impacts of climate change on agriculture and Agriculture as a potential moderator of climate change.

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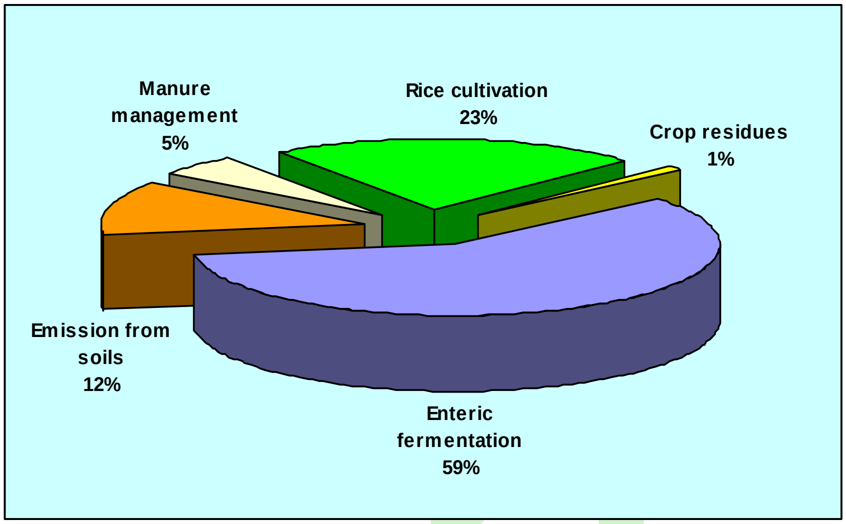

Figure Contribution of Agriculture in India to climate change

(Sources of greenhouse gas emissions in India)

Impact of climate change on Agriculture

Climate is an important factor determining the production of crops and if there is change, it poses a serious threat to agriculture. Agriculture is important for food security. "Food security exists when all people at all times have physical or economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" FAO (1996).

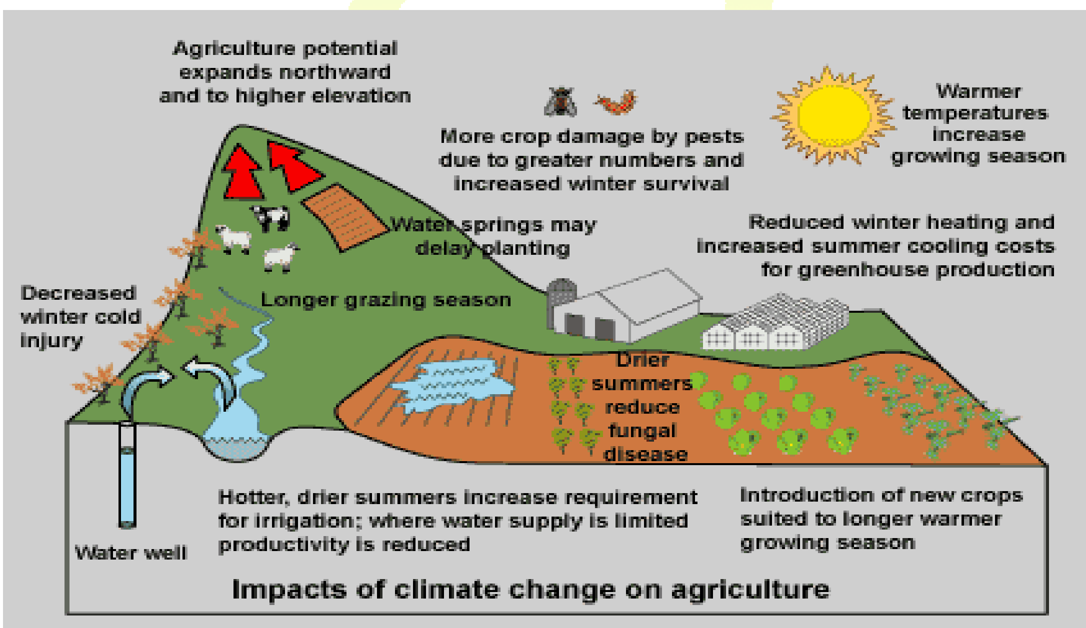

Figure: Impact of climate change on agriculture

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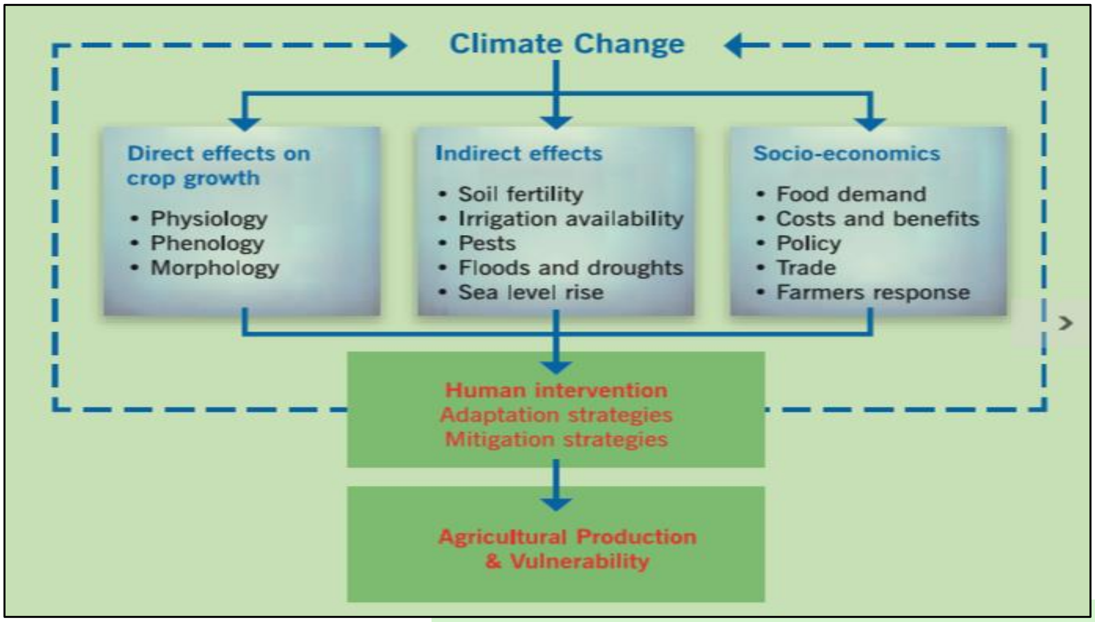

Figure: Climate change impact on agriculture

Impacts of Climate Change on Agriculture Yield

The impact of climate change on agricultural systems is a major concern as it can have a significant effect on the world food supply. Greater loss expected in Rabi. Every 1°C increase in temperature reduces wheat production by 4-5 million tons. Loss only 1-2 million tons if farmers could plant in time. Reduced frequency of frost damage, less damage to potato, peas, mustard. Increased droughts and floods are likely to increase production variability. Cereal productivity to decrease by 10-40% by 2100.

Projected impacts of climate change on food security in India

Imbalance in food trade due to positive impacts on Europe and N. America, and negative impacts on us. Increased water, shelter, and energy requirement for livestock; implications for milk production. Increasing sea and river water temperatures are likely to affect fish breeding, migration, and harvests. Coral reefs start declining from 2030. Considerable effect on microbes, pathogens, and insects. Increasing temperature would increase fertilizer requirement for the same production targets and result in higher emissions. Increasing sea and river water temperatures are likely to affect fish breeding, migration, and harvests. As a result of this food demand will rise. In order to meet global demands, we need 60-70% more food by 2050.

CONCLUSION

Climate change is a reality. Indian agriculture is likely to suffer losses due to heat, erratic weather, and decreased irrigation availability. Climate change has significant implications for agriculture and food security, creating new risks and challenges and exacerbating existing vulnerabilities from the local to the global level. Rural livelihood systems and poor or marginalized groups that mainly depend on agriculture, forestry, fishery sectors, are the most vulnerable and strongly affected by climate change. Climate change can affect all dimensions of the food security of vulnerable groups as well as different elements of food systems. Climate change and food security are twin challenges which need to be addressed together.

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Cultivation practices and economical importance knol khol

Article id:

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Natural order Cruciferae/ Brassicaceae

Botanical name: *Brassica oleracea* var. gongylodes Linn.

Vernacular names Ganath Gobhi, nool, khol, gaddagobhi, olkabi, old kapi, nawalkol, navilu kosu

Botanaically Brassica oteracea, var. gongytodes Linn, knolkhol goes by many names in India, as indicated above. It is grown for the turnip like enlargement of the stem above ground. Although it is an excellent vegetable if used before it becomes tough and stringy, it is little known throughout India. But it is particularly popular in Kashmir, West Bengal and Karnataka.

SOIL

Since knolkhol is a hardy vegetable it can be grown on a veriety of soils. Well darained red loamy soil is best suited for its cultivation.

SEASON

It is essentially a winter vegetable but can also be grown during monsoon. June-July and October-November are ideal months for sarting the crop.

CULTIVATION

Prepare 15 raised seed beds of 7.50m long, 1.20 m wide and 10 cm high for raising nursery required for one hectare. Apply 10-15 kg farmyard manure or compost and 1/2 kg 15-15:15 complex fertilizer per bed and mix them well in the soil. Sow the seed in 7.5 cm rows. Provide irrigation regularly. The seeding will be ready for transplanting in 3-4 weeks.

PLANTING

After the land is ready for transplanting, apply the entire quantity (12.5 tons) of farmyard manure of compost and mix well in the soil. Prepare ridges and furrows at 30 cm apart. Apply 50%N, and the entire P and K in the furrows and mix them well in the soil. Provide light irrigation befor transplanting. Transplant seeding on one side of the ridge at 22.5 cm apart. Provide irrigation once in 4-6 days depending upon the soll and weather conditions. Apply remaining 50% N, 4 weeks after transplanting. Keep the polt free from weeds.

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VARIETIES

1. White Vienna: It is an early variety (60-80 days). The heads are slightly oblong and light green.

2. Purple Vienna: It takes 80-90 days to manure. The heeds are slightly purple and medium sized.

3. King of North: Plant hight 20-30 cm; darks green foliage with broad leaf, blade. Knobs are flattish round and dark green in colour. Leaf-sheath is large and well spread over the knob. Matures in 65-70 days.

All varieties are foreign introductions and little improvement work is going on
In India because of the limited importance of this crop (Gill, 1989).

INPUTS (Per hectare)

1.	Seed, (g)		1250
2.	Organic manure FYM or compost, (tons)		12.5
3.	Fertilizers, (kg)	N	150
		P_2O_2	100
		K_2O	125

Plant protection

Follow the same plant proctions measure as suggested for cabage.

Harvesting & Yield

Depending on the variety the crop will be ready for harvest in 45 to 60 days after transplanting. About 200 q/ha knolkhol heads can be expected.

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Integrated Disease Management in Soybean

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Soybeans can be affected by diseases throughout the growing season. More than 100 pathogens soybean but only third of them are economic importance yield reduction varies between 10-30 %.disease management depends on several factors involved that cultural practices , biological management and climatic conditions are involved depends upon such conditions what practices can be adopt for particular diseases. Its is one of diagnostic tool to the farmers to particular areas.

INTRODUCTION

Soybean production has shifted from a largely subsistence farming to more market oriented, commercial production. However, it has not been possible to exploit the full genetic potential of high yielding soybean varieties because of extensive losses due to diseases. On a rough estimate in soybean, losses due to disease often between 10 to 30 percent. Total dependence on chemical control approaches has further aggravated the diseases problem in soybean. In the present context, the viable approach to save the crops from the ravages of diseases is integrated disease management (IDM) technologies. The aim of IDM is to prevent economic loss and increase the value of the crop. Farmers should be educated regarding IDM approaches. However, this is possible not only with the involvement of extension agencies but with the frequent visits or monitoring by the scientist of nearby institution.

Soybean (Glycine max) also known as "golden bean" is leading oilseed crop in India. It forms the cheapest and easiest source of high quality protein (40%). Soybean seed contains 20% oil. Its forage and oil cake can be used as quality feed of cattle and poultry. These benefits make soybean cultivation more relevant to Asian farmers, who rear animals along with cropping. Globally, soybean accounts for nearly 35% of total harvested area devoted to annual and perennial oil crops, and shares 44% global oil crop output. Major soybean growing countries, USA (29Mha). Brazil (23Mha), Argentina (14Mha) and China produce 90% of world's soybean. In India it is grown on an area about 9.95Mha with production of 12.6Mt. The important soybean producing states include Madhya Pradesh, Maharashtra, Rajasthan, Karnataka and Andhra Pradesh.

The productivity of soybean in India is much lower than the actual yield potential of the crop. The major constraints of low productivity of this crop are the heavy losses caused by diseases, pests and weeds. soybean is affected by more than 100 diseases of which about 35 are of serious concern. On a rough estimate in soybean, losses due to diseases often between 10 to 30 percent. Total dependence on chemical control approaches has further aggravated the diseases and pest problem in soybean. In the present context, the viable approach to save the crops from the ravages of diseases is Integrated diseases management (IDM) technologies. The aim of IDM is to prevent economic loss and increase the value of the crop.

Key disease and their diagnostic Details

1. **Brown spot:** Irregular light-brown lesions, ranging in size from small specks to a few mm in diameter.

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Lesions eventually darken to brownish black. Lesions are primarily found on leaves, but can also occur on stems, petioles and pods. Early season infection is restricted to unifoliate and first trifoliate leaves.

2. **Bacterial Blight:** Initial symptoms are small angular water soaked spots on leaves. Lesion centers dry out and turn brown to black with water soaked margins and yellow halos. Lesions may coalesce resulting in large blighted areas. Affected tissue often drops out, giving a tattered appearance to the leaves. Rarely a serious disease in Indiana soybeans.
3. **Pod and stem Blight:** No definite leaf or stem lesions are produced under field conditions. Fungal spore-bearing structures (pycnidia) appear as black specks in linear rows on dead stems and poorly-developed pods. Pod blight phase results in poor quality seeds and sees decay. Seedling blight may occur from seed infection.
4. **Downy Mildew:** Pale green to yellow spots on upper leaf surface. Lesions turn grayish brown to dark brown with a yellow or light green margin. Tufts of gray fungal growth may be visible on lower leaf surface during moist weather. Severely affected leaves turn brown and drop. Whitish fungal growth may be present on interior of pods and seed coats. Systemically infected seedlings from infected seeds are stunted with mottled foliage. A common disease, but rarely causes significant yield loss.
5. **Phytophthora Rot:** Seed rot and pre-emergence damping-off root and stem rot of older seedlings. In more mature plants chlorosis and wilting of leaves, with a dark brown and discoloration on lower stem progressing upward from the soil line. Root rot of older plants may also occur. Affected plants are clustered in field.
6. ***Sclerotinia Stem Rot*:** Wilting and death. Dead leaves remain attached to stems. Tan to white lesions at nodes can girdle stems. Cottony fungal growth may be present on diseased plant parts. Large black structure (sclerotia) from in pith and on infected stems.
7. **Charcoal root Rot:** Loss of vigor in mature plants. Leaves turn yellow and wilt but remain attached. Light gray or silver discoloration in taproot and lower stem after flowering. Small black fungal structure (miscrosclerotia) presents in taproot and stem tissues.
8. **Bud Blight:** Stunting occurs when young plants are infected. Minor disease in most fields in most years. Stem terminals will curve, forming a crook. Lateral buds become brown and drop off. Brown discoloration of stems, beginning at nodes. Leaves are dwarfed and curl upward. Pods often abort, or are underdeveloped. Infected plants remain green longer than healthy plants (delayed maturity). Symptoms often develop first on plants near the edges of a field.
9. **Soybean Mosaic:** the initial symptoms of the disease are severe mosaic of dark and light green areas of downward curling of primary leaves giving seedlings spindly appearance. Such plants have rugosed crinkled, mottled, puckered curled and severly stunted leaves. Dark green enations along the puckered leaves and necrosis are also occasionally present. Necrosis, leaf yellowing, terminal necrosis and defoliation at times lead to death of plant. Diseased pods often remain stunted, flattened and curved with less pubescence and fewer and small sized seeds.

Development of IDM package:

The IDM package should be carefully formulated taking into consideration the weather, site, type and condition of soil, the condition and stage of the crop. Attempt should be made to manage more than one disease in the same operation. To be effective, a large number of farmers and over a large contiguous area should adopt the IDM on a cooperative basis.

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IDM components: IDM components include:

- Sowing a crop variety with resistance to a disease.
- Modified farm management practices that result in reduction of diseases damage viz. altering sowing date or sowing pattern, inter cropping etc.
- The enhancement of natural control processes.
- The judicious application of pesticides only when necessary.
- Based on the above components a package can be developed for the management of chick pea disease detailed below.

Step wise IDM in soybean:

Cultural practices:

1. Deep summer ploughing by soil turning plough to burry debris and sclerotia to a depth of 15 to 25 cm help in reducing the disease.
2. Pre sowing soil application of phorate @10 kg/ha to reduce the incidence of mosaic.
3. Apply recommended dose of NPK
4. Adjustment of planting and harvesting time for avoidance of disease. Early sowing escape the infection of collar rot or sclerotial blight.
5. Follow crop rotation with non host crops like cotton, cereals etc. to minimize soil and seed borne disease.
6. Inter or mixed cropping of soybean with over rainy season crops of the area to reduce rust, root rot, stem rot and foliage blight incidence.

Grow resistant/ tolerant varieties: as under

Diseases	Resistant/ Tolerant varieties
For Cracoal rot	NRC2, NRC37, JS71-05, LSb1
For Anthracnose	Bragg, Himso 1563, Hardee, PK472, JS80-21, Pusa37, VLS21, NRC 21
For Rust	Ankur, PK 1024, PK 1019, JS 80-81, Indira soybean 9, MAUS 61-2
For Myothecium	Bragg, JS 71-05, JS 335, MACS 13, MACS 124,
Leaf spot	NRC7, PK564
For Bacterial	PK327,PK416, PK1042, JS71-05, JS90-41,
Pustule	NRC7, NRC37
For Soybean	JS71-05, KHSb 2, LSB 1, MACS 58, MACS 124,
mosaic	PK416, PK564, Punjab 1
For Yellow mosaic	PK 416, PK 472, PS564, PK1034, PK1029, PK 1042, Pusa37, SL295

Seed treatment with

1. Thiram+carbendazim (2:1) @3g/kg or with a combination product of thiram and carboxin @ 2g/kg seed against charcoal rot, Anthracnose, Myothecium leaf blight and purple seed stain were found effective.
2. Streptocyline @ 500 mg/kg seed against bacterial pustules.
3. *Bradyhizobium* culture @ 8ml/packets/ha.

Mechanical practices

1. Affected plant should be roughed out.
2. Collect and destroy the affected plant parts after harvest by burning.

Bio control practices

1. Seed treatment with *P. fluorescens* (10/kg seed) + soil application (2.5 kg/ha) and spray @ 0.1% and seed treatment with *Trichoderma viride* (5 g/kg seed) appears to

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have promise for control of *Rhizoctonia* and *Phytophthora* root rots.

Chemical practices

1. Apply carbendazim (0.1%) or thiphanate methyl (0.05%) or mancozeb (0.25%) for control of Anthracnose, *Cercospora* blight, and *Myothecium* leaf blight disease.
2. Foliar sprays of hexaconzole, propiconazole or triadimefon or oxycarboxin @ 0.1 percent at 15 days interval against rust.
3. Two foliar spray of thiomethoxam 25 WG @ 100g/ha or methyl demeton 0.8 lit/ha or ethofenprox 10 EC @ 1.0 lit./ha at 15 days interval against mosaic and yellow mosaic.
4. Foliar spray of copper oxychloride (1.6 kg) + Streptocycline (160g) or Kasugamycin / Validamycin (1.6kg) + Copper oxychloride (1.6 kg) in 800 litre of water/ha. Against bacterial pustules.

CONCLUSION

Crop health is basic means of food security and sustainability. A host of uncontrolled diseases still plague us and Pathogens lose 10 to 30 percent soybean output, stressing production and productivity. Globalized trade and supply chains are likely to aggravate this. Freer trade terms have compounded pathogen threat and made crop risky. Sustainable disease diagnosis, increased surveillance, breeding for resistance and transgenics should receive greater focus and international cooperation. However to combat with various disease problem integration of technologies would be a better approach than to opt for a single one. Farmers should be educated regarding IDM approaches. However this is possible not only with the involvement of extension agencies but with the frequent visits or monitoring by the scientist of nearby institution.

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Weedy rice: Origin & management

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Rice is the most important staple crop of Asia. Asia accounts for 90% of area and production of rice globally. Conventional method of growing rice is puddling and transplanting, which are labour, water and energy intensive. Due to limitation of manpower, water management problem and energy crises, conventional practices of growing rice are less profitable. In addition to this, it deteriorates the soil physical properties and causes reduction in final yield. These are the factors forcing farmers to shift from transplanted rice to direct seeded rice (DSR). DSR is more rapidly and easily planted, is less labour intensive and consumes less water. But, DSR has one disadvantage of weedy rice, which is one of the most difficult and competitive weed species of rice in the world and cause complete failure of crop if not controlled. Weedy rice is also referred to as red rice because of its red pericarp. Therefore, there is need to develop the sustainable ecological sound integrated weed management practices to control weedy rice in DSR.

Origin of weedy rice

Wild rice belongs to the genus *Oryza*. According to the previous literature available, there are three hypotheses explain evolution of weedy rice:

1. Natural hybridization by continuous flow of gene between cultivated species and reproductively compatible wild rice population
2. De-domestication of cultivated rice in to weedy rice
3. Direct adaptation of wild rice from rice agricultural fields

Undesirable characteristics of weedy rice

These are the traits that make weedy rice such a troublesome and persistence weed of direct seeded rice:

- Seed dormancy
- Longevity
- Flowering
- Seed shattering
- Red pericarp color
- Stress tolerance

Management of weedy rice

Management of weedy rice from single method is very difficult; therefore, integrated weed management approach is needed for its effective control in DSR system. It consists of two strategies - to prevent the introduction of weedy rice and to control its spread and economic impact.

1. Prevention

Prevention is the primary step to reduce weedy rice infestation in the rice field. Planting the certified weed free seed is the most effective means to prevent the spread of weedy rice. Besides this, use of clean agricultural equipments, making the farmers aware about risk imposed by weedy rice and close monitoring of species in new area is also needed to avoid invasion.

2. Cultural method

This includes non chemical means of weed control techniques *i.e.*, land preparation, varieties, fertilizer management, water management. These practices reduce the chance of emergence of weedy rice seedlings at crop establishment, thus, also preventing subsequent seed return in to the soil from mature plant.

- **Stale seed bed technique**
  This technique also called as false seeding technique, is an efficient means to manage weedy rice. After seed bed preparation, the area is left to allow growing weeds. The rice can then either be drilled or water seeded after the weeds are destroyed by either mechanical or chemical means. This technique is aimed at reducing the weed infestation in the same season in which it is applied and gradually decreasing its seed bank.
- **Soil solarization**
  Soil solarization is a non chemical field technology for weed management. In this technique, field is sprinkled with water first and then covered by using thin transparent polyethylene films to trap the solar radiation. It will increase soil temperature by 10-15ºC above the normal temperature. Soil solarization process is practiced in the summer months for duration of 4- 6 weeks. This method is very effective to control the weed seed bank before the season starts.
- **Enhanced seed rate**
  Increased crop seeding rates above the optimum rate in infested fields suppress weedy rice infestations. .
- **Row seeding**
  Row seeding is also reported as a better and easy method to differentiate cultivated rice plants in rows and weedy rice between rows.
- **Water management**
  Water management is very important for reducing weedy rice in DSR. Initial flooding days before land preparation would help to control weedy rice in direct seeded rice, after seeding of pre-germinated seeds; water management plays a crucial role to successfully suppress weedy rice.
- **Hand weeding**
  The control of weedy rice plants is sometimes carried out by hand, but this practice is time consuming and costly. Hand weeding is very difficult up to 30-40 days after crop emergence as it is very difficult to distinguish the cultivated varieties from the weedy rice in the early stages. Hand weeding of weedy rice can be done when light infestation is there and it is frequently used with other means of control.

3. Mechanical control

Mechanical removal of weeds can be done just before the planting with the help of blade or rotary harrowing in both dried and flooded condition. This practice is satisfactory but more time consuming and usually not that effective as chemical control. Weedy rice could also be controlled mechanically in line planted rice using tools. This practice is aimed at preventing the spread of the weed and is mainly carried out by cutting tall weed panicles before they set seeds.

4. Chemical control

Pre-emergence herbicide can effectively control weedy rice, when applied before crop and after the emergence of weedy rice but, Selective control of weedy rice with post-emergence herbicides is very difficult due to its genetic, morphological, anatomical and physiological similarity to cultivated rice.

5. Emerging management strategies

The adoption of new emerging strategies to weed management will be necessary to sustain the cultivation of DSR on a global basis.

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- Genetic and biotechnological approach for weedy rice control

The use of herbicide-resistant rice cultivars is another strategy developed for selective control of weedy rice in cultivated rice. Development of herbicide-resistant rice was done mainly with the aim to obtain effective and selective control of weedy rice in the rice crop.

- Modeling population dynamics of weedy rice.
- In this approach, models are used to predict weedy rice impact and can help in choosing appropriate weed management technology. Several models are prepared for different crop-weed combination and specifically for weedy rice.

CONCLUSION

DSR has a number of advantages like easy planting, is less labor intensive, less water consuming, reduction in methane emission and matures 7-10 days earlier. Despite of the fact that weedy rice is the major problem of DSR due to its unique characteristics *i.e.,* early and heavy seed shattering, prolonged dormancy, flowering, stress tolerance, longevity and high competitiveness make it a difficult-to-control, troublesome weed in DSR. Satisfactory control of weedy rice requires an integrated weed management approach based on the combination of preventive, cultural, mechanical, chemical, and biotechnological approach rather than a single method for its control. We should also emphasize on carrying more research in the following direction as it would assist in developing efficient and economical management of weedy rice in India.

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Export potential of spices and its value added products

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Spices are very important wing of horticulture and a variety of spices are used in everyday cooking. Value addition is the highest recognition of the value of the product through processing, packaging and marketing. In other words, it is the process of changing or transforming a product from its original state to a more valuable state. Nowadays, many value-added spices are used and they impart a special taste to food preparations. Value addition has several plus points, viz. the value added products are simple to carry, having long-lasting flavours, with low bacterial contamination, having higher income from food industry, used as preservatives and also in pharmaceutical industry. Some prominent value-added products accredited globally are black pepper powder, pepper oleoresin, cardamom oil, curcumin, turmeric oleoresin, bleached ginger, garlic paste, onion powder, coriander oleoresin, etc. Big entrepreneurship to be developed in large scale, and year round production of the value-added product for meeting the international demand is feasible. This report would review the importance of the need in export of spice and spice based products. It would also discuss the possible threats and challenges of spice industry as well.

1. INTRODUCTION

India is the largest producer, consumer, and exporter of spices in the world. The demand scenario for major and minor spices is increasing at an enormous rate in India and abroad. Spices have been an integral part of the Indian diet, and the demand for spices has been growing year after year.India has certain natural comparative advantages with respect to production and utilization of spices. India is the world's largest producer, consumer and exporter of spices; the country produces about 75 of the 109 varieties listed by the International Organization for Standardization (ISO) and accounts for half of the global trading in spices.These factors include diverse agro-climatic conditions, environments and availability of innumerable varieties and cultivars of each spice suitable for different climatic conditions. Other factors like cheap availability of labour, large domestic market and a strong tradition of using spices and their products in food, medicine and cosmetics.

Indian spices scored its recognition in the world for centuries. At present scenario, even the western countries are very much aware about the importance of spice, its bi-products and its various value added products. Yet this time the Indian spices is being in demand due to varying Food Habits and Middle East countries, of people in American and European countries. Spices are grouped basically as major and minor spices in terms of availability, use, importance and demand. Major spices include both seed spices, rhizome spices and tree spices as well. Major spices in terms of demand include chilli, ginger, turmeric, black pepper, small cardamom, garlic, cumin, clove, coriander, all spice, cinnamon, etc. Minor spices include fennel, black cumin, curry leaf, large cardamom, bay leaf, *tejpata*, etc.

The present review would illustrate the diverse availability of spice in India, its utilization potential and the possibility of export in its pure form and in form of various value added products.

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2. Importance of spice and its value added products

The country exports spice oils and oleoresins to the global spices market. India in year 2012- 2013 had produced around 6 million tons of spices and condiments. Out of this, around 8 to 10 percent was exported to other countries. They contribute about 28 per cent of the total export earnings from spices [1].The major proportion of the spices produced in India is absorbed in the domestic market and only about 10 per cent is exported to over 150 countries [2].India is known to trade around 50 percent of spices by volume, all over the world. As per the latest news and research, there is a high demand ofspices around the globe and the country is predicted to export powdered and other spices likeoils, seasoning, oleoresins, and extracts.

The demand for Indian spices used all over the world has not only increased the demand for vegetarian and non-vegetarian recipes to be filled with tasteful and medicinal qualities, but their use in the cosmetics industry has increased in record quantities this year. Export of spices has increased by 12 percent in the financial year 2016-17 and exports of spices of 9, 47,790 tons worth Rs. 17,664.61 Crore have been exported [3].

In 2014-15 fiscal, a total of 8,93,920 tonnes of spices and spice products valued at Rs 14,899.68 crore (USD 2,432.85 million) were exported, registering a 9 per cent increase in volume and 8 per cent in rupee terms and 7 per cent in dollar terms in value as compared to 8,17,250 tonnes valued at Rs. 13,735.39 crore (USD 2,267.67 million) in financial year 2013-14 [4].

3. Demand of spice globally

Increasing demand for ethnic cuisines, Indian, Chinese and Mexican, which use lots of spices, changing food habits, higher focus on replacing artificial ingredients with natural substitutes (like spices) are also increasing global demand.

a) Total spices export from India stood at 1.08 billion kgs, valued at US$ 3.11 billion in the year 2017-18. Between Apr-Oct 2018, 621.98 kgs of spices worth US$ 1.84 billion have been exported [5].
b) Top 10 importers of Indian spices between Apr-Oct 2018 were the US, China, Vietnam, Hong Kong, Bangladesh, Thailand, UK, UAE, Malaysia and Sri Lanka.
c) During 2017-18, top 10 exported spices and spice products in terms of value were Chilli, Mint products, Spice Oils & Oleoresins, Cumin, Turmeric, Pepper, Curry powders/paste, Cardamom seeds, other spices (Tamarind, Asafoetida, and Cassia) and Garlic [16].
d) The total export of spices in 2017-18 stood at US$ 3.11 billion [6].
e) Chilli retained its position as the most demanded spice with exports of 235,000 tonnes amounting to Rs 2,125.90 crores in value registering an increase of 42% in volume [7].
f) It was followed by cumin with a total volume of 79,460 tonnes worth Rs.1324.58 crore showing an increase of 16% in volume and 20% in value [7].
g) In 2014-15 fiscal, a total of 8,93,920 tonnes of spices and spice products valued at Rs 14,899.68 crore (US $2,432.85 million) were exported, registering a 9% increase in volume and 8% in rupee terms and 7% in dollar terms in value as compared to 8,17,250 tonnes valued at Rs 13,735.39 crore (US $2,267.67 million) in financial year 2013-14 [8].
h) Turmeric had an export volume of 59,000 tonnes having a value of Rs 547.63 crore [7].

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i) According to Prathyush T.P, Assistant Director of the Spice Board told SBS Gujarat, "To Australia, Indian spices are in high demand because of the quality and the benefits of the spices. Australians are buying valueaddedproducts like the curry powder and the chilli as it is good in quality".
j) Garlic also chipped in substantially with a total volume of 37,830 tonnes valued atRs.255.58 crore as against 19,729 tonnes and Rs.196.06 crore, respectively in the first three quarters of FY 2016-17, registering an increase of 92 per cent in volume and 30 per cent in value [9].
k) Garlic exports contributed substantially to the overall growth during the year, notching figuresof 92 per cent in value terms and 39 per cent in quantity. The export demand of nutmeg and mace was also on the higher side, registering an increase of 25 per cent to 5,070 tonnes, ascompared to 4,050 tonnes during 2015-16.
l) Increased global demand for turmeric, especially in the pharmaceutical sector, drove its exports to attain figures of 1,16,500 tonnes in volume and crossed Rs 1,241 crore in value terms in 2016-17.

4. Demand of oleoresin and essential oils

Oleoresin and essential oils are most important value added products of spices and condiments. Notably there is a tremendous increase in demand of value added products of spices and condiments. Spice demand is increasing but demand of spice based value added products is increasing exponentially.

The export of value added products like curry powder, mint products, spice oils and oleoresins increased in volume and value while the export of chilli, coriander, fennel and nutmeg and mace registered an increase in terms of volume only [9].

As for value added products, the export of curry powder/paste was 25,200 tonnes worth Rs.517.52 crore as against 23,027 tonnes valued at Rs.468.35 crore, registering an increase of 9 per cent in volume and 10 per cent in value [9].

During the period, 12,700 tonnes of spice oils and oleoresins valued Rs. 1873.22 crore were exported as against 9,251 tonnes and Rs.1695.17 crore, respectively in April-December 2016, marking an increase of 37 per cent in volume and 11 per cent in value [9].

This is fostering global confidence that India can also offer value addition in line with global standards and food safety. ITC, for instance, has developed a complete value chain for food safety which complies with stringent global standards. A pioneer in the backward integration of chillies and cumin, ITC is working with about 4,000 farmers over 7,500 hectares to ensure food safety. ITC has achieved Rainforest Alliance (RFA) certification—a sustainability certification for its chilli programme.

Value-added spice products like spice oils and oleoresins notched a significant high with figures of 11,475 tonnes (exports) and Rs 1,91, 090 lakhs (earnings), registering a growth of 1% in quantity and 10% in value, respectively [8].

Value added products like curry powder and spice oils and oleoresins are gaining much importance in the international market and hence have tremendous export potential [7].

Decoding the Spices, notes that India, historically a bulk commodity supplier of spices, is now becoming a global hub for exporting processed powdered and value-added spice products, such as oleoresins, oils, extracts and seasonings.

"Some countries—Germany, UK, Netherlands and France—which previously imported whole spices, have shifted to imports of ground and blended spices from India," explains Rabobank analyst Shiva Mudgil. According to Rangrass, "There is a clear global focus on sourcing directly from origin, to ensure the

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authenticity of spices and cut out intermediaries, and this is driving spice exports from India and lessening the role of hitherto re-trading hubs like Spain, Netherlands and Germany."

In response to the winds of change, Indian merchant exporters are switching to process manufacturing. "Demand for oleo develresins and seasonings has also led many Indian players (such as Synthite, Plant Lipids and Kancor) to focus on research and technology in order to manufacture innovative value-added products such as oleoresins, extracts like essential oils, seasonings, organic spices, vanillin, menthol and marigold based ingredients," notes Mudgil. "Spice oils, oleoresins, liquid seasonings (around 40 national and international flavours) which can be used in masalas (spices) and in the ready-to-cook and ready-to-eat food segments are some of our latest innovations." shares Dr Jacob. "Additionally, we are isolating top aromas of spices through the carbon dioxide process for improving the fresh notes of spices in final products. Absolutes from spices for various segments such as cosmetics, perfumes and even high value food segments are also in demand. We are making new blended natural colours as per customer requirements, such as floral anthocyanin in blue colours." With players willing to innovate, India's reputation for being the home of the choicest spices is sure to grow [10].

5. Country wise demand of spice and spice products (2017-18) [11]

A. United States of America - The demand for Indian spices has also gone up in U.S.A. It has imported nearly **79,882 MT** of spices worth **Rs. 3024.22 crores** from India. Hence, it is the largest International marketplace for spice exports from India. It imports pepper, cardamom, chilli, ginger, turmeric etc from India

B. Vietnam -Vietnam imports spices such as pepper, chilli, cumin, fennel etc. Vietnam has imported **206,879 MT** spices valuing around Rs. **2267.43 crores** from India.

C. China- China has imported spices such as pepper, chilli, cumin and cardamom. China has imported around **28,981 MT** of spices valuing around Rs. **1934.22 crores** from India.

D. United Arab Emirates- UAE imported spices such as pepper, cardamom, chilli, ginger, turmeric, coriander etc. from India. The country has imported around **54,550 MT** spices valuing around Rs. **762.83 crores** from India.

E. Thailand- India being the home of spices export, Spice Oils and oleoresins etc. to Thailand. Thailand has imported **67,043 MT** spices around Rs. **710.37 crores** from India.

F. United Kingdom- UK imports pepper, cardamom, ginger, turmeric etc from India. United Kingdom has import **30,659 MT** spices valuing around Rs. **681.38 crores** from India.

G. Malaysia- It imports spices like chilli, turmeric, coriander, cumin and other spices. Malaysia has imported **62,545 MT** spices valuing around **600.45 crores.**

H. Saudi Arabia- Cardamom, chilli, ginger, turmeric, coriander etc. are the spices Saudi Arab has imported around **26,267 MT** spices from India. This is valuing around 597.32 **crores.**

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I. Germany - Germany imports chilli, ginger, cumin, etc from India. It imports a total quantity of **10,222 MT** of spices which is worth Rs. **522.49 crores** from India.

J. Sri Lanka- Sri Lanka imports spices such as turmeric, cumin, fenugreek etc. from India. In total Sri Lanka has imported **65,518 MT** spices valuing Rs. **477.23 crores** from India.

6. Some value added products of spice

A. Ready-made spice powder and paste

Powdered spice is air tight packaging material is of enormous demand. Increasing urbanization paired with a rise in number of working women has reduced the time of cooking. Consequently, home-makers have started demanding readymade spice powder that includes chilli powder, cumin powder, fennel powder, black pepper powder, turmeric powder. Also popular are ready made paste of onion, garlic, ginger in packet form.

An official report from Everest Spices Ltd. Reveals their exports about 10 per cent of its products to the US, West Asia, Singapore,Australia, New Zealand and East Africa, said: "The total market size of branded spices is estimated at 6,600 crore, and is growing at 14 per cent annually[12].

B. Spices extractives

i. Essential oil

Essential oils are major flavouring constituents of spices, highly concentrated about 75-100 times than the fresh spice. Coriander: Major component of volatile oil is linalool (67.7%) followed by alphapinene (10.5%), amma-terpinene (9.0%), geranyl acetate (4.0%), camphor (3.0%) and geraniol (1.9%). Minor components include beta-pinene, camphene, myrcene, limonene,*p*-cymene, borneoletc. Indian coriander oil differs from European oil in Possessing a lower linalool contents and comparatively higher linalyl acetate contents. In cumin the main constituent is cuminaldehyde and three other aldehydes up to 70%. Dominant monoterpenes hydrocarbons (total about 50-55%) are *B*-pinene, *g*-terpinene and *p*-cymene, plus myrceneaand b phellandrene and limonene, with minor amounts of sesquiterpenes hydrocarbons (Baser et al 1992). Cumin oil is sometimes adulterated with synthetic cuminaldehyde, which is difficult to detect. The oil is a raw material for the production of thymol. Fennel:Fennel seed oil, usually traded as fennel oil, is mainly obtained by steam distilling whole or crushed fruit with a yield of 1.5-6.5%, and more recently by supercritical carbon dioxide extraction. In general, oil content is greatest in European and lowest in Asian varieties. The main constituents are transanethole (60-65%, but up to 90%), fenchone (2-20%) estragol (methyl chavicol), limonene, camphene, a-pinene and other monoterpenes, fenchyl alcohol and anisaldehyde. Oil produced in Nigeria from fennel of Indian origin had 80% anethole content but no fenchone..Fenugreek:Major constituents are the dihydroactinidiolide, 2,3-dihydrobenzofuran and 1-heanol totaling 7-9% with 20 other constituents at less than 3% and the remainder below 1%. The furanone derivative, sotolon, is reportedly mainly responsible for the characteristic fenugreek odour.

ii. Oleoresin

Oleoresin represents the complete flavour and non-volatile resinous fraction present in the spices. The aroma and taste fractions are proportionally blended to constitute the 'true essence' of the natural spice. The oleoresin can be obtained in a single step by elimination of the steam distillation process.

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iii. Derivatives of essential oil and oleoresins

They include plated encapsulated forms of spice extractives, seasonings in dry carrier such as dextrose, salt or rusk powder. They impart the strength of good quality freshly ground spices and can be easily incorporated in the food.

C. Dried whole spice

Dry ginger and kalaunji prices increased by Rs 200 each to finish at Rs 15,200-18,200 and Rs 9,700-10,200 per quintal, respectively [13].

7. Value added products of some major spices

Listed below are the major spices and value added products from different major spices:

A. Black pepper

A variety of products are being made from black pepper. This also includes green pepper based products, black pepper and white pepper based products and pepper by- products. The major green pepper based products are canned green pepper, green pepper in brine, bulk-packaged green pepper in brine, cured green pepper, frozen green pepper, freeze dried green pepper, dehydrated green pepper, green pepper pickle, mixed green pepper pickle, green pepper sauce and green pepper-flavoured products. Black pepper and white pepper based products include whole black pepper, sterilized black pepper, ground black pepper, cryoground black pepper powder, pepper oil and oleoresin, white pepper and white pepper powder. Other miscellaneous products from pepper are pepper-flavoured products, pepper extract, curry powder spice blends, peppersal, pepper mayonnaise, pepper cookies and pepper tofu.

B. Cardamom

Major products of cardamom are bleached cardamom, decorticated seeds and seed powder, cardamom volatile oil and cardamom oleoresin. In addition to this, CFTRI, Mysore has developed the following products: Encapsulated cardamom, cardamom tea, cardamom coffee and cardamom soft drink mix.

C. Ginger

Ginger powder, ginger oil, ginger oleoresins, encapsulated ginger, ginger preserves and salted ginger are the value added product from ginger.

D. Turmeric

Major value added products are ground turmeric, turmeric oil, turmeric oleoresin and curcuminoids.

E. Chilli

Oleoresin is the main value added product that can be obtained from chilli.Other products from chillies are dehydrated chilli, canned chilli, brined/pickled chilli and fermented chilli.

F. Nutmegandmace

Nutmeg oil and mace oil, Nutmeg oleoresin, Nutmeg butter are the main value added products. By utilizing nutmeg pericarp (rind), many value-added productshave been developed viz., Nutmeg (rind) pickle, Nutmeg (rind) preserve from slices, and Nutmeg (rind) preserve from shreds, Nutmeg (rind) candy, Nutmeg (rind) sweet chutneyand Nutmeg (rind) powder.

G. Cinnamon

In addition to cinnamon bark, various other products are obtained from the tree namely, bark oil, leaf oil, bark oleoresin etc.

H. **Seedspices:**Value added products such as ground spices, spices extractives, curry powder, consumer packed spices and organic spices can be obtained from seed spices.

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I. Curry Powders / blends and mixes:

Curry powder is an indigenous seasoning made from various spices (coriander, cumin, fennel, fenugreek are common) constitute the raw materials used in quality curry powder. The ingredients of curry change according to different needs. The colour, form and taste of various curries are in accordance with the custom of various nations and regions. Consumers all over the world demand different curry powder. The export trade in curry powder at present is dominated by India. Curry powder is made from a blend of several spices, the number vary from a minimum of 5 to more than 20 depending on end uses.

Table 1: Commodity-Wise Export of Spices from India from 2013-2018 (*Quantity in Tonnes*) [14]

ITEM-WISE EXPORT OF SPICES FROM INDIA (QTY. IN TONNES & VALUE IN Rs. LAKHS)										
	2013-14		2014-15		2015-16		2016-17(*)		2017-18(Est)	
ITEM	QTY	VALUE	QTY	VALUE	QTY	VALUE	QTY	VALUE	QTY	VALUE
PEPPER	21,250	94,002.34	21,450	120,842.16	28,100	173,041.50	17,600	114,312.50	16,840	82,078.00
CARDAMOM(S)	3,600	28,380.88	3,795	32,346.75	5,500	44,982.75	3,850	42,150.00	5,680	60,908.50
CARDAMOM(L)	1,110	7,961.15	665	8,403.90	600	7,550.70	780	8,265.50	760	5,646.00
CHILLI	312,500	272,227.20	347,000	351,710.00	347,500	399,743.97	400,250	507,075.00	443,900	425,633.00
GINGER	23,300	25,614.27	40,400	33,133.00	24,800	27,595.56	24,950	25,705.00	22,605	21,606.55
TURMERIC	77,500	66,675.85	86,000	74,435.00	88,500	92,165.00	116,500	124,189.00	107,300	103,567.00
CORIANDER	45,750	37,185.65	46,000	49,812.50	40,100	42,680.50	30,300	29,207.50	35,185	27,274.70
CUMIN	121,500	160,006.00	155,500	183,820.00	97,790	153,113.00	119,000	196,320.00	143,670	241,799.50
CELERY	5,600	3,661.48	5,650	4,302.10	5,310	5,328.24	6,250	6,246.00	6,480	5,950.40
FENNEL	17,300	16,001.42	11,650	13,165.50	15,320	17,239.60	35,150	30,875.50	34,550	25,906.50
FENUGREEK	35,575	13,378.37	23,100	13,947.63	33,330	23,380.70	34,680	18,276.50	29,280	12,688.90
OTHER SEEDS (1)	27,800	15,425.65	28,250	16,512.50	23,880	16,205.75	18,100	15,455.00	22,175	16,045.80
GARLIC	25,650	8,387.05	21,610	8,183.00	23,085	15,959.00	32,200	30,711.50	46,980	30,936.00
NUTMEG & MACE	4,450	26,285.62	4,475	26,797.50	4,050	20,928.25	5,070	23,641.65	5,500	22,094.30
OTHER SPICES (2)	34,700	41,846.80	36,500	44,915.00	43,955	58,348.50	40,210	50,595.00	38,305	60,192.75
CURRY POWDER/PASTE	23,750	40,132.03	24,650	47,626.00	26,550	53,174.50	28,500	59,910.00	30,150	61,619.50
MINT PRODUCTS (3)	24,500	343,042.20	25,750	268,925.00	23,250	258,130.47	22,300	252,750.00	21,500	322,835.50
SPICE OILS & OLEORESINS	11,415	173,324.85	11,475	191,090.00	11,635	214,255.00	12,100	230,775.00	17,200	266,172.40
TOTAL	817,250	1,373,539.26	893,920	1,489,967.53	843,255	1623822.99	947,790	1,766,460.65	1,028,060	1,792,955.30
VALUE IN MILLION US $		2,267.67		2432.85		2482.83		2,633.30		2,781.46

(1) INCLUDE BISHOPS WEED(AJWANSEED), DILL SEED, POPPY SEED, ANISEED, MUSTARD ETC.

(2) INCLUDE ASAFOETIDA, CINNAMON, CASSIA, CAMBODGE, SAFFRON, SPICES (NES) ETC.

(3) INCLUDE MENTHOL, MENTHOL CRYSTALS AND MINT OILS.

SOURCE : DGCI&S., CALCUTTA/SHIPPING BILLS/EXPORTERS' RETURNS.

8. QUALITY CONTROL OF SPICE FOR EXPORT

A. ORGANIC CERTIFICATION

The package of spice which passes three way screening is actually imported to developed countries. Unlike underdeveloped and developing countries the countries that imports spice follows a three step checking that a lot of spice imported are 100% organic. The three dimensional screening includes:

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a. Initial organic certification by a recognized organic certification agency.
b. 2nd screening of spice package before departure from dock.
c. Final screening when the spice actually reaches the nations dock.

B. ABSENCE OF TOXIC RESIDUES

Absence of toxic residues in the spice is the only possible solution by which a package of spice can easily be exported to a different country. Toxic compounds present in a package due to residual effect of insecticide, fungicide or herbicide might led to cancelation of entire fleet of spice import

C. OPTIMUM GRADE REQUIREMENT

Unlike developing and underdeveloped countries, developed countries have strict norms about the grade of spice they import. Usually the spice which is of superior quality are having a higher export potential. Only superior quality spice is having demand in foreign market. Due to improper agronomic practice the quality of Indian spices are often impaired. It's a natural tendency of spice growers in India to go for quantity instead of quality. This is another reason why the overall quality is somehow less than the best grade product. The second grade product doesn't have that demand in foreign market.

D. Optimum handling and quality packaging

Export of spice usually takes place though ship in cargo. Only high value spices like saffron are exported by air transport as well. As export of spice are long time oriented, there is dire need that the spices do not get spoiled in the way to the offshore port and ultimately to the consumers abroad. Hence there is a need for quality handing during harvesting and during all the post-harvest operations. Spices are needed to be dried to obtain optimum moisture content and reduce the water activity so that there is lesser chance of spoilage.

As spices are also valued for their exclusive flavor and the factors responsible for flavor are volatile in nature. Hence there is a need for such a package that is not breathable in nature. If the spices are packed in such a packaging material which is not air tight then, there is a chance of volatile matter to get out of the packaging system. At the same time, odorous components can also enter the package. Usually quality package that is not breathable and are have good moisture and gas barrier are selected as primary packaging material for spices.

9. Challenges and threats to Indian spice and its value added product export[15]

It is a fact that industry of spice in India is divided. The production of spices is huge and the farming and small farms continue to play an important role in near future. These farms are usually owned by private Indian Spices Traders and now by companies. The growing ambition and passion of local Indian companies to introduce fresh products has led to new revolutions in the market. In order to meet this demand, various brands are looking towards other countries like Vietnam and China to secure supplies. Sensing the increased profits from export market, the MNCs are also trying to partner with Indian companies with a purpose of meeting the global demands of Indian spices.

Following the challenges and threats to Indian spice and its value added product export:

i. Lack of planting material

In India (other than south India), the availability of quality planting material is always an issue. Even though planting material is available they are not that superior in quality as that of the elite one. Hence the production is quite low.

ii. Small size of spice growing farms

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India is a nation with several small land holdings. This is the main reason why the production is scattered and hard to be computed and estimated in a single platform. Unlike developed countries with a larger land holding, the spice industry is scattered and is disruptive in nature.

iii. Lack of technical skills

In a huge nation like India, it is very tough to ensure that the spice growers in every corner are trained with the latest skills needed for optimum cultivation, management and processing of spice. In India, farming as a profession is accepted by the least educated section. Hence, the best technologies are hard to be transmitted at grass root level

iv. Quality standards

Certain spice growers do not follow the ideal growing techniques nor do they obtain a product quality of an elite grade. Very often they tend to go for the quantitative aspects instead of quality. This is the reason why the harvested spice are produced in excessive quantity but the overall grade and quality is impaired.

v. Residual toxicity of chemicals

Usually the developed qualities which are the potential market of spice and value added products of spice are very much aware and concerned about residual toxicity in the food product they import. Quality of spice crops are ensured by proper PGR applications.Pest management seldom needs spraying of chemicals. These agro-chemicals have residual effects. Due to lack of proper organic practice and absence of Organic certification, export is limited to organic spices only.

vi. Lack of value addition and quality upgradation

Developed countries do import spices at a decent rate and extract the oil and oleoresins to obtain a huge margin of profit. Spices produced in India are rarely value added in India due to lack of proper platforms and little MNC/s intervention,.They are imported and value added in different country. As soon as bigger companies and MNC's start investing on spice value added products, spice industry would show an upsurge.

vii. Adoption of improper post-harvest practices

Some spice growers do not follow proper post-harvest practices for their spice crop. This includes right from the optimum stage of harvesting to proper handling, storage packaging, etc. Maturity indices for fresh consumption in chilli must be different from that of that of dried chilli for spice purpose. Similarly, proper packaging is also necessary for ensuring optimum quality after harvest. Rough handling during interstitial stages can endure rottenness to spices like ginger and turmeric. Improper drying of cinnamon and black pepper could led to loss of flavor and destruction of oil glands.

10. Promotion of export for value added spices

The Spices Board of India works towards the development and worldwide promotion of Indian spices. It provides quality control and certification, registers exporters, documents trade information and provides inputs to the central government on policy matters. The board participates in major international fairs and food exhibitions to promote Indian spices, apart from organizing various domestic events.

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11. CONCLUSION

Spices and value added products of spices are having huge demand in foreign countries. The demand is increasing day by day. By increasing the export of these products the nation's economy can be improved. GDP growth in horticulture would be higher as well. Foreign exchange would be also higher. Hence government must give emphasis on promotion of export of spices and its products. Value addition of spices would bring more income generation to the farmers and small scale industries. However there is also scope and need for improvement in export of spice and vits value added products.

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Origin, area, production, varieties, package of practices for fruit vegetables – tomato

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INTRODUCTION

Tomato is a warm season crop, it requires warm and cool climate. The plants cannot withstand frost and high humidity. Also light intensity affects pigmentation, fruit colour, fruit set. The plant is highly affected by adverse climatic conditions. It requires different climatic range for seed germination, seedling growth, flower and fruit set, and fruit quality. Temperature below 100C and above 380C adversely affects plant tissues thereby slow down physiological activities. It thrives well in temperature 100C to 300C with optimum range of temperature is 21-240C. The mean temperature below 16^{0}C and above 27^{0}C is not desirable. The plant doesn't withstand frost, it requires low to medium rainfall, and does well under average monthly temperature of 21 to 230C. Avoid water stress and long dry period as it causes cracking of fruits. Bright sunshine at the time of fruit set helps to develop dark red colored fruits.

Improved varieties:

Arka Saurabh, Arka Vikas, Arka Ahuti, Arka Ashish, Arka Abha , Arka Alok, HS101, HS102, HS110, Hisar Arun, Hisar Lalima, Hisar Lalit, Hisar Anmol, KS.2, Narendra Tomato 1, Narendra Tomato 2, Pusa Red Plum, Pusa Early Dwarf, Pusa Ruby, Co-1, CO 2, CO 3, S-12, Punjab Chhuhara, PKM 1, Pusa Ruby, Paiyur-1, Shakthi, SL 120, Pusa Gaurav, S 12, Pant Bahar, Pant T3, Solan Gola and Arka Meghali.

F1 hybrids:

Arka Abhijit, Arka Shresta, Arka Vishal, Arka Vardan, Pusa Hybrid 1, Pusa Hybrid 2, COTH 1 Hybrid Tomato, Rashmi, Vaishali, Rupali, Naveen, Avinash 2, MTH 4, Sadabahar, Gulmohar and Sonali.

Nutritive value and medicinal use

Tomato occupies a prime position in list of protective foods since it is a rich source of minerals like calcium (48 mg / 100g), sodium (12.9 mg), trace elements, copper (0.19 mg), vitamins like vitamin A (900 IU), vitamin C (27 mg), vitamin B complex (thiamine), essential amino acids and healthy organic acids like citric, formic and acetic acids.

Botany

Tomato is a true diploid with 2n=24. Plant is annual with herbaceous prostrate stem having determinate or indeterminate growth habit. In the determinate growth, terminal bud ends in a floral bud and further growth in arrested resulting in dwarf and bushy stature. In indeterminate growth, terminal bud is a leafy bud and terminal and lateral buds continue to grow and there are less production of flowers and fruits on mains tem.

Flowers are borne in racemose cyme and flower cluster is known as 'truss' ands its position is extra axillary. Flowers are hermaphrodite, pendulous, pentamerous and hypogenous. Stamens are six in number and inserted on throat of corolla tube and anthers are convent around style.

Tomato is a self pollinated crop due to hermaphrodite flowers, introvert stigma, internal and synchronized anther dehiscence, and stigma receptivity. Self fertilization occurs when pollen grains are shedding during growth of style through anther corn. In warm regions of the country, some amount of crossing was observed when stigma protrudes out the level of anthers.

Climate

Tomato is a day neutral warm season crop, which cannot tolerate frost. Cool and dry weather is preferred by the crop and optimum temperature is 21-28oC during day and 15-20oC during night. Night temperature is more critical than day temperature. High temperature results in exerted stigma, dryness of stigma, burning of anther tip, poor pollen dehiscence, low pollen viability and slow pollen tube growth leading to low pollination and fruit set. Incidence of viral diseases also will be more at high temperature. Optimum temperature for colour development of fruit

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is 21-24oC. Development of colouring pigment, lycopene will be hampered above 27oC. Seed germination and pollen germination are adversely effected below 10oC.

Sowing time and seed rate

Under mild climatic conditions, where there is no danger of frost, three crops can be raised in a year. In the hills, seeds are usually sown in March-April. In plains is grown during June to November.

Seed rate

Open pollinated variety: 400-500 g / ha
Indeterminate F2 hybrid: 125-175 g / ha.

Main field preparation and transplanting

Seedlings are transplanted on raised beds or on sides of ridges. Field is ploughed 4-5times and raised beds of 80-90 cm width or ridges and furrows are prepared. Spacing depends on the growth habit (determinate, indeterminate or semi determinate) of variety and various spacing followed are 60 x 30-45cm, 75 x 60cm and 75 x 75 cm. Usually closer spacing results in early and higher yield, but it may effect size of fruits.

Manures and fertilizers

Manure and fertilizer recommendation for tomato depends on the growth habit and productivity of variety and it varies from state to state. In most of states, in addition to 15-20 tonnes of FYM, 100-125 kg, N, 50-60 kg P2O5 and 50-60 kg K2O are recommended for one hectare. Recommendation for F1 hybrid is 250:250:250 kg NPK/ha.

Irrigation

Furrow irrigation is the most common method in tomato and the crop require adequate moisture throughout growth period. Frequency of irrigation depends on the climatic and soil conditions. During summer, crop should be irrigated at 3-4 days interval. Water stress at flowering stage will adversely effect fruiting and productivity.

Training and pruning

All indeterminate varieties are trained with wires, strings or stacks to prevent lodging and loss of fruits by coming in contact with soil. It is done by providing individual stack or by erecting 2-2.5 m long poles on either side of ridges for stretching G1 wire. Branches of plants are supported on poles or strings with twine.

Pruning is also generally followed in indeterminate varieties to improve size, shape and quality of fruits. It is removal of unwanted shoots to enhance vigor of plants.

Harvesting

Crop starts yielding by 70 days after planting. Usually fruits are harvested with hand by a gentle twist so that the stalk is retained on plant. Intervals of harvests depend on season and it is twice in a week during summer and weekly during winter and rainy days. Harvesting maturity depends on the purpose whether for fresh market, processing, long distance transport etc.

Yield

Open pollinated varieties: 20-25 t/ha.
F1 hybrids: 50 t/ha.

Grading storage and marketing

Fruits after harvesting are graded and packed in bamboo baskets or wooden boxes. Four grades specified by Bureau of Indian Standards are Super A, Super, Fancy and Commercial.

Physiological disorders

Fruit cracking

- Radial Cracking: Usually seen at ripe stage and crack radiate from pedicel end to stylar end.
- Concentric cracking: Seen around shoulder of fruit even at green stage.
- Cuticular: Seen on outer skin of fruit.
- Burst: Burst occurs at certain points on shoulder of fruit.

Sun scald

Due to extreme heat, tissues on exposed fruit develop a blistered appearance leading to sunken areas, which have a light or grey colour on green fruit and yellow colour on red fruit. In varieties with heavy foliage, fruits are shaded and incidence of sun scald is less.

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Experimental methods for stream flow measuremeent

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Stream flow is serving as a runoff in hydrological cycle. Beside the all components of hydrological cycle stream flow is accurately measured. Measurement of stream flow data is important for the designing of hydraulic structure, estimating of extreme events such as flood and drought, water availability assessment etc. Stream flow is a measurement of the amount of water flowing through a stream or river over a fixed period of time. Stream flow cannot be measured directly it is measured by use of an instrument. The *flow* rate of *water* is *measured* in cubic meters (m3) or liters on an electronic or mechanical register. The measurement of discharge in stream is important branch of Hydrometry. Stream flow is measured by the several techniques, which are listed below –

1. **Direct methods –**

- **Area velocity methods** – (i) Float method
  (ii) Water meter
  (iii) Current meter method
  (iv) Co- ordinate method
  (v) Dethridge method
- **Tracer methods** – (i) Dilution method
  (ii) Radio isotropic method
- **Electromagnetic method**
- **Ultrasonic method**

2. **Indirect methods** –

- **Hydraulic structure** – (i) Weir
  (ii) Orifice
  (iii) Parshall flume
  (iv) Cut throat flume
  (v) Meter gate
- **Slope area method**

Stream flow measurement is time consuming and costly. So in this respect, stream flow is basically measured by the direct method which involves the two step procedure method.

The two step procedure is very simple and easy to understand. This method is relatively inexpensive. In this firstly measured the discharge of a given stream related to the water surface elevation and formed the stage discharge relationship. In the second step, the stage of the stream is observed routinely and discharge is to be estimated by using the previous stage discharge relationship. The observation of the stage is easy, inexpensive and if desired continuous readings can also be obtained. The two stage procedure for estimating the stream flow discharge is adopted universally.

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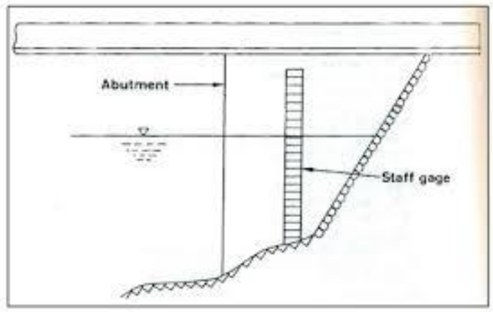
Firstly stage is defined as the water surface elevation above the datum or mean sea level. Stage is to be measured by the different method-

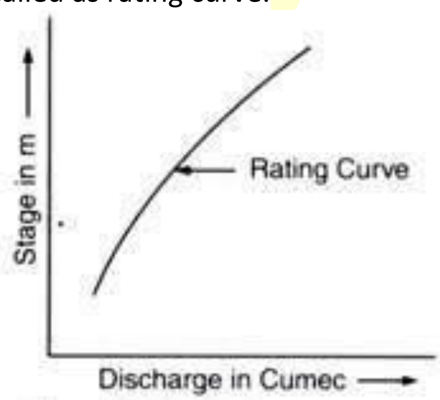
1. **Manual gauge** –
    - **Staff gauge** – it is the simplest way to measure the stage. In this basically scale is used to measure the stage of water surface above the MSL. It is used in plain areas as well as in the sloping areas.



- **Wire gauge** – In this rotation of wire is counted and finds the stage.

2. **Automatic gauge** –
    - **Float gauge recorder**
    - **Bubble gauge**

Discharge (Q) at different stage (G) is estimated by the direct methods (current meter, float method etc.). Once the stage discharge (G-Q) relationship is established, the subsequent procedure consists of measuring the stage and reading the discharge from the (G-Q) relationship. The stage discharge relationship is also called as rating curve.



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Stage discharge Curve (rating curve)

Once the rating curves are plotted it can be conveniently used at a later date to predict the discharge simply by noting the stage of the river. From the rating curve rating tables are generally prepared to facilitate quick calculations.

So for measuring the stream flow discharge, direct methods is to be used which involve the two step procedure because of simplicity, easy, less time consuming and inexpensive in nature.

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Strategies for improving Agricultural productivity under climate change scenario

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An increase in the global average surface temperature since the late 19th century has driven a disastrous consequence on the agriculture sector. In order to feed the ever-increasing growing population, augmenting food production to the tune of double of present has become a necessity. It is a major challenge since an increase in cultivated land area is not feasible and climate change further aggravates the problem. The changes in the pattern of rainfall, temperature and the environment as a whole is directly impacting agricultural productivity, thus a holistic approach has become very pertinent. That agriculture is vulnerable to climate change is a fact true to its origin, it is the mitigation or adaptation strategies where the focus is to be emphasized. A brief yet consolidated prognosis of the course of actions involving crop residue recycling, carbon sequestration, zero tillage, crop relocation, concept of climate smart village etc. is the prima facie outlook of the article.

INTRODUCTION:

Climate change is the major challenge which the world is facing now. Its impact on the humans, animals and agriculture is disastrous. The planet's average surface temperature has increased about 1.62 degrees Fahrenheit (0.9 degrees Celsius) since the late 19th century, a change driven largely due to increase in carbon dioxide and other human-made emissions into the atmosphere (NASA report, 2017). There is a continuous emission of greenhouse gases like CO_2, methane, nitrous oxide and chloro-flouro carbons (CFC) from industries, agriculture, transportation etc. which results in global warming.

India currently produces about 270 million tons of food grains and around 230 million tons of cereals to meet the dietary needs of 1.20 billion populations. The country is facing major challenges to extend its food production to the tune of 300 mt by 2020 in order to feed its ever-growing population which is likely to reach 1.30 billion by the year 2020 (Ganesh-Kumar *et. al.*, 2012). The current situation in India is that cereal production has to be doubled by 2050 in order to meet the needs of the expected population of 1.8 billion, in addition to meeting the needs of livestock and poultry (AGRICULTURE - Statistical Year Book India, 2017).

Climate change:

According to IPCC (2007) “Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer)”. Climate change has adverse impacts on agriculture, hydropower, forest management and biodiversity. In the long run, the climatic change could affect agriculture in several ways such as quantity and quality of crops in terms of productivity, growth rates, photosynthesis and transpiration rates, moisture availability etc. Climate change has a direct bearing on food production across the world.

Major parameters of climate change:

1. High CO_2 in the atmosphere, 2. Increase in temperature, 3. Variation in rainfall pattern, number of rainy days/ shift in season as well as amount and distribution of rainfall, 4. Change in

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solar radiation and day length and 5. Drought and Flood.

Energy supply (which is unavoidable) is the major cause for emission of greenhouse gases followed by agriculture. Coal, petroleum and natural gas, the sources of energy (like fuel, electricity etc.), on consumption, emit greenhouse gases. In agriculture emission of gas occurs through use of chemicals, soil and crop management practices and transportation contributing to climate change. In return, climate is affecting pattern of rainfall, temperature and environment which have a negative impact on agricultural productivity.

Why Agriculture is vulnerable to climate change?

- Highly diverse in nature
- High rainfall dependency (2/3rd area rain dependent) and its unpredictability
- Inadequate infrastructural facilities for supply of quality inputs
- Rapid degradation of soil and nutrient levels and loss of soil fertility
- Poor resource base for the farmers
- Poor technology penetration and lack of application

Adaptation /Mitigation Strategy for climate change:

1. Recycling of crop residues

- A large portion of the crop residues are burnt on-farm primarily to clear the field for sowing of the succeeding crop. On-farm burning of crop residues acts as a source of greenhouse gases (CO_2, CO, CH_4, N_2O, SO_2), aerosols, particulate matters, smoke, volatile organic compound and radioactive gases; thereby they exacerbate global and regional atmosphere chemistry (Crutzen and Andreae, 1990). The problem of on-farm burning of crop residues has been increased in recent years due to the shortage of human labour, high cost of removing the crop residues by conventional methods and use of combines for harvesting of crops.
- Crop residue recycling acts as a reservoir of plant nutrients and also prevents their losses, affects the availability of nutrients by chelation, improves buffering capacity of soil and maintaining soil structure, helps in transmission of heat, acts as a source of carbon for heterotrophs, influences the efficiency of chemicals, their degradability and toxicity and conserves the soil and water. It helps in minimization of environmental pollution and helps in bridging the fertilizer gap.

2. Carbon sequestration:

- Carbon sequestration is the long-term storage of carbon in plants, soils, geologic formations, and the ocean. Carbon sequestration occurs both naturally as well as due to anthropogenic activities and usually refers to the storage of carbon that has the immediate potential to become carbon dioxide gas. In response to growing concerns regarding climate change resulting from increased carbo dioxide concentrations in the atmosphere, considerable interest has been drawn to the possibility of increasing the rate of carbon sequestration through changes in land use and forestry and also through geoengineering techniques like carbon capture and storage.
- The Intergovernmental Panel on Climate Change (IPCC), suggested that improving agricultural practices and forest-related mitigation activities can make a significant contribution to the removal of carbon dioxide from the atmosphere at relatively low cost. These CO_2 mitigation activities might embrace improved cropping and grazing land management for instance, more efficient fertilizer use efficiency to prevent

the leaching of unused nitrates, and tillage practices that can minimize soil erosion, the restoration of organic soils, and the restoration of degraded lands.

3. **Zero tillage /minimum tillage:**

- Zero tillage or no till is a way of growing crops or pasture from year to year without disturbing the soil through tillage practices. No-till is an agricultural technique which increases the amount of water infiltration into the soil, retention of organic matter to soil and cycling of nutrients.
- No-till farming has the carbon sequestration potential through retention of soil organic matter in the soil of crop fields. Tilling inverts soil layers, mixes in air, and greatly increases microbial activity as a result organic matter breaks down much faster, releasing carbon into the atmosphere. Also, farm tractors emit carbon dioxide (Bayer, 2006).
- Crop land soils are ideal for carbon sink, as they have been depleted of carbon in most areas. Tillage and conventional farming have released an estimated 78 billion metric tonnes of carbon, by removing or burning crop residues such as left over corn stalks and adding chemical fertilizers. Without tillage, residues decompose where they lie, and growing of winter cover crops can slow and reverse carbon loss (Lal, 2010).

4. **Crop relocation:**

- Replacing underperforming crops with more resource-efficient and nutritious ones is called as crop relocation.
- If we strategically rearranged the location of crops across the world we can feed 825 million more people, globally. (Davis *et al.*, 2017)
- Changing the distribution of crops may reduce global rainfall consumption by 13.6% and irrigation by 12.1%.

5. **Climate smart villages:**

- Climate Smart Villages are sites where farmers, researchers, and local government partners and the private sector come together to understand which climate smart agriculture practices are best suited for a particular location.
- A list of interventions is chosen that will increase farmer's income through higher productivity, while building their flexibility to extreme and variable climatic events. The interventions aim to reduce greenhouse gas emissions and thus ensure that resources are used sustainably.
- The location of a Climate-Smart Village is selected based on its climate risk profile and the willingness of farmers and local governments to participate.

CONCLUSION:

Although, the phenomenon of global climate change is not a new phenomenon the outcome of the said changes are now cropping up worldwide having catastrophic consequences. 'Global Warming' is not an unknown term any more, its impacts have already crippled the society in one way or the other- one of the major threats emerging in the form of changes in the quality and quantity of water resources and crop productivity. The situation in India is far grave as our economy is highly dependent on agricultural sector. The repeated occurrence of extreme weather conditions like floods and droughts and cold and heat waves even in the same year is having an adverse impact on the livelihood of farming community. The provision of food for the ever growing population is under severe jeopardy. Thus to assess the net impact of food security; the exposure to global environmental change and the

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capacity to cope up and recover from the same needs to be computed. Careful management of natural resources like soil, water and biodiversity is a must. An urgent necessity of coordinated research strengthening efforts to assess climate change impact on agriculture through adaptation strategy modeling in combination with locally adapted plant varieties, cropping systems and soil condition can be the future way out to have a resilient agriculture.

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Buckwheat as an Aluminium Phytoremediator

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INTRODUCTION

Increasing levels of heavy metals in the environment, their bioavailability to plants and entry into the food chain are of major health concerns. Soil contamination with heavy metalsdo result in a series of environmental problems, including deterioration of the soil health quality, lossof vegetation, contamination of surface waters and aquifers, besides direct toxicity to microorganisms, animals and humans (Gupta et al., 2013).Therefore, restoration of such heavy metal affected soils is of great significance to maintain the harmony andquality of the ecosystems.Though traditional physical and chemical methods of recoveryof heavy metal affected areas are in practice, they are quite cumbersome as they usually involve excavation and removal of soil layer, physical stabilization and/or washing the soil with strong acids, which,besides being difficult to carry out, often are costly and hostile to the environment (Seth et al., 2011; Tangahu et al., 2011).Owing to these reasons, there has recently been growing preferences for *in-situ* methods that cause lesser harm to the environment.Cost-effective and highly efficient technologies for the remediation of heavy metal contaminated sites (Chatterjee et al. 2011) have been developed lately. In this regard, plants can be employed as a promising alternative for the remediation of heavy metals from contaminated soil (termed as phytoremediation) and is considered to be an eco-friendly solution.

Interest has been developed lately to employ buckwheat, *Fagopyrum esculentum* Moench (common buckwheat, Polygonaceae) to remediate heavy metal contaminated soils (Rascio et al., 2011) since it possesses a range of potential cellular mechanisms that is involved in the detoxification and tolerance of heavy metals stress and proved to be a potential hyperaccumulator, a promising candidate for phytoremediation which is conventionally defined as species capable of accumulating metals at levels 100-fold greater than those typically measured in common non-accumulator plants (Kramer, 2010).

Aluminium phytotoxicity

Aluminium (Al), the most abundant metal and third most abundant element (8%) in the earth's crust, is one of the most used metals in the world today. Owing to its wide usage, it can be detrimental to the biota, including crop plants and has been considered a potential contributor to Parkinson's disease and Alzheimer's disease in humans since many years (Bhattacharjee et al., 2014). Phytotoxic forms of Al are relatively insoluble at alkaline, neutral or mildly acidic soil pH values, but, at soil pH values ≤ 5 (von Uexküll and Mutert, 1995), the rhizotoxic Al species, Al^{3+}, is solubilized into the soil solution, lessening the availability of essential nutrients and inhibiting root growth and function and thus decreasing crop productivity (Kochian et al., 2004). Nearly 30% of the world's total land area falls under acid soils, and it has been estimated that over 50% of the world's potentially arable lands are acidic (von Uexküll and Mutert, 1995). Aluminium has been long associated with damaging plant root systems. It can profoundly affect the metabolism, and slow

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the functioning, of plant cells (Kochian et al., 2004) by affecting the mitochondrial function through reduction of adenosine triphosphate (ATP) production in the cell (Yamamoto et al., 2002) which is the driving force of cell metabolism.

Aluminium resistance mechanisms in buckwheat

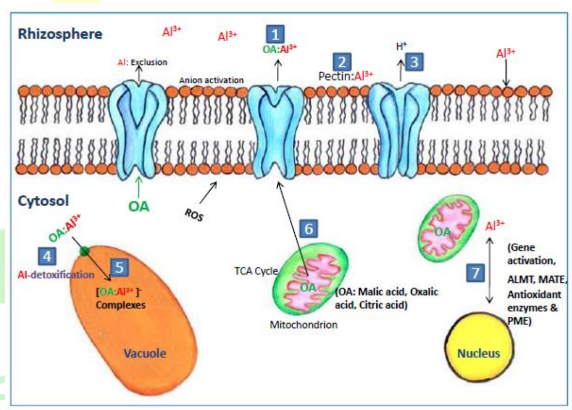
Common buckwheat has been found to exhibit aluminium resistance and has been shown to accumulate the majority of aluminium in its leaves (Ma et al., 1997). It also grows very fast, generating a large amount of biomass in a short period of time, fulfilling a main criterion to be a hyperaccumulator. Two classes of mechanisms have been proposed to account for Al tolerance in buckwheat: exclusionary resistance mechanisms which exclude Al from the root apex and internal detoxification mechanisms that allow the plant to tolerate Al accumulation in the symplasm (Delhaize and Ryan, 1995; Kochian, 1995).

Exclusion Mechanisms

Presence of Al in the rhizosphere possibly triggers the exudation of organic acids (OA), specifically citric, malic, and oxalic acids, from the roots from the root cells via the operation of Al-gated anion channels at the plasma membrane. Oxalic acid is considered to be a strong Al chelator (Hue et al., 1986) and thus renders buckwheat a high Al resistant crop. As OA is exuded from the plant roots it reacts with Al in the soil forming a complex that does not easily cross the cell membranes (Fig. 1) (Kochian et al., 2004). The exudation is usually confined to the first 1-2 cm of the root, as this is the area in which Al toxicity is initiated, however, the exact location of exudation differ largely from plant to plant species and cultivar (Kochian et al., 2004) and has been shown to increase with increasing concentrations of Al (Piñeros et al., 2005). It may be mentioned that, in most cases, the organic acid anions are not released continuously from the roots but require Al^{3+} to trigger the response (Ma, 2000).

Internal Detoxification Methods

Contrary to external exclusion, the internal Al detoxification mechanism involves chelation of cytosolic Al by organic acid anions and subsequent sequestration into the vacuole through the process known as compartmentalization which is the main mechanism of Al resistance in buckwheat where Al is transported into a location in the cell where it cannot injure the cell (Fig.1). Confocal microscopy studies by Zheng et al., (2005) showed that buckwheat may detoxify Al by storing aluminium-phosphorous complexes in its cell walls other than the cell's vacuoles which is the prime location. This plant has been shown to detoxify Al in this location through an aluminium-oxalic acid complex (Ma et al., 1997). Zheng et al., (1998) showed that the exudation of oxalic acid by buckwheat was in response to Al stress and not stress from other heavy metals, nor was it in response to phosphorous deficiency. Ma et al., (1998) showed that buckwheat also detoxifies Al internally through aluminium-oxalic acid complexes in the leaves. Further research has shown that Al tolerance can also be attributed to superior phosphorous-use efficiency (Zhu et al., 2002).



(*Adapted from* Nunes-Nesi et al., 2014)

Fig.1: An illustration for Aluminium resistance in plant cells. (1-3: Exclusion Mechanism); (1) Release of OA anion and chelation of $OA:Al^{3+}$ in

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response to the presence of Al^{3+} in the rhizosphere; (2) Binding of Al^{3+} to pectin in cell wall; (3) decreasing pH of the Rhizosphere. (4-7: Inclusion mechanism); (4) Al^{3+} is chelated in the cytosol by the OA anion [$OA:Al^{3+}$]; (5) Compartmentalization of Al^{3+} in vacuole; (6) changes in organic acid metabolism in the tricarboxylic acid (TCA) cycle caused by excess Al; (7) activation of metabolic pathways involved in Al resistance.

CONCLUSION

Though studies on phytoremediating capacity of buckwheat for Al is available, only few exist for Nickel (Ni), Cadmium (Cd) and Copper (Cu) do exist, extensive research needs to be undertaken to prove the potential of buckwheatfor phytoremediating heavy metals of concern. Understanding the mechanisms and subsequent transformation capacity of heavy metals to simpler and less toxic forms in buckwheat as a hyperaccumulator are necessary for future phytoremediation studies. This would provide information in developing technologies with the use of new transgenic plants with improved capacity of biochemical processes such as metal uptake, transport, accumulation and detoxification of metal pollutants.

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MICROENCAPSULATION: Prilling by vibration

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INTRODUCTION

Microencapsulation, defined as a process which involves the complete envelopment of a material(s) within a porous/impermeable membrane to produce microcapsules, has already provided users with a myriad of applications. These particles have enabled the generation of innovative products in areas such as food, laundry, agricultural, textiles, cosmetics and the pharmaceutical sector (Whelehan *et. al.,* 2011), as well as helping scientists to develop new treatments against many diseases (Strand *et. al.,* 2004.). There are numerous reasons for encapsulating a product within a membrane and are summarized in Figure 1. The most common is the protection of a product from a harmful environment(s) (Whelehan *et. al.,* 2011). Examples include the encapsulation of animal and stem cells for generating artificial implants (Park *et. al.,* 1998; Visted *et. al.,* 2001) or enabling the obtainment of high density cell cultures to produce larger quantities of medically important drugs (Whelehan *et. al.,*2011). In these cases the encapsulation process protects the cells against immune response in the body and shear stress in the bioreactor.

The food industry has been by far the biggest benefactor of the process. A strategic business report published in 2010 estimates encapsulation processes such as coacervation and spray drying will generate nearly $40 billion in revenue for the food industry by 2020 (San Jose, 2010). Here microcapsules are used to prevent unfavorable reactions with other ingredients, control organoleptic properties, and prevent degradation of expensive bioactive ingredients during processing and packaging (Whelehan *et. al.,* 2011). The latter has enabled food manufacturers to add significant value to their products and obtain considerably higher markups.

Microencapsulation has also been employed for sustained, controlled or targeted release of encapsulated products, and has found substantial usage for the delivery of numerous materials such as pharmaceuticals, bioactive ingredients, fragrances, adhesives, vitamins and flavors (Whelehan *et. al.,* 2011). Recently the technology has being applied to new fields, which includes environmental applications for the recovery of pollutants from water (Whelehan *et. al.,* 2010), in fermentations to help purify bio-products (Whelehan *et. al.,* 2011) and chemical processes to optimize reactions. The technology has also being adopted for technical applications, whereby it has being employed to improve flow and handling (including safety) properties of solids and liquids (Whelehan *et. al.,* 2011).

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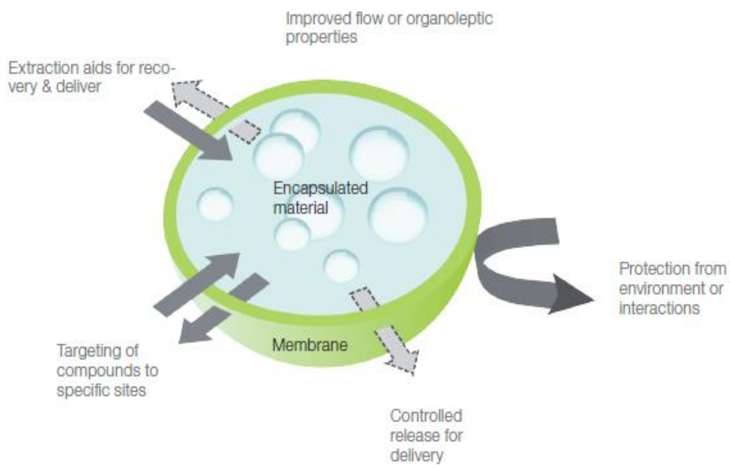

Figure 1: Main reasons why microencapsulation (producing microcapsules) of a product takes place

Prilling by vibration

Successful application of microencapsulation to a variety of process requires a production technique which is not only flexible and easy to implement, but also has the ability to adhere to stringent production criteria with regard to final product characteristics. One such technique which fits this role is "Prilling by Vibration" (also commonly referred to as vibrating-nozzle), and can be performed on the Encapsulator. The Prilling by Vibration technique works on the principle of controlled breakup of a laminar liquid jet into droplets using mechanical vibrational frequencies (Figures 2 & 3). Extrusion of a polymer liquid (containing the material to be encapsulated) through a nozzle of the Encapsulator results in formation of a laminar liquid jet. A controlled vibrational frequency is applied to the liquid jet and causes its breakup into equally sized droplets which are subsequently solidified and converted into the desired beads or capsules by different hardening techniques (Figure 4). The size of the produced beads/capsules is mainly dependent on nozzle size, flow rate and vibrational frequency applied and all parameters can be controlled on the Encapsulator. This enables the operator to pre-determine the size and characteristics of the beads and capsules that are produced.

This production technique has gained significant interest from manufacturers and scientific researchers on account of its ability to produce small, mono-dispersed, homogenous microcapsules and particles with a narrow size distribution. In addition it is easy to set up and operate, has low operating costs and can be integrated into a GMP process if required. For these reasons it is one of the most commonly employed techniques to produce microcapsules at lab-scale (Whelehan *et. al.,* 2011). The most important criteria for any microcapsule production technique are the ability to scale-up the process to produce higher quantities of particles, without incurring a significant change in capsule properties.

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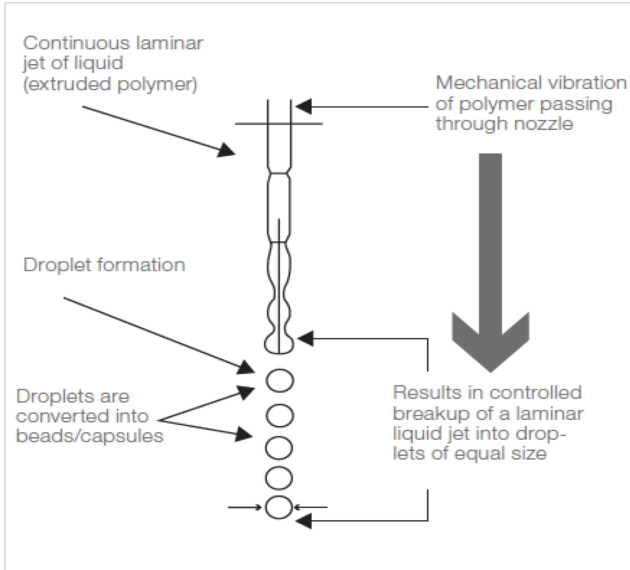

Fig.2: Schematic displaying the operational principle of the Encapsulators which uses vibrational frequencies for the controlled breakup of a laminar liquid jet into equally sized droplets (Whelehan *et. al.,*2011)

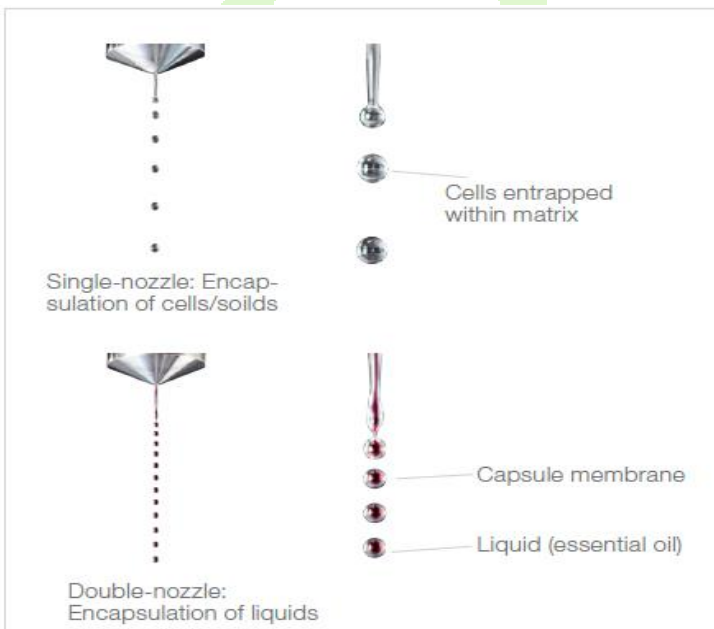

Fig. 3: Real-time image of droplets being produced on the Encapsulator using prilling by vibration technology. The produced droplets are converted into beads/capsules using different hardening techniques.

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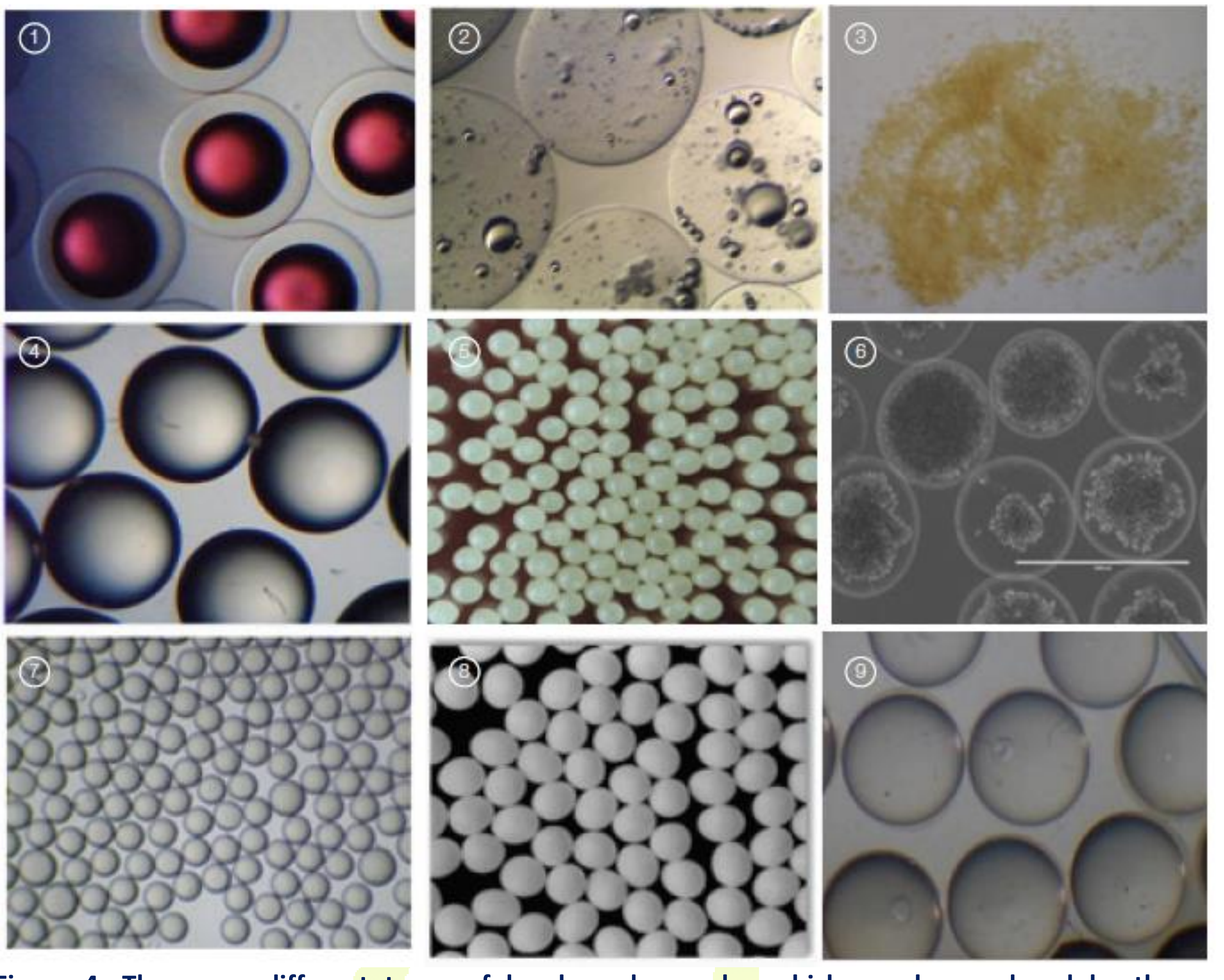

Figure 4: The many different types of beads and capsules which can be produced by the Encapsulators and can be used for numerous applications in different industries

1. Capsules with a core of sunflower oil (with a red dye) and an alginate shell.
2. Beads containing sunflower oil.
3. Dried alginate beads containing yeast.
4. Wet gelatin beads containing vitamin C.
5. Dried gelatin beads.
6. Encapsulated CHO cells in alginate-PLL-alginate microcapsules.
7. PLGA beads encapsulating Ibuprofen.
8. Wax-based beads and
9. Core-shell capsules containing olive oil.

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Applications of prilling by vibration technology

The Prilling by Vibration technique has being used for over two decades by scientists to develop new innovative products. The table below highlights some of this work performed on the Encapsulator and also explains the benefits of encapsulating a selected material for application in a particular segment.

Industries	Encapsulated material	Benefits (Applications)	References
Food and Beverage Feed	Sunflower oil	Control bioavailability of lipids in food	Hoad, C. *et. al.,*(2011)
	Folic acid	Improve stability during freeze drying & storage	Madziva, H. *et. al.,*(2005)
	Probiotics (*Lactobacillus acidophilus*)	Protection of bacteria in gastric conditions	Chandramouli, V. *et. al.,* (2004)
	Probiotics (*Lactobacillus fermentum*)	Oral and controlled delivery	Bhathena, J. *et. al.,*(2009)
	Probiotics (*Lactobacillus casei*)	Controlled release (Gastrointesinal (GI) Tract of pigs)	Lyer, C. *et. al.,*(2005)
	Flavourzyme	Encapsulation of enzyme to improve acceleration of cheese ripening	Anjani, K. *et. al.,*(2007)
	Avocado oil	Improve storage stability	Sun-Waterhouse, D. *et. al.,* (2012)
	Olive oil	Improve storage stability	Sun-Waterhouse, D. *et. al.,*(2011)
	Canola oil	Improve storage stability	Wang, W. *et. al.,* (2013)
	Essential oils	Improve storage stability (prevent evaporation)	Soliman , E.A. *et. al.,* (2013)
	Iron	Controlled release in the GI Tract	Perez-Moral, N. *et. al.,* (2013)
	Carvacrol (essential oil)	Controlled delivery (GI Tract of pigs)	Wang, Q. *et. al.,* (2009)
Pharma	Celecoxib	Controlled release	Zvonar A. *et al.,*(2009)
	Furosemide	Enhanced solubility & permeability	Zvonar A. *et al.,*(2010)
	Thalidomide	Controlled delivery (Crohn's	Metz, T.

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		disease)	*et. al.,*(2005)
	Methotrexate	Controlled release	Genc, L. and Butuktiryaki, S.(2014)
	Salicylic acid, propranolol and insulin growth factor I	Controlled release	Wenk, E. *et. al.,*(2008)
Bio-Pharma	Bacteriophage (Felix O1)	Oral delivery	Ma, Y. *et. al.,*(2008)
	Sperm (bovine)	Storage and controlled release (artificial insemination)	Weber, W. *et. al.,*(2006)
	Vaccine (*Brucella*)	Controlled release	Arenas-Gamboa, A.M. *et. al.,* (2009)
	Vaccine (*B. melitensis* vjbR::Tn5 mutant)	Controlled release (treatment of Brucellosis)	Arenas-Gamboa, A.M. *et. al.,* (2008)
	Stem cells (human adipose)	Transplantation in vivo for production of growth factors	Paul, A. *et. al.,*(2012)
	Mesenchymal stem cells (Whartons Jelly)	In vivo applications	Penolazzi, L. *et. al.,* (2010)
	Carbon nanotubes	Controlled delivery	Kulamarva, A. *et. al.,* (2009)
	Therapeutic proteins	Targeted and controlled delivery	Fluri, D.A. *et. al.,*(2008)

CONCLUSION

The simplistic nature of the Encapsulator should help further improve and expand the applications of microencapsulation technology in many fields. To-date this hasn't always been possible due to the unavailability of suitable production techniques to produce the required microcapsules with the desired characteristics. For manufactures this will lead to the establishment of new products, improvement of existing ones (by delivering new functionality), or in some cases completely redefine the role of a commodity. Delivering new product functionality is seen by many as the most important feature of the technology as it will help extend a products life-cycle as well as increasing market share – all without having to develop a completely new product. Furthermore as expressed by many international experts in medicine and biotechnology, further developments in microencapsulation also has the potential to help scientists to make breakthroughs in treating and preventing many incurable diseases. Due to its many existing and potential applications in many diverse areas, microencapsulation has already received much attention from both academic and commercial bodies. For the future its further development is seen as a major interest both from an economic and scientific point of view.

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Holistic Education

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INTRODUCTION

Holistic Education is a new philosophy of study, which began taking form as a movement in the mid 1980s in North America. It is a methodology which focuses on the fullest development of student, encouraging individual to become the very best that they can be and enabling them to achieve their goals. Its aim is to prepare students for a productive life in which their knowledge, excellence and their performance constantly challenged, developed and applied as the process of their lifelong learning.

It is an educational journey of learning about oneself, developing health relationship and positive social behaviour, resilience and ability to view beauty around the world and take responsibility within formal education and then continuing throughout life.

The main characteristics of Holistic Education :

Holistic Education aims to include all aspects of personal knowledge, growth and focuses on the active relationship at all levels. Relationship, Responsibility and Reverence for life are the three main basics of it.

- Students need to have knowledge about themselves. This gives the knowledge of self respect and self esteem.
- Students need to have knowledge about social and emotional literacy this enables them to see social influence and one's own relationship to others.
- Students need to have knowledge about resilience. This involves overcoming problems, facing difficulties or hurdles and learning how to maintain long term success.
- Student need to have knowledge about aesthetics and spiritual potentials. This enables them to keep high moral values and to view the beauty of the world.

Main characteristics

Holistic Education

- Personality development
- Emotional development
- Healthy social skill
- Critical thinking skill
- Conflict resolution skill
- Interdisciplinary thinking skill
- Core academics
- Creative thinking skill
- Communication skill

Teachers play a role less as a person of authority who controls. Teachers play a role of friend, a mantes, a facilitator or an experienced companion. School is try places where students and teachers work towards mutual goals

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cooperation and open communication are the norms of it.

Benefits of a Holistic Education

A holistic education is based on philosophy that children should be taught in a more natural and engaging way. It redefines how the core subjects should be taught. Not only mental but psychological, social and emotional, growth of the children is also the biggest benefit of it. It creates natural environment for the children to learn actively. It is also atuned to each child's individual persona and style, in the contrast of the present educational system.

A number of benefits can be noticed in holistically educated student's profile. It develops communication and social skills within the children Strength and skill development are the biggest benefit of it that gives positive and long term result. The child feel positively motivated and innovated in the workplace.

- Holistically educated children take responsibility of their own development and learning through planning and prioritization. They complete their task on time through determination and maintain high standards in their outcomes.
- They consistently think creatively and latterly using approaches from a number of experiences in new and unfamiliar areas of thinking and action.

Benefits of holistic education

- Communication skill
- Social skill
- Positive attitude
- Motivated personality
- Responsibility taker
- Determined
- Confident

Holistic Education is clearly a new movement in the knowledge transmission field. It prepares a student for long-life learning. An emphasis is placed on relationship and interpersonal skills that will remarkable advantages to the students' performance beyond their formal education. It has become a very popular approach within current educational system but a single definition remains elusive.

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Assessment of advantages, disadvantages and limitations of applying e-learning to agricultural education in India

Article id: 21755

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E-learning focuses on uses of technology in the field of education and learning. The use of ICT in education has intensely reformed learning and teaching processes. Furthermore, it has expanded new opportunities for learning and accessing to educational resources beyond those traditionally available. In this condition, the use of ICT in education creates a method of training called E-learning. This article attempts to investigate advantages, disadvantages, conveniences and limitations of applying ICT in conjunction with E-learning to agricultural students. Thearticler accentuates the role of ICT on Indian students in Agricultural Higher Education in particular.

INTRODUCTION

E-leaning focuses on usage of technology in the field of education and learning. E-learning refers to the use of advanced technology of information communication in the learning process where the advanced technology comprises of electronic media. In the current scenario, the rapid growth of information and communication technology has led to the alphabet "e" becoming the symbol of this latest age of information technology. The alphabet "e" is used as abbreviation for electronics. Thus, words prefixed with "e" are currently emerging in every second field, like e-learning, e-health, e-business, e-government and many more. In the current scenario, where the world is being dominated by globalization, networking and information technology has reached its peak, e-learning plays a vital role in the field of education. In the field of agriculture, according to Nelson, "Today, farmers feed 6 billion people. However, some 800 million people go to bed hungry every night and 166 million children are malnourished. At the same time, current agricultural practices are responsible for dead zones at the mouths of the human population will grow by two to three billion. The challenge for agriculture is not only producing more food but producing it in a sustainable manner while raising living standards for the poor, many of whom live and work in rural areas. All this must be done while dealing with the uncertain consequences of global warming and geopolitics. The solutions will include new policies, new technologies, and new production practices".

The use of ICT is a symbol of a new era in education. Besides, ICT alters thought patterns, enriches existing educational models and provides new training models. These models shares features of a technology-based training and suggest new learning methods in which the learner plays an active role and also emphasizes self-directed, independent, flexible and interactive learning.In this condition, combination of the Internet and computer has createda kind of training called e-learning.

Characteristics of e-learning for agricultural students in India

1. Teachers have taught through lectures and presentations and learning activities are designed to combine and rehearse the content.

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2. One of the mostimportant features of e-learning is the students' interaction with learning materials and learning environment.
3. Learning accompanied with thinking and developing sensitivity to the external environment leads to building confidence and development of learners' characteristics.
4. In general, enhancing and improving the quality of education and instruction is a vital concern. ICTs can improve the quality of education in a number of ways.
5. E-learning is emerging as an important strategy to provide widespread and easy access to high quality education.On the other hand, it is said that the educational effectiveness of ICTs depends on how they are used and for what purposes.

Advantages of e-learning

1. Time and place access: Users can proceed through a training program both at their own pace and at their ownplace. They can also access the training system at any time, receiving only as much as they need. In other words,"just in time and just enough".
2. Equity: e-learning provides opportunities thatagricultural students canaccess to highereducation in this field in every situation. Indeed equal access and equal competence is the objective of thiseducation system.
3. Enhancing group collaboration:Learners and teachers can be connected together via chatting, voice and videoconferences, interactive TV, virtual classes and eliminate physical separation simultaneously. In this way,learners are active in learning and interactive processes.
4. Direct access to many other training resources: Number of copies of a book or magazine is limited. However, digital libraries simply offer electronic copies of resources and students will be able to usethem everywhere.
5. Determining the rate of progression in courses: This feature reduces the level of anxiety of students due to fear offalling behind others in class and also increases satisfaction of gifted learners regarding education system.

Disadvantages of e-learning

1. Absence of teacher: Compared with traditional methods, face-to-face and lively communication does not exist in e-learning. This can cause negative effects on academic progression and characteristic development of students.
2. Access to unsupportive information:In this type of training, learner sometimes access to erroneous information onthe Internet which is not scientifically confirmed and therefore unsupportive to refer to. Using this type information may cause confusion and making it difficult for individual learning.
3. Students assessment and feedback is limited: The Internet provides a wonderful opportunity to get all kinds ofinformation back and forth, but it also makes it harder to assess some types of students' feedback and knowledge.
4. Being unsuitable for practical courses in agricultural education: Learning can providetraining for students in agricultural education, but education should be such that learners would be able to testtheir performance and get master in visualizing. There is no advantage in memorizing the content of course as aparrot and transfer it haphazardly to others. In this case, we are just consuming the knowledge and do not get tothe deep of knowledge.

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Limitations of e-learning

1. E-learning can enhance the speed of learning and simplify its process. It may take long time designing and developing web based training (WBT) courses at the beginning.
2. High costs for establishment, enquiry for high funding to conserve: Providing hardware instruments is costly.
3. E-learning is not appropriate to be used as teaching method in every field.Some, such as agriculture, are required to carry out practical activities and observing events.
4. Due to different climate conditions in different parts of the country, a unique education inagriculture cannot be delivered to students from all over the country.
5. Training methods should be in a way that practical and productive thinking skills of students grow in the end. It means the person will be able to devise the problem and finds its solution.In other words, in an efficient and practical education system, the learner has to beencouraged to find a method to solve the problems curiously and expand his understanding which requirespractice and is based on the learner's activity.
6. The need for computer literacy.
7. The Need to learn English Language.
8. Lack of access to computers and Internet in all areas

CONCLUSION

The use of ICT is a symbol of a new era in education. ICT and e-learning are the new ways of education for developing countries like India in order to improve knowledge, skill and betterment of agriculturalstudents but due to some social, economical and technological constraints it has some limitations.

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Zero Budget Natural Farming-Need of hour

Article id: 21756
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INTRODUCTION

Zero Budget Natural Farming (ZBNF) is a set of farming methods, and also a grassroots peasant movement, which has spread to various states in India. It has attained wide success in southern India, especially the southern Indian state of Karnataka where it first evolved. The movement in Karnataka state was born out of collaboration between Mr Subhash Palekar, who put together the ZBNF practices.

The *neoliberalization* of the Indian economy led to a deep agrarian crisis that is making small scale farming an unviable vocation. Privatized seeds, inputs, and markets are inaccessible and expensive for peasants. Indian farmers increasingly find themselves in a vicious cycle of debt, because of the high production costs, high interest rates for credit, the volatile market prices of crops, the rising costs of fossil fuel based inputs, and private seeds. Debt is a problem for farmers of all sizes in India. Under such conditions, 'zero budget' farming promises to end a reliance on loans and drastically cut production costs, ending the debt cycle for desperate farmers. The word 'budget' refers to credit and expenses, thus the phrase 'Zero Budget' means without using any credit, and without spending any money on purchased inputs. 'Natural farming' means farming *with* Nature and *without* chemicals.

Zero Budget Natural Farming (ZBNF) is a farming practice that believes in natural growth of crops without adding any fertilizers and pesticides or any other foreign elements. The word Zero Budget refers to the zero net cost of production of all crops (inter crops, border crops, multi crops). The inputs used for seed treatments and other inocluations are locally available in the form of cowdung and cow urine.

A ZBNF practicing farmer has lower cost of inputs and thus has better capacity to increase the incomes. At the same time, ZBNF crops helps in retaining soil fertility and is climate change resilient. The father of ZBNF and Padma Shri Awardee, Sh. Subhash Palekar has provided four important non-negotiable guidelines: Bijamrita (Seed Treatment using local cow dung and cow urine), Jiwamrita (applying inoculation made of local cow dung and cow urine without any fertilizers and pesticides), Mulching (activities to ensure favorable microclimate in the soil), and Waaphasa (soil aeration).

Sh. Subhash Palekar defined Zero Budget Natural Farming (ZBNF) or holistic agriculture as a method of agriculture that counters the commercial expenditure and things required for the growth of plant are present around the root zone.

Some unique quality of ZBNF

- In the Zero Budget Natural Farming nothing has to be purchased from the outside. All things required for the growth of the plant are available around the root zone of the plants.
- 98 to 98.5% nutrients are taken from air, water & solar energy.
- Remaining 1.5% nutrients taken from the soil are also available free of cost as it is taken from the prosperous soil which is enriched with these nutrients.

Concept of ZBNF

- An approach towards sustainability
- Expense-free farming
- Farming up to 30 acres with one native cow
- Farming with minimum electricity and water consumption
- Producing quality, poison-free food
- Agriculture without external input
- Techniques of multi-crop cultivation for higher net income
- Reducing external labor requirement
- Farming in tune with nature

- Saving the farmers from suiciding themselves and leaving behind their families as beggars.

The four pillars of ZNBF

1. Jivamrita / Jeevamrutha is a fermented microbial culture. It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity; During the 48 hour fermentation process, the aerobic and anaerobic bacteria present in the cow dung and urine multiply as they eat up organic ingredients (like pulse flour). A handful of undisturbed soil is also added to the preparation, as inoculate of native species of microbes and organisms. Jeevamrutha also helps to prevent fungal and bacterial plant diseases. Palekar suggests that Jeevamrutha is only needed for the first 3 years of the transition, after which the system becomes self-sustaining.

How to prepare Jeevamrutha?

Put 200 liters of water in a barrel; Add 10 Kg fresh local cow dung and 5 to 10 liters aged cow urine; Add 2 Kg of Jaggery (a local type of brown sugar), 2 Kg of pulse flour and a handful of soil from the bund of the farm. Stir the solution well and let it ferment for 48 hours in the shade. Now Jeevamrutha is ready for application. 200 liters of Jeevamrutha is sufficient for one acre of land.

Jeevamrutha Application

Apply the Jeevamrutha to the crops twice a month in the irrigation water or as a 10% foliar spray.

2. Bijamrita/beejamrutha

Bijamruta is a treatment used for seeds, seedlings or any planting material. Bijamrita is effective in protecting young roots from fungus as well as from soil-borne and seed-borne diseases that commonly affect plants after the monsoon period. It is composed of similar ingredients as jeevamrutha - local cow dung, a powerful natural fungicide, and cow urine, a strong anti-bacterial liquid, lime, soil.

Bijamrita Application as a seed treatment

Add Bijamrita to the seeds of any crop: coat them, mixing by hand; dry them well and use them for sowing. For leguminous seeds, just dip them quickly and let them dry.

3. Acchadana - Mulching

According to Palekar, there are three types of mulching:

A. Soil Mulch: This protects top soil during cultivation and does not destroy it by tilling. It promotes aeration and water retention in the soil. Palekar suggests avoiding deep ploughing.

B. Straw Mulch: Straw material usually refers to the dried biomass waste of previous crops, but as Palekar suggests, it can be composed of the dead material of any living being (plants, animals, etc). Palekar's approach to soil fertility is very simple – provide dry organic material which will decompose and form humus through the activity of the soil biota which is activated by microbial cultures.

C. Live Mulch (symbiotic intercrops and mixed crops): According to Palekar, it is essential to develop multiple cropping patterns of monocotyledons (monocots; Monocotyledons seedlings have one seed leaf) and dicotyledons grown in the same field, to supply all essential elements to the soil and crops. For instance, legumes are of the dicot group and are nitrogen-fixing plants. Monocots such as rice and wheat supply other elements like potash, phosphate and sulphur.

4. Whapasa (moisture)

Palekar challenges the idea that plant roots need a lot of water, thus countering the over reliance on irrigation in green revolution farming. According to him, what roots need is water vapor. *Whapasa* is the condition where there are both air molecules and water molecules present in the soil, and he encourages reducing irrigation, irrigating only at noon, in alternate furrows ZBNF farmers report a significant decline in need for irrigation in ZBNF.

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Advantages of Zero budget natural farming

- There is a direct financial savings, from not using commercial sold chemical fertilizers and pesticides.
- It has been found from research that plants grown with zero budget natural farming techniques are more resistant to diseases and pests over time, this decreases the labours required for crop maintenance practically.
- Water retention capacity of the soil increases over time making crops more drought resistant and reduce water and electricity requirement for irrigation.
- Being a completely natural method there are no ill effects to the health of the farmer. High return on investment for each crop as the investment is zero or very low. Additional return can be derived from companion planting and using monocot and dicot combinations in farming

Constraints in ZBNF

- ZBNF requires time and well trained extension workers
- Major problem is lack of public awareness of organic food
- Development of viable producer and consumer linkages
- Agronomic crops are high fertilizer responsive is also a problem
- We cannot sudden convince farmer about ZBNF
- Requires skill

CONCLUSION

ZBNF is a viable alternative because it enlivens the soil, strengthens the natural resource base and sustains biological production at levels to commensurate the carrying capacity of the managed agro eco-system.

- ZBNF is actually the turning of your spoil into the soil having all the micro + macronutrients, leading to healthy environment
- ZBNF practices generally have positive impacts on the environment. Organic farms tend to have higher soil organic matter content and lower nutrient losses.

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Improved technologies for climate change adaptation in rainfed agriculture

Article id: 21757

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INTRODUCTION

Indian economy is mainly dependent on agriculture, which contributes 21 per cent of the country's GDP and 60 per cent of the employment. Rainfed agriculture occupies 67 per cent net sown area, contributing 44 per cent of food grains and supporting 40 per cent of the population. In view of the growing demand for food grains in the country, there is a need to increase the productivity of rainfed areas from the current 1 t ha^{-1} to 2 t ha^{-1} in the next two decades. The quality of natural resources in the rainfed ecosystem is gradually declining due to over exploitation. Rainfed areas suffer from bio-physical and socio economic constraints affecting the productivity of crops and livestock.

In this context a number of economically viable rainfed technologies have been discussed. These include soil and rainwater conservation measures, efficient crops and cropping systems matching to the growing season, suitable implements for timely sowing and saving of labour, integrated nutrient and pest management (INM and IPM). To provide stability to farm income during drought and to utilize the marginal lands, different alternative land use systems like silvipasture, rainfed horticulture and tree farming systems were evolved and demonstrated on watershed basis. Integration of livestock with arable farming systems and incorporation of indigenous knowledge in farming systems perspective are also discussed. Formation of self-help groups, use of innovative extension tools like portable rainfall simulators and focus group discussions to help for quick spread of the rainfed technologies in the farmers' fields are highlighted. The farming systems approach in rainfed agriculture not only helps in addressing income and employment problems but also ensures food security.

Improved technologies in rainfed agriculture

1. Soil and Rain water harvesting
2. In-situ moisture conservation
3. Integrated nutrient management
4. Integration of livestock with rainfed farming system
5. Integrated pest management
6. Conservation agriculture
7. Efficient crops and cropping system
8. Alternate land use system
9. Farm implements
10. Site specific nutrient management
11. Watershed approach

1. Soil and rain water conservation techniques

Efficient conservation of rainwater is the central issue in successful dryland farming. Extensive trials conducted by the soil conservation and dryland research centres have led to the identification of a number of inter-terrace land treatments besides contour and graded bunds (Sharma *et al.,* 1982). These techniques are location specific and the benefits from their adoption are highly variable depending on the rainfall intensity, slope and texture of the soil besides the prevailing crop/cropping system. (Katyal and Das, 1993). Farmers have not widely adopted mechanical measures like contour bunds, graded bunds, grassing of waterways and construction of farm ponds without the government support due to financial constraints.

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2. Timely planting of crops

Timely sowing and precision are essential for getting good plant stand, higher yield and optimum utilization of rainfall and reduction in the incidence of pests and diseases. A number of demonstrations have been taken up in farmer's fields through ORPs, KVKs and IVLP programmes in different rainfed regions of the country.

3. Adoption of improved crop varieties

A number of improved varieties and hybrids were evaluated in the farmers fields to identify suitable ones for matching growing periods for inter and sequence rainfed cropping systems. For example, farmers gained additional benefit ranging from Rs. 2000-4000/ha by adopting improved varieties of sorghum, castor and sunflower in Alfisols of Hyderabad.

4. Efficient crops and cropping systems

To achieve appropriate land use, efficient inters and sequence-cropping systems were recommended based on soil type, rainfall and length of growing seasons.

5. Farm implements

Proper tillage and precise placement of seed and fertilizers in the moist zone are most critical to for successful crop establishment in drylands. Since the sowing of crops must be completed in a short span of time, use of appropriate implements is necessary to cover large area before the seed zone dries out. Suitable implements have been recommended for various locations to meet this requirement. These are designed to suit the soil type, crop and the draught power availability.

6. Nutrient management

Fertilizer recommendations in rainfed crop production have been made primarily for NPK along with the conjunctive use of chemical, organic and bio-fertilizer (Rao and Das, 1982). Inclusion of legumes in cropping systems can supplement fertilizer N to the extent of about 20 kg N per ha. Conjunctive use of fertilizer N with FYM, croppings of luecaena and gliricidia help in reducing the requirement of fertilizer by 50 percent (Reddy et al., 1996).

7. Integrated pest management (IPM)

Pests and diseases constitutes a major constraint to increased food production. Crop losses due to pest attack range from 10-30 percent depending on the crop and environment. Complete crop failure may occur in case of serious attack. Indiscriminate use of the pesticides in rainfed crops will lead to harmful side effects such as direct toxically to the applicator or consumer, development of strains or pests resistant to pesticides, resurgence of pest species, outbreak of secondary pesticides, destruction of non-target organisms such as parasites and predators and accumulation of harmful residues of food products. Integrated pest management is one of the alternatives for the chemicals used for pest management. IPM encourages the most comfortable and ecologically sound combination of available pest suppression techniques and to keep the pest population below economic threshold. Easily adaptable and economically viable integrated pest management strategies have been developed for the control of major pest in rainfed crops like cotton and pulses.

8. Alternate Land use Systems

Despite evolving a number of production technologies, arable cropping in drylands continues to suffer from instability due to aberrant weather. To provide stability to farm income and also utilize the marginal lands for production of fodder, fuel wood and fibre, a number of alternative land use systems were evolved based on location specific

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experimentation and cafeteria studies (Singh, 1988).

9. Integration of livestock with rainfed farming systems

Livestock is treated as a part of farming system in rainfed agriculture in India. The soil, plant, animal cycle is the basis for all feed used by the animals. The livestock in the rainfed regions are weak. Farmers in this area often sell their cattle due to the scarcity of fodder. In India the land holdings are being reduced with increased population pressure. Hence, land not suitable for agriculture has to be diverted for raising fodder need of animals through the appropriate alternate land use system such as improved pasture, silvipasture, hortipasture and tree techniques.

10. Integration of the technologies through watershed approaches

The concept of watershed is important in efficient management of water resources. As the entire process of agricultural development depends upon the status of water resources, the watershed with distinct hydrological boundary is considered ideal for taking up a development programme. In brief, planning and designing of all soil conservation structures are carried out considering the peak runoff. In this context, the watershed concept is of practical significance. Also, the entire development needs are to be taken up on topographic considerations from ridge to valley.

11. Resource Conservation Measures

Details about conservation measures adopted in cultivated lands have been delineated by Katyal et al., (1995) and Sharma and Mishra (1995). Based on the nature and type of barriers and their cost, the conservation measures in arable lands can be divided into three categories: (i) Hardware treatments (ii) Medium software treatments and (iii) Software treatments.

12. Farming system approach

Of late, it has been increasingly recognized that unlike irrigated areas, it is difficult to develop profitable technologies for heterogeneous agro-ecological and socio-economic conditions of small holders in arid and semi-arid regions (Osten et al., 1989). Since, the problems are complex ,addressing only a component of the farming system, e.g crop variety, fertilizer use or even crop husbandry per se is not expected to bring about a significant increase in the productivity as witnessed in irrigated areas. The extension strategy should be such as to match this challenge.

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Biology and management of banana leaf and fruit scarring beetle (*Nodostoma subcostatum*)

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INTRODUCTION

Banana is one of the oldest fruits cultivated by man from pre-historic times and today it is the leading tropical fruit in world market with a highly organized and developed industry. India is the largest producer of banana in the world (Sharangi and Acharya, 2007) and West Bengal is a major banana growing state like Maharashtra, Tamil Nadu, Gujarat, Karnataka, Andhra Pradesh, Bihar and Madhya Pradesh (Bauri *et al*., 2014). Banana is a nutritious gold mine. They are high in vitamin B6, which helps fight infection and is essential for the synthesis of heme, the iron containing part of hemoglobin. They are also rich in potassium and are a great source of fibre. Insect pests play a major role in lowering both the quantitative and qualitative value of banana. A total of 470 species of insects and mites were reported to infest banana (Ostmark, 1974), however, in Indian condition, rhizome weevil, pseudostem weevil (BSW), leaf and fruit scarring beetle, leaf feeding caterpillar are some important insect pests causing serious damage to this crop (Singh, 1970).

Leaf and fruit scarring beetle Damage

Among all leaf and fruit scarring beetle is most damaging. The extent of damage has been reported to be approximately 30 per cent of the banana bunches during rainy season in Bihar (Ahmad *et al*., 2003; Mukherjee, 2004; Samui *et al*., 2004 and Mukherjee, 2006). Leaf and fruit scarring beetle, (*Basilepta sp.,Colaspis sp.)* (Coleoptera: Chrysomelidae) is considered as one of the most economically important pests in Eastern India which is reported to occur in West Bengal and some other parts of India also. The damage done by this beetle has tremendous influence on both quantity and quality of banana. The extent of damage inflicted upon banana crop by this pest has been reported to be around 80 per cent (Roy and Sharma, 1952) and in case of severe infestation, the percentage of infested orchards and intensity of the pest have been recorded up to 100 per cent (Sah *et al.*, 2018). It causes considerable damage to leaves as well as fruits during summer and rainy seasons resulting in heavy economic losses (Sen and Prasad, 1953).

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Biology of Leaf and fruit scarring beetle

The beetle lives within the roll of the central leaf, flower bracts and feeds the epidermis of leaves, skin of newly emerged young and tender fruits, upper and lower surface of the flower bracts causing innumerable scars on them. Adults have brown forewings with characteristics rows of small parallel dots. They are very good fliers. Female lay pale lemon yellow eggs, singly or in clusters varying in number from 5-45. Egg laying is taking place in cavities gnawed in leaf sheaths near the crown or in natural depressions that expose the surface of roots. After 7 to 9 days the newly hatched larvae start to feed on the young roots or to bore tunnels into the soft epidermal tissues of the older roots to feed on them. They have a whitish slender and hairy body and the head somewhat amber-colored. The pupae is dirty yellow, becoming darker as the adult becomes ready to emerge. This pest is associated with the plant from the sucker stage till fruiting. Only young leaves and fruits are attacked by this beetle. The beetle feeds on their surface superficially in irregular patches. As a result, the mature fruit is disfigured by dark irregular scars and its size is somewhat affected depending on the extent of attack. The quality of the fruit may also be affected. The beetle appears in May and causes the greatest destruction in August and September when huge Plantations are done- in this time and disappears by March (Sen and Prasad, 1953). The Market value may be reduced up to 50% due to attack of this pest and 100% banana may be attacked if no control measure is undertaken (Alam *et al* 2000).

Ecofriendly management technique of banana leaf and fruit scarring beetle (*Nodostoma subcostatum*):

Ecologically sound and environmentally safe method of the pest control is of prime importance now. Considering the need for increased production and highest market value of banana on a sustainable basis, weeding and covering of banana with polyethylene bag, nylon net and insecticide impregnated nylon net were investigated in controlling banana leaf and fruit beetle, *Nodostoma subcostatum*. Adults caused damage by feeding on tender leaves and fruits by scarring of skin. Plant losses its vigour and quality of fruits. In order to develop eco- friendly control measures suitable for farmer, three inflorescences of same date of shooting from each treatment were covered with white, black polythene and gunny bag. The bags were 1.5x 0.6m in size to allow free growth and development of the fruits inside the bag. Few holes were made for proper aeration and easy exit of moisture condensed inside. The bags

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were removed after 75 percent maturity of fruits/ bunches were recorded. Banana bunches covered with white polythene bag recorded lowest fruit infestation (8.35%) of scarring beetle. Bunches covered with white polythene bags attained physiological maturity earlier (12 days) then control (Srivastava *et al.*, 2008). Covering of banana bunches with polythene or a gunny bag is considered as ecofriendly techniques for the management of fruit scarring beetle of banana.

The effectiveness of weeding in controlling banana leaf and fruit beetle, Nodostoma *subcostatum* is presented in Percent fruit infestation in weed infested garden was higher (96.42 ± 1.18) than weed free garden (32.55 ± 1.49). Number of scars per square inch of banana in weed infested garden and weed free one were 19.96 ± 0.75 and 1.36 ± 0.18 respectively. Higher value indicates more infestation and lower value indicates less infestation. Infestation by N *subcostatum* depends on weed because weed acts as alternative host of the pest and the larvae survive feeding on roots of banana and weed. Simmonds (1958) pointed out that the larval population can sufficiently be reduced to procure effective control by weeding and cleanings of drains. Feakin (1971) also viewed the similar result. Weight per fruit before and after ripening in weed infested garden were 159.04 ± 1.32 and 142.04 ± 1.47 but in weed free orchard 170.91 ± 0.74 and 152.70 ± 0.97 respectively (Table 1). Comparatively higher values indicate good quality fruit. Fruit size and fruit weight depend on nutrients, water and light but weed competes with banana plant for that component (Feakin, 1971). Therefore, weights of bananas in weed infested garden are lower than the banana of weed free garden.

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Anticancerous properties and diversified uses of cow urine

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INTRODUCTION

Cow urine has a unique place in Ayurveda and has been described in 'Sushrita Samhita' and 'Ashtanga Sangraha' to be the most effective substance/secretion of animal origin with innumerable therapeutic values. It has been recognized as water of life or "Amrita" (beverages of immotality), the nector of the God. In India, drinking of cow urine has been practiced for thousands of years. It is an important ingredient of panchgavya, a term used to describe five major substances (urine, milk, ghee, curd and dung), obtained from cow. All the five products possess medicinal properties, and are used singly or in combination with some other herbs against many diseases, even those not curable by allopathic treatments. This kind of alternative treatment, termed as 'panchgavya therapy' or 'cowpathy', has been reported to be beneficial even for dreaded diseases like cancer, AIDS and diabetes. Practitioners of Ayurvedic medicine from India routinely use cow urine as a remedy and the medicines made from it are used to cure several diseases.

Improvements have been shown or reported with those suffering from flu, allergies, colds, rheumatoid arthritis, bacterial/viral infections, tuberculosis, chicken pox, hepatitis, leucorrhoea, leprosy, ulcer, heart disease, asthma, skin infections, aging, chemical intoxication etc. Cow urine can kill the number of drug resistant bacteria and viruses. "Panchagavya" is a combination of cow urine, milk, dung, ghee and curd. Indian cow breeds are unique and distinct species, popularly known as "Kamdhenu" and "Gaumata, has high socio-cultural values, plays significant role in rural economy, represent cattle wealth and bio-diversity.

Anti-cancer properties of cow -urine

Cow urine possesses anti-cancer properties. Research works carried out by Go-Vigyan Anusandhan Kendra (Cow Science Research Center) at Nagpur revealed the beneficial properties of cow urine in the treatment of cancers. Further extensive research on cow urine therapy against fighting cancer carried out by Scientists of Central Institute of Medicinal and Aromatic Plants (CIMAP), CSIR Center at Lucknow, along with collaboration with Go-Vigyan Anusandhan Kendra, Nagpur confirmed this milestone achievement. Studies highlight the role of cow urine in curing cancers and that cow urine enhances the efficacy and potency of anti-cancer drugs. Recently, this significant achievement has been validated by the grant of U.S. Patent (No.6896907) in the field of treatment of cancers (Amar Ujala, July, 19, 2005).Scientists have proved that the pesticides event very low doses cause apoptosis (cell suicide) in lymphocytes of blood and tissues through fragmentation of DNA. Distilled cow urine protects DNA and repairs it rapidly as observed after damage due to pesticides (Ambwani, 2004). It protects chromosomal aberrations by mitocycin in human leukocyte (Datta, 2001). Cow urine helps the lymphocytes to survive and not to commit suicide (apoptosis). (Chauhan, 2004) reported the prevention of pathogenic effect of free radicals through cow urine therapy. Thus, the cow urine therapy is suggested to possess potent anti-cancer abilities by the virtues of the following properties –

Antimicrobial capability: Cow urine can kill the number of drug resistant bacteria and viruses, thus can reduce the incidences of cancer since many a viruses have been reported to cause cancer.

Bioenhancing property: It can promote and augment the bioactivity or bioavailability or the uptake of cancerous drugs, thus could enhance the efficacy and potency of the chemotherapy drugs, and reduce their dose and duration of treatment, which could also help reduce the cost and side effects of chemotherapy. So in combination therapy cow urine can be used efficiently.

Immunomodulating activity: Cow urine enhances the immune competence and improves general health of an individual. It has vital potential to enhance the activity of macrophages and lymphocytes (both T and B cells), and has been reported to increase the humeral and cellular mediated immunity. Increased immune competence of an individual is a very essential parameter to prevent the development of cancers by several mechanisms, of which the up regulation of lymphocyte proliferation and stimulation activity, increased macrophage activity, higher anti body production and increased synthesis and secretion of cytokines (IL-1, Il-2) plays significant role by enhancing the recognition of tumor cells by the immune cells of the body and cytotoxic activities of the tumor killing cells, the lymphocytes.

Anti-aging factor: It is an efficient anti-aging factor, since prevents the free radicals formation, which could help preventing cancers as the incidences of cancer increases as the one progresses towards old age.

DNA repairing potential: Cow urine efficiently repairs the damaged DNA, thus can be very effective for the cancer prevention and therapy, and can also reduce the spread of malignant cancers and help fighting tumors.

Apoptosis inhibitor: Cow urine can tremendously reduce apoptosis in lymphocytes and helps them to survive, thus the body can avail the tumor fighting abilities of the lymphoctyes at their optimum activity and survival ability.

COW URINE THERAPY (CUT)

As therapeutic agent

Cow urine is basically an excellent germicide and a potent antibiotic. Therefore, cow urine therapy destroys all the pathogenic organisms and if it is taken on a daily basis, it boosts immunity. Some of the diseases that are proven to be cured by cow urine are Cough, Dysmenorrhoea, Migraine or headache, Constipation, Thyroid and Skin diseases like eczema, ringworm, and itching, Acne, Cancer, Heart Diseases, Musculoskeletal Disorders, Male Sexual Disorders, AIDS, Diabetes Mellitus, Blood Disorders, Respiratory Disorders, Gastrointestinal Disorders, Endocrine Disorders, Gynaecological Disorders, Opthalmic Disorders, Psychiatric Disorders, Urological Disorders, Asthma, Kidney Shrinkage, Hepatic Disorders and Canceretc. Presence of urea, creatinine, swarnkshar (aurumhydroxide), carbolic acid, phenols, calcium and manganese has strongly explained for exhibition of antimicrobial and germicidal properties of cow urine.

As bio-pesticide and bio-enhancer

Panchgawya' made up of five cow products; milk, curd, ghee, urine and dung, is also used as fertilizers and pesticides in agricultural operations. As per recent studies cow urine has proved to be an effective pest controller and larvicide when used alone and also in combination with different plant preparations by enhancing the efficacy of different herbal preparations. The recent invention related to cow urine was its role as a bioenhancer. Distillate cow's urine is an activity enhancer and availability facilitator for bio active molecules (antibiotic, antifungal and anticancer drugs).

1. Immunomodulatory effect

Cow urine increases both cellular and humoral immunity, but mainly cow urine shows effect on humoral immunity. Cow urine enhances antibodies like IgG and IgM .Cow urine enhances B and T lymphocytes production and facilitates interleukin-1 and interleukin-2 synthesis.

2. Antioxidant effect

Volatile fatty acids are present in the cow urine which act as antioxidant. In re distillate cow urine the concentration of volatile fatty acids is about 1500mg/dl. Antioxidants protects cell against the effect of free radical. Free radicals are produced due to exposure of tobacco, smoke and radiation. Free radical may damage cell and cause heart and cancer disease. Antioxidant effect of cow urine may support the patient for prevention and treatment of disease.

3. Antidiabetic effect

Cow urine reduces the blood sugar level. The most probable mechanism of action is that it increases the glucose transport across cell membrane thus it increases peripheral glucose utilization. It increases glycogen synthesis from glucose, and also increases insulin release from beta cells. Cow urine enhances sensitivity of insulin receptor, decreases insulin resistance, and decrease insulin absorption from intestine. Various herbal metabolites are present in cow urine and they produce anti hyperglycaemic effect.

4. Bioenhancer

Cow urine distillate is more effective as bioenhancer to increase the antifungal, antibacterial and anticancer activity than cow urine. Cow urine distillate increases the activity of antibiotics like rifampicin by enhancing the transport of antibiotic across the membrane of GIT. In cadmium chloride toxicity cow urine is used as a bioenhancer of zinc.

5. Anti-urolithiatic effect

Cow urine has diuretic and nephroprotective action. It probably exerts its action by reducing oxalate excretion and by crystallization inhibition.

6. Germicidal activity

Cow urine exerts an excellent germicidal and antibiotic activity. Cow urine destroys all pathogenic organisms. Presence of urea, creatinine, swarnkshar (aurum hydroxide), carbolic acid, phenols, calcium and manganese are basically responsible for germicidal and antimicrobial activity.

7. Cardiovascular disorder

The cow urine contains various components responsible for proper working of CVS system. Kallikrein acts as a vasodilator reduces the risk of hypertension. Enzyme Urokinase acts as a fibrinolytic agent, Ammonia maintains the structural integrity of the blood corpuscles, Nitrogen, sulfur, sodium and calcium components act as blood purifiers, while iron and erythropoietin stimulating factor maintain haemoglobin levels.

8. Cow urine in wound healing process

Cow urine contains volatile salts these salts destroys acidity and reduce the pain in kidney, intestine and womb. The cow urine provides quick recovery of the wound.

9. Antimicrobial and anthelmintic activity

The cow urine could be used for the treatment of the disease caused by Pathogenic bacteria, Opportunistic fungi and parasitic helminthes. It was reported from various analysis that cow urine concentrate shows more inhibition of gram positive bacteria in

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comparision of gram negative bacteria. Cow urine shows marked anthelmintic activity by causing paralysis and death of worms in a dose dependent manner. Cow urine is also effective against vegetative form of fungi. It was concluded that cow urine increases antibiotic activity against various pathogens due to its bioenhancing property.

10. Gomutra in hypertension

Cow urine acts as a Diuretic so it is effective in hypertension. The diuretic action can be determined by urine output and sodium content of the blood before and after administration of the cow urine.

11. Gomutra in anaemia

The cow urine contains erythropoietin hormone so it is useful in anaemia.

12. Cow urine in skin disorder

When Cow urine is used along with hareetaki it is most effective against various type of skin disorders like acne etc.

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Are the researchers ready to develop technologies through Investment Appraisal?

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Every day we are producing a number of technologies, obviously agriculture is no exception. A lot of technologies were produced and are producing in agriculture but only a few are viable in farmers' perspective. The main problem behind this scenario is the failure of many technologies in farmers existing situation. Farmers when choose a technology, they try to assess the worth of the technology in terms of their bio-physical and socio-economic situations. But many a times they cannot measure the actual competence of a superior technology like an experience project manager do. Therefore, it is the duty of scientists/ researchers to develop newer technologies through investment appraisal and classify the technologies accordingly to eliminate the risk and uncertainty.

Agriculture is the main occupation of the people in rural India. Therefore, for the development of agriculture, it is essential that technology should be adequately used and implemented. Technology in today's world has become imperative in all areas and regularly a dozen of technologies are produced, obviously agriculture is no exception (Kapur, 2019). Normally there is a misunderstanding that if an idea/ product/ service/ method are having technical possibilities often called as technology (Theodorson & Theodorson, 1969). However, in reality, technical possibility is not only the answer. Technical possibility along with economic feasibility, social acceptability and so on is the way out. In agriculture system varieties of breeds, newer technologies, methods are producing regularly but how many of them are assessed in the light of farmers' perspective? Farmers when choose a technology he tries to understand the technology considering his bio-physical and socio-economic situation. He tries to assess the worth of the technology in terms of economic viability; social acceptability and manageability like a big project manager do Investment Appraisal.

At the present time farmers are facing problems regarding important strategic investment decisions to increase their production along with profit from the farming venture. The strategic investment decisions which are to be made in uncertain environments, unusual market behaviour, abnormal price moves, costs of development of new technologies or weather conditions may be unknown or hard to assess. Therefore, if the farmers want to make agriculture remunerative, it must be technology driven (Dixit and Pindyck, 1994). Thus, evaluating the adoption of a newer technology in agriculture must be accompanied by an investigation of the effect of uncertainty and risk (Pindyck, 1991).

In case of agriculture, various economic decisions including crop production absorb benefits and costs that are expected to occur at future time period. From field preparation to harvest crop production involves a series of activities, which requires an immediate cash flow. The future cash inflows or returns depend on production and sale of the produce. In order to determine whether the future cash inflows justify present initial investment, we must

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compare money spent today with the money received in the future (Shyam, 2008).

Many production decisions (i.e. financial decisions, economic decisions) were influenced by the time value of money. In order to invest a rupee in farming, the farmer obviously looking for a guaranteed return in future either in an equal amount or in a greater share than today's investment. The preference for the rupee now instead of a rupee in the future arises from three basic reasons: Uncertainty - Influences preferences because one is never sure what will take place tomorrow, alternative uses - It will determine whether one invests in one project or another and inflation - affects the purchasing power of the rupee.

Investment appraisal is an exercise whereby, a farmer makes an independent and objective assessment of various aspects of an investment proposition to arrive at the financial decisions. In case of a newer technology, investment appraisal means the assessment of the technology in terms of its economic, social and financial viability. It is a complete scanning of the technology to ensure farmer's return from his investment. Consequently, a farmer always conducts a critical appraisal of his investment for getting a considerable return after a short period of investment (Lazarus & Folkman, 1984).

An investment appraisal in newer technologies can be estimated in various ways. Among numerous options economic analysis used most frequent. Economic analysis in general looks at the investment from the viewpoint of the whole economic process (Fig 1). It also seeks adequate information whether the production latter will show benefits sufficiently greater than the cost involve into it to justify investment (McGregor & Little, 1998).

Fig 1: Economic aspects for investment appraisal.

The purpose for financial appraisal (Fig 2) of a technology is generally to ensure its initiation of financial conditions for the sound implementation and efficient operation under the existing condition of the farmer. Market appraisal is also an important criterion to ensure economic justification of the investment. Potential demand of a technology not only widens its acceptability but also raise its socio-economic impact among the farmers. The process of market appraisal of a technology covers anticipated market for the technology, life cycle of the technology, analysis of market opportunities and so on.

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Fig 2: Financial aspects for investment appraisal.

Technical appraisal involves a critical study of various concealed factors associated with use of technology in farming. Location of using a technology in farmers existing situation may not be suitable with reference to market proximity, availability of inputs for using the technology, transportation facilities. Most of the time, Scale of operation also determines the viability of a newer technology. Even a good technology may not be viable if there is a lack proper management. This indicates the importance given to proper managerial strategies to prevent mismanagement and promote a superior technology.

CONCLUSION:

The role of technology is imperative in agriculture now a day. Superior technologies also produced by the scientists and researchers every day. But the uncertainty and high risk associated with the use of these technologies sometimes trim down the popularity among farmers. So, the researchers can develop newer technologies through investment appraisal and classify the technologies accordingly to eliminate the risk and uncertainty.

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