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Chitosan in agriculture

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Current advances in water management for soil sustainability

Preeti Singh*, Seema and Harish Kumar Singh

Department of Soil Science & Agricultural Chemistry
Institute of Agricultural Sciences, Banaras Hindu University,
Varanasi-221005, Uttar Pradesh, India
*Corresponding Author: Singh.preeti8888@gmail.com

Abstract

There is a global crisis about water and its management. The crisis is significantly about availability of water for use and its highly uneven spatial distribution. Enhancing water availability, making it amenable for use and managing the distribution are challenges of a tall order due to the dynamic nature of the resource and its varied usage. The situation of water availability has changed drastically over the last 4 -5 decades. Measures to increase water supply such as completion of storage dams, interlinking of rivers, desalination of sea - water and artificial recharge of groundwater and rainwater harvesting are costly and long term steps. The marginal gains from traditional, civil and engineering oriented solutions have increasingly become costlier and more difficult to achieve. Water management is directly correlated with soil management. Hence, advanced technology needed to improve the efficiency of irrigation water along with cost effectiveness. Some tools like a wireless sensor system, a crop stress response model etc will help in achieving our goal of more crops from one drop.

Key words:-Rainwater harvesting, engineering, storage dams.

INTRODUCTION

Agriculture accounts for a majority of global freshwater withdrawals and almost all in some fast -growing economies (WWDR, 2012). At the global level more than two thirds of the blue water withdrawals are for irrigation. Irrigated agriculture represents almost a fifth of the total cultivated land but contributes more than one third of the total food produced worldwide (FAO, 2012) and therefore it is of critical importance to sustenance of the human race. So, below are some of the water management approaches for increasing water use efficiency.

METHODS/APPROACHES-

A wireless sensor system for irrigation management always and everywhere access to soil water information. The approach was to optimise and precise irrigation control, it requires a large number of sensors that are spread out on each plot of the farm. These sensors have to communicate with the irrigation system. A wireless sensor network has been developed based on commercially available components. These components have been intensively tested and adapted to the boundary conditions. Results have shown that with the wireless sensor network it is possible to monitor soil

temperature, moisture and electrical conductivity (EC) in a robust manner. Distances up to 500 meter between base station and field and up to 200 meter between two sensor nodes can be achieved. The used system is solar powered and self recharging and practically maintenance-free. Data can be transferred automatically over internet and processed by a remote decision support system for irrigation. Users can at any time obtains information about the actual soil water status for their cropping fields, and thus optimizes their irrigation management practices. Installation costs of sensors may be kept low due to the wireless concept.

A crop stress response model for understanding the effect of water-shortage and salinity. The approach was to optimize irrigation scheduling; growers need to understand plant-water relations and the related effects on the plant, such as reduced growth and wilting. World-wide a great effort has been undertaken to obtain the response of a large number of agricultural and horticultural crops. To disclose new knowledge about the effect of crop water stress, this information was collected from the literature and incorporated into a database. Results have shown participating growers have received an easy to use tool to make an optimal decision on which crop to grow. An on-line version of the MOPECO model has been developed which was extended for deficit conditions in order to make the decision support system available to a great number of users. The database is designed in such a way that it allows users to modify the data provided for specific crops as well as to add new crops. The information in the database can help growers to improve crop selection in regions affected by water shortage and/or salinity. Optimization of crop selection will help growers to increase their yield with minimal use of water.

A decision support system for irrigation under deficit, optimum irrigation and fertilizer management in dry regions. The approach was that, that scarce water should be applied with the highest possible efficiency and crop damage must be limited when using water of poor quality. A decision support system that combines information from various sources (visual observations, sensors, expert examinations and forecasts) has been developed. The tool has been evaluated at sites located in Lebanon, Jordan, Turkey, Italy, the Netherlands and Spain. The result has shown that, decision support system for irrigation management has been evaluated. The system is based on soil-water-plant reactions and fertilizer balance encoded knowledge. It combines information of wireless soil water sensors and data from a database of crop response to drought and salinity. It is robust, safe and easy to use, and is interoperable with other affordable deficit irrigation equipment and management tools. At all locations, irrigation based on the new system has reduced water use without loss of yield or quality. Growers will obtain affordable hard- and software, such as a maintenance-free tensiometer, a wireless and low-power sensor network and an expert system for farm zoning, crop planning and irrigation scheduling. These instruments will help them to increase

the efficiency of their water use and fertilization management under soil water deficit conditions.

Sensor-activated irrigation controllers, minimizing wastage and environmental damage. The approach was, having a low-cost irrigation controller with soil condition feedback takes out the guesswork of deficit irrigation. The GP1 data logger has therefore been designed to control irrigation. Sensors are connected to the data logger to feedback information on soil condition, such as soil water content, and EC (obtained with WET-sensors) and matrix potential. GP1 loggers have been successfully installed in a network with remote access and control capability. A local computer regularly reads out sensor data and updates autonomously the running scheduling program. The decision support system helps the grower to optimize irrigation. The improved decision support software and the GP1 based irrigation controller have resulted in a tool that is suited for scientific studies and to assist the further development of practical irrigation control strategies. The software capabilities of the GP1 logger/controller have been enhanced to include safety features such as: sensor misreporting, overdue irrigation, metered Irrigation quantity, cut sensor cables or irrigation delivery failure to improve crop security and irrigation overshoot. The flexible GP1 based irrigation controller makes more precise water management possible. Environmental damages will be limited, water will be saved and crop yields are maximized.

CONCLUSION

In India the area irrigated with groundwater has increased since 1960. As of 2009, annual ground water withdrawal for irrigation has been estimated as 221 billion cubicmetres(BCM). The overall irrigation efficiency in India is often found to be quite low compared to global standards due to the use of conventional flood irrigation technique, practiced in large parts of India. So, above method will help in increasing water use efficiency of irrigation water.

REFERENCES

World Water Development Report, (2012). World Water Assessment Programme. UNESCO.

FAO,(2012). http://www.fao.org/news/story/en/item/45210/icode

Need of Micronutrients In Soil

Preeti Singh*, Seema and Harish Kumar Singh

Department of Soil Science and Agri. Chemistry
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi
*Corresponding Author: singh.preeti8888@gmail.com

"Micronutrients are to agriculture as vitamins are to the human diet." – Braun

Abstract

India was dependent on external food supplies in the early 1960s. To meet the growing demand for food, fiber and fuel, high yielding cultivars were introduced. These high yielding crop cultivars were highly responsive to fertilizers. Thus, slowly the soils were exhausted of their nutrients. Application of major nutrients (nitrogen, phosphorus, and potassium) became common; therefore the crops started responding to micronutrient fertilizers. Concerted efforts have been made through the All India Coordinated Research Project on Micronutrients to delineate the soils of India regarding the deficiency of micronutrients. At present about 48.1% of Indian soils are deficient in diethylene-triaminepentaacetate (DTPA) extractable zinc, 11.2% in iron, 7% in copper and 5.1% in manganese. Apart from the deficiency of these micronutrients, deficiencies of boron and molybdenum have also been reported in some areas. Areas with multi-micronutrient deficiencies are limited, thus simple fertilizers are sufficient to exploit the potential of crops and cropping systems. Based on the extent of deficiency, cultivated area, and crop removal, the micronutrient fertilizer demand in 2025 is projected using sufficiency and maintenance approaches. Hence study of micronutrients in soil need special attention.

THE ROLES OF MICRONUTRIENTS ELEMENTS IN PLANTS

The micronutrients are boron, chlorine, cooper, iron, manganese, molybdenum, and zinc. These plant food elements are used in very small amounts, but they are just as important to plant development and profitable crop production as the major nutrients. Especially, they work "behind the scene" as activators of many plant functions.

Boron are essential for germination of pollon grains , growth of pollen tubes, essential for seed and cell wall formation ,promotes maturity ,necessary for sugar translocation, affects nitrogen and carbohydrate. Chlorine interferes with P uptake, enhances maturity of small grains on some soils. Copper catalyzes several plant processes major function in photosynthesis. Major function in reproductive stages, indirect role in chlorophyll production, increases sugar content, intensifies colour, improves flavour of fruits and vegetables. Iron

promotes formation of chlorophyll, acts as an oxygen carrier, reactions involving cell division and growth. Maganese functions as a part of certain enzyme systems, aids in chlorophyll synthesis, increases the availability of P and Ca. Molybdenum required to form the enzyme "nitrate reductase" which reduces nitrates to ammonium in plant, aids in the formation of legume nodules ,needed to convert inorganic phosphates to organic forms in the plant .Zinc aids plant growth hormones and enzyme system , necessary for chlorophyll production, necessary for carbohydrate formation, necessary for starch formation , aids in seed formation.

SOIL FACTORS THAT AFFECT MICRONUTRIENT AVAILABILITY

Physical and chemical characteristics of soil affect the availability and uptake of micronutrients:

- Soils low in organic matter (less than 2.0%) may have lower micronutrient availability.
- Soils with higher amounts of clay (fine texture) are less likely to be low in plant available micronutrients. Sandy soils (course texture) are more likely to be low in micronutrients.
- Soils that have very high levels of organic matter (greater than 30% organic matter to a depth of 30 cm) often have low micronutrient availability.
- Soil temperature and moisture are important factors. Cool, wet soils reduce the rate and amount of micronutrients that may be taken up by crops.
- As soil pH increases the availability of micronutrients decreases, with the exception of molybdenum.

DETERMINING THE NEED FOR MICRONUTRIENTS

Diagnosing a micronutrient deficiency can be a difficult and time consuming process. To identify a micronutrient deficiency follows these steps:

- Ensure that poor crop growth is not the result of a macronutrient deficiency, drought, salinity, disease or insect problem, herbicide injury or some physiological problem.
- Find out if a micronutrient deficiency has been identified before in a particular crop or soil type in the area.
- Examine the affected crop for specific micronutrient deficiency symptoms.
- Take separate soil samples from both the affected and unaffected areas for complete analysis, including micronutrients.
- Send plant tissue samples from both the affected and unaffected areas for complete analysis that includes tests for micronutrient levels.
- If all indications point to a micronutrient deficiency, apply the micronutrient to a specific, clearly marked out affected area of land to observe results in subsequent seasons.

CONCLUSIONS

The importance of micronutrients to a plant's health has gotten more attention recently as their incorporation into broad fertilizers has become more common. A decision as to whether or not to apply secondary or micronutrient fertilizers should take into account the sensitivity of the crop to be grown to the element as

well as other soil characteristics that affect the availability of the element, such as soil pH, organic matter, soil texture, and soil P level.

Use a combination of all of the above factors, along with plant analysis, in deciding the probability of a deficiency. If both soil test and plant analysis indicate the potential for a deficiency, apply the element on a trial basis.

Pheromones: An Effective Tool for Enhancing Fertility

Stuti Tanaya Mohanty[1], *Prasanna Pati[2], AlakaAbhipsaBaliarsingh[1] and Bikash Chandra Sardar

M.V.Sc[1]and Ph.D Scholar[2]
[1,2.]Department of Animal Reproduction, Gynaecology and Obstetrics
College of Veterinary Science and Animal Husbandry,OUAT,Bhubaneswar
**Corresponding Author: prasanna.62.pati@gmail.com*

Pheromones

- The word *pheromone* comes from the Greek word *pherein* which means to carry or to bear. This makes sense because pheromones carry or bear information.
- Pheromones are types of chemicals that are released by organisms as a means of communication with organisms of the same species.
- Some animals release it through their urine, their skin or even in their feces, and it is detected using smell.
- Pheromones can be released for a variety of reasons including readiness to mate, an alert to danger, showing a certain territory or even when an animal is ovulating.

Function And Types Of Pheromones-

There are two types of pheromones:

1. Releaser Pheromones
2. Primer Pheromones

1.Releaser pheromones get an immediate response.

- Have you ever seen an ant wandering around and wondered, 'How in the world is this little thing going to find her way home?' Ants release releaser pheromones, which are detected as a smell to other ants, when they have found food. This lets the other ants know that they can return to the nest

in order to feast. Once the food runs out the ants release a separate pheromone that lets the ants know that the food is gone.

- Another example of a releaser pheromone, is an *alarm* pheromone.
- In this case, the ants that are in danger release a pheromone that basically says 'come over and help me!' This results in ants coming to their aide.

2. Primer pheromones do not cause an immediate response.

Let's look at an example:

When female rats are housed together without a male, their reproductive cycle stops or is slowed. This is signaled through pheromones released in the female rats' urine. Since there is no male around, there is no point in expending the excess energy.

Application Of Pheromones In Reproduction-

- Numerous works have been carried out in insects, wild animals, small ruminants and in pig.(Berman et.al.)
- However in cattle and particularly buffaloes, application of pheromones have been tried to augment reproductive efficiency only in the recent years. (Kumar &Patra 2012)

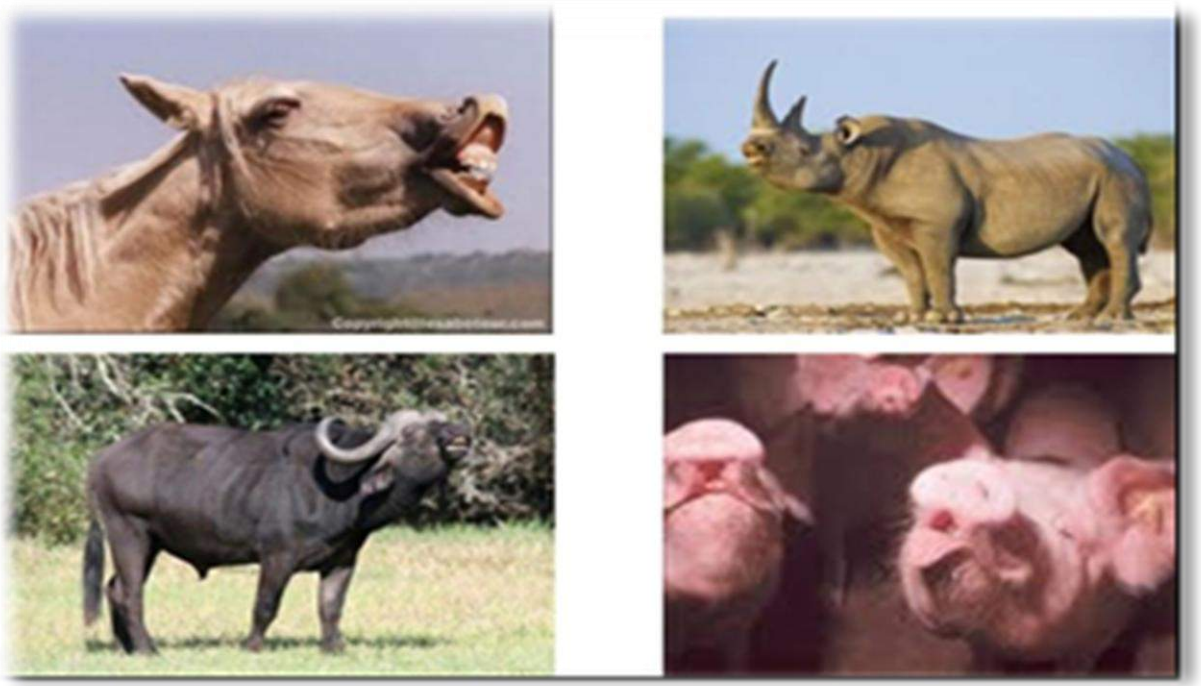
APPLICATION

- Augmenting Sexual maturity.
- Curtling the incidence of silent estrous.
- Curtling Incidence of postpartum anestrous.
- Detection of estrous.
- Detection of pregnancy.
- Improving sexual desire in males.

Males of many ungulates routinely investigate the ano-genital region or urine of females and use the olfactory cues to determine the stage of estrous cycle.

During parading, a teaser bull receives the estrus specific chemical signal from females and then exhibits flehmen behavior.

- Quantitative data about behavior of bulls in contact with cows may be the most reliable biological indicator of



the presence of pheromones.

Priming pheromones-

- Priming pheromones modulate physiological events through inhibition or stimulation of endocrine, reproductive and other body systems.

In domestic animals, priming pheromone from the male have an influence on the induction of puberty, termination of seasonal anestrus and shortening of postpartum anestrus.

Different Sources of pheromones-

- In pig sub-maxillary salivary gland secretions contain priming pheromone, 5α androstenone, which accelerates puberty and shortens the postpartum anestrus.
- In sheep, wool wax and possibly urine contain some priming pheromones, which serve to terminate seasonal anestrus and even synchronize estrus.
- Urine and mohair are the probable sources of pheromone in goat.
- Similarly, urine, cervico-vaginal mucus (CVM) and perineal skin gland secretions are the potential source of pheromone in cattle.
- Even cow milk contains some volatile compounds, which possibly function as pheromones for olfactory communication.
- In the cow, the perineal skin glands (sweat and sebaceous glands) also act as source of pheromone.

Pheromone transport-

- Here the transport of semi volatile compounds from an individual into the environment and from environment to other individual.
- There has been very little study on pheromone transport in large animals.
- Lazar et al. (2004) identified elephant serum albumin(ESA) as the pheromone transport protein.
- ESA releases the pheromone, presumably as a result ofchange in pH in trunk of male, to an odorant binding protein on the nasal mucosa and the male detects that the female is in estrus.
- In nasal cavity vomeronasal organ (VNO) appears to be specialized to detect species specific chemical signals (Pheromones) that carry specific information about gender,reproductive or dominance status.

Effect of pheromones on reproduction-

- In domestic mammals, pheromones from male influence the induction of puberty, termination of seasonal anestrous and shortening of postpartum anestrous.
- pheromones from females influence ovarian activity in other females of the same species.

SWINE

- Puberty in gilts has found to be accelerated by the presence of the male.
- Daily introduction of a mature boar to pre-pubertal gilts from an age of approximately 160 days onwards will also advance attainment of puberty (Dyck, 1988).
- Boar's presence provides enough stimulation to overcome some of the adverse effects of confinement on puberty,lowering the age at first farrowing, thereby increasing lifetime productivity.
- Gilts reaching early puberty through boar contact have higher ovulation

rates, more synchronous estrous cycles and therefore, higher reproductive potential than controls.

- Sows go through a period of postpartum anestrous, thecause of which is thought to be inhibition of the synthesisof LH and release of FSH via the suckling stimulus. Specific boar stimuli are also known to be beneficial for the onset of estrus in sows after weaning.

SHEEP AND GOATS-

- The introduction of rams to ewes early in the breeding season stimulated a varying proportion of the ewes to ovulate within at least 6 days of the ram introduction (Cushwa et al., 1992).
- Knight and Lynch (1980) tested the capacity of ram urine or a combination of wax, collected from around the eyes and from the flanks of rams to induce ovulation in ewes early in breeding season, and reported that urine, wax and wool - effective as contact with rams.
- Similarly, the introduction of a buck to a group of does just before the start of the breeding season results in initiation of synchronized estrus 5-10 days after the onset of exposure to the buck (Shelton, 1960).
- In buck during the breeding season, a behavior termed as scent-urination; the function is to hasten and synchronize the onset of estrus in females.
- The influence of ram and buck alone on the induction and synchronization of estrus in conjugation with hormone treatments can be used to improve reproductive efficiency in breeding flocks.
- It is inexpensive and suitable for extensive management systems aimed at controlling reproductive performance.

CATTLE-

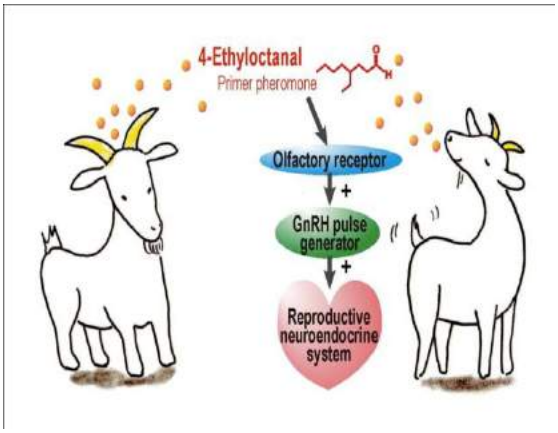
- Izard and Vandenbergh (1982b) first reported that oronasal application of bull urine induced puberty in heifers as compare to untreated heifers.
- Patra *et al. (*2010b) reported that the oronasal treatment with bull urine induced estrus in a significant higher proportion (87.5%) of heifers as compared to estrus cow urine and cervical mucus treated (37.5%) heifers.
- Rekwot *et al.*(2000) reported that heifers exposed to vasectomized bull attained puberty at 23.1 months, significantly lower than the age of 26.4 months at onset of puberty for the non-exposed heifers.
- Early postpartum exposure of cows to bulls reduces the postpartum anestrus interval.
- Recently, Ahmad et al. (2010) observed that bull urine exposure induced estrus 6 days earlier in greater proportion of postpartum crossbred cows (72.2 vs.58.3%).
- It was also found that the cows with good body condition score and higher parity responded better to biostimulatory effects of bull urine and maximum biostimulatory effect was found during 45 to 55 days postpartum in cows. Thus, the bull cow interactions do influence reproductive activity in the cow at

least under certain conditions through olfactory cues.

- In another study, it was observed that bull urine exposure failed to induce estrus in prolong anestrus However, when applied along with Ovosynch program bull urine exposure facilitates estrus synchronization response .
- A male effect favors estrus detection in the animals of a herd. The mere presence of a male facilitates a group's activity or its commencement, favoring the nuclei of activity which causes more intense stimulation and thereby decreases the rate of silent heats.
- There is possibility that the effect of the bull on resumption of cycling activity is mediated via the central nervous system by stimulating LH release immediately following exposure.

BUFFALO

- Very limited studies have been carried out pertaining topheromonal communication in buffalo reproduction.
- As the resumption of estrous cyclicity after calving in postpartum buffaloes plays a major role in obtaining a satisfactory reproductive performance, the excessively long postpartum interval(400 to over 600 days) in this species results in substantial economic loss, as well as creating managerial problems.
- Recently, Barman (2008) observed that exposing the buffaloes continuously to vasectomized bull from day 3 to day 60 postpartum reduced the incidence of short cycle (33.3 vs. 46.15 %), silent estrus (57.14 vs. 85.71 %) and a significantly greater conception rate in bull exposed than non-exposed (81.18 vs. 40.0 %) buffalo cows.
- In another experiment, Gokuldas et al.(2010) observed that continuous vasectomized bull exposure to postpartum buffaloes from 40 days onwards reduced the interval to resumption of ovarian cyclicity (47.4 vs. 56.0 days) as compared to non-exposed buffaloes.
- The mean progesterone rise above 1ng/ml was observed as early as day 44 th postpartum in bull exposed buffaloes while this rise was delayed up to56 th day in non-exposed groups indicating a delay in resumption of ovarian activity in non-exposed animals.



CONCLUSION:

- Pheromonal communication plays an important role in mammalian behavior and reproductive processes.
- Biostimulation through pheromones can exert profound effects on reproductive activity via the hypothalamic system that generates pulses of gonadotropin-releasing hormone.

The economic benefits of using biostimulation –

- To enhance early onset of puberty.
- Significant reduction in period of postpartum anestrus in livestock .
- Silent estrus particularly in buffaloes
- Enhancing conception rate in animal may serve as a management tool.

The exact nature of the chemical and the role of pheromonal communication in livestock species, especially pig, sheep, goats, cattle and buffaloes require more attention for its effective use as potential management practices.

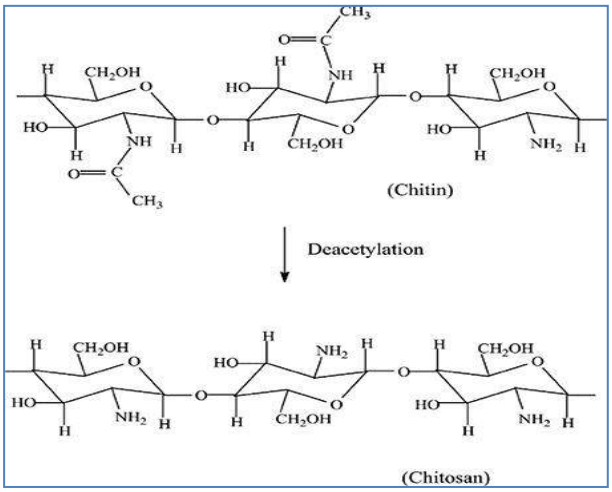
Use of Chitosan In Agriculture

Priyal Pandey[1*] and Nirmal De[2]

[1]*Research scholar , Department of Soil Science & Agricultural Chemistry, Institute of Agricultural Sciences ,Banaras Hindu University, Varanasi, India - 221005*
[2] *Professor, Department of Soil Science & Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India-221005*
Corresponding author – piu.pandey89@gmail.com*

Chitosan (pronounced *Kite-O-San*) discovery can be traced back from 1811 when "chitin", from which it is derived, was first discovered by Henri Braconnot, who was director of the Botanical Gardens at the Academy of Sciences in Nancy, France. He identified an extract from mushrooms that wouldn't dissolve in sulphuric acid, which he named 'fungine'. This was renamed 'chitin' a few years later in 1823 when another French scientist called Auguste Odier isolated it from beetle cuticles, and named it after the Greek word for 'tunic', 'chiton'. Chitin was the first polysaccharide identified by man, preceding cellulose by about 30 years.

The presence of nitrogen in it was identified by Lassaigne in 1843. In 1859, Professor C. Rouget subjected chitin to alkali treatment, which resulted in a substance that could, unlike chitin itself, be dissolved in acids. The term "chitosan" was given to deacetylated chitin by Hoppe-Seiler in 1894.While chitin remained an unused natural resource for a long time, interest in this polymer and its derivatives such as chitosan and chito-oligosaccharides has increased manifold



in recent years due to their unique properties.

Chitin is poly [b-(1-4)-N-acetyl-D-glucosamine. It is the most abundant polymer after cellulose. The most important derivative of chitin is chitosan. It is a random linear chain of N-acetyl-D-glucosamine units (acetylated unit) and D-glucosamine (deacetylated unit) joined by b-(1-4) linkages. Conventionally, the distinction between chitin and chitosan is based on the degree of acetylation (DA), with chitin having DA values higher than 50% and chitosan having lower percentages. Chitin and chitosan are biocompatible, biodegradable, and non-toxic polymers. It has immense unexplored potential which can

ultimately help to make sustainable agriculture a reality.

SOURCES OF CHITOSAN

Chitosan is prepared by chitin deacetylation. Chitin occurs in a wide variety of species, from ciliates, amoebae, chrysophytes, some algae, yeasts and the lower animals like crustaceans, worms, insects and mollusks. Vertebrates, plants and prokaryotes do not have chitosan (Sandford, (2004). Fungi are abundant sources of chitosan .Chitosan exists naturally in fungi like zygomycetes and mucorales such as *Absidia coerulae* (Muzzarelli ,1994) but practically chitosan prepared by chitin deacetylation. Chitosan production by Fungus is still an emerging technology.

METHOD OF PREPARATION OF CHITOSAN FROM CHITIN

Chitosan is prepared by 2 methods
1. Deacetylation of chitin
2. Fermentation technology

Raw materials most abundantly available for chitin production are the shells of crab, shrimp, and prawn (69- 70%).Chitin is associated with other constituents; chemical treatments are needed for removing impurities. Proteins are removed by sodium hydroxide or by digestion with proteolytic enzymes such as papain, pepsin, trypsin, and pronase. Minerals such as calcium carbonate and calcium phosphate are extracted with hydrochloric acid. Pigments such as melanin and carotenoids are eliminated with 0.02% potassium permanganate at 60◦C or hydrogen peroxide or oxalic acid. Conversion of chitin to chitosan generally is achieved by hydrolysis of acetamide groups of chitin by severe alkaline hydrolysis treatment. It is due to the resistance of such groups imposed by the *trans*-arrangement of the C2-C3 substituent in the sugar ring (Sandford, 1989).

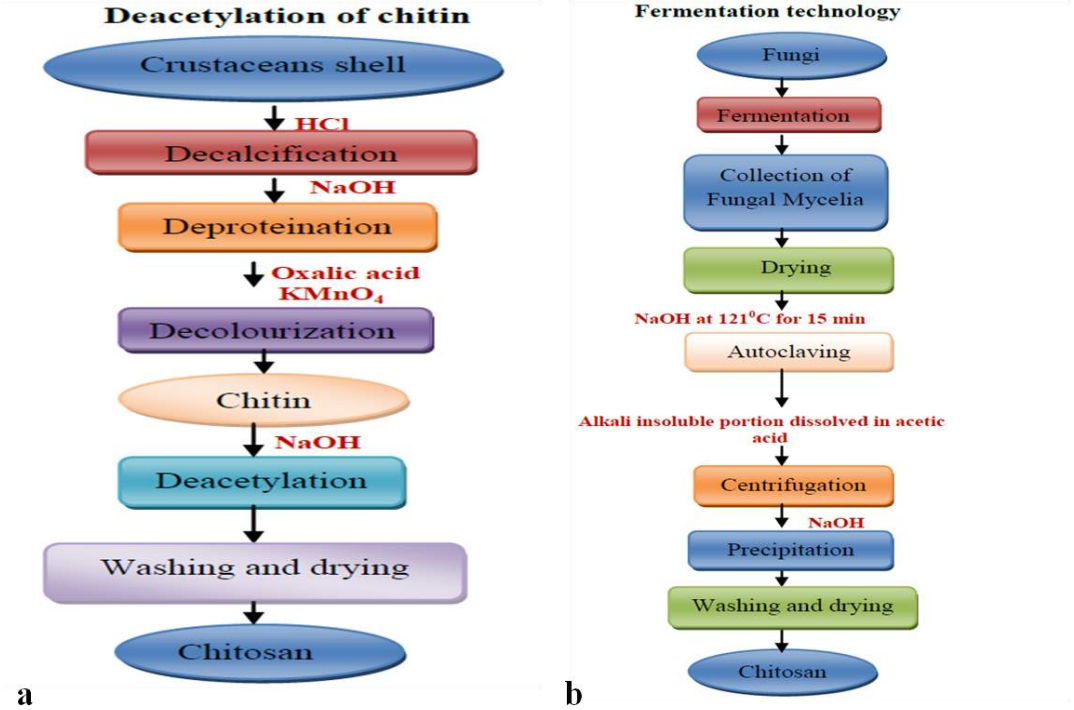


Fig . 1. Chitosan production by (a) Deacetylation of chitin (b) Fermentation technology

Chitosan produced by fungus have much importance over chitosan produced by crabs, shrimps, due to the degree of acetylation, molecular weight, viscosity and charge distribution of the fungal chitosan. They are more stable than crustacean chitosan. The production of chitosan by fungus in a bioreactor at a technical scale offers additional opportunities to obtain identical material throughout the year. The fungal chitosan is free of heavy metal contents such as nickel; copper (Nwe and Stevens 2002). Moreover the production of chitosan from fungal mycelia gives medium-low molecular weight chitosan (1–12 × 104 Da), whereas the molecular weight of chitosan obtained from crustacean sources is high (about 1.5 ×106 Da) (Nwe and Stevens 2002). For these reasons, there is an increasing interest in the production of fungal chitosan. Preparation of fungal chitosan and from chitin deacetylation is explained by flow diagram (fig 1).

CHITOSAN USE IN AGRICULTURE

Plant Defence Mechanism

Plants respond naturally against biological and environmental stress condition, but sometimes induced defence is needed against harder threats. Chitosan is a great polymer induces defence actions, and responses against pathogens attack. Substances that get favoured due to the presence of chitosan are phytoalexines; pathogenesis related proteins (PR), protein inhibitors, chitinases and glucanases, as well as Reactive Oxygen Species (ROS) and hydrogen peroxide generation (Muzzarelli, 2008).

As Plant Growth Promoter and combating abiotic stress

Chitosan acts as plant growth promoter in some crops like Faba bean plant, radish, passion fruit, potato, gerbera, cabbage, soybean and other crops when it is incorporated in solution. It increases plant production and protects plants against pathogens. Chitosan has a significant effect on growth rates of roots, shoots, flowering, and number of flowers. These molecules are strongly hydrophilic, and alleviate stress damage in plant cells by reducing the water potential and increasing the activities of some biological macromolecules (Rathinasabapathi, 2000).

As antitranspirant

Chitosan foliar application increases stomatal conductance and reduces transpiration, without affecting plant height, root length, leaf area or plant biomass (Bittelli *et al.* 2001). When chitosan was sprayed in leaves, abscisic acid (ABA) content increases (Iriti *et al*. 2009).chitosan has potential to be developed as an antitranspirant in agricultural situations where excessive water loss is undesirable. While both ABA and jasmonic acid have both been found to raise in concentration in response to chitosan treatment and these hormone are involved in control of opening of stomatal aperture (Bittili *et al.* 2001).

SEED COATING/ PRIMING

Chitosan can be used as a seed coating material for cereals, nuts, fruits and vegetables. It alters permeability of the seed plasma membrane, increasing the concentrations of sugars and proline, and enhances peroxidise (POD), catalase (CAT), phenylalanine ammonia-lyase

(PAL) and tyrosine ammonia-lyase (TAL) activities (Guan *et al*. 2009).Germination rates of seeds increases significantly and seedlings germinate quicker, better, and vigorously(Zhou *et al.* 2002).

BIONEMATICIDE

Nematodes proliferation can be controlled when chitosan is applied in soil, because chitinolytic microorganisms proliferate destroying nematode eggs and degrading the chitin containing cuticle of young nematodes. Because of the high content of nitrogen in chitosan and chitin molecules, concentrations of ammonia emissions increase turning toxic to nematodes which principally affect plant roots and shoots.

Post harvest treatment

One of the potential approaches to extend the storability of perishable commodities is to apply edible coatings on the surface, followed by a cold storage. The major postharvest losses of fruits are due to fungal infection, physiological disorders, and physical injuries. Chitosan coating has ability to modify internal atmosphere in the tissue and fungi static property has a potential to prolong storage life and control decay of fruits. In fruits and vegetables, chitosan provide more firmness and it promotes diminution of the normal microbiological charge (Devlieghere *et al.* 2004) increasing the product life. Chitosan coating is likely to modify the internal atmosphere without causing anaerobic respiration, since chitosan films are more selectively permeable to O_2 than to CO_2 (Bai *et al*. 1988).

Water retention in soil

Chitosan has gel forming properties and it can be used for preparation of hydrogel. Chitosan is an excellent biodegradable biomass and can be degraded into nontoxic products *in vivo*. It has both reactive $-NH_2$ and –OH that can be convenient for graft polymerization of hydrophilic vinyl monomers onto it under mild reaction condition, and the acquired superabsorbent resin can absorb aqueous solution hundreds of times than their own dry sample. So it is used for preparation of ecofriendly superabsorbent.

As soil conditioner

Being a polysaccharide, chitosan acts as a bioremediator molecule that stimulates the activity of beneficial microorganisms in the soil such as *Bacillus spp., fluorescent Pseudomonas spp.*, Actinomycetes, Mycorrhiza and Rhizobacteria. This alters the microbial equilibrium in the rhizosphere promoting beneficial micro organism and reducing plant pathogens, thus improving soil health.

CONCLUSION

Chitosan is a versatile polymer having unique features. Chitosan use in agricultural field is fetching great attention as antimicrobial agent, plant growth promoter, as edible film for coating of fruit and vegetable. It can be used as fertilizer sources enhancing water retention capacity of soil. This area of research is still at its nascent stage requires much more attention for its promotion.

REFERENCES

Bai, R.K., Huang, M Y and Jiang, YY (1988). Selective permeabilities of chitosan-acetic acid complex membrane and

chitosan-polymer complex membranes for oxygen and carbon dioxide. *Polym. bull.,* **20 ,**83–88.

Bittelli, M., Flury, M., Campbell, G S and Nichols, E J (2001). Reduction of transpiration through foliar application of chitosan. *Agr. Forest. Meteorol.*, **107,** 167–175.

Iriti,M., Picchi,V., Rossoni, M., Gomarasca, S., Ludwig, N., Garganoand,M and Faoro, F (2009). Chitosan antitranspirant activity is due to abscisic acid-dependent stomatal closure. *Env. exp. bot.* **66,** 493–500.

Muzzarelli R A A (2008). Aspects of chitin chemistry and enzymology. Paoletti M and Musumeci S (Eds.). Binomium chitin-chitinase: emerging issues, auppauge. NY, Nova Science. ISBN: 978-1 60692-339-9.

Muzzarelli, R.A.A., Ilari, P., Tarsi, R., Dubini, B and Xia, W (1994). Chitosan from *Absidia coerulea*. *Carbohyd. Polym.,* **25,** 45-50.

Nwe, N and Stevens, W F (2002). Chitosan isolation from the chitosan-glucan complex of fungal cell wall using amylolytic enzymes. *Biotechnology Letters* **24,**1461-1464.

Rathinasabapathi, B (2000). Metabolic engineering for stress tolerance: installing osmoprotectant synthesis pathways. *Annals of Botany*. **86(4),**709–716.

Sandford, P A (1989). Chitosan—commercial uses and potential applications. *Chitin and Chitosan*, G. S. Brack, T. Anthonsen, and P. Sandford, Eds., Elsevier, New York, NY, USA, 51–69.

Sandford, P A (2004). Advances in chitin science. vol (5) Proceeding from the international conference of the Europian Chitin Society. *Carbohyd. Polym*., **56(1),** 59-95.

Zhou, Y.G., Yang, Y.D., Qi ,Y.G., Zhang, Z.M., Wang X J and Hu X J (2002). Effects of chitosan on some physiological activity in germinating seed of peanut. *Journal of Peanut Science*.**31(1),** 22–25.

Pregnancy Termination in Bitch

Rupali Rautela* and Rahul Katiyar

Ph.D. Scholar, Division of Animal Reproduction,
Indian Veterinary Research Institute, Bareilly, Utter Pradesh
Corresponding Author: rautela14rupali@gmail.com

The most common request asked to veterinarian from the pet owners is termination of pregnancy. A situation happens when a bitch accidentally bred by an undesirable dog or do not want pups due to some other health issues with pet however, want to breed in the future; termination of pregnancy can be done by pharmacological methods. The drugs should be used based on its margin of safety, efficacy, compliance in the treatment and its cost. However, none of the drugs is completely safe and have some disadvantages. However, choosing the therapy by keeping in mind the stage of gestation or time elapsed since mating is of utmost importance.

ESTROGENIC COMPOUNDS:

Estrogens are commonly used drugs for mismating or pregnancy termination within 72 hrs of mating. These compounds delay prevent migration of embryos through uterine tubes by inducing endometrial edema. Also have embryotoxic effects.

Estradiol benzoate @ 0.01mg/kg can be given intramuscularly on day 3, 5 and 7 or, Estradiol cypionate @ 44µg/kg intramuscularly once or,

Tamoxifen citrate @ 1mg/kg twice a day orally for 10 days can be given.

However, complications include aplastic anemia, increased risk of pyometra etc.

Prostaglandins:

The demise of corpora lutea using prostaglandins, a luteolytic compound, results in decrease in serum progesterone level and abortion.

Dinoprost @ 0.1mg/kg twice a day subcutaneously or,

Cloprostenol @ 1µg/kg once a day subcutaneously for 4 to 5 days results in abortion.

Side effects include vomiting, diarrhea, hypersalivation, trembling etc. These complications generally subside within 2 to 3 hrs or can be overcome by giving atropine injection.

Dopamine agonist compounds:

Dopamine inhibits prolactin secretion, which is luteotrophic during the second half of gestation, causes luteal demise and pregnancy loss.

Bromocriptine @ 25-50µg/kg orally or subcutaneously thrice a day for 7 days or,

Cabergoline @ 5µg/kg orally once daily for 7 days or,

Metergoline @ 400-500µg/kg orally once a day for 5 days are efficient to cause abortion after 40 days of LH surge.

Post therapy complications are minimal. Emesis can occur with bromocriptine.

Progesterone action inhibitors: These compounds prevent binding of progesterone to its receptors and causing termination of pregnancy.

Mifepristone @ 20mg/kg subcutaneously once or,

Aglepristone @ 10mg/kg subcutaneously once daily for 2 days terminate pregnancy within 4-7 days.

Side effects include Slight depression, anorexia and mammary gland congestion.

Progesterone secretion inhibitors:

They inhibit steroid synthesis by inhibition of enzymes involved in conversion of pregnenolone to progesterone.

Epostane @ 50mg/kg orally once daily for 7 days starting on first day of diestrus causes conception failure.

Dexamethasone:

The luteolytic action of dexamethasone is not known however, these drugs are found effective in terminating pregnancy. Efficacy of these drugs is good past 30 days of LH surge.

Dexamethasone @ 5mg/kg intramuscularly twice a day for 10 days leads to fetal death.

Minor complications followed by therapy include anorexia, polydipsia and polyuria.

DRUGS IN COMBINATION:

The synergistic effect of the combined drugs allows reduced dosage regimen and fewer side effects.

Bromocriptine/ Cabergoline @5µg/kg orally once a day for 7 days along with Cloprostenol @2.5µg/kg subcutaneously three times on alternate days (Day 1, 3 and 5) is 100% efficient after 25 days of LH surge.

Drugs chosen for the management of mismating or pregnancy termination should be discussed with owners regarding their efficacy, safety and side effects. However, the best alternative to the use of drugs is Ovariohysterectomy.

Plant Disease Management In Organic Farming

[1]Meenakshi Sharma, [2]Tarun Kumar Jatwa and [3]Jeetendra Sharma

[1,2] Department of Plant Pathology, [3]Department of Soil Science Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur-313001, Rajasthan (India)

Corresponding Author: sharmameenakshi986@gmail.com

ORGANIC AGRICULTURE

Organic agriculture as holistic food production management system, which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system".(Codex Alimentarus Commission , 1999)

Principles of Organic Agriculture:

1. The principle of health – Organic Agriculture should sustain and enhances the health of soil, plant, animal, human and planet as one and indivisible.
2. The principle of ecology – Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.
3. The principle of fairness – Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities and
4. The principle of care - Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well being of current and future generations and the environment.

Disease management in organic agriculture:

Organic disease management is a holistic management approach, that Disrupt congenial agro-ecosystem of the pathogens. Reduces farm input costs due to reduced use of chemical (fungicides, bactericides, nematicides) pesticides resulting in reduced health hazards and environmental pollution. Provides greater acceptability and market value of quality produce.

Need for Organic Disease Management

There is no doubt that green revolution has made our country self sufficient in food grains, but at the same time proven to be detrimental. Indiscriminate or overzealous use of pesticides and chemicals polluted soil, water and whole ecosystem. Soft soil getting hardened due to chemical residue, ground water getting polluted and pest control ran out of control leading to pest resurgence and pesticide resistance. We

have lost rich biodiversity and balance nature before we get alerted. Only chemicals are not the sole culprit excessive tillage, hybrid varieties focusing on higher yields, GMO, tendency of easy crop production practices is reason for today pathetic situation of agriculture. Sustainable agriculture is the only solution to all these problems. For this, all non chemicals methods are combined under the title organic Organic Agriculture is the answer to today agriculture pathetic situation.

Basis of Organic Disease Management:

Managing the ecosystem on an organic farm is very challenging. It is made even more complex when factoring in insect and disease pests. Since the uses of synthetic pesticides are prohibited, the organic cropping system should be focused on the prevention of pest outbreaks rather than coping with them after they occur.Optimize the growing condition of crop to make them strong and competitive. Healthy plants are able to resist and tolerate physiological disruption and damage from disease-causing organisms and pests. Thus, organic farmers aim at optimizing the growing conditions for their crops to make them strong and competitive. At the same time encourage natural control mechanisms to prevent pests, diseases and weeds to develop in a way that they cannot damage the crops. Enhance self defense in plants. Give priority to preventive measures to prevent & limit the spread of infection, instead of relying on direct control measures as soon plant got diseased, there was little possibility to get them recovered by organic methods. African Organic Agriculture Training Mannual, FIBL (2012).

Managing Disease in Organic Agriculture: Integrated disease management strategy in organic farming should include methods these are following

I .Preventive Measures

Cultural method:

At least 90% of plant disease control is accomplished through proper cultural methods and sanitation. Cultural practices usually influence the development of disease in plants by affecting the environment. Such practices are intended to make the atmospheric, edaphic, or biological surroundings favorable to the crop plant, unfavorable to its parasites. Cultural practices that lead to disease control have little effect on the climate of a region but can exert significant influence on the microclimate of the crop plants in a field. Important cultural practices that can be used to manage plant disease in organic are

(a) Crop rotation: Sowing of series of dissimilar or different types of crop in same area in sequenced season. Crop rotation is essentially a preventive measure and has its effect mainly on the succeeding crop. Eg. Onion smut (*Urocystis cepulae*)and club root (*Plasmodiophora brassicae*)organisms are producing resistant type of spores while *Rhizoctonia, Fusarium* and some species of *Pythium* are those which could remain in soil as saprophytes for a very long time. Crop rotation with sugarcane or paddy is effective

in the control of 'Panama wilt' of banana (*Fusarium oxysporum* f.sp. *cubense*) and crop rotation with paddy or green manures is effective in the control of red rot of sugarcane (*Colletotrichum falcatum*). (Van bruggen *et al.* 2016) Rotation of cereal crops like pearl millet, finger millet or fox-tail millet is recommended for the control of *Macrophomina* root rot of pulse crops. Two year crop rotation with lucerne is recommended inthe control of *Verticillium* wilt of cotton.

(b) Mixed and inter cropping: Mixed cropping materially helps in checking certain diseases.Blight of pulse crop *(Phyllosticta phaseolina)* has been successfully overcome by growing pulses as a mixed crop with cereals like sorghum and pearl millet. Intercropping is also a device in the control of some soil borne diseases. Intercrops should be properly chosen so that they should not have any common pathogen for e.g.,*Macrophomina phaseolina* has got wide host range and hence common host should not b*e* grown as intercrops.

(c) Sanitation: Field and plant sanitation is an important method of disease control through cultural practices. The inoculum present on field plants in the field may multiply on the plant or in the soil and in due course of time may be sufficient to nullify or reduce the effect of control practices. Many pathogens overwinter or over summer on plant debris during the off-seasons and become active when the crop is again grown in the field. Hence plants bearing pathogens or plant debris introducing inoculums into the soil should be removed as early as possible.. In this manner *Fusarium* wilt of cotton, pigeon pea and banana, *Verticillium* wilt of cotton, root rot of beans, downy mildew of pearl millet, sorghum, maize and peas, bacterial blight of cotton, white rust of crucifers, black spot of rose, powdery mildew can be reduced.

(d) Rouging: Rouging consists of completely removing or uprooting the diseased plants to prevent further spread of the disease. This method is widely adopted in the control of virus diseases spread by insects (cassava mosaic, yellow mosaic of blackgram and greengram, citrus tristeza, katte disease of cardamom, bunchy top of banana) and basal stem rot of coconut, green ear of pearlmillet and broomrape (*Orobanche*) in tobacco.

(e) Deep summer ploughing: This practice reduces the contact between plant roots and pathogens propagules or to expose propagules to natural heating and desssication to inactivate them. the spread of the disease is avoided. Groundnut blight (*Corticium rolfsii*) is controlled by ploughing the soil to a depth of 20 cm.

(f) Adjustment of sowing time: In many diseases the incidence is more severe when the susceptible stage of the plant growth and favorable conditions for the pathogens coincides. While choosing the time of sowing it should be taken into consideration that susceptible stage

of the crop growth and soil conditions and other environments favorable for maximum activity of the pathogen does not fall at the same time.

(g) Organic amendments: It has been proved that the organic amendments rich in carbon and deficient in nitrogen control the take-all disease (O*phiobolus graminis*) of wheat. There is considerable liberation of CO_2 by soil saprophytes which suppresses the pathogenic activity of this fungus .In the process of survival also; low nitrogen content in the soil reduces the longevity of the fungus. *Phytophthora* root rot of avocado is controlled by amending the soils with alfalfa meal- amaterial of low C/N ratio .(Bailey *et al.*2003)

(h) Decoy crop and trap crop: Decoy crops (hostile crops) are non-host crops sown with the purpose of making soil-borne pathogens waste their infection potential.Eg. Rye grass, *Papaver rhoeas, Reseda odorata* used in reduction of *Plasmodiophora brassicae* in cabbage, *Datura stramonium* used in reduction of *Spongospora subterranean* in potato and sunflower, safflower, Lucerne and chickpea used in reduction of*Orobanche* spp. in tomato and tobacco.

(i) Spacing: Closer spacing invariably alters the microclimate underneath the canopy of the crop which may provide favorable environment for development of diseases. Early spread of black rot of cabbage takes place in closer spacing. Crowded stands may reduce some systemic diseases. Cotton wilt caused by *Verticillium albo-atrum* will be less in closely planted crop if the fungal inoculum is less in thesoil.

PHYSICAL METHODS:

Soil solarization: Soil solarization or slow soil pasteurization is the hydro/thermal soilheating accomplished by covering moist soil with polyethylene sheets as soil mulch during summer months for 4-6 weeks. Soil solarization was developed for the first time in Israel (Egley and Katan) for the management of plant pathogenic pests, diseases and weeds. Solarization is more effective in limiting *Pythium* spp. in a pepper field (Saha *et al.,* 2005). Southern blight (*Sclerotium rolfsii*) and Fusarium wilt (*Fusarium oxysporum f.sp. lycopersici*) can also be substantially reduced with solarization.

Soil sterilization: Soil can be sterilized in green houses and sometimes in seed beds byaerated steam or hot water. At about 50^0C, nematodes, some oomycetous fungi and other water molds are killed. At about 60 and 72^0C, most of the plant pathogenic fungi and bacteria are killed. At about 82^0C, most weeds, plant pathogenic bacteria and insects are killed. Heat tolerant weed seeds and some plant viruses, such as TMV are killed at or near the boiling point (95-100^0C).

(j) Hot water or Hot air treatment: Hot water treatment or hat air treatment willprevent the seed borne and sett borne infectious diseases. Hot water treatment of certain seeds, bulbs and nursery stock is done to kill many pathogens

present in or on the seed and other propagating materials. Hot water treatment is used for controlling sett borne diseases of sugarcane [whip smut, grassy shoot and red rot of sugarcane (52^0C for 30 min)] and loose smut of wheat (52^0C for 10 min).

BIOLOGICAL CONTROL: Biological control is the reduction of inoculum density or disease producing activityof a pathogen or a parasite in its active or dormant state by one or more organisms accomplished naturally or through manipulation of the environment of host or antagonist by mass introduction of one or more antagonists (Baker and Cook, 1974)

MECHANISMS OF BIOLOGICAL CONTROL

1. Competition: Most of the biocontrol agents are fast growing and they compete withplant pathogens for space, organic nutrients and minerals (Pal *et al.* 2006). Most aerobic and facultative anaerobic micro-organisms respond to low iron stress by producing extracellular, low molecular weight (500-1000 daltons) iron transport agents, designated as Siderophores, which selectively make complex with iron (Fe^{3+}) with very high affinity. Siderophore producing strains are able to utilize Fe^{3+} - Siderophore complex and restrict the growth of deleterious micro-organisms mostly at the plant roots (Kloepper *et al. 1980*). Iron starvation prevents the germination of spores of fungal pathogens in rhizosphere as well as rhizoplane. Siderophores produced by *Pseudomonas fluorescens* (known aspseudobactinsorpyoveridins) helps in the controlof soft rot bacterium, *Erwinia caratovora.*

2. Antibiosis: Antagonism mediated by specific or non-specific metabolites of microbialorigin, by lytic agents, enzymes, volatile compounds or other toxic substances is known as antibiosis.

(a).Antibiotics: Antibiotics are generally considered to be organic compounds of low molecular weight produced by microbes. At low concentrations, antibiotics are deleterious to the growth or metabolic activities of other micro-organisms.

Ex: *Gliocladium virens* produces gliotoxin that was responsible for the death of*Rhizoctonia solani* on potato tubers (wilhite *et al.* 2001). Colonization of pea seeds by *Trichoderma viride* resulted in the accumulation of significant amount of the antibiotic viridin in the seeds, thus controlling *Pythiumultimum*. Some strains of *Pseudomonas fluorescens* produce a range of compounds, viz., 2,4-diacetyl phloroglucinol (DAPG), phenazines, pyocyanin, which have broad spectrum activity against many plant pathogenic bacteria and fungi

Bacteriocins: These are antibiotic like compounds with bactericidal specificity closelyrelated to the bacteriocin producer. Ex: The control of crown gall (caused by *Agrobacterium tumefaciens*) by the related *Agrobacterium radiobacter* strain K 84 is bythe production of bacteriocin, Agrocin K84. (kerr, 1980)

(b).Volatile compounds: Antibiosis mediated by volatile compounds has been observed inthe management of soil borne pathogens, viz., *Pythium*

ultimum, Rhizoctonia solani and *Verticillium dahlia*, by *Enterobacter cloacae*. The volatile fraction responsible forinhibition was identified as ammonia.

3. Hyperparasitism: Direct parasitism or lysis and death of the pathogen by anothermicro-organism when the pathogen is in parasitic phase is known as hyperparasitism. Ex: *T. harzianum* parasitize and lyse the mycelia of *Rhizoctonia* and *Sclerotium*. (Howell, 2003)

Important fungal bio control agents:

Most of the species of Trichoderma, viz., *T. harzianum, T. viride, T. virens* (*Gliocladiumvirens*) are used as biocontrol agents against soil borne diseases, such as, root rots,seedling rots, collar rots, damping off and wilts caused by the species of Pythium, Fusarium, Rhizoctonia, Macrophomina, Sclerotium, Verticillium, etc. (Junaid *et al.*2013)

II .Direct control / curatives.

Botanicals: Some plant contains components that are toxic to pathogens. When extracted from the plant and applied on infested crops, these components are called botanical pesticides or botanicals. **Botanical pesticides are best suited for use in organic disease management.** Certified organic, must choose bio-pesticide that is approved for organic production by consulting with certifying agency or OMRI.Application of essential oils extracted from plants is a very attractive method for controlling post harvest diseases. Essential oil extracted from lemon grass (*Cymbopogon spp.)* is used against post harvest anthracnose of mango fruit. **(Salomone *et al.,* 2008)**

Commonly used botanicals:

Plant extracts: Neem (*Azadirachta indica),* Garlic *(Allium sativum)* , Eucalyptus *(Eucalyptus globulus)* , Turmeric *(Curcuma Longa)* , Tobacco *(Nicotiana tabacum)* ,Ginger *(Zingiber officinale).*

Essential oils: Nettle oil (*Urtica spp.),* Thyme oil *(Thymus vulgaris, Linn.),* Eucalyptus oil *(Eucalyptus globulus),* Lemon grass oil *(Cymbopogon flexuosus) and* Tea tree oil *(Melaleuca alternifolia).*

Gel and latex: Aloe Vera. **(Gurjar et al; 2012)**

Mode of action of antimicrobial compounds obtained from botanicals.

Plants have limitless ability to synthesize aromatic secondary metabolites, most of which are phenols or their oxygen-substituted derivatives. These groups of compounds show antimicrobial effect and serves as plant defense mechanisms against pathogenic microorganisms.

CONCLUSIONS

Disease management is key component in organic farming which mainly relies on preventive measures. Multidisciplinary approach involving molecular biology, biochemistry, plant breeding, entomology, crop management and economics can facilitate the investigation and subsequently provide real world solutions for disease problems in organic agriculture. The introduction and adoption of biological; and organic plant protection measures on a mass

scale may be a hill sum task in Indian farming. In intensive farming integrated and judicious use of all the inputs including the fertilizers and organic sources, coupled with minimal use of pesticides may be better choice than pure organic farming. A sudden switch over to organic farming is not feasible.

REFERENCES

African Organic Agriculture Training Mannual, FIBL (2012).

Bailey, K.L. and Lazarovits, G. (2003). Suppressing soil-borne diseases with residuemanagement and organic amendments. *Soil & Tillage Research***72** : 169–180.

Gurjar, M.S., Ali, S., Akhtar, M. and Singh, S. 2012. Efficacy of plant extracts in plant disease management.*Agricultural Sciences.* **3:** 425-433**.**

Howell, C.R. (2003). Mechanisms Employed by *Trichoderma* Speciesin the Biological Control of Plant Diseases:The History and Evolution of Current Concepts. *Plant Disease* . Vol. **87 (1):** 4-10.

Junaid, J.M., Dar, N.A., Bhat, T.A., Bhat, A.H. and Bhat, M.A. 2013. Commercial Bio control agents and their mechanism of action in the management of plant pathogens. *International Journal of Modern Plant & Animal Sciences.* **1(2):** 39-57.

Kerr, A. (1980). Biological control of crown gall through production of agrocin 84*. Plant Disease.* **64:** 25-30.

Kloepper, J.W., Leong, J., Teintze, M. and Schroth, M. N. (1980). *Pseudomonas* siderophores: A mechanism explaining disease suppression in soils. *Current Microbiology.* **4:** 317-320.

Pal, K. K. and McSpadden, G. (2006). Biological Control of Plant Pathogens. *The Plant Health Instructor*.:1-25.

Saha, S.K., McSorley, R., Wang, K.H., and McGovern, R.J. 2005. Impacts of extreme weather and soil management treatments on disease development of Pythium spp. in field grown pepper. *Proceedings of the Florida State Horticul-tural Society***118:**146-149.

Salomone, A., Scaritto, G., Sacco, A., Cabras, G. and Angioni, A. (2008) Inhibitory effects of the main com-pounds of oregano essential oil against some pathogenic fungi. Modern fungicide and Antifungal compounds . *Deutsche Phytomedizinische Gesellschaft*, **44**, 345-360.

Van Bruggen, A.H.C.,Gamliel, G. and Finckh, M.R . (2016). Plant Diseases and their Management in Organic Farming Systems*. Pest Manag Sci.* **72**:30–44.

Wilhite ,S.E. , Lunsden, R.D. and Strancy, D.C. (2001). Peptide synthetase gene *in Trichoderma virens*. *Applied Environmental Microbiology,* **67:** 5055-5062

Application of Statististical Measures In Agriculture: Comparison Of Means For Testing The Significance

Rumana Khan[1] and B R Ranwah[2]

Ph.D. Scholar, Department of Plant Breeding & Genetics[1]
Emeritus Scientist, ICAR and retired professor, Department of Plant Breeding & Genetics[2]
Rajasthan college of Agriculture, MPUAT, Udaipur, Rajasthan, 313001
[1]Corresponding author:-khanrumana315@gmail.com

Statistical procedures which are used to decide whether the differences under study are significant or might be attributed to chance or the fluctuation of sampling are known as tests of significance. The well known and commonly used tests of significance include t test an F test.

t-Test / t-Distribution:

In small samples (n<30) drawn from normal population the ratio of the difference between sample mean and population mean to its estimated standard error is known as t-distribution.

$$t = \frac{\bar{X}-\mu}{s/\sqrt{n}}$$

$$s = \sqrt{1/n-1\sum(x-\bar{x})^2}$$

s = sample standard deviation.

(I) One sample t-test: It is used for testing the significance of difference between sample mean and population mean.

Assumptions:

1) Population is normal.

2) Sample is drawn at random.

1. Set Null hypothesis (H_o): $\mu = \mu_o$

2. Alternative hypothesis (H1): $\mu \neq \mu$

3. L.O.S (level of significance): α

4. Test Statistic:

$$t_{n-1} = \frac{| \bar{X} - \mu_o |}{s/\sqrt{n}}$$

Where, $\bar{x}$ = sample mean

μ_o = population mean

5. Conclusion: If t calculated > t tabulated with n-1 D.O.S. at α L.O.S. H_o is rejected. Thus we conclude that there is significant difference between sample mean and population mean otherwise accepted.

(II) Independent Two sample t-test: It is used for testing the significance of difference between two sample means. It is the test of equality of means for independent samples. Two samples are called independent if the objects of the two samples different. For example the samples of yield of two varieties, soil samples from two locations etc.

Assumptions:

1) Populations are normal.

2) Samples are drawn at random.

1. Set Null hypothesis (H_o): $\mu_1 = \mu_2$

2. Alternative hypothesis (H1): $\mu_1 \neq \mu_2$

3. L.O.S: α

4. Test Statistic:

(1) When variance is homogenous:

$$t = \frac{| \bar{x}_1 - \bar{x}_2 |}{\sqrt{s_c^2 (1/n_1 + 1/n_2)}}$$

$$s_c^2 = \frac{(n_1-1)\, s_1^2 + (n_2-1)\, s_2^2}{n_1 + n_2 - 2}$$

$$s_1^2 = \frac{1}{n_1-1} \sum (x_1 - \bar{x}_1)^2$$

$$s_2^2 = 1 \quad \sum(x_2-\bar{x}_2)^2$$

$$Sc^2 = \frac{\sum(x_1-\bar{x}_1)^2 + \sum(x_2-\bar{x}_2)^2}{n_1 + n_2 - 2}$$

$$Sc2 = \frac{\{\sum x1^2 - (\sum x1)^2/n1\} + \{\sum x2^2 - (\sum x2)^2/n2\}}{n1+n2-2}$$

(2) When variance is heterogeneous:

$$\frac{\bar{X}1-\bar{X}2}{\sqrt{s_1^2/n1+s_2^2/n2}}$$

Where, s_1^2 = sample variance of first sample

s_2^2 = sample variance of second sample

n1 & n2 = sizes of first and second samples respectively.

Test of homogeneity of variance: F ($_{GDF,SDF}$) = G variance/S variance

Significance of F indicates heterogeneity of variances. In such cases variances cannot be pooled.

5. Conclusion: If t calculated > t tabulated with $n_1 + n_2 - 2$ D.O.S. at α L.O.S. H_o is rejected. Thus we conclude that there is significant difference between two sample means otherwise accepted.

(III) Paired t-test: It is the test for equality of means of dependent observations recorded on the samples of a population or same character recorded on intervals. In such cases one observation is dependent on the other one.

Assumptions:

1) Populations are normal.

2) Samples are drawn independently at random.

1. Set Null hypothesis (H_o): $\mu_d = 0$

2. Alternative hypothesis (H1): $\mu_d \neq 0$ (μ_d = mean difference of population mean)

3. L.O.S: α

4. Test Statistic: $t = \frac{|\bar{d}|}{Sd/\sqrt{n}}$

$d = \bar{x}_{1i} - \bar{x}_{2i}$

$\bar{d} = \sum d/n$

$sd = \sqrt{1/n-1\{\sum d - (\sum d)^2 /n}$

Where, $\bar{d}$= difference of means of two samples

n = number of paired samples

5. Conclusion: If t calculated > t tabulated with n-1 D.O.S. at α L.O.S. H_o is rejected. Thus we conclude that there is significant difference between two sample means otherwise accepted.

F Test: It is the ratio of variances applied when means are more than two. The significance of F indicates that treatments are falling in at least two groups. The exact difference between any two means is tested by different post hoc tests. In F test the effect of different sources of variation can be judged using different experimental deigns.

The experimental designs can be classified on the basis of sources of variations, precision required, condition of experimentation etc. The layout of experiment is based on following principles to reduce the experimental error.

1. Replication: It is the repetition of experiment more than one time.

2. Randomization: It is the random allocation of treatments to the experimental units.

3. Local control: It is the grouping of homogenous experimental units together.

The designs can be classified as follows-

(A) Complete Block Designs- All treatments appearing in all replication. These are as follows-

1) **Completely randomized design (CRD)** - Only one source of variation under control. Error is estimated with less precision. It is used in lab and pot experiments. In this design whole experimental material is supposed to be homogenous and divided into number of experimental units depending upon number of treatments and number of replication for each treatment. Then treatments are allocated randomly to these experimental units.

2) **Randomized block design (RBD)** – Two sources of variation are under control. Error is estimated with more precision. It is used in field experiments. Whole experimental unit is divided into homogenous groups known as blocks. In RBD, t

treatments are assigned to r blocks such that each treatment occur precisely once in each block.

3) **Latin square design (LSD)** – Three sources of variation under control. Error is estimated with higher precision. In this design two restrictions are imposed by forming blocks in two directions i.e. row wise and column wise. Treatments are allocated in such a way that each treatment occurs precisely once in each row and column.

(B) **Incomplete Block Designs**-Appearance of all treatments in all replications is not necessary. These are as follows-

1) **Lattice designs-** In lattice designs the number of treatments must be perfect squares. The number of plots and number of blocks in each plot is the square root of number of treatments. These incomplete blocks are combined into groups that form separate complete replications. These are of two types-

1a) Balanced lattice

1b) partially balanced lattice-these are simple lattice, triple lattice, quadruple lattice, alpha lattice etc.

2) **Augmented design –** The area is divided into blocks, the plots in the blocks being single rows. Two or more check varieties are then assigned at random to rows within the blocks, with the same check varieties appearing in each block. The remaining rows within the block are assigned to new selections with a different set of new selection in each block.

The interpretation of F is based on following assumptions:

1) Observations have come from normally distributed population.

2) Treatments are assigned to the experimental units randomly.

3) The factors of the model are independent and additive.

4) All experimental errors (e_{ij}) are independently distributed normally with mean (μ) and standard deviation ( ).

5) Appropriate statistical model is adopted for experimental design.

Analysis of variance is always represented in the form of table generally abbreviated as ANOVA.

Skeletal ANOVA table

Source	d. f.	SS	MS	F cal	F tab
Replication	r-1	SSR	MSR=SSR/r-1	MSR/MSE	
Genotype	t-1	SST	MST=SST/t-1	MST/MSE	
Error	(r-1)(t-1)	SSE	MSE=SSE/(r-1)(t-1)		
Total	Rt-1	TSS			

Fruit Drop and it's Management

[1]Mahaveer Suman, [2]Pency D. Sangma and [3]Deshraj Singh

[1]Senior Research Fellow, College of Horticulture and Forestry, Jhalawar, Agriculture University, Kota, (Rajasthan), India
[2]Department of Agricultural Economics, VNMKV, Parbhani (M.S.)
[3]Division of Agronomy, RARI, Durgapura (SKNAU, Jobner)
*Email:-mahaveersuman001@gmail.com

Globally India is the second largest producer of fruit in the world next to china with a production of 88.9 million tonnes of fruit from an area of 7.2 million hectare. However, the average productivity of fruit in India is 12.3 tonnes/ha (Annon, 2015). Drop of flowers and fruits is common problem in most of the fruit. There are many factors, which fruit drop is influenced by several factors but plant stress and premature ethylene production are the basis of true physiological drop. Stress factors such as nutrient imbalance or deficiency, primary and secondary pest infestation, late season heat and heavy summer pruning all can contribute to fruit drop. (Sharma R.R. 2006). Fruit drop is a major problem in mango, citrus, apple, pear, sapota and stone fruits. Lack of pollination, self-incompatibility, embryo abortion, competition among developing fruit also responsible for fruit drop. It can be controlled by good irrigation, proper nutrient management and exogenous application of plant growth regulators like NAA, GA_3 etc.

Causes of Fruit Drop

1. Genetic variability

Genetic variability among plant species or among cultivars in respect to sex ratio, position of perfect flowers, development of sex organs etc., all regulate the fruit drop. Thus genetic constitution of the plant or a variety play a major role in fruit drop.

2. Pathological factors

Incidence of some disease can result in severe shedding of blossoms and fruits. In mango, anthracnose and powdery mildew disease cause excessive drop of flowers and fruits.

3. Climatic factors

Different climatic conditions have also been reported to be associated with fruit drop in many fruit crops. Among them, temperature, relative humidity, and wind have been considered to have profound influence on fruit drop in many fruit plant. High temperature and high wind velocity contributes also greatly to fruit drop

4. Entomological factors

A good proportion of fruit drop occurs due to the incidence of various insect-pest. For example, mango flowers and fruit in the early stage are attacked by a number of insect-pests, like hoppers, mealy bug, which suck the sap from the panicle and developing fruits, and cause them to drop off pre -maturely.

5. Physiological factors

Several physiological factors are associated with flower and fruit drop in many fruit drop. The important physiological factors, are defective flowers, embryo abortion, poor pollen transference, lack of cross pollination, low stigmatic respectability, competition among developing fruits, etc.

6. Biochemical factors

Many research investigators have reported that some enzyme are also involved in abscission layer formation, which basically required for fruit drop to occur. It has been emphasized that the region of abscission layer formation is predetermined. The cells are detached in abscission zone by the dissolution of middle lamella.

FACTORS AFFECTING OF FRUIT DROP

a. Biotic factors

1. Varietal differences

Certain morphological characteristics, such as strong fruit stalk and heavy fruit weight are directly associated with difference in fruit drop. For example, Langra mango is highly prone to fruit drop as compared to other commercial cultivar of mango. Halmet and Trichur citrus types are less prone to fruit drop due to their strong fruit stalk.

2. Canopy direction

The eastern and western sides of the tree usually retain more fruits as compared to northern or southern sides because these sides get medium insulation. The south side of the tree gets maximum and northern the minimum insulation, the condition not congenial for better fruit retention.

3. Position of fruit on the tree

Fruit retention is very poor if panicles are located deeper into the crown as compared to those located on the tree periphery. Retention of fruit is lesser in deeper canopy because of poor light penetration as compared to periphery, where panicles get sufficient light.

4. Presence of pollinators

Most fruit crops are cross pollinated, and thus require suitable agents to carry out effective pollination. Major pollinators are honeybees, blowflies, wasp and housefly. When the population is an orchard is less, it would affect fruit set. Usually the un- pollinated flower drop within a few days. 4-5 bee hives/ha are considered adequate for optimum fruit set in temperate and stone fruits.

5. Pollinizers

For effective pollination and fruit-set, adequate number of pollinizers must be there in an orchard. For example, In delicious apple, at least 33 per cent plants should be of pollinizing varieties. In absence of suitable pollinizers, the plant in a orchard may have false set, and the fruit drop off in the later stage.

6. Fruit number

In the initial stages, there are numerous fruits and their growth rate is very high. These fruit compare with each other for nutrition and water in the later stages, which result in high drop.

7. Shoot growth

Emergence of vegetative flush along with flowers causes heavy drop in mango, primilarly due to competition between vegetative and reproductive phase. Sometimes, post bloom vegetative flush also pre-mature senescence of entire panicle in mango.

b. Abiotic factors

1. Diurnal variation

Fruit drop during day time is nearly double of that occurring during night hours. Such variation in fruit drop may be due to calm weather and satisfactory internal water relationship during night time compared to day time.

2. Wind velocity

In general, high wind velocity favours fruit drop, because shaking of fruit drop may cause their detachment at higher rate. Maximum wind velocity is basically responsible for fruit drop,but not the low wind velocity.

3. Climatic factors

Among different climatic factors, high temperature and low humidity are potent and cause maximum drop of fruit. Both these condition are responsible for high transpiration rate from young leaves and fruit.

CONTROL OF FRUIT DROP

1. Provision of windbreaks

Planting of a row or two of tall trees as windbreaks on the periphery of an orchard, improves the microclimate, avoids the unfavorable effects of high temperature and desiccating winds, and thereby reduces the chances of fruit drop to some extent.

2. Provision of suitable pollinizers

In fruit crops which require pollinizers for proper pollination, desirable pollinizers should be planted in orchard in a suitable ratio. For example, Tydeman' Early Worcester and Golden Delicious are good pollinizers for apple. The placement of pollinizers in an orchard that holds importance. For planting 33 per cent pollinizers in an apple orchard, every third row should be of pollinizer.

3. Provision of pollinators

Cross-pollination is known to enhance fruit –set not only in cross-pollinated fruit plant, but also in self- pollinated crops. There are various agencies, which helps in cross-pollination , but insects are the major agents. Thus provision of 4-5 beehives/ ha is always beneficial for higher fruit-set and retention of fruit.

4. Proper upkeep of the orchard

The orchard should be maintained properly. All cultural practices viz., irrigation, weeding, manuring and fertilization etc., should be followed properly and at right time, which helps in retaining higher number of fruits in trees.

5. Avoid moisture stress

Moisture stress at flowering, fruit-set and later stages of fruit development is highly detrimental and largely associated with fruit drop. Hence water should be applied to the plant at right time to avoid moisture stress. In general, higher irrigation frequency is required in summer than in winter.

6. Use of mulch

Mulching is considered as one of most important cultural practices, which regulate soil temperature, conserve moisture and suppress weed growth in the orchard. All these factors help to retain higher fruit on the plant. Thus, locally and easily available material (e.g., hay, dry grass, paddy straw etc.) may be used for mulching the plant in the orchard.

7. Control insect-pests and diseases

Although, absolute control of any insect-pest is not recommended to reduce fruit drop and to get better returns from the orchard, but some

control of insect-pest and disease is must. In addition, a proper spray schedule should be followed to keep control on insect-pest and disease as and when they appear.

8. **Check nutritional deficiencies**
For proper growth and development higher fruit-set and better retention of fruit, balanced dose of manures and fertilizer should be given as per recommendations. Complex nutrient deficiencies can be corrected by foliar application of individual nutrient or by following combined nutritional sprays as in citrus. 250 gm Zinc sulphate/plant gave minimum fruit drop 60.30 per cent, (Yadav et al 2007).

9. **Use of growth regulators**
Different growth regulators can be used to check pre- harvest fruit drop. However, their use should be done with great care because a concentration recommended for a particularly variety or a species may be completely useless for the same at different place. Plant growth regulators like GA_3 and NAA and Ethrel is used. NAA 20 ppm gave minimum fruit drop while NAA 30 ppm gave maximum fruit yield of 110.3, (Bal *et al*. 2007).

10. **Use of chemicals**
Some chemicals, particularly calcium nitrate (0.4%) and borax (0.5%) have been found to be very useful for better fruit retention in mango and some other fruit crops.

11. **Special cultural techniques**
Some cultural practices, like ringing or girdling of the shoots have been found effective to increase fruit –set, fruit size and fruit retention in citrus and some other fruit.

CONCLUSION

Fruit drop after June drop varies with cultivar, environmental factors particularly temperature and water. Fruit drop can be controlled by using good irrigation, proper nutrition management and exogenous application of plant growth regulators like NAA, GA_3, *etc.* in various fruit crops**.**

REFERENCE

Anonymous, (2015) Indian Horticulture Data base, National Horticulture Board, Gurgaon **pp.** 1-289.

Bal, J. S. and Singh, C. (2006) Effect of nutrients and growth regulators on fruit drop, size and yield of ber (*Zizyphus mauritiana* Lamk.). *Internat. J. agric. Sci.* **2**.(2) January 2006 : (358-360).

Fruit Production : Problems and Solutions by R R Sharma, *International Book Distributing co.,* 2006.

Yadav R. K., G. S. Rana, V. P. Ahlawat, D. S. Dahiya and S. Kumar. 2007. effect of zinc application on growth and fruit drop of sweet orange (Citrus sinensis Osbeck). *Hariyana J. Hort. Sci*. **36**:205-206.

Utility of different chemicals on seed germination of dry land fruit crops

[1]Mahaveer Suman, [2]Deshraj Singh and [3]Pency D. Sangma

[1]Senior Research Fellow, College of Horticulture and Forestry, Jhalawar, Agriculture University, Kota, (Rajasthan), India
[2]Division of Agronomy, RARI, Durgapura (SKNAU, Jobner)
[3]Department of Agricultural Economics, VNMKV, Parbhani (M.S.)

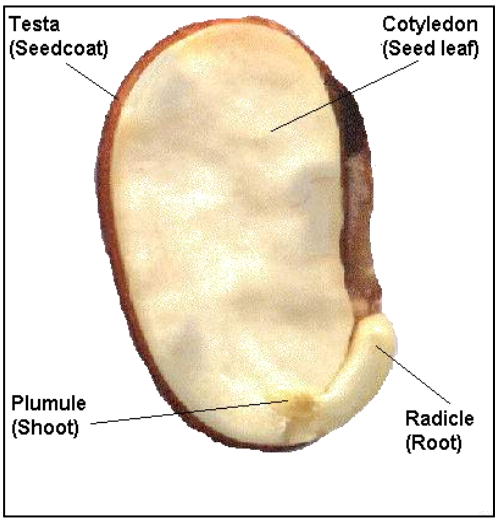
Dry land fruit crops can be propagated by asexual and sexual methods. Seed germination is not even and also irregular, making sexual propagated difficult. Irregular germination in dry land fruit crop seeds may be due to dormancy or due to its hard seed coat. Therefore, pre- treatment is very important and it can be done either by physical methods such as scarification or by soaking in water to reduce impermeability of the seed coat or by using chemicals such as gibberellic acid and potassium nitrate to improve germination. Presoaking of ber seeds in GA_3 200 ppm either alone or combination with 5 percent sucrose solution or thiourea at 500 ppm was found to improve the seed germination and seedling growth, Krishnan and Kulasekaran (1984). As these treatments were found to be useful in improving the germination and increase the production and productivity in many fruit crop species having hard coated seeds.

Seed

- Seed is a mature ovule
- A seed contains the developing plant embryo in a protective coat (testa)
- Seeds form from ovules fertilized in the ovary
- Ovaries with seeds ripen into dry or fleshy fruits

Parts of a Seed

- External seed coat or testa
- Developing plant embryo
- Stored food called endosperm
- Seeds may be in one part
- monocot or two parts dicot

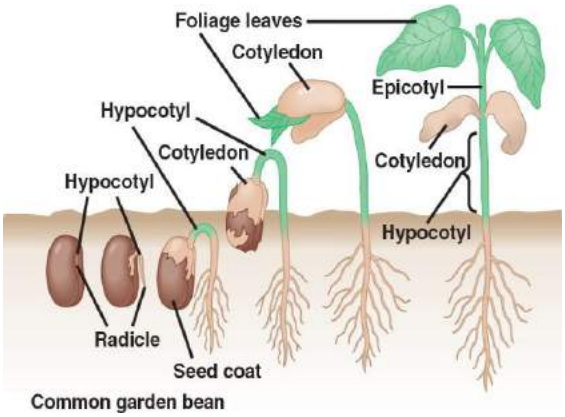


Seed Structure

- ✓ Plumule: develops into the stem.
- ✓ Cotelydon: stores or absorbs food for the developing embryo.
- ✓ Radicle: first part of a seedling - primitive root

- ✓ Micropyle: small pore on the seed coat for absorption of water.
- ✓ Testa: outer seed coat, protective layer

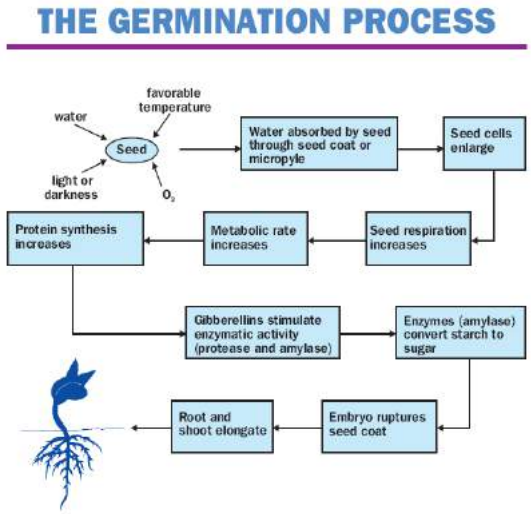
SEED GERMINATION PROCESS



Common garden bean

Conditions for seed germination

1. Water 2. Warmth 3. Oxygen



What is Seed treatment

- Seed treatments are defined as chemical or biological substances that are applied to seeds or vegetative propagation materials to control disease organisms, insects, or other pests.
- Seed treatment using different chemicals like H_2SO_4, GA_3, KNO_3 etc.
- Most seed treatments are applied to true seeds, such as ber, guava, custard apple or karonda, which have a seed coat surrounding an embryo.

Purpose of seed treatment

1. Control of Seed borne Pathogens:

➢ Seed treatments can often be used to control pathogens that occur on or in the seed. The choice of seed treatment may be by whether the pathogen is borne externally or internally.

2. Protection of Seeds and Seedlings:

➢ Seed treatments can protect the seed and seedling from attack by certain insects and

3. To improve the seed germination:

➢ Seed treatment often improve the standard of germination through the control of seed surface flora. Though normally not considered pathogenic, this may infect the seed following moist harvesting and storage condition.

Seed dormancy:

- Active growth temporarily suspended Survival mechanism
- Genetically inherited trait
- Wild plants show more dormancy than crop plants
- A degree of dormancy is desirable as it prevents premature sprouting on the parent plant
- Dormancy is defined as a state in which seeds are prevented from germination even when environmentalconditions are favourable.

CAUSES OF SEED DORMANCY

- Lack of water due to impermeability of seed coat
- Impermeability of the seed coverings to gases (oxygen)

- Mucilaginous material surrounding seed
- Mechanical restriction of embryo growth
- Hard Seed Coat

METHODS OF BREAKING SEED DORMANCY

Mechanical scarification

- Brief immersion in boiling water
- Piercing seed coats
- Rubbing seed on Hard surface

Chemical scarification

- Sulphuric acid
- Sodium hypochlorite
- Hydrogen peroxide
- Cellulase and pectinase

ROLE OF GROWTH REGULATORS IN SEED GERMINATION

Gibberellin

- Increase in germination due to Gibberellic acid might be due to the promoter role in releasing the dormancy mechanism and starch hydrolysis
- Enhances alpha-amylase synthesis Which breaks down starch to glucose
- Sour lime seeds treated with GA_3 500 ppm for 40 hrs, result indicated that the maximum number of germination percentage, number of leaves per seedling, diameter of stem and survival of seedling. Dhaka and Pal (2009).

Auxins

Auxins and other plant growth regulators are universal components of plants and common constituents of seeds.

- Auxins used widely to break the seed dormancy
- IAA, IBA, 2,4-D used in seed soaking for germination
- At very low concentration promote germination
- But higher concentration retard germination
- The growth parameters like height of plant, number of leaves per plant, fresh and dry weight of shoot, root and Biomass study like Length of tap root were significantly influenced by application of GA_3 150 ppm plant growth regulators and chemical NAA 150 ppm of Kagzilime, Kadam *et al*. (2010).

Abscisic acid

- Inhibit growth and seed germination
- Promote dormancy
- Help to tolerate stressful condition

Cytokinins

- Breaking the dormancy of seed
- Major role in root initiation

Ethylene

- Abscission of leaves , fruits and flowers
- Stimulate fruit ripening
- Release of dormancy
- Enhance seed germination
- Sapota seeds pre – soaked in GA_3 400 ppm produced significantly higher shoot length and the highest root length. The number of leaves per seedling was maximum and the seedling vigour index was highest with GA + ethrel each at 400 ppm pre – soaked seeds, Pampanna and Sulikeri (2002).

Sulphuric acid

- To improve the seed germination,
- Increase the stem elongation,
- Increase the root initiation.

Potassium nitrate

- To break the seed dormancy,

- Increase the number of leaves per seedling,
- Increase the root length.

REFERENCE

Krishnan, B.M. and M. Kulasekaran., 1984. Studies on seed germination in wild Ber (Zizyphus rotundifolia). South Indian. Hort. **32** : 153-154.

Kadam, A.B., B.D. Singh., and R. A. Kade ., 2010. Effect of plant growth regulators and potassium nitrate on growth of seedling of Kagzilime. Asian J. Hort. 5 (2): 431 – 434.

Pal,S. L., and S.S. Dhaka ., 2010. Effects of GA_3 on germination of seeds and growth of seedlings of sweet orange (*Citrus sinensis).*Prog. Agric. 10 (1): 166 – 167.

Pampanna, Y. and G. S. Sulikeri., 2001. Effect of growth regulators on seed germination and seeding growth of Sapota. Karnataka J. Agric. Sci., **14** (4) : 1030-1036.

Nutriseed Pack: An Alternative Fertilization Method

Kalaiselvi Beeman[1] and Arulmozhiselvan K[2]

[1]*National bureau of soil survey and land use planning, RC, Hebbal, Bangalore-560 024, Karnataka, India*

[2]*Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore- 641 003, Tamil Nadu, India*

Corresponding author: kalaimitra15@gmail.com

Nutriseed pack technique is an innovative approach of placing all nutrients just below the root in soluble and slow release form, which remain intact as a ready reserve, to supply nutrients in small and adequate amounts as and when the roots require the nutrients. Nutriseed Pack Technology is a new method of crop production developed by the Department of Soil Science and Agricultural Chemistry, TNAU, Coimbatore. In Nutriseed Pack technology each plant can be established by placing a Nutriseed Pack in soil. Nutriseed Pack contains seed at top, enriched manure in the middle and encapsulated fertilizer at bottom. Nutriseed Pack gives support for each plant in the root zone in terms of optimum nutrient supply, biological activity and consequently enables the fullest utilization of nutrients by plants. There is no wastage of fertilizer nutrients with Nutriseed Packs.

Design of Nutriseed Pack

Nutriseed Pack has 3 parts viz., top bioinoculant mixture with seeds; central manure pellet and bottom fertilizer pellet. On the top, seeds with bioinoculant mixture which are responsible for N_2 fixation, P and Zn solubilization and biocontrol agents are placed as powder or granules. Highly decomposed manure having C:N ratio below 30:1 enriched with P, micronutrients and pesticide/ fungicide is pelleted with pelleting device and placed at the centre. At bottom a mixture of NPK fertilizers made in pellet form and encapsulated in polyester coated (bio degradable) pack is placed. The amount of nutrients in fertilizer pellet is in amount equal to the recommended dose of the crop. Each Nutriseed Pack is assembled by combining the 3 parts together and wound in newspaper as a roll (Fig. 1).

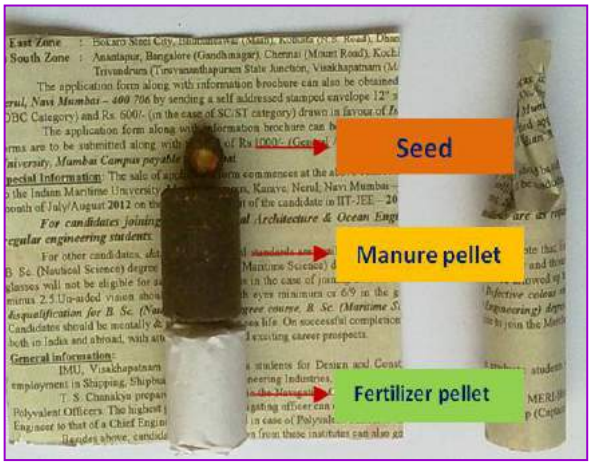


Fig. 1: Design of Nutriseed pack

Fabrication of Nutriseed Packs involved following steps:

Preparation of enriched manure: For preparing manure pellet, enriched vermicompost was used. For this purpose, enriched vermicompost can be prepared by mixing with 5% of Diammonium phosphate, 0.5 per cent Furadan or other pesticides, 0.5 per cent micronutrient mixture and incubated for 30 days with appropriate moisture content. At the end of the period, the enriched manure was pelletized in the pelleting device.

Pelleting of enriched manure: In the feed tray of pelleting machine enriched manure was added. Then, by the action of rotating roller on a circular perforated die the enriched manure was compacted and taken out as manure pellet measuring about 30 mm length.

Pelleting of fertilizers: In the feed tray of pelleting machine the fertilizer mixture (Urea, Single Super phosphate /DAP, Potash) prepared as per treatment was placed. Then by the reciprocating action of the piston fertilizer mixture was compacted and taken out as fertilizer pellet measuring about 30 mm length.

Encapsulation: Each fertilizer pellet was placed in a small pouch made of polyester coated paper and the mouth was sealed with the sealing machine. Small micropores were provided on surface of pouch for the release of nutrients, as per treatments.

Nutriseed Pack assembling: When fertilizer pellets, manure pellets and bioinoculants were ready, they were assembled on a 10 cm x 10 cm newspaper as a roll. The paper was placed on a flat surface. On middle lower portion of paper, first encapsulated fertilizer pellet was placed, coinciding to the bottom edge. Over fertilizer pellet, the manure pellet was placed. Over manure pellet seeds with bioinoculants were placed. The bioinoculants used were *Azophos* (mixture of *Azospirillum* and *Phosphobacteria*) and *Trichoderma*. Then, one end of paper was flipped over the pellets and then folded as a roll. The closing side edge of the paper roll was fixed with white adhesive and pasted. These rolls were then air dried and stored in cartons.

Placement of Nutriseed Pack in soil: Each Nutriseed Pack was implanted in the field horizontally, parallel to surface of soil at about 3 to 5 cm depth. When the seeds in the Nutriseed pack grew, the seedling roots tap the diffusing nutrients from the surface of Nutriseed pack. No top dressing of fertilizers was done.

Fig. 2: Placement of Nutriseed pack and germinated seedlings from Nutriseed pack

ADVANTAGES OF NUTRISEED PACK TECHNIQUE:

- Sowing of seeds and application of bioinoculants, enriched manure and fertilizers are done in the field in a single attempt.
- Nutrient support is provided to the highest extent to the plant in the root zone.
- Weeds have less chance to tap the nutrients from Nutriseed Pack.
- Inclusion of systemic pesticide/ fungicide in enriched manure pellet gives protection against pests/ wilt in the early stages of plant growth.
- Slow release of nutrients support the crop throughout the crop period and result in desirable yields.

REFERENCES

Arulmozhiselvan, K., R. Vengatesan and M.Deivanai. 2009. Nutriseed holder technique for increasing nutrient use efficiency and yield under wetland and upland situations in rice and Maize, Research on crops, 10: (3).

Asha, V. S. 2003. Assessment of contribution of Azolla and deep placed fertilizers in direct seeded rice using ^{15}N technique. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Kalaiselvi, B. 2013. Regulating nutrient release of Nutriseed pack for enhancing yield of upland maize and cotton and flooded rice. Ph.D (SS&AC) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Role of Plant Growth Promoting Rhizobacteria in Sustainable Agriculture

[1]Jitendra Kumar Sharma, [2]Divya Vyas and [3]Priyanka

[1,3]Department of Agriculture chemistry and soil science, [2]Department of Molecular Biology and Biotechnology, Rajasthan College of Agriculture, MPUAT, Udaipur
Corresponding author:jitendrasharma38163@gmailcom

Plant growth promoting rhizobacteria (PGPR) can be defined as the indispensable part of rhizosphere biota that when grown in association with the host plants can stimulate the growth and nutrient uptake (Bai *et al*., 2002; Salamone *et al*., 2001). PGPR are the rhizosphere bacteria that can enhance plant growth by a wide variety of mechanisms like phosphate solubilization, siderophore production, biological nitrogen fixation, rhizosphere engineering, production of 1-Aminocyclopropane-1- carboxylate deaminase (ACC), quorum sensing (QS) signal interference and inhibition of biofilm formation, phytohormone production, exhibiting antifungal activity, production of volatile organic compounds (VOCs), induction of systemic resistance, promoting beneficial plant-microbe symbioses, interference with pathogen toxin production etc. However, in accordance with their degree of association with the plant root cells, PGPRs can be classified into extracellular plant growth promoting rhizobacteria (ePGPR) and intracellular plant growth promoting rhizobacteria (iPGPR). The ePGPRs may exist in the rhizosphere, on the rhizoplane or in the spaces between the cells of root cortex. For eg. *Agrobacterium, Arthrobacter, Azotobacter, Azospirillum, Bacillus, Burkholderia, Caulobacter, Chromobacterium, Erwinia, Flavobacterium, Micrococcous, Pseudomonas* and *Serratia* etc. iPGPRs locates generally inside the specialized nodular structures of root cells. For eg. *Allorhizobium, Azorhizobium, Bradyrhizobium, Mesorhizobium* and *Rhizobium* of the family *Rhizobiaceae.* The potentiality of PGPR in agriculture is steadily increased as it offers an attractive way to replace the use of chemical fertilizers, pesticides and other supplements. Several PGPR formulations are currently available as commercial products for agricultural production of beneficial crops.

APPLICATION OF PGPR IN SUSTAINABLE AGRICULTURE:

Bioremediation: The application of PGPRs in rhizoremediation technologies is now being considered as effective, since inoculation of PGPR strains could aid remarkable enhancement in plant growth and development on contaminated agroclimatic conditions. Rhizobacteria can directly assist rhizoremediation by producing IAA, biological nitrogen

fixation, solubilizing P and secreting siderophores. PGPR strains, *Pseudomonads* and *Acinetobacter* enhance uptake of Fe, Zn, Mg, Ca, K and P by crop plants. PGPR along with AM fungi are now being utilized in the nutrient poor agricultural soils to increase the solubility of heavy metals and thereby increasing the chances of success in rhizoremediation.

Phosphate (P) solubilization (Ahemad and Khan, 2012): This low availability of phosphorous to plants is because of the vast majority of soil P is found in insoluble forms, while the plants can only absorb it in two soluble forms, the monobasic ($H_2PO_4^-$) and the diabasic (HPO_4^{2-}) ions. The solubilization of P in the rhizosphere is the most common mode of action implicated in PGPR that increase nutrient availability to host plants. Bacterial genera like *Azospirillum, Azotobacter, Bacillus, Beijerinckia, Burkholderia, Enterobacter, Erwinia, Flavobacterium, Microbacterium, Pseudomonas, Rhizobium* and *Serratia* are reported as the most significant phosphate solubilizing bacteria. Besides, examples of some widely reported P solubilising microbial species intimately associated with a large number of agricultural crops like potato, tomato, wheat, radish, pulses etc.

Production of plant growth regulators: PGPR can alter root architecture and promote plant development with the production of different phytohormones like IAA, gibberellic acid and cytokinins. Several PGPRs as well as some pathogenic, symbiotic and free living rhizobacterial species are reported to produce IAA and gibberellic acid in the rhizospheric soil and thereby play a significant role in increasing the root surface area and number of root tips in many plants. The biosynthesis of indole acetic acid by plant growth promoting rhizobacteria involves formation via indole-3- pyruvic acid and indole-3-acetic aldehyde, which is the most common mechanism in bacteria like *Pseudomonas, Rhizobium, Bradyrhizobium, Agrobacterium, Enterobacter and Klebsiella* (Shilev 2013).

PGPR as biofertilizer and biopesticides: Biofertilizers are the substances, prepared from living microorganisms which, when applied to the seeds or plant surfaces adjacent to soil can colonize rhizosphere or the interior parts of the plants and thereby promotes root growth. *Allorhizobium, Azorhizobium, Bradyrhizobium, Mesorhizobium, Rhizobium* and *Sinorhizobium* are reported as the potent PGPR strains for their ability to act as biofertilizers. Besides, iron-chelating siderophores, antibiotics and hydrogen cyanides are also likely to be produced by PGPR strains, participating tremendously in the reduction of phytopathogens and deleterious rhizobacteria with a corresponding improvement in plant health.

Production of ACC deaminase and regulation of ethylene level in plants: Although ethylene is essential for normal growth and development in plants, at high concentration it can be harmful as it induces defoliation and other cellular processes that may lead to reduced crop performance. Using their 1-amino cyclopropane-1-carboxylic acid (ACC) deaminase activity, PGPR can divert ACC from the ethylene biosynthesis pathway in the root system of *Arabidopsis thaliana*

plant. PGPR containing ACC deaminase can boost the plant growth particularly under stressed environmental conditions like salinity, drought, water logging, temperature, pathogenicity and contaminants in response to a multitude of abiotic and biotic stresses.

Production of volatile organic compounds: The discovery of rhizobacterial-produced volatile organic compounds (VOCs) constitutes an important mechanism for the elicitation of plant growth by rhizobacteria. Some PGPR strains namely *Bacillus subtilis* GB03, *B. amyloliquefaciens* IN937a and *Enterobacter cloacae* JM22 that released a blend of volatile components, particularly, 2, 3-butanediol and acetoin, which promoted growth of *Arabidopsis thaliana*.

PGPR as biotic elicitors: Elicitors are chemicals or biofactors of various sources that can trigger physiological and morphological responses and phytoalexin accumulation in plants. It may be abiotic elicitors such as metal ions or inorganic compounds and biotic elicitors, basically derived from fungi, bacteria, viruses, plant cell wall components and chemicals that are released due to antagonistic reaction of plants against phytopathogens or herbivore attack.

Nitrogen fixation: Number of PGPR strains such as *Azoarcus sp., Beijerinckia sp., Klebsiella pneumoniae, Pantoea agglomerans* and *Rhizobium sp.* are reported to fix atmospheric N_2 in soil and make it available to plants. PGPR can fix atmospheric N_2 either symbiotically or non-symbiotically.

Maintenance of soil fertility and nutrient uptake: Inoculation of rhizobacteria increased uptake of nutrient elements like Ca, K, Fe, Cu, Mn and Zn by plants through stimulation of proton pump ATPase. Reports are available on the combinations of *Bacillus* and *Microbacterium* inoculants to improve the uptake of the mineral elements by crop plants.

Commercialization of PGPR: The first commercial product of *Bacillus subtilis* was developed during 1985 in US. 60–75% of cotton, peanut, soya bean, corn, vegetables and small grain crops raised in US are now treated with commercial product of *B. subtilis,* which become effective against soil borne pathogens such as *Fusarium* and *Rhizoctonia.* In India, more than 40 stakeholders from different provinces have registered themselves for the mass production of PGPRs with Central Insecticide Board (CSI), Faridabad, Haryana through collaboration with Tamil Nadu Agricultural University, Coimbatore, India.

REFERENCES

Bai Y., Aoust D., Smith F.D.L., Driscoll B.T. (2002). Isolation of plant growth promoting *Bacillus* strains from soybean root nodules. *Can. J. Microbiol.,* 48: 230–238.

Ahemad M. and Khan M.S. (2012). Evaluation of plant growth promoting activities of rhizobacterium *Pseudomonas putida* under herbicide-stress. *Ann. Microbiol.,* 62: 1531– 1540.

Salamone I.E.G., Hynes R.K., Nelson L.M. (2001). Cytokinin production by plant growth promoting rhizobacteria and selected mutants. *Can. J. Microbiol.,* 47: 404–411.

Shilev S. (2013). Soil Rhizobacteria Regulating the Uptake of Nutrients and Undesirable Elements by Plants. In: Arora NK (ed.) Plant Microbe Symbiosis: Fundamentals and Advances. Springer, India, 147-150.

Urea Molasses Mineral Block as Feed Supplement in Ruminant Nutrition

[1]Vivek, Narender Singh[2], Sushil Kumar[3] and Ravi Kumar[2]

[1]Technical manager, Neospark Drugs & Chemicals Pvt. Ltd.
[2]Deptt. of LPM, [3]Animal Nutrition, LUVAS, Hisar-125004

The production level of dairy animals in India is greatly influenced by the lack of green fodder and good quality feed. Crop residues and dry grasses are the major source of forages for feeding livestock in our country. These crop residues are low in nitrogen and high in fibre and lignin; characteristics thaat restrict intake and digestibility in animals. Urea is a rich source of nitrogen which can be fed in several forms. It may be included in solid blocks which also provides vitamin and mineral supplementation and contains a readily available source of energy. Usually urea can be fed through urea molasses mineral block at prescribed limits of daily

Molasses	30-50%
Rice bran	15-25%
Urea	5-10%
Cement(bentonite)	5-7%
Salt	5-7%
Dicalcium phosphate	2-4%
Trace minerals	1-2%

intake of urea as NPN source. UMMB is a high protein concentrated feed in addition containing necessary amount of carbohydrate, minerals and vitamins. The

Urea supplies as protein to the Microbes and increase the population of microbes and thereby it maintenance rumen microbial environment which enhance the digestion of cellulose as ruminants can produce microbial protein from non-protein nitrogen, UMMB supplementation in the ration is quite beneficial, especially when fed crop-residue-based diets. The use of UMMB for supplementing crop-residue-based diets for livestock has the potential to increase livestock production and net daily income. UMMBs can be fed throughout the year but are more-beneficially utilized during the dry season or when the animals are grazing low-quality fodder.

The ingredients and chemical composition specification of UMMB:

Moisture (%), Max	3.5
Crude Protein (%), Min	58.0

Crude Fibre (%), Max	2.0
Total Ash (%), Max	34.0
Acid Insoluble ash (%), Max	3.0
Calcium (%), Max	4.0
Phosphorus (%), Min	1.5
Sulphur (%), Min	1.0
Urea (%), Max	10-15.0

METHODS OF PREPARATION

1. The hot process-

National Dairy Development Board (NDDB) first introduced UMMB to farmers in 1983, by manufacturing block licks using a 'hot process'. Blocks were produced by steam-heating the molasses and then mixing it with other ingredients in a double-jacketed insulated vessel. But It was difficult to handle the hot material manually at 130 °C and the blocks, being highly hygroscopic, would start melting and de-shaping on storage.

2. The cold process-

To avoid problems faced in manufacturing the block licks by the 'hot process', efforts were made to produce blocks by the 'cold process' using lime as a gelling agent. It was possible to produce reasonably-hard blocks using lime, however these blocks had very low palatability due to their bitter taste, resulting in poor acceptance at the field level. To overcome these problem efforts were made to improve the block lick formulation, to ensure that the blocks were hard enough and also palatable to the animals. To achieve this, lime and magnesium oxide were used in combination, and a buffering agent was added towards the end of the process to reduce the pH which considerably improved palatability of the blocks.

Advantages of urea Molasses Mineral Blocks (UMMB)

- Ingredients are easily available in almost all parts of Indian and its preparation is very easy and cheaper than conventional sources of protein (Oil cakes)
- Density of UMMB is much higher than the ingredients, which facilitates long distance transportation, at a cheaper rate.
- UMMB blocks are suitable for supplementing dry fodder based diets for sustainability of ruminants during droughts and floods.
- UMMB licks are hard enough to control gradual intake limited to about 700 g in adult bovines and 800 -1000 g in growing bovines of about 200 kg body weights.

Precautions while supplementing UMMB

- Fed strictly to ruminants only sheep, goats, cattle.
- Harmful to mono gastric animal i.e. horses, donkeys or pigs.
- Avoid to fed young ruminant less than six months of age (calf, kids and lambs)
- Blocks should fed as a feed supplement and not as the basic ration
- Never feed blocks to a thin animal with empty stomach, there is risk of poisoning due to excessive consumption.
- The block should never be supplied in ground (powder) form or dissolved in water as this can result in over consumption resulted toxicities of urea

- Supply sufficient amount of water to avoid urea toxicity.
- Block should be fed as a lick
- The block should be introduced slowly and should fed forage in adequate quantity
- UMMB should not replace the entire concentrate feeding

CONCLUSION

UMMB appears to be a simply way of improving the efficiency of utilization of fibrous feeds by ruminants. UMMB have proven to be an excellent tool for the improvement of ruminant feeding. Thus Urea Molasses Minerals Blocks is a unique cost effective feeds supplement for ruminants which increase the intake of roughages and as a result increase the milk production.

SWOT analysis of "How to double the farmer's income till 2022?"

Amit Guleria[1], Vikram Singh[2], Kartikey Sahil[3] and Prabhat Tiwari[4]

Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh
Corresponding author: amitgauleria1201@gmail.com

Abstract

Farming now-a-days is very difficult as a profession due to poor infrastructure in rural areas, no electricity, no irrigation facility, Poor availability of quality inputs, Small holdings and lack of technology etc. but there is always a scope for improvement. Like, diversification, organic farming, better market facilities, improvement in agricultural techniques, and betterment in financial services, proper utilization of government subsidies, better extension activities by agricultural institution and role of NGOs for awareness programmes which make the interest of farmer to adopt farming as a profession. All these efforts were taken by the farmer and government together ultimately leads to double the farmer's income till 2022 which can help to prosper nation.

"To forget how to dig the earth and to tend the soil is like forgetting ourselves."

Mohandas Karamchand Gandhi

His words stand still today what is India if we have no agriculture. Apart from just being a sector in the union budget, it is the mother of all employment in our economy. Being one of the fastest growing economies of the world where changes have been so drastic and rapid agricultural practice is one occupation which hasn't changed over the years. It is said that the pleasure of feeding a hungry person is equivalent to a life worth living and that is the correct explanation for all the sweat, labour and hard work of all the farmers be it a big established farmer who uses all the modern technology to yield fruits from the land or a small framer who is working on his land with a hope that this season he will have enough food for himself and to sell so that he hasn't had to look back the entire year.

STRENGTH

India has proudly opened its gates to the world platform. The only thing that is uncertain is change according to the changing economy our country faces the agricultural techniques have also been drastically changed over the years. The Indian government has taken steps to come forward and help the neediest and the most profitable sectors of the Indian economy. The agricultural technology information centre comes up with the distribution of free products, information, and diagnosis of land to several farmers, entrepreneurs, stakeholders to help them diversify the

farming practices and lead it into a growth face. From the past few years the organic farming techniques which yield organic food products have taken significant rise, there are new variants entering the wheat department, there has been a significant start to the aromatic rice farming, various pesticides like neem oil EW, water dispersible granules of DDT and many other forms have entered into commercialization which has given rise to this sub segment to. The most significant part of agriculture is water introduction and application of solar water pumps and eco-friendly way of pumping water for irrigation is a smart move to conserve the society as well provide with water to farmers.

WEAKNESS

Crisis due to act of God like tsunami, cyclones like hud-hud, heavy downpour, water scarcity are almost beyond our control but with today's high-tech capabilities and cross national cooperation we could go a long way to mitigate it through measures like the much proposed interlinking of river project which could transfer excess flow in flood prone conditions to places of water scarcity and it also gives us an opportunity to resolve the interstate river disputes, we need better early warning system(EWS), disaster management training for volunteers, National Disaster Response Force(NDRF) with proper training and rescue equipment . Here cooperation of neighbours could be a huge boon like the ongoing hydro project in Nepal, Bhutan could check the potential water crises and at the same time address our energy deficit issues. The proposed SAARC satellite by our PM seems to be a compelling means to monitor the future crisis and help forces to better resolve and rescue. But we also need to monitor the river treaty like Indus treaty with Pakistan and Bangladesh treaty to have a good sense of understanding and cooperation on water sharing and crisis management.

OPPORTUNITY

"Prevention is always better than cure" is an often quoted line but highly downplayed too otherwise our country would not have been facing so many water crisis which mainly includes floods and droughts in spite of a growing technical base. The recent flood in Kashmir further plunged the heavenly state into despair when the locals were still trying to recover from the devastating wrath of Jhelum overflow but the main bone of contention is the total failure of authorities specially the state functionary to even provide basic rescue and support to those affected. Here we should feel honored to have a dedicated army and air force who left no stone unturned to help the needy and saved the state from further crisis. This should open our eyes and make us take efficient steps to strengthen the response level and helplessness of authorities and our volunteer base in face of any future crisis.

THREAT

The crisis in the agrarian industry of India, which employs nearly 52% of the

nation's working population, has assumed epidemic proportions and has pervaded throughout India, transcending all boundaries of states and climate.

One of the most glaring fault lines is the constant dip in crop production post liberalization. The agricultural production growth rate, which was steadily increasing during 1950-1990, was incidentally higher than the population growth rate, thus helping India achieve self-sufficiency in foodgrain output. However, the Mid-term Appraisal of the Tenth Five Year Plan (2002-07) estimated that the growth rate of the GDP in agriculture and allied sectors was just one per cent per annum during the year 2002-05. The reduction in per capita foodgrain availability forced India to import foodgrain from foreign markets at much higher price than domestic markets.

CONCLUSION

It is a high time where we have to think and be liable to answer those dreamy eyes that always wonder what the harvest of the next season bring to him. Why can't there be a smile on the optimistic Indian farmer's face instead of a frown? Why can't there be hope and wisdom instead of failure why can't there be a success instead of giving up on life? The exigency of the hour is for the government to give ample subsidies to farmers, to encourage efficient microfinance ventures in villages and to periodically revise the procurement prices of farm produce. Bold steps taken by the government will help in making India a prosperous nation and an agricultural superpower.

Bio-Fortified Crops For Improved Human Nutrition

B R Ranwah[1] and Rumana Khan[2]

Emeritus Scientist, ICAR and retired professor, Department of Plant Breeding & Genetics [1]
Ph.D Scholar, Department of Plant Breeding & Genetics[2]
Rajasthan college of Agriculture, MPUAT, Udaipur, Rajasthan, 313001
[2]Corresponding author:-brranwah@yahoo.com

People's deficiencies in key vitamins and minerals continue to pose a very serious constraint to human health and economic development. Bio-fortification represents one promising strategy to enhance the availability of vitamins and minerals for people whose diets are dominated by micronutrient-poor staple food crops. It involves the identification of varieties of a crop that naturally contain high densities of certain micronutrients. The Global Nutrition Report (2014) and the Kigali Declaration on bio-fortified Nutritious Foods (Harvest Plus 2014a) both highlight the need for multiple complementary strategies to address key micro-nutrient deficiencies. Bio-fortification is the development of nutrient-dense staple crops using the best conventional breeding practices and modern biotechnology, without sacrificing agronomic performance and important consumer-preferred traits.

Status of bio-fortified crops:

The following outline covers a small selection of the many varieties that have so far been bio-fortified through public research organisations and released for open access in 27 developing countries to date. Reference is made to some of the studies that have confirmed the nutritional value and cost-effectiveness of such crops:

High-iron bean varieties are now being disseminated in Rwanda, Uganda and the Democratic Republic of Congo. In addition to having higher iron content than traditional varieties, preliminary evidence shows that bio-fortified beans can improve iron status in Rwandan women (Haas *et al.* 2014). Acceptability (to taste) and uptake by farmers exposed to the new varieties have been good. In Rwanda, the UN's World Food Programme has purchased these beans for use in refugee camps with a view to improving iron intake among these nutritionally vulnerable consumers (WFP 2014).

Orange flesh sweet potato contains high levels of beta-carotene (a building block for vitamin A). Tests show that 75% of the beta-carotene is retained in the potato even after boiling in preparation for a meal (Harvest Plus 2014a). Consumer acceptability and nutritional impacts have been widely documented; that is, higher vitamin A status among consumers in some contexts **(**Hotz *et al.* 2012), and

higher beta carotene concentrations in others (Van Jaarsveld *et al*. 2005; Jamil *et al.* 2012). Africans have typically eaten Bio-fortification – Evidence and Uptake white sweet potato which contains no vitamin A. Yields of orange flesh sweet potatoes are as high as those of the white sweet potatoes. Since 2009, eight African countries have released 31 orange flesh sweet potato varieties (Harvest Plus 2014d).

Cassava varieties with high levels of beta carotene are called yellow or golden cassava. These varietals were released in 2013 in Nigeria, where 100 million Nigerians eat cassava daily. Consuming yellow cassava has been shown in one small study to have small but significant improvements in vitamin A status of children (Talsma 2014). Currently, more than 500,000 farmers have received and planted this bio-fortified cassava (Harvest Plus 2014d). Human studies of nutritional impact are ongoing.

Maize with high beta carotene traits has been shown to be as efficacious as supplements (Gannon *et al.* 2014). Varieties of this orange maize were released in Zambia in 2012. They yield at least as well as traditional varieties and have been shown to have nutritional impact (de Moura *et al.* 2014). Bio-fortification has been highlighted in Zambia's National Food and Nutrition strategy, and has received strong government support, including tastings by members and staff of the Zambian Parliament.

Rice bio-fortified with zinc was released to farmers in Bangladesh in 2013 (Chowdhury 2014). The country's first bio-fortified rice varieties have a zinc content that is 30% higher than local varieties (Harvest Plus 2014a). The new rice matures faster than some traditional varieties and contains the zinc in the endosperm rather the outer periphery of the grain, which is usually lost to the consumer when rice is polished. The capacity to scale up high-zinc rice has still to be demonstrated, but if widely planted and consumed in poor households, it could contribute significantly to meeting zinc requirements in countries like Bangladesh, where the poor consume large amounts of rice daily and often sacrifice the consumption of other more nutrient-rich foods as a result. Because of its significance to poor consumers in Asia and parts of Africa, and because rice shows low natural variation or complete absence in some micronutrients, rice has been a particular target of transgenic approaches to micronutrient enhancement. Transgenic research has focused on improving beta-carotene and iron levels, but transgenic varieties have not yet been released.

Bio-fortified pearl millet, with higher iron and zinc content, is already being grown widely in Maharashtra, India. Studies showed that porridges or breads made with this new pearl millet provide a significant amount of iron and zinc (Harvest Plus 2014d). Iron bio-fortified millet has been shown to improve the iron status of school-aged children (Beer *et al.* 2014).

STEPS FOR BIO-FORTIFICATION:

1. Identification of genetic variability within the range that can influence human nutrition.

Table- 1 Schedule of product release:

Crop	Nutrient	Countries of first release	Agronomic Trait	Release year [a]
Sweet Potato	Pro-vitamin A	Uganda, Mozambique	Disease resistance, Drought tolerance, acid soil tolerance	2007
Beans	Iron, Zinc	Rwanda, DR Congo	Virus resistance, Heat and drought tolerance	2010
Pearl Millet	Iron, Zinc	India	Mildew resistance, Drought tolerance	2011
Cassava	Pro-vitamin A	Nigeria, DR Congo	Disease resistance	2011-12
Maize	Pro-vitamin A	Zambia	Disease resistance, Drought tolerance	2011-12
Rice	Iron, Zinc	Bangladesh, India	Disease and pest resistance, cold and submergence tolerance	2012-13
Wheat	Iron, Zinc	India, Pakistan	Disease resistance, Lodging	2012-13

[a] - *Approved for release by National Governments after intensive multi-location testing for agronomic and micronutrient performance.*

2. Introgressing this variation into high yielding, stress tolerant genotypes possessing acceptable end-use quality attributes.
3. Testing the stability of micronutrient accumulation across the target environment.
4. Large scale deployment of seed of improved cultivars to farmers.

There is substantial natural variation of micronutrient content (e.g. iron) in many staple crops, including maize, beans, cassava, rice and millet. In bio-fortification, conventional crop breeding techniques are used to identify varieties with particularly high concentration of desired nutrients. These are cross-red with high yielding varieties to develop bio-fortified varieties that have high levels of, for instance, zinc or beta-carotene, in addition to other productivity traits desired by farmers. The bio-fortified seeds or cuttings are made available through extension programmes, market mechanisms or by programmes targeting nutritionally vulnerable smallholders.

Bio-fortification requires a multi-disciplinary research approach

Direct linkages between agricultural researchers and various specialists like nutritionists, public health officials, sociologists, political scientists, food technologists and economists are needed.

ADVANTAGES OF BIO-FORTIFICATION:

1. Implicitly targets low income house-holds: capitalizes regular daily intake of staple.
2. Reach the poor in rural areas with poor access to markets or health care systems.
3. One-time investment – seeds that fortify themselves: shared Advantages
4. Low recurrent costs – cost of seed production and deployment: Cost effective
5. Sustainable in the longer term, varieties will continue to be grown and consumed year after year.
6. Relies on the plant's biosynthetic (Vitamin) or physiological (mineral)

capacity: no effect of policy change or weak funding.

CRITERIA OF BIO-FORTIFICATION:

1. Crop productivity must be maintained /enhanced to guarantee farmer acceptance (high yielding).
2. Micronutrient enrichment levels must have significant impact on human health (effective).
3. Enriched levels must be relatively stable (stability).
4. Bioavailability in enriched lines must be tested in humans to ensure that they improve the micronutrient status of people preparing and consuming them (efficacious).
5. Consumer acceptance has to be tested (taste and cooking quality).

INDIAN SCENARIO:

1. Intake of micronutrients in daily diet is < 50% RDA in over 70% of Indian population.
2. Alarmingly high deficit among children, adolescents, and pregnant and lactating women.
3. About 57% of pre-schoolers and their mothers have subclinical VAD.
4. Iron deficiency anaemia (IDA) is the most serious; 62% of pre-school children are deficient in vitamin A, leading to an annual 3.3 lakh child deaths; and 58.7% of pregnant women, 63.2% lactating mothers and 69.5% of pre-school children are anaemic.
5. The prevalence of Zn deficiency has not been adequately investigated, partly due to lack of suitable biomarkers.
6. 2004 - DBT initiated the India Bio-fortification Programme - rice, wheat and maize bio-fortified with Fe, Zn and pro-vitamin-A.
7. XI Plan – DBT funded bio-fortification of groundnut and pigeon pea for alleviating vitamin A; Sorghum bio-fortification for high grain Fe and Zn content.
8. High-iron pearl millet variety ICTP 8203Fe developed by ICRISAT was released as 'Dhan-shakti' in Maharashtra during April 2013.

CONCLUSION

Through plant breeding, bio-fortification can improve the nutritional content of the staple foods poor people already eat, providing a comparatively inexpensive, cost-effective, sustainable, long-term means of delivering more micronutrients to the poor. This approach will not only lower the number of severely malnourished people who require treatment by complementary interventions, but will also help them maintain improved nutritional status. Moreover, bio-fortification provides a feasible means of reaching malnourished *rural* populations who may have limited access to commercially marketed fortified foods and supplements. Unlike the continual financial outlays required for traditional supplementation and fortification programs, a one-time investment in plant breeding can yield micronutrient-rich plants for farmers to grow around the world for years to come. It is this multiplier aspect of bio-fortification across time and distance that makes it so cost-effective.

REFERENCES

Beer H, Luna S, Pompano L, Przybyszewski E, Udipi S, Ghugre P and Haas B. 2014. Consuming iron-biofortified pearl millet increased hemoglobin concentrations and prevented a decline in energy efficiency in Indian girls. FASEB Jou. 28: 1, Supplement 646.7. http://www.fasebj. org/content/28/1_Supplement/646.7

Chowdhury M. 2014. Address of ICN2 by Ms. Matia Chowdhury, Honorable Minister for Agriculture, Government of People's Republic of Bangladesh, November 2014, Rome, Italy. http://www.harvestplus.org/sites/default/files/ Bangladesh%20Statement%20at%20ICN2.pdf

De Moura F, Palmer A, Finkelstein J, Haas J, Murray-Kolb L, Wenger M, Birol E, Boy E, and Peña-Rosas JP. 2014. Are Bio-fortified Staple Food Crops Improving Vitamin A and Iron Status in Women and Children? New Evidence from Efficacy Trials, *Adv Nutr* (5): 56-570. doi: 10.3945/an.114.006627Adv

Gannon B, Kaliwile C, Arscott S, Schmaelzle S, Chileshe J, Kalungwana N, Mosonda M, Pixley K, Masi C and tanumihardjo S. 2014. Bio-fortified orange maize is as efficacious as a vitamin A supplement in Zambian children even in the presence of high liver resources of vitamin A: a community-based, randomized placebocontrolled trial. *American Journal of Clinical Nutrition*, 100: 1541-50.

Global Nutrition Report. 2014. *Actions and Accountability to Accelerate the World's Progress on Nutrition*. Washington, D.C.: International Food Policy Research Institute.

Haas J, Beard J, Murray-Kolb L, del Mundo A, Felix A and Gregorio G. 2005. Iron-biofortified rice improves the iron stores of non-anemic Filipino women. *Jou. Nutr*., 135: 2823–30.

HarvestPlus. 2014. Kigali Declaration on Bio-fortified Nutritious Foods. Second Global Conference on Bio-fortification, March 31st-April 2nd, 2014, Kigali, Rwanda. http://biofortconf. ifpri.info/files/2014/04/Kigali-Declaration-on-Biofortified-Nutritious-Foods-April-9-20142.pdf.

HarvestPlus. 2014d. Bio-fortification Progress Brief: August 2014. Washington, D.C. http://www.harvestplus.org/sites/default/files/Biofortification_Progress_Briefs August2014_WEB_2.pdf

Hotz C, et al. 2012. Introduction of β-carotene rich orange sweet potato in rural Uganda resulted in increased vitamin A intakes among children and women and improved vitamin A status among children. *Jou. Nutr*. 142: 1871-80.

Jamil K, Brown K, Jamil M, Peerson J, Keenan A, Newman J and Haskell M. 2012. Daily Consumption of Orange-Fleshed Sweet Potato for 60 Days Increased Plasma β-Carotene Concentration but Did Not Increase Total Body Vitamin A

Pool Size in Bangladeshi Women. *Jou. Nutr*. 142 (10): 1896-1902.

WFP (World Food Programme). 2014. P4P promoting increased access to micronutrientrich crops. *Purchase for Progress Newsletter* (July 2014), pp. 1-2, Rome, Italy. http://documents. wfp.org/stellent/groups/public/documents/special_initiatives/WFP266841.pdf.

Talsma E. 2014. Yellow cassava: efficacy of provitamin A rich cassava on improvement of vitamin A status in Kenyan schoolchildren. Dissertation for Wageningen University, Netherlands. http://library.wur.nl/WebQuery/wurpubs/454759

van Jaarsveld P, Faber M, Tanumihardjo S, Nestel P, Lombard C, and Spinnler Benadé A. 2005. β-Carotene–rich orange-fleshed sweet potato improves the vitamin A status of primary school children assessed with the modified-relative-dose-response test. *Am J Clin Nutr*, 81 (5): 1080-87.

Malaria and its Public Health Significance

Raghavendra Prasad Mishra[1], Barkha Sharma[2], Rishi Kumar Gupta[1], Deepesh Gautam[3] Prashant Singh[4]

[1]Department of Veterinary Public Health (DUVASU), Mathura, Uttar Pradesh.
[2]Department of Veterinary Epidemiology and Preventive Medicine (DUVASU), Mathura, Uttar Pradesh.
[3]Division of Surgery, Indian Veterinary Research Institute, Bareilly, Uttar Pradesh
[4]Department of Livestock Products Technology (DUVASU), Mathura, Uttar Pradesh.
Corresponding author: rmishra523@rediffmail.com

Malaria is a mosquito-borne infectious disease affecting humans and other animals caused by parasitic protozoans belonging to the Plasmodium type (WHO, 2014). Malaria causes symptoms that typically include fever, fatigue, vomiting, and headaches. In severe cases it can cause yellow skin, seizures, coma, or death . The disease is widespread in the tropical and subtropical regions that exist in a broad band around the equator (Caraballo, 2014). This includes much of Sub-Saharan Africa, Asia, and Latin America. In 2015, there were 214 million cases of malaria worldwide resulting in an estimated 438,000 deaths, 90% of which occurred in Africa and rates of disease have decreased from 2000 to 2015 by 37% (WHO, 2016) , but increased from 2014 during which there were 198 million cases (WHO, 2014). Malaria is commonly associated with poverty and has a major negative effect on economic development (Worrall *et al.,* 2005). In Africa, it is estimated to result in losses of US$12 billion a year due to increased healthcare costs, lost ability to work, and negative effects on tourism (Greenwood *et al.,* 2005). In India, nine Anopheline vectors are involved in transmitting malaria in diverse geo-ecological paradigms. About 2 million confirmed malaria cases and 1,000 deaths are reported annually, although 15 million cases and 20,000 deaths are estimated by WHO South East Asia Regional Office. India contributes 77% of the total malaria in Southeast Asia.

TRANSMISSION

Malaria is transmitted through the bites of female Anopheles mosquitoes. There are more than 400 different species of Anopheles mosquito; around 30 are malaria vectors of major importance. All of the important vector species bite between dusk and dawn.

The intensity of transmission depends on factors related to the parasite, the vector, the human host, and the environment. Anopheles mosquitoes lay their eggs in water, which hatch into larvae, eventually emerging as adult mosquitoes. The female mosquitoes seek a blood meal to nurture their eggs. Each species of Anopheles mosquito has its own preferred to lay their egg in small, shallow collections of fresh water, such as puddles and hoof prints, which are abundant during the rainy season in tropical countries. Transmission also depends on climatic conditions that may affect the number and survival of mosquitoes, such as rainfall patterns, temperature and humidity. In many places, transmission is seasonal, with the peak during and just after the rainy season. Malaria epidemics can occur when climate and other conditions suddenly favour transmission in areas where people have little or no immunity to malaria. They can also occur when people with low immunity move into areas with intense malaria transmission, for instance to find work, or as refugees. Human immunity is another important factor, especially among adults in areas of moderate or intense transmission conditions. Partial immunity is developed over years of exposure, and while it never provides complete protection, it does reduce the risk that malaria infection will cause severe disease. For this reason, most malaria deaths in Africa occur in young children, whereas in areas with less transmission and low immunity, all age groups are at risk

SIGNS AND SYMPTOMS

The signs and symptoms of malaria typically begin 8–25 days following infection (Fairhurst and Wellems, 2010). Initial manifestations of the disease common to all malaria species are similar to flu-like symptoms and can resemble other conditions such as high fever (up to 105 degrees Fahrenheit) with shaking chills Profuse sweating when the fever suddenly drops, Fatigue, Headache, Muscle aches shivering, joint pain, vomiting, hemolytic anemia, jaundice, hemoglobin in the urine, retinal damage, and convulsions. Severe malaria is usually caused by P. falciparum (often referred to as falciparum malaria). Symptoms of falciparum malaria arise 9–30 days after infection. Individuals with cerebral malaria frequently exhibit neurological symptoms, including abnormal posturing, nystagmus, conjugate gaze palsy (failure of the eyes to turn together in the same direction), opisthotonus, seizures, or coma(Bartonoli and Zammarchi, 2012).

DIAGNOSIS

- Diagnosis of malaria can be primarily done by on the basis of signs and symptoms, examines of spleen; spleen become enlarged because the spleen commonly swells during a malaria infection.
- To confirm the diagnosis of malaria, samples of blood to be smeared on glass slides. These blood smears will be stained with special chemicals in a laboratory and examined for *Plasmodium* parasites. Blood

tests will be done to determine whether malaria has affected your levels of red blood cells and platelets, the ability of your blood to clot, your blood chemistry, and your liver and kidney function.

TREATMENT

Malaria is treated with antimalarial drugs and measures to control symptoms, including medications to control fever, antiseizure medications when needed, fluids and electrolytes. The type of medications that are used to treat malaria depends on the severity of the disease and the likelihood of chloroquine resistance. The drugs available to treat malaria include: Chloroquine, Quinine, Hydroxychloroquine, Proguanil (sold as a generic), Mefloquine, Clindamycin and Doxycycline.

PREVENTION

- One way to prevent malaria is to avoid mosquito bites with the following strategies:
- As much as possible, stay indoors in well-screened areas, especially at night when mosquitoes are most active.
- Use mosquito nets and bed nets. It's best to treat the nets with the insect repellant permethrin.
- Wear clothing that covers most of your body.
- Indoor residual spraying (IRS) with insecticides is a powerful way to rapidly reduce malaria transmission. Its full potential is realized when at least 80% of houses in targeted areas are sprayed. Indoor spraying is effective for 3–6 months, depending on the insecticide formulation used and the type of surface on which it is sprayed. In some settings, multiple spray rounds are needed to protect the population for the entire malaria season.

REFERENCE

Bartoloni A, Zammarchi L (2012). "Clinical aspects of uncomplicated and severe malaria". Mediterranean Journal of Hematology and Infectious Diseases. 4 (1).

Caraballo, H. (2014). "Emergency department management of mosquito-borne illness: Malaria, dengue, and west nile virus". Emergency Medicine Practice. 16 (5).

Fairhurst RM. and Wellems TE. (2010). "Chapter 275. Plasmodium species (malaria)". In Mandell GL, Bennett JE, Dolin R. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 2 (7th ed.). Philadelphia, Pennsylvania: Churchill Livingstone/Elsevier. pp. 3437–62.

Gollin D. and Zimmermann C. (2007). Malaria: Disease Impacts and Long-Run Income Differences (PDF) (Report). Institut e for the Study of Labor.

Greenwood BM., Bojang K., Whitty CJ. and Targett GA. (2005). "Malaria". Lancet. 365 (9469): 1487–98.

WHO, (2014). World Malaria Report 2014. Geneva, Switzerland: World Health Organization. pp. 32–42. ISBN 978-92-4-156483-0.

WHO. Retrieved 2 February 2016.

Worrall E., Basu S. and Hanson K. (2005). "Is malaria a disease of poverty? A review of the literature". Tropical Health and Medicine. 10 (10): 1047–59.