Indian Farmer

ISSN 2394-1227

A Monthly Magazine

Volume– 7 | Issue - 03 | March - 2020 | Pages - 59

Weedy/Red rice
Origin, Morphology and Management

www.indianfarmer.net

INDIAN FARMER

A Monthly Magazine

Volume: 7, Issue – 03 March–2020

Fertigation: An effective tool of saving water in fruit crops

Yamini Sharma and Gayatri Verma

Assistant Professor (Fruit Science), Krishi Vigyan Kendra, Gurdaspur, PAU, Ludhiana
Soil Chemist, Regional Research Station, Gurdaspur, PAU, Ludhiana
Corresponding author: drgayatriverma@gmail.com

India has witnessed immense increase in production of fruit crops in last few years but in the context of increasing population, raising productivity is still a constraint. In today's scenario, climate change, increasing food demands, and population pressure demands for quality produce with higher yields. Among all these, the most critical concern is the scarcity of water. Moreover, to attain more production, shifting towards high density plantation has resulted in imbalance of nutrients in last four decades, due to which the deficiency of secondary and micronutrients have developed in addition to N, P & K. One of the reasons for low productivity is our failures in understanding the behavior of soil-plant relationship as a nutrient and water supply chain. In fruit crops, the economic concern is of fertilizer cost, market value of crop, yield and quality. Thus, Fertigation is an effective tool which helps in enriching fruit crops with the with the right nutrient quantities, combinations, and at the right timings. These crops are quite reactive to changes in water and nutrient management and therefore to the application of fertigation techniques.

OBJECTIVE OF FERTIGATION

Fertigation is the advanced and efficient practice of fertilization. The objective of fertigation management is to ensure a correct nutrient balance among various vegetative and reproductive organs of fruit plants. It also allows application of nutrients directly at the site of active root zone. It helps in the saving of water and is very efficient and useful for quality production. Additionally, it significantly lowers leaching losses of nutrients while meeting the water and nutrient requirements of crops throughout their growing stage. Fertigation can be practiced under sprinkler, surface as well as drip irrigation. Among these drip irrigation provides more uniform distribution with more efficient water use.

IMPROVEMENT IN FERTILIZER USE EFFICIENCY

Fertigation combines the application of water and nutrient required for plant growth and development. In fertigation, availability of nutrient is very high and due to this it is gaining popularity especially in perennial fruit crops. When it is combined with good irrigation system both nutrient and water can be manipulated and managed to obtain

possible marketable production. It requires less water and avoids fertilizers to leach, volatize and fixation in the soil there by reducing fertilizers dose. The right combination of water and nutrients is the key to produce high yield and quality fruits. It is quiet effective in areas of water. Fertigation under drip irrigation is being used commonly for nitrogenous fertilizers in all fruit crops. This technology is environmental friendly as it reduces the production cost and lessens ground water pollution caused by fertilizer leaching.

FACTORS FOR FERTIGATION MANAGEMENT

No doubt the choice of fertilizers depends on availability of product and its price. When choosing a proper fertilizer, crop growth stages, irrigation system type and water quality should be considered. In fertigation, we can use both liquid as well as water soluble fertilizers which include single or double nutrients. The advantage of liquid fertilizers is that they are quickly absorbed, so plants get their benefits soon as they are applied. Instead of using agricultural grade fertilizers we should use technical grade as these have less impurities and higher level of desired mineral like technical grade salts (eg potassium sulphate), acids (nitric acid) and chelates (iron EDTA). If we are using solid fertilizers then we should use fine grained and fully soluble. In general, highly soluble fertilizers suitable for the use in fertigation are ammonium nitrate, potassium chloride, potassium nitrate, urea, ammonium monophosphate and potassium mono-phosphate. Fertilizers should have high nutrient content there should be no chemical reaction between irrigation water and fertilizers. Care should be taken while mixing the solution of two or more water soluble or liquid fertilizers there should be no chemical reaction between irrigation water and fertilizers, as it can create the problem of precipitation due to incompatibility. For example calcium nitrate with any phosphates or sulphates cause precipitation. Fertilizers should be dissolved separately and then added into the water tank. For deciding fertigation schedule care must be taken regarding nutrient requirement of crop to get target yield, nutrient supplied , irrigation system, climatic conditions and at which growth stage nutrient is required. Accurate fertilizer application determines fertigation management.

WATER QUALITY FOR FERTIGATION

Water plays a significant role as dissolution of fertilizers depends highly on quality and temperature of water used. Therefore, irrigation water quality is very important in fertigation. The concentration of nutrients in irrigation water should be in such a way so as to maintain the required soil solution concentration in the wetted root zone. If the concentration exceeds the above limit, buildup of salinity can be there and it hinders the nutrient uptake. The level of pH, salt, sodium hazards and toxic ions should also be taken under consideration while using irrigation water. Irrigation water with pH <5 can have detrimental effect on plant roots and too high pH can reduce the availability of essential plant nutrients. The irrigation water having calcium, magnesium and bicarbonates can have interaction with fertilizers and may cause diverse problems like precipitation in fertilizer tank and clogging of drip system.

Advantages of fertigation

- It assures efficient use of water.
- Improves nutrient use efficiency as application of fertilizers is more accurate and uniform.
- Nutrients are immediately available to plants.
- Fertilizers can be applied at those stages of growth where the demand of nutrients is maximum.
- It is less labour intensive.
- Maximize crop yield and better quality crops.
- Prevents loses of fertilizers like leaching, volatilization and fixation in the soil
- Minimize ground water pollution.
- Restricts weed growth and prevents leaf diseases.

Disadvantages of fertigation

- Sensitive to clogging
- Salinity hazards
- Initial cost required for installation and design is high

Precautions

- Soluble fertilizers should be used so that they can be quickly dissolved in irrigation water to avoid clogging.
- The selected fertilizers should be fully compatible with each other.
- Mesh filters should be cleaned.
- Remove any algae or bacterial formation from drip pipes by using HCL @1Lt/1000 liter of water.
- Incorrect application may lead to salinity problems, crop damage, leaching loses and pollution of ground water.
- The material used must not cause corrosion of the system.
- Constant operating pressure for uniform mixing of water and fertilizers.
- Fertilizers/pesticides should not be injected at the same time.

CONCLUSION

Fertigation has got practical significance in terms of increasing scarcity for water. For minimizing the cost of irrigation and fertilizers, fertigation maximize the nutrient uptake, using minimum amount of water and fertilizer. Fertigation is less labour intensive, plants response better in terms of yield, nutrient management efficiency is high, reduce compaction in the field, uniformly distribution of fertilizer among roots especially feeder roots and rapid uptake by the plants, It is considered ecofriendly as it reduced nutrient loses. Though initial cost of installation of the system is high but in the long run, it is economical.

FUTURE THRUST

To get quality fruit production and high productivity, there is need to promote the fertigation at a large scale.

REFERENCES

Anoop Kumar Srivastava and Chengxiao Hu (2019) Fruit crops diagnosis and management of nutrient constraints. Elsevier; 1 edition.776p.

Sharma R, Bhardwaj S and Choudhary M (2014). Fertigation on fruit crops: A Review. *Annals of biology* 30(1): 48-53.

Management of mite pest in stored products

Shamik Dey

Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, Nadia, West Bengal, India
Corresponding Author: deyshamik93@gmail.com

ABSTRACT

Mites are very common inhabitants of stored products of all including grain and grain based commodities at all stages of processing. They are very difficult to observe in naked eye and can cause severe economic loss if proper management has not taken. Different management strategies like hot water treatment, sun drying, fumigation, flood irrigation, crop rotation are recommended for managing those pests. In spite of availability of physical and chemical measurer, more emphasize should be given on biocontrol aspect as it is eco friendly, safe to our environment no residue hazard issue. Very few phytoseiid mites are reported as bioagents though more research is required in exploration of phytoseiid fauna against for the notorious pest.

Key words: Mite-pests; stored grain; Fumigation; Biocontrol.

INTRODUCTION

Stored product insects and mites are tiny and very difficult to control. They can easily escape and transported from one place to another by the products, storing material. Eradication of that tiny and notorious pest is essential to get the high quality food materials. Once an infestation occurs in one commodity, it can quickly spread to others unless appropriate and timely control measures are taken. The most difficult part of managing stored product mites is detecting their infestation. Large populations can be developing before they are discovered and a considerable damage might have already been done. The stored food has a bad odor when it gets infested by the mites and it is the first indication of the mite infestation. Using a hand lens or observe the infected part under microscope give the clear idea about their presence and it may be colorless or cream colored (Armitage et al., 1994; Hubert and Pekar, 2009; Sinha, 1966a; Wilkin and Hope, 1973).

Strategies to be taken for management the mite pest in stored products

In dry climate, insects are dominant; mites and fungi are relatively less important. But in our tropical and subtropical climate all the three types organisms are equally

important and can lead up severe damage. Here the management options are discussed below:

1. Proper drying of the harvested grains either through sunlight or artificial heat to reduce the moisture level less than 12% (Pulpan and Verner, 1965; Palyvos and Emmanuel, 2006; Sinha, 1966b).
2. Fumigation of grain can be done by Alluminum phosphide (AlP_3) and Methyl bromide (MBr) at proper dose.
3. Rapid rotation from one crop to the next fosters survival of mites on the leftover vegetation in the soil from the previous crop. Decaying Cole crops, especially cauliflower, may harbor very high bulb mite populations. So it is highly recommended to uproot and destroy them.
4. Flood irrigation or heavy rains during winter reduces the mite population in the soil.
5. Avoid successive onion or garlic crops.
6. Growers must insist on clean seed cloves.
7. Hot water treatment for 10-15 min. reduces the mite population in garlic cloves.
8. In field conditions, fallow the fields to allow complete decomposition of organic matter which leads to reduction of mite population.
9. Farmers are advised to avoid long term storage.
10. Wash the food containers frequently in detergent and hot water (54°C) and then dry completely before reusing them.
11. Always shop for dry goods from the store so that there may be high shelf turnover.

Biological strategies for management of mite pest in stored grains

There are some reports that introduction of predatory mites, *Cheyletus eruditus*, *Cheyletus malaccensis*, *Acaropsis docta*, *Androlaelaps casalis*, *Blattiscocius* sp. and *Pyemotes tritici* can successfully control the stored grain mites (Pulpan and Verner, 1965; Diaz et al., 2002).

Conclusion

Extensive research on taxonomy, life history, feeding patterns, ecology of stored grain mite pests had been carried out but there is a still gap of knowledge on the proper management aspects. So far biocontrol has been concerned more research is needed to explore more bioagents against the mite pests. Still more work is needed on economic losses caused in different regions of the world in granaries, warehouses and flour mills.

REFERENCES

Armitage, D.M., Cogan, P.M. and Wilkin, D.R. (1994). Integrated pest management in stored grain: combining surface insecticide treatment with aeration. Journal of Stored product Research, 30: 303-319.

Diaz, A., Okabe, K., Eckenrode, C.J.,Villani, M.G. and Oconnor, B.M. (2002). Biology, ecology and management of bulb mites of the genus *Rhizoglyphus* (Acari: Acaridae). Experimental and Applied Acarology, 24: 85-113.

Hubert, J. and Pekar, S. (2009). Combination of the antifeedant bean flour and the predator, *Cheyletus malaccensis* suppresses storage mites under laboratory conditions. Biocontrol, 54: 403-410.

Palyvos, N.E. and Emmanuel, N.G. (2006). Seasonal abundance and vertical distribution of mites in flat storage containing wheat. Phytoparasitica, 34: 25-36.

Pulpan, J. and Verner, P.H. (1965). Control of Tyroglyphid mite in stored grain by the predatory mite *Cheyletus eruditus*. Canadian Journal of Zoology, 43: 417-432.

Sinha, R.N. (1966a). Feeding and reproduction of some stored product mites on seed-borne fungi. Journal of Economic Entomology, 59: 1227-1232.

Sinha, R.N. (1966b). Association of granary mites and seed borne fungi in stored grain and outdoor and indoor habitats. Annual Entomological Society of America, 59: 1170-1181.

Wilkin, D.R. and Hope, J.A. (1973). Evaluation of pesticides against stored product mites. Journal of Stored product Research, 8: 323-327.

Neonatal Calf Diseases

Dr. Vishnurahav R. B. **(M.V.Sc., Ph.D.)**

Teaching Assistant

University Veterinary Hospital and Teaching Veterinary Clinical Complex
College of veterinary and animal sciences university
Mannuthy, Thrissur
Corresponding Author: vishnurahav@outlook.com

During the first 90 days of life is when most of the problems arise in dairy calves. Infectious diseases are the primary cause of mortality in young dairy calves. Most calves tend to become infected with certain diseases at particular times of their lives. Knowing what disease affect calves during different stages of their life can makemanaging these disease problems easier. This discussion will cover some of the moreimportant calf hood diseases during the first 90 days of life of calf.

CALF SCOUR (DIARRHOEA)

It is the most important problem in young calf and milk fed animals. Calves are particularly susceptible during their second week of life. Approximately 40% of calf deaths in the first six weeks of life are related with scour. Calf scour are classified into two types: Nutritional and infectious. Sometimes nutritional scour often progresses to becomean infectious scour, which is caused by different types of pathogens. Infectious agents includes bacteria, parasites and viruses. *E. coli* is the most predominant bacteria (environmental pathogen) affecting less than five year of old calves. *Salmonella* infection mostly affects the 2-6 weeks age group.Rota and corona virus are the most commonly infecting viruses mainly in the age group of 1-3 weeks. Protozoon parasites involved are cryptosporidium (first week of life) and coccidian (3-6 weeks of age).

Calf scour is easily recognised, with calf faeces increasing in frequency and quantity, and having ahigher than normal water content. Whatever the cause, farmers can notice some or all of the following:

- ✓ White or bright yellow faeces
- ✓ Depressed calves
- ✓ Reluctant to feed
- ✓ Weight loss and weakness
- ✓ In severe cases, calves will collapse, become comatose and die

Treatment

- ✓ Isolation
- ✓ Fluid therapy
- ✓ Antibiotic therapy

Prevention of calf scour.

- Provide adequate colostrum in the first few hours after birth
- Provide proper shelter or housing from the adverse weather conditions to reduce stress and plan carefully to design sheds to avoid overcrowding
- New born calves should not be mixed with calves of different age group as young calves are more susceptible to infections
- Routine farm management activities (i.e. castration and disbudding) should be carried out with minimal stress possible to the animals.
- Maintain strict hygiene by cleaning and sterilising feeding utensils and facilities. Prevent the build-up of faecal contamination around feed and water troughs. Raise feeding andwater troughs off the floor, to at least 0.75m
- Respond quickly to symptoms of scour; isolate sick calves and address the cause.

Joint ill (Infectious polyarthritis)

Infectious arthritis is caused by localization of bacteria in joints. bacteria enters to the blood stream from the gut, upper respiratory tract and the navel infection in calves born in poor sanitary conditions and delayed and or inadequate feeding of colostrum immediately after birth. The most common bacterial isolates of infected joints are*E.coli* and *Streptococcus* species.

The joints most commonly affected are the fetlock, hock, stifle and carpal joints. The affected jointswill be swollen, hot, and painful. The lymph nodes (prescapular or popliteal) will be enlarged and typically two to four times their normal size. Infection causes considerable muscle wastage over the gluteal/shoulder regions. Affected animals adopt different walking stance when two or more limbs are affected. Rectal temperature isoften within the normal range or high.

Navel ill (Omphalitis, omphalophelibitis and urachitis)

Infection of the umbilicus and its associated structures occurs commonly in newbornfarm animals and appears to be particularly common in calves. The umbilical cordconsists of the amniotic membrane, theumbilical veins, the umbilical arteries, andthe urachus.The drying time varies from 1 to 8 days, withvariation between breeds and a longer dryingperiod in bull calves.Approximately 90% of calveshave dry navels by 4 days of age. Inflammation of external aspects of umbilicus is called as omphalitis. Omphalitis occurs commonly within 2 to 5days of birth to and often persists for severalweeks.Omphalophlebitis is inflammation of the umbilical veins and large abscess may be formed. Calves are usually 1to 3 months of age and are unthrifty becauseof chronic toxaemia.

Treatment

Veterinary advice must be sought regarding:

- Antibiotic selection and therapy
- Non steroid anti-inflammatory drugs

- Joint lavage can be undertaken where one joint is affected and the joint is flushed in the early stages of infection
- Single infected joint-appropriate analgesia needed
- Variable response if treatment is delayed and the infection is well-established
- Separate and isolate infected animals
- Antibiotics and painkillers are effective inmost mild cases
- Antibiotic treatment should continue untilafter the signs have disappeared. Severecases may not recover even with prolongedantibiotic treatment
- For large navel abscesses, veterinaryintervention to drain and remove theinfected tissue is often necessary

PREVENTION AND CONTROL MEASURES

- Reduce environmental bacterial challenge in calving boxes by cleaning out between each calving cow. Animals nearing parturition should be moved to clean environment.
- Ensure adequate passive antibody transfer with a minimum of threelitres of good quality colostrum during the first 6 hours of life but preferably the first two hours.
- Umbilicus (navel) must be fully immersed in the solutions of tincture iodine or 7% iodine or chlorhexidine within the first 15 minutes of life and repeated 2 to 4 hours later where possible.
- Bull's navels tend to dry more slowly than heifer's making them a higher risk. Repeated application of antiseptics over bull's navel area can reduce this risk.
- Ensure or restrict the movement of calves to other pens or contaminated pastures until navel has dried off completely
- An oesophageal feeder can be used to administer colostrum if the calf will not suck
- Treat all infections promptly after seeking veterinary advice (Vaccination should be done against tetanus)

Nutrient Changes with Sprouting Grain in Hydroponics

Rachel Jemimah, E.*, T.Muthuramalingam and S. MeenakshiSundaram

Livestock Farm Complex, TANUVAS, Madhavaram milk colony, Chennai, Tamil Nadu
Corresponding author: racheljemimah@gmail.com

Growing of plants without soil but in water or nutrient solution in a greenhouse (hi-tech or low cost devices) for a short duration (approx. 7-8 days) is hydroponics fodder production (Ramchandra et al., 2019). Hydroponic fodder is a palatable and germinated grain embedded in the root system, consumed along with the shoots of the plants without any nutrition wasting (Pandey and Pathak, 1991). In agriculture hydroponics is an advanced technology. Hydroponic production is used to guarantee a constant production of high quantity of green forage throughout the year for livestock feed with suitable prices. Hydroponics avoids problems shown in conventional methods of fodder production. This is realized through use of mall piece of land with vertical growing process that permits production of a large volume of hydroponic fodder on a fraction of area needed by conventional fodder production and thus increases stocking capacity of livestock (Girma andGebremariam, 2018).The green fodder from hydroponics is highly palatable, easily digestive and of better quality as compared to traditional fodder production (Ramchandra et al., 2019). This article deals with nutrient changes that occur during sprouting of grains in hydroponic cultivation.

Sprouting

According to Peer and Leeson (1985) a dry seed is metabolically dormant, its respiration rate is extremely low and its enzymes are inactive. As soon as the seed imbibes water, respiration rate increases, enzyme systems gets activated and protein synthesis is started. Starch stored in the embryo and endosperm is used as a source of energy for respiration. The desirable nutritional changes that occur during sprouting are mainly due to the breakdown of complex compounds into a more simple form, transformation into essential constituents, and breakdown of nutritionally undesirable constituents (Chavan and Kadam, 1989).

Changes in DM

Lorenz (1980) stated that the sprouting of grain causes increased enzymeactivity, a loss of total DM, an increase in total protein, a change in amino acid composition, a decrease in starch, increases in sugars, a slight increase in crude fat and crude fibre, and slightly higher amounts of certain vitamins and minerals. Most of the

increases in nutrients are not true increases; they simply reflect the loss of DM, mainly in the form of carbohydrates, due to respiration during sprouting. As total carbohydrates decreases, the percentage of other nutrients increases. Due to their active enzymes, sprouts are much easier to be digested than dry seeds (Goodwin and Mercer 1993).Naik*et al.* (2015) stated that during sprouting, starch is catabolized to soluble sugars for supporting the metabolism and energy requirement of the growing plants for respiration and cell wall synthesis, so any decrease in the amount of starch causes a corresponding decrease in DM and OM.

Changes in fibre and protein

Cuddeford (1989) stated that loss of dry matter is caused by the energy reserve in the endosperm fuelling the growth process. Protein, which is not used for growth, increases in percentage terms but in absolute terms remains fairly static; this also generally applies to the other nutrients. The exception is fibre, a major constituent of cell walls, which increases both in percentage and real terms with the synthesis of structural carbohydrates, such as cellulose and hemicelluloses. Chung *etal.* (1989) found that the fibre content increased from 3.75% in unsprouted barley grain to 6% in 5-day sprouts. Morgan *et al.* (1992) found that changes in the ash and protein contents occur rapidly from day 4 corresponding with the extension of the radicle (root), which allows mineral uptake. The absorption of nitrates facilitates the metabolism of nitrogenous compounds from carbohydrate reserves, thus increasing the levels of crude protein (CP). There is increase in the lysine (0.39 vs. 0.54%) content of the hydroponics fodder as there may be degradation of prolamins into lower peptides and free amino acids which supply the amino groups for the trans-amination to synthesize lysine (Peer and Leeson, 1985; Chavan and Kadam, 1989).

Changes in EE

The increase in EE content of the hydroponics fodder may be due to the increase in the structural lipids and production of chlorophyll associated with the plant growth (Naik*et al*., 2015). Peer and Leeson (1985) stated that the concentrations (as percent of the total fatty acid content of the triglyceride fraction of the fat of linolenic acid and stearic acid increased with the sprouting time. The increase in the percentage of CF, NDF and ADF and decrease in the NFE and NFC may be attributed to the increase in the number and size of cell walls for the synthesis of structural carbohydrates (Naik*et al*., 2015).

Changes in ash

Morgan *et al.* (1992) found that the ash content of sprouts increased from day-4 corresponding with the extension of the root which allowed the mineral uptake. However, sprouting of cereals makes the minerals more available by chelating or merging with the protein (Shipard, 2005). The ash content of the sprouts increases more, if nutrient solution is used rather than water which may be due to the absorption of minerals by the roots (Dung *et al.,* 2010). During sprouting of cereal grains, the contents (mg/kg DM) of B-vitamins (Chavan and Kadam, 1989), b-carotene, vitamin E,

biotin and free folic acid (Cuddeford, 1989) have been reported to be increased.The nutrient contents of hydroponics fodder are superior to certain common non-leguminous fodders but comparable to leguminous fodders (Reddy *et al*., 1988; Pandey and Pathak, 1991; Naik*et al*., 2012) in terms of available OM, CP, EE and NFE content.

Changes in enzymes, vitamins, minerals and trace elements

Shipard (2005) and Naik*et al.* (2014) stated that hydroponic fodder is also a rich source of bioactive enzymes, with the highest activities in sprouts being generally between germination and 7 days of age (Chavan and Kadam, 1989). Besides, helping in the elimination of the anti-nutritional factors such as phytate in the grains, hydroponic fodders are good sources of chlorophyll and contain a grass juice factor that improves the performance of livestock (Naik*et al.,* 2015). The crop is free from antibiotics, hormones, pesticides, or herbicides (Naik, 2014).

Shipard (2005) stated that the physiology of vitamins, minerals and trace elements is dependent on enzyme activity and sprouts can be a rich source of antioxidants, in the form of Beta-carotene (a precursor of Vitamin-A), Vitamin-E, Vitamin-C and related trace minerals such as Selenium and Zinc. All these positive nutritional changes causes improvement of digestion and absorption by using less energy, enabling the animal to save and use energy for other important activities as reproduction, wool production, weight gain as a refluxes of these nutritional improvements (Fayed, 2011).Gunasekaran*et al*. (2017) reported that the hydroponic maize fodder has 251.87±1.10 mg/ 100 g beta carotene content which was 47% higher compared to that of maize seed. Besides, sprouting also helps in the elimination of the anti-nutritional factors such as phytic acid, oxalic acid and other toxicants of the fodder.

CONCLUSION

Hydroponic fodder production method is widely adopted in many parts of the country due to its advantage of over conventional fodder production in terms of ease of production methods. Further from this article it is evident that not only the method is beneficial to livestock farmers but the fodder produced by this method also benefit farmers through better nutritional quality.

REFERENCES

Peer, D.J. and S. Leeson, 1985. Nutrient content of hydroponically sprouted barley. *Animal Feed Science and Technology*, **13**: 191-202.

Chavan, J. and S. S. Kadam, 1989. Nutritional improvement of cereals by sprouting. *Crit. Rev. Food Sci. Nutr.,***28** (5): 401-437.

Lorenz, K., 1980. Cereal sprouts: composition, nutritive value, food applications. *Crit. Rev. Food Sci. Nutr.,***13**(4): 353-385.

Goodwin T.W. and E. I. Mercer, 1993. Introduction to plant bio- chemistry. Second edition copyright 1983. Pergamu press Ltd.

Naik, P.K., B.K. Swain and N.P. Singh, 2015. Production and utilization of hydroponics fodder. *Indian J. Anim. Nutr*., **32**: 1-9.

Cuddeford, D., 1989. Hydroponic grass. *In Practice*, **11**(5): 211-214.

Chung, T.Y., E. N. Nwokoloand J.S. Sim, 1989. Compositional and digestibility changes in sprouted barley and canola seeds. *Plant Foods for Human Nutrition*. **39**: 267-278.

Morgan, J., R. R. Hunter and R. O'Haire, 1992. Limiting factors in hydroponic barley grass production. In: *Proc.8th International Congress on Soilless Culture*.Hunter's Rest, South Africa, pp: 241-261.

Sipard, I., 2005. How can I grow and use sprouts as living food. Steward publishing.

Dung, D. D., I.R. Godwin and J. V. Nolan, 2010. Nutrient content and in sacco digestibility of barley grain and sprouted barley. *Journal of Animal and Veterinary Advances,* **9**(1–9): 2485–2492.

Pandey, H.N. and N.N. Pathak, 1991. Nutritional evaluation of artificially grown barley fodder in lactating crossbred cows. *IndianJ. Anim. Nutr.***8**(1): 77- 78.

Naik, P.K., R.B. Dhuri, B.K. Swain and N.P. Singh, 2012. Nutrient changes with the growth of hydroponics fodder maize. *Indian J. Anim. Nutr*.**29**: 161- 163.

Reddy, G.V.N., M.R. Reddy and K.K. Reddy, 1988. Nutrient utilization by milchcattle fed on rations containing artificially grown fodder. *Indian J. Anim. Nutr*.**5** (1): 19-22.

Naik, P.K., R.B. Dhuri, M. Karunakaran, B.K. Swain and N.P. Singh, 2014. Effect offeeding hydroponics maize fodder on digestibility of nutrients and milk production in lactating cows. *Indian J. Anim. Sci.,***84** (8): 880-883.

Naik, P.K., 2014. Hydroponics green fodder for dairy animals. In: Recent Advances in Animal Nutrition (Eds. Bakshi, M.P.S. and wadhwa, M.). Pp 191-210. Satish Serial Publishing House, New Delhi.

Gunasekaran, S., C. Bandeswaran and C.Valli, 2017. Effect of different nutrient solutions on the biomass yield and nutritive value of low cost hydroponic fodder maize. *Indian J. Anim. Sci.,* **87**(11): 1418–1419.

Fayed, M., 2011. Comparative study and feed evaluation of sprouted barley grains on rice straw versus TamarixMannifera on performance of growing Barki lambs.Sinai. *J. American Sci.,* 7(1):954-961.

Ramchandra R, Raina D, Gendley MK. Hydroponic Techniques for Fodder Production. Acta Scientific Nutritional Health. 2019; 3(5):127-132.

Girma F, Gebremariam B. Review on Hydroponic Feed Value to Livestock Production. Journal of Scientific and Innovative Research. 2018; 7(4):106-109.

The Nematodes of Nilgiris

Berliner, J.[1], Priyank H. Mhatre[2], Kasthuri Thilagam, V.[3] and Nanjundan, J.[1]

[1]Scientist, ICAR-IARI, RS, Wellington – 643231
[2]Scientist, ICAR-CPRS, Udagamandalam – 643004
[3]Scientist, ICAR-IISWC, RC, Udagamandalam – 643001
**Corresponding author: - j_ber@rediffmail.com*

The Nilgiris district is located in one of the eight biodiversity hottest hotspots of the world. They have wonderful landscape with ecologically unique high elevation grass lands interspersed with lush green bushes and trees called Sholas. Geographically, it covers an area of 2545 Km^2 with altitude range of 800 to 2595 meters above the sea level accompanied with annual rainfall of 1400mm distributed from April to November. Demographically, the district consists of six taluks viz., Udhagamandalam, Kotagiri, Kundah, Coonoor, Gudalur and Pandalur. The soils of Nilgiris are rich in Organic carbon whereas the Nitrogen, Phosphorus and Potassium are in medium to high level. Yet, the soils are deficient in micronutrients like Zinc due to low pH (pH 4.6 to 6.1). This pH highly influences the nutrient availability of plant and population dynamics of microorganisms as well. As per the Agro climatic zonation of ICAR, the district mainly falls under Western Ghats and Coastal Plain, hot humid-per humid eco-region (19.2.), Southern Plateau and Hills Agro-Climatic Region (X), as per Planning Commission and Southern Plateau and Hills Agro-Climatic Zone (X), as per NARP.

BRIEF HISTORY OF AGRICULTURE IN NILGIRIS:

Geologically, the Nilgiris in Western Ghats was formed during break up of supercontinent, Gondwana some 150 million years ago and hence, it is older than Himalayas. *Todas* and *Kotas* are believed to be first tribal groups migrated from Kerala and Karnataka area and inhabited Nilgiris centuries Before Common Era (BCE). The tribal groups such as *Kurumbas* and *Irulas* entered the Nilgiris at later years. These four tribal groups inhabited the fertile high elevation grass lands upto the early 15th century. Only in the mid 15th century another tribal group called *Badgas* migrated from Nanjangudu area of Mysore to escape or avoid the influence of non Hindu kings of the Deccan. It is believed that the Badgas were the first to bring the practice of agriculture to the hills. Further, they were progressive in adopting new technologies and crops introduced by Britishers such as tea, coffee, potato and several other western fruits and vegetable. The founder of present day Udhagamandalam, Mr. John Sullivan introduced potato to Nilgiris (Tamil Nadu state) in 1822 A.D. Since then, nearly 400 exotic plants

were introduced in Nilgiris in the last 200 years. Along with that many new pests, diseases and nematodes were also introduced in Nilgiris.

THE POTATO CYST NEMATODE:

The Potato Cyst Nematode (PCN) is one of the important pests that got introduced in Nilgiris along with potato. Due to its microscopic size, the PCN slowly spread to all potato growing area of the Nilgiris, unnoticeably along with the soil adhering to seed potatoes. The ability of the PCN to tolerate lower pH and formation of cyst provided added advantage for its survival. It is observed that the PCN can survive in soil without any nutrition for more than 30 years. This makes them one of the highly stubborn and difficult pests to manage in potato cultivation. The presence of this nematode was undetected until 1961, when F.G.W. Jones first discovered the presence of *Globodera rostochiensis* from Nilgiris. Though the first report on the nematodes (Root-Knot Nematode - *Meloidogyne* sp.) from Indian soil dates back to 1901 by Barber from tea at Devala estate, Nilgiris, Tamil Nadu, the PCN discovery only paved the way for establishment of Nematology as a separate discipline in India. The PCN were observed to cause up to 80 % loss to potato. The Indian government took stringent measures to contain the nematodes within Nilgiris by imposing domestic quarantine. Procurement of potato was fully controlled by government run cooperative societies. In 1961 the first Nematology lab was established at Tamil Nadu Agriculture University, Coimbatore in association with Rockfeller foundation and ICAR. In the same year the first Nematology department was established at Central Potato Research Station, Shimla. Within two years (1963) another Nematology lab was started at Udhagamandalam to carry out research on PCN. Howard in 1977 discovered the presence of another PCN species, *Globodera pallida* from Nilgiris. Since that time, much of the nematological research work only hovers around PCN ignoring the other economically and ecologically important nematodes.

OTHER PLANT PARASITIC NEMATODES FROM NILGIRIS:

The area of potato cultivation declined from 10000 ha during 1944-45 to approximately 2000 ha in 2018 because of late blight of potato, potato cyst nematode, and introduction of tea and high income vegetables like carrot, beetroot, garlic, cauliflower, beans etc. Along with the change in crops, the status of nematode pest also slowly changed. The introduction of new fruits and vegetables favoured the root-knot nematode species (*Meloidogyne* spp.) to dominate the agro-ecosystem than the PCN of Nilgiris. In 1963 Murthy reported the presence of reniform nematode, *Rotylenchulus reniformis* from potato crop. In 1986 *Meloidogyne hapla* was reported from Nilgiris from scented geranium plant (Kumar, 1986). In 1997, Anitha and co-workers reported the presence of five genera of nematodes such as *Meloidogyne hapla*, *Helicotylenchus* sp., *Pratylenchus* sp., *Criconemoides* sp. and *Xiphinema* sp. from scented geranium plantation from Nilgiris (Anitha et. al., 1997). The *M. hapla* was reported to cause extensive forking in carrot, which accounts to 36% avoidable yield loss in carrot (Fig. 1).

Figure 1: Forking in carrot due to *Meloidogyne* spp. and collage of nematodes isolated from Nilgiris

One of the comprehensive studies made to document the overall plant parasitic and predatory nematodes from Nilgiris was by Sivakumar and his group, where the investigation revealed the presence of 48 species of nematodes, however, the associated host crops were not enlisted (Sivakumar et. al., 2002). Recently two new records such as barley root knot nematode, *M. naasi* from orange jessamine (*Cestrum aurantiacum* L.) (Suresh et al., 2017) and Estonian cyst nematode, *Cactodera estonica* from *Polygonum nepalense* roots (Saranya et al., 2017) were reported from Nilgiris.

In our ongoing research on Nematode Trophic Group Diversity (NTGD) in different Cropping Sequence of Nilgiris, we came across the presence of cotton wool nematode, *Ecphyadophora* sp., from the soil samples of tea, mustard, potato and garlic. The *Paratylenchus* species was observed in huge numbers from the fields of carrot, garlic, tea and Neelakurinji (*Strobilanthus kunthiana*). The southern RKN, *M. incognita* generally believed to be present only in tropical area are also encountered in Nilgiris. In our recent investigations, we observed that the population of *M. incognita* was found to be more than the cold loving *M. hapla* and this might be due to climate change.

Free Living and Animal parasitic nematodes from Nilgiris:

Several free living nematodes such as *Rhabditis* sp., *Cephalobus* sp., Mononchids, *Diptherophora* sp., *Wilsonema* sp., *Acrobeles* sp. and Dorylaimids were observed during our NTGD study (Berliner et. al., 2016). In addition to this one native species of Entomopathogenic nematode, *Steinernema cholashanense* was isolated and identified from infested potato cut worm, this was the first report of the species from Nilgiris as well as India (Mhatre *et. al.,* 2017).

The Animal parasitic nematodes such as abomasal worm (*Haemonchus* sp. and *Trichoshongylus* sp.), whip worm (*Trichuris* sp.) and Lung worm (*Dictyocaulus* filarial) were reported to infest gastro-intestinal tracts of sheep in Nilgiris (Soundarajan and Iyue, 2003). Likewise nematodes such as *Toxocara* sp., *Strongyle* sp., *Oesophagostomum*

sp., *Trichuris* sp. and *Mecistocirrus* sp. were found in wild gaur and domestic cattle from interface zones of Nilgiri hills (Allwin et. al., 2016). Moreover, in the very same year, the presence of *Ascaris* sp., *Trichuris* sp., *Strongyloides* sp. from Bonnet macaques (*Macaca radiata*) were reported from Coonoor area of Nilgiris (Sundar et. al., 2016). Furthermore, eight gastro intestinal nematodes (*Ascaris* sp., *Trichuris trichiura*, *Strongyloides* sp., *Trichostrongylus* sp., *Oesophagostomum* sp., *Enterobius* sp., *Bunostomum* sp., *Gongylonema* sp.) were reported from Nilgiri langurs (*Trachypithecus johnii*) from Anamalai hills (Tiwari et. al., 2017).

The salubrious Nilgiris boasted to be within the hottest hot spots of the world had only 48 plant-parasitic nematodes, eight free-living nematodes, one entomopathogenic nematode and 14 Animal-parasitic nematodes reported from it. Yet, umpteen numbers of nematodes are present in the ecosystem in several unexplored areas. This shows that the nematode biodiversity was still untapped from the Nilgiris and this open up Pandora box for the nematode taxonomists to continue their research exploration. The proper identification of a nematode species not only helps in nematode-biodiversity documentation, but also assists in adopting proper management practices against plant, animal and human parasitic nematodes.

REFERENCE

Allwin B, Balakrishnan S, Kumar NV, Jayathangaraj MG, Vedamanickam S, et al. (2016) Prevalence of Gastrointestinal Parasites in Gaur (*Bosgaurus*) and Domestic Cattle at Interface Zones of the Nilgiri Hills, Tamil Nadu, India. J Veterinar Sci Technol 7: 280. doi:10.4172/2157-7579.1000280

Anitha, B. 1997. Nematodes associated with scented geranium, *Pelargonium graveolens* in Nilgiris and pathogenicity of *Meloidogyne hapla*. Pest management in horticultural ecosystems. 3 (2): 117-119.

Berliner, J., Manjunatha, C., Umamaheswari C., Nallathambi P., Vikas V.K, Nanjundan J., Jayaprakash P. and Sivasamy M. 2016. Nematode profiling in I.A.R.I. farm and adjoining area. Nilgir wheat news. 8: 8

Howard, H.W. 1977. Report on the experiments at the PotatoExperimental and Trial Centre, Ootacamund to test resistance of material of Plant Breeding Institute, Cambridge, to Nilgiri populations of potato cyst nematodes, p.17

Jones FG. 1961. The potato root-eelworm *Heterodera rostochiensis* Woll.in India. Current Science. 30(5): 187.

Kumar, S. 1986. Note on growth of geranium plants influenced by different inoculums levels of Meloidogyne hapla. South Indian Horticulture. 34: 56-57.

Mhatre, P.H., Patil, J., Vijayakumar, R., Venkatachalam, E.P., Divya, K.L., Jenifer, J., Pankaj and Chavan, S. 2017. The First Report of *Steinernema cholashanense* (Rhabditida: Steinernematidae) from India. Indian Journal of Nematology, 47 (2): 254.

Saranya, C., Sundararaj, P., Mhatre, P.H., Venkatasalam, E.P. and Nivitha, S. 2017. First Report of Estonian Cyst Nematode *Cactodera estonica* from India, *Journal of Nematology,* 49 (4): 384-385.

Sivakumar, M., Poornima, K., Mani, M.P. and Umamaheswari, R. 2002. Biodiversity of nematode fauna in Tamil Nadu range of Nilgiris biosphere. Indian Journal of Nematology.32 (2): 139-142.

Soundarajan, C. and Iyue, M. 2003. Seasonal prevalence of Helminthic infection of sheep in Nilgiri hills. Indian Journal of Small Ruminants, 9 (2): 144-145.

Sundar, M.B., Allwin, B., Vedamanickam, S., Mohanraj, A. and Jothi, B.S. 2016. Endoparasitic Prevalence of Urban Free Ranging Bonnetmacaques (*Macaca radiata*) in Coonoor Town, Nilgiris, Tamil Nadu: A Transversal Study. J Bacteriol Parasitol 7: 293. doi:10.4172/2155-9597.1000293

Suresh, P., Poornima, K., Kalaiarasan, P., Sivakumar, M. and Subramanian, S. 2017. Occurrence of barley root knot nematode, *Meloidogyne naasi* in orange jessamine (*Cestrum aurantiacum* L.) in Nilgiris, Tamil Nadu, India: A new record. Journal of Entomology and Zoology Studies. 5(6): 629-634.

Tiwari, S., Reddy, D.M., Pradheeps, M., Sreenivasamurthy, G.S. and Umapathy, G. 2017. Prevalence and co-occurrence of gastro-intestinal parasites in Nilgiri Langur (*Trachypithecus johnii*) of fragmented landscape in Anamalai Hills, Western Ghats, India. Current Science. 113 (11): 2194-2200.

Weedy/Red rice: Origin, Morphology and Management

Simranpreet Singh Bola[1*] and Talwinder Singh[2]

[1] Ph.D. research scholar, Department of Agronomy, Punjab Agricultural University, Ludhiana, Punjab, India
[2] Assistant Professor, Post Graduate Department of Agriculture, G.S.S.D.G.S. Khalsa College, Patiala, Punjab, India
**Corresponding Author: ssaini447@gmail.com*

The evolutionary history of rice is a complex selection process byhumans which lead to the development of *Oryza sativa* L. (cultivated rice). Further, two crop species have emerged as the most popular cultivated rice, namely *Oryza sativa* and *O. glaberrima*, of which theformer is more widely distributed and produced. From an early history in the Asian region, rice has widespread and is now grown worldwide on all continents except Antarctica. The predecessor of *O. sativa* are the common Asian wild rice species *viz.*,*O. rufipogon* (perennial) and *O. nivara* (annual) (Vaughan and Morishima, 2003). Due to domestication, *O. sativa* has evolved into many different cultivars thatare adapted to a wide range of climatic conditions found in the various rice growing regions of the world. Weedy rice (*Oryza sativa*f. *spontanea*) is one of the most persistent and noxious weeds found in rice-growing ecosystems globewide (Cao et al., 2007). Being genetically very similiar and having a very close morphology andlife history to that of cultivated rice, has made weedy rice create an emerging challenge to farmers and scientists in the Asian region and globewide in overcoming the constraints to rice production.

Weedy rice (*Oryza sativa* f. *spontanea*) is one of the most noxious weeds occurring in rice growing areas worldwide, and the problem is persistent. Theorigin of the weedy forms of rice is closely related to that of the cultivated rice (*O. sativa*) and it will continue tobe a major problem worldwide where rice crops are direct-seeded as they have special characteristics such as phenological and morphological similarity to cultivated rice crop species.Earlier, weedy rice was not an important weed problem in Asian rice production systemowing to the dominance of the transplanted rice practices(Delouche et al., 2007) as puddling of the soil with retention of a filmof water on the surface destroys weed seedlings that have emerged and resultsin anaerobic conditions that are not suitable for germination of weed seeds. Additionally, the use of relatively well-developed rice seedlings for transplanting provides a competitive advantage to the growing rice crop and facilitates the identification of weedy rice and other weed seedlings that emergeswhich can be removed during post-transplant weeding operations but an extensive cultivation of direct-seeding rice technique, crop

establishment has coincided with the increased occurrence of weedy rice worldwide (Chin et al., 1999; Vaughan et al., 2005; Cao et al., 2007). In recent periods, weedy rice has been increasingly reported as a major weed problem in Asian countries, such as Malaysia, Sri Lanka, Thailand, India, Philippines and Vietnam (Delouche, et al., 2007).

ORIGIN OF WEEDY RICE

In midst of 1990's, weedy rice was first identified in Sri Lanka as a threat from various districts of Vavunia, Ampara, and Batticaloa(Marambe and Amarasinghe, 2000). At present,the weedy rice has been spread to Puttalam, Anuradhapura, Polonnaruwa,Kurunegala and Matara districts of Sri Lanka. The term weedy rice refers to the populations of *Oryza* sps. that diminish farmers income both quantitatively *via* yield reduction and qualitatively as well through lowered commodity value at the harvest. Weedy rice which belongs to family 'Poaceae' is a weed accompanying cultivated rice and is widely distributed in rice growing areas all over the world, particularly in South and South-east Asia,South and North America, and southern Europe (Mortimer et al., 2000; Noldin, 2000). Weedy riceis seperately characterized by its characters like seed shattering mechanism and dormancy, which apparently increase the distribution of this species worldwide. Baltazar and Janiya (2000) reported that varied weedy rice accessions shatters most of their seeds before cultivated rice is harvested, as a result farmer loses rice yield while filling weedseed bank in soil.

Akasaka et al. (2009) concluded that weedy rice originated from cultivated rice varieties as an off-type caused by genetic mutation accompanied by the development of a strong shattering habit and is derived from cultivated rice does not escape from the agricultural setting and remain confined to rice fields and their immediatesurroundings (Vaughan et al., 2005). Ithas higher tolerance levels than the improved cultivars to various adverse environmental conditions such as drought, low temperature, flooding etc. (Suh et al., 1997).If weedy rice found in regions where no wild rice species occurs, is probablythe derivatives of cultigens and they have been selected either from cultigens or from progeny of natural hybridization between various cultivars. Such weedy plants may have been established for a long time at low frequency but with higher rate of adaptability than the improved cultivars when and where adverse climatic conditions prevailed. Moreover, weedy rice found in areas where wild rice exists is probably a result of natural hybridization between the cultivar and the wild type grown in the close proximity. Furthermore, gene flow is mainly from cultivated to wild forms, because former is predominantly inbreeding where the latter is partially outcrossing. On the flip side, cases where weedy rice is not related genetically with the associated cultigen, they are supposed to be relics of abandoned cultivars or introduced from outside through mixtures with rice seeds.

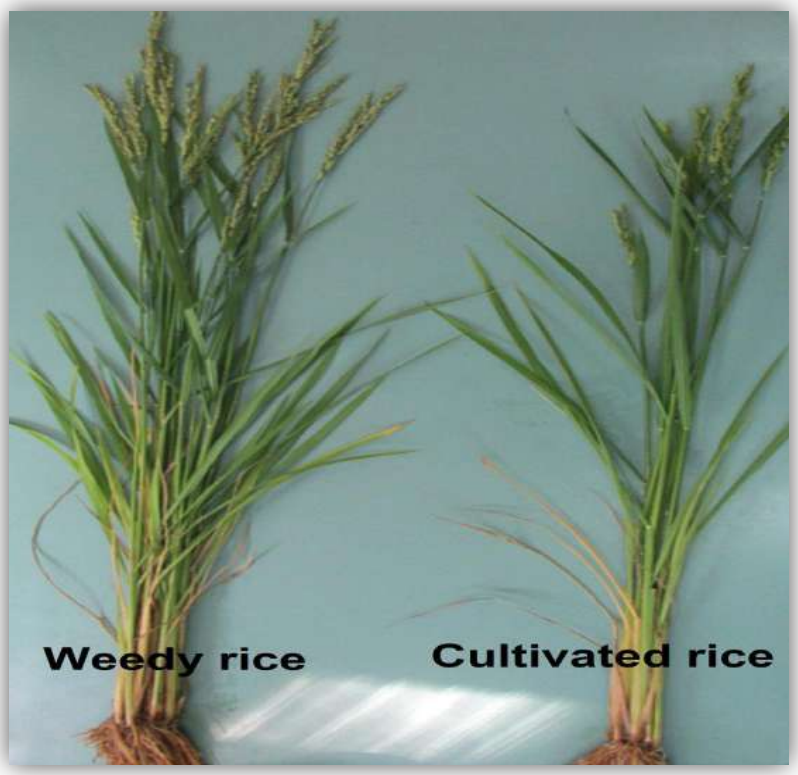
MORPHOLOGICAL AND BIOLOGICAL CHARACTERISTICS OF WEEDY RICE

The usual characters associatedwith weedy rice are; theyare annual and most commonly found in direct seeded rice fields, generally mature before the crop is harvested, with variable degree of shattering and dormancy (Oka, 1988; Ferrero,

2003).Weedy rice are generally taller plants, more heavily tillered, more open or spreading, have weaker culms, are more susceptible to lodging, produce more straw than cultivated rice plants, germinate and emerge a day or two earlier, emerge from greater depths,and exhibit more rapid seedling growth when compared to the cultivated rice that they usually infest (Delouche et al., 2007). The dormancy duration varies according to the biotype and the storage conditions of the seeds after shattering, and could range from 1-3 years (Ferrero, 2003), and the longevity of weedy rice could be up to 12 years (Diarra et al., 1985).Here, it is worth mentioning that early seed shattering, which is a specific characteristic of weedy rice, is controlled by the gene Sh, which shows the shattering character (Sastry and Seetharaman, 1973).Likewise shattering, seed dormancy is an important step in the evolution of weedy rice. The gene Rc encodes a transcription factor that has been shown to pleiotropically control both pericarp color and seed dormancy (Gu et al. 2011). The non-functional domestication Rc allele resultsinwhite pericarpsandareduction indormancy, while thefunctional Rc allele resultsinredpericarpsandvariabledormancy.Gene sequencing in US weedy rice revealed that these weed strains contain a functional Rc allele (Gross et al. 2010).

MANAGEMENT OF WEEDY RICE

Morphologically, weedy rice appears to be an intermediate between wild and cultivated rice species and widely distribution has led to similarities between weedy and cultivated rice through natural hybridization, making weedy rice control very difficult as compared with other weed species. The yield losses due to weedy rice vary from 10-100% due to their competitive ability (Marambe and Amarasinghe, 2000).Once farmersrice fields are infested, the control costs for weedy rice are very high which is uneconomical. At present, no single management technique can effectively control this weed problem. Considering the complexities and multi-dimensional aspects of the diversity, phenology and distribution of weedy rice, the control measures are also complex, difficult and require exceptional discipline in crop management, patience andperseverance as it cannot be controlled overnight (Delouche et al., 2007). Ferrero (2003) recommended integrated approaches that combine preventive, cultural and chemical control methods to overcome the problems of these noxious weeds (Table 1).



Pic 1. Habit of weedy rice vs cultivated rice*

Pic 2. Seed shattering character in weedy rice- each arrow represents a position where a grain has fallen off*

Pic3. Weedy rice has pronounced tillering and produces more tillers and panicles per plant as compared to weedy rice*

Pic 4. Dormancy in weedy rice vs cultivated rice*

*Source: www.temperategardening.com

Table 1. Various strategies and methods to control weed rice:

Control strategy	**Control method**
Preventive	Certified seeds
	Cleaning of machinery
	Field inspections
Cultural	Soil tillage (minimum tillage)
	Summer Fallowing
	Stale seed bed preparation
	Water management
	Rice variety
	Hand weeding
	Crop rotation
Mechanical	Before rice planting
	After rice planting
Chemical	Pre-plant application
	Post-plant application
Genetic	Biotechnology: Herbicide-resistant rice varieties

Source: updated from Ferrero (2003)

Pic 5. Weedy rice grains; Source: www.researchmatters.in

In USA, imidazolinone-tolerant (IT) rice cultivars have offered an opportunityfor selectivechemicalcontrol, but rapid geneintrogression into rice has now constrained the utility of this germplasm (Rao et al., 2007). Resultds obtained with IT rice shows that gene flow to weedy rice is rapid, negating the utility of the technology. Furthermore, transgenic technologies can be employed that can contain herbicide resistance within the crop *viz.,*targeting to chloroplast genome, cleistogamy, male sterility etc.).

CONCLUSION

Weedy rice is very well adapted to the habitat of direct-seeded rice, as it possesses many of the same life-history characteristics as the crop cultivar.The incomplete knowledge of weedy rice genetics hinders the design of effective practical tools and

methods for weedy rice management. The weedy rice effectivecontrol cannot be based on one single practice, but should rely on integrated management programme based on an appropriate combination of preventative, cultural, mechanical, chemical and genetic means.Development of a system for producing goodquality paddy seeds freeof weedy rice seeds is an imperative first step in the implementation of control programmes for weedy rice, among many other options available. However, the real impact will be limited until and unless all stakeholders in the rice industry are convinced that control of weedy rice is possible and neededand that the variouscontrol measures have to be integrated and inclusive.

REFERENCES

Akasaka, M., J. Ushiki, H. Iwata, R. Ishikawa, and T. Ishii(2009). Genetic relationships and diversity of weedy rice (*Oryza sativa* L.) and cultivated rice varieties in Okayama Prefecture, Japan. Breed. Sci. Vol. 59: 401-409.

B.L. Gross, M. Reagon, S.C. Hsu, A.L. Caicedo, Y. Jia, K.M. Olsen (2010). Seeing red: the origin of grain pigmentation in US weedy rice, Mol. Ecol. 19, 3380–3393, http://dx.doi.org/10.1111/j.1365-294X.2010.04707.x.

Baltazar, A.M. and J.D. Janiya(2000). Weedy rice in the Philippines. In: Wild and Weedy Rice in Rice Ecosystems in Asia – A Review (Ed: B.B. Baki, D.V. Chin, and A.M. Mortimer,). pp 75-78. Limited Proceedings No 2, International Rice Research Institute.

Cao, Q.J., B. Li, Z.P. Song, X.X. Cai, and B.R. Lu(2007). Impact of weedy rice populations on the growth and yield of direct-seeded and transplanted rice. Weed Biol. and Mgt. 7: 97-104.

Chin, V.C., Hach, C.V., Thanh, N.C., and Tai, N.T. (1999): Weedy rice situation in Vietnam. In FAO. Global workshop on red rice control, pp. 67–74. Report of Workshop, 30 August – 3 September 1999, Varadero, Cuba. Plant Production and Protection Division. Rome. 155 pp.

Delouche, J.C., N. Burgos, D. Gaely, G. Zorrilla and R. Labrada(2007). Weedy rices - origin, biology, ecology and control, FAO Plant Production and Protection Paper 188, Rome, pp. 3–15.

Diarra, A.R.J., R.J. Smith and R.E. Talbert (1985). Growth and morphological characteristics of red rice (*Oryza sativa* L.) biotypes. Weed Science 33: 310314.

Ferrero, A.(2003). Weedy rice, biological features and control. In Weed Management for Developing Countries FAO Plant Production and Protection Paper 120 Add. 1 (Ed: R. Labrada). UN-FAO, Rome.

Marambe, B. and L. Amarasinghe(2000). Weedy rice in Sri Lanka. In Wild and Weedy Rice in Rice Ecosystems in Asia – A Review (Eds: B.B. Baki, D.V. Chin and A.M. Mortimer), pp 79-82. Limited Proceedings No 2. International Rice Research Institute, Philippines.

Mortimer, M., S. Pandey and C. Pigginb (2000). Weedy rice: approaches to ecological appraisal and implications for research priorities. In: Wild and weedy rice in rice ecosystems in Asia – A Review (Eds. B.B. Baki, D.V. Chin, A.M. Mortimer), pp 97-

105. Limited Proceedings No 2, International Rice Research Institute, Philippines.

Noldin, J.A.(2000). Red rice status and management in the Americas. In: Wild and weedy rice in rice ecosystems in Asia – A Review (Eds. B.B. Baki, D.V. Chin, and A.M. Mortimer), pp 21-24. Limited Proceedings No 2, International Rice Research Institute, Philippines.

Oka, H.I. (1988). Origin of cultivated rice Japan Scientific Societies Press, Tokyo. 254 pp.

Rao, A.N., D.E. Johnson, B. Sivaprasad, J.K. Ladha and A.M. Mortimer(2007). Weed management in direct-seeded rice. Advances in Agronomy 93: 153–255.

Sastry, M.V.S. and R. Seetharaman(1973). Inheritance of grain shattering and lazy habit and their interrelationship in rice. Indian Journal of Genetics and Plant Breeding 38: 318-321.

Suh, S.H., Y.I. Sato and H. Morishima(1997). Genetic characterization of weedy rice (*Oryza sativa* L) based on morpho-physiology, isozymes and RAPD markers. Theory of Applied Genetics 94: 316-321.

Vaughan, D.A. and H. Morishima, (2003). Biosystematics of the Genus Oryza. In Rice - origin, history, technology and production (Eds: W.C. Smith and R.H. Dilday). pp 27-65. Wiley Series in Crop Science, USA.

Vaughan, D.A., P.L. Sanchez, J. Ushiki, A. Kago and N. Tomooka, (2005). Asian rice and weedy rice evolutionary perspectives. Chapter 16. In Crop Ferality and Volunteerism (Ed. J Gressel). pp. 257–277. Boca Raton, USA, CRC Press.

X.Y. Gu, M.E. Foley, D.P. Horvath, J.V. Anderson, J. Feng, L. Zhang, C.R. Mowry, H. Ye, J.C. Suttle, K.I. Kadowaki, Z. Chen (2011). Association between seed dormancy and pericarp color is controlled by a pleiotropic gene that regulates abscisic acid and flavonoid synthesis in weedy redrice,Genetics 189; 1515–1524.

Modal File Repositories for Agricultural Organizations using Open Source Software

V V Sumanth Kumar* and Praneetha Y

Senior Scientistand Young Professional at ICAR-National Academy for Agricultural Research Management, Rajendranagar, Hyderabad
**Corresponding Author: sumanth.naarm@gmail.com*

ABSTRACT:

File repositories have long been rewarded, for they ease the work flow in any organizational setup. Agricultural organizations for that matter, generate huge amount of datasets through multi-disciplinary research and academic activities. Modernization of these research systems has been achieved through use of cloud computing enabled software solutions ensuring secured and broader dissemination of scholarly research among various stakeholders. One such cloud powered repository was built at ICAR-NAARM using customizable open source Next Cloud software that is built upon using hybrid technology, facilitating access both through mobile application and web interface. This is realized to have improved the Research management efficiency and eased the process.

Key Words: *File Repositories, Cloud Computing, Open source software, Hybrid technology*

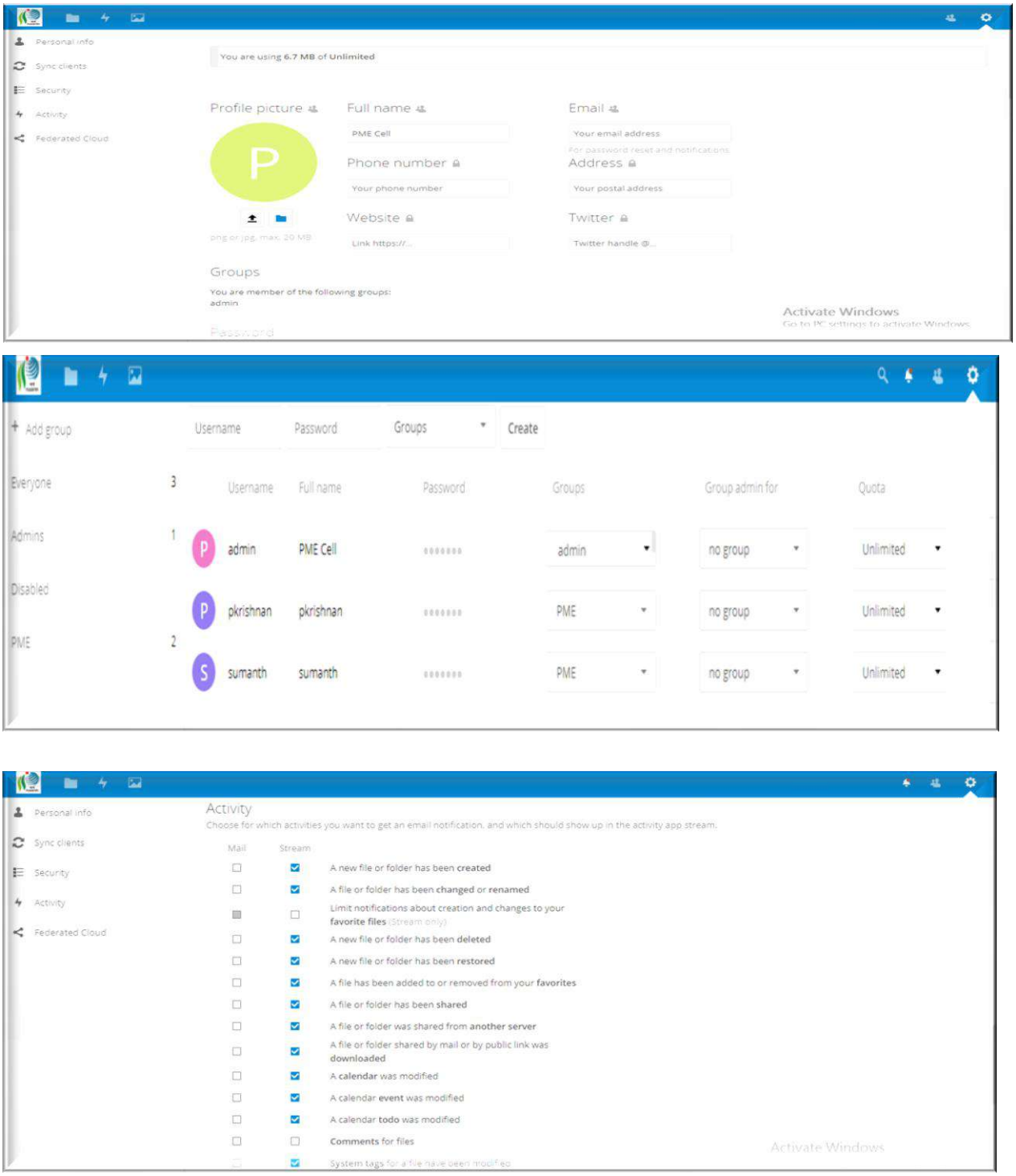
ARTICLE

Any File repository specifically developed for an Organization, acts as a digitalarchive that could securely preserve, centralize and manage the huge amount of datasets besides facilitating easy access and share of data. Agricultural organizations both academic and research oriented, were in great need to institutionalize File repository mechanism to efficiently manage and curate the huge amount of heterogeneous data generated in the form of documents, pictures, videos from research outcomes, classroom presentations, conference and workshop proceedings etc., With this goal and challenge, an attempt was made at ICAR-NAARM,that led to development of cloud powered, common file repository system (http://pgdma.in/naarmcloud) within which all the files uploaded can be accessed by designated users of the Academy.This application is restricted to be accessed by only the users provided with unique username and password.

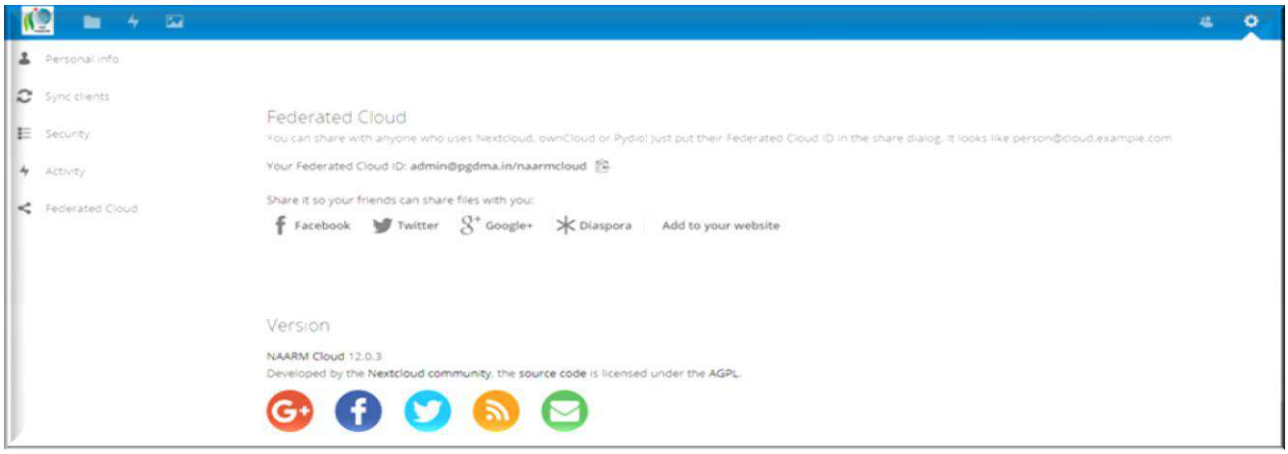
The NAARM cloud is built using "Next Cloud" an open source, customizable, self-hosted software that employed hybrid technology facilitating users to access both through Android mobile application and web interface.This file sync and share software can be used by all the individuals from within and outside the institute operating the pgdma.in server, in the privacy of their own location, to other large organizations supported by the Next Cloud Organizational Subscription. This software provides a safe, secure, and compliant file synchronization and sharing solutions.

It is made possible for users to access unlimited space to share multiple files and folders containing datasets in any format (audio files, video files, excel, word docs, pdf, odt, etc., unrestricted to a particular type) from a computer and synchronize them with the Next cloud server. Once the user place files in locally shared directories, those files are immediately synchronized to the server and to other devices using the own Cloud / Next cloud Desktop Sync Client, Android app, or iOS app. This software is released under the license agreement GNU AGPLv3.

As it can be seen, the application was initially designed for PME cell. Under personal profile it is possible to add few personal details facilitating for others users for further correspondence regarding the files shared if required. Also any number of user groups can be created and users can be added, so that they can access specific datasets shared in a particular user group. Also, the admin of user group as well as users can be able to trace the activities performed periodically, through opting for email alerts so that the updated information is quickly made to reach the end users.



Also, it is possible to share files to the people outside the domain by creating the link to a particular dataset under federated cloud complying a source code and shared through any other digital communication paltform.



The other distinguished features of the software that can be derived benefit from, through use of file repository system are: there are no limitations and any user can inspect, integrate, extend and modify the server settings as per need, and also offers an easy user interface which comes with search functionality, favorites, tags and even more ways to quickly reach the files to be accessed. Also, there is provision for document editing and creation of thumbnail previews specific to different format of datasets.This On-premise server underlying any file repository system accords with the legal terms of any organization, as it offers solution for sharing of even highly confidential research data without compliance and hence reduces the vulnerability for data breaching.

Integration of anti-virus scanning functionality with the anti-virus app ensures more secured and reliable data storage and transmission. It can be trusted as a powerful tool with all research data, for it has integrated logging detail display and password policy control functionalities.

Also, new users can be made to quickly adopt to an organizational system for they are also provided with access to pre-loaded files and folders. Also, there is possibility for Advanced quota management with configurable accounting of external storage.Also, it enables for Quick access to core functions for app development with the powerful Nextcloud App API and webhooks following the publication / subscription model and this also facilitates for integration of remote 3rd party applications that might be required for monitoring or other extended services.

Even this simple intervention with improved functionality over conventional system of data sharing, in terms of data back up and restoration;archival and data retrieval; controlled sharing and swift data migration from one device to another is witnessed to have greatly contributed to the research management efficiency. Hence, it is much timely and utmost important that all the Agricultural organizations should be aware of and realize the importance of expanding their digital repository services for secured, continuous and long term access of data by all the stakeholders involved in the domain.

REFERENCES

1.About Nextcloud software at https://nextcloud.com/

2. Hilton Gibson. (2013). Practical guidelines for starting an institutional repository. https://www.researchgate.net/publication/237075772_Practical_guidelines_for_starting_an_institutional_repository_IR
3. Rachel Smart (2019). What is an institutional repository to Do? Implementing Open Access Harvesting workflows. https://www.researchgate.net/publication/333412474_What_Is_an_Institutional_Repository_to_Do_Implementing_Open_Access_Harvesting_Workflows
4. KRISHI, ICAR data repository for knowledge Management. https://krishi.icar.gov.in/

Nuisance of gall insect and its management in Arjun tree, Terminalia arjuna Primary host plant of tasar silk worm

C. Selvaraj*

Scientist-B, BSM&TC, BTSSO, CSB, Madhupur, Deoghar, Jharkhand- 815353.
**Corresponding Author: selvaarjun665@gmail.com*

Gall insect, *Trioza fletcheri* minor (Psyllidae: Hemiptera) is very important gall producing pest on the stems and leaves of tasar food plants (Arjun and Asan). These gall inducing pest occurs in the wide geographical areas *via*., subtropical, peninsular and deciduous forests of India. Most of the gall inducing psyllids are normally site and host specific. Gall insect damages primary host plants of tasar silk worm Arjun, *Teminalia arjuna* and Asan, *Terminalia tomentosa* and their hybrids. Gall insect life cycles are unique because time of emergence, availability of food plants, reproductive ability, quality of their progeny, feeding habitat and place of settlement etc., are highly specialized. Gall insect forms a gall chamber, settle inside and derives its nutrition from those galls. Leaf damage caused by Gall insect in Arjun tree, *T. arjuna* was recorded up to 40-50 per cent under lack of proper management practices during peak period (August-September) (Mukherjee *et al.*, 2017).

Fig: Symptoms of Gall insect injury to Arjun plant, *T. arjuna*

LIFE CYCLE

Gall insect, *Trioza fletcheri* minor life cycle comes under incomplete metamorphosis and its life stages consists of egg, five nymphal instars and adult. The fifth instar undergoes diapauses and emerges out as a adult. Newly emerged adults are transparent white in

colour and it changes as green when feeds for some time. Adult emergence and new flush developments are positively correlated. Gall infestation attains peak stage during August month but infestation was observed all the months in low or negligible amount.

a. Nymph of *T.fletcheri* **(**Source: Sudhir Singh. 2016)

b. Adult of *T. fletcheri* **(**Source**:** Datta *et al.,* 2019**)**

GALL INSECT FEEDING AND GALL FORMING MECHANISM

Gall as a result of defensive responses of plant over feeding injury caused by gall insect. Sufficient information is available on the mechanism of gall formation in Arjun, *T. arjuna* and Asan, *T. tomentosa.* Females of gall insect lays eggs on the stems axis and petioles of newly emerged vegetative branches. While laying the eggs pedicle of the eggs inserted into the host tissues cortical parenchyma cells. Embryo development completes within 48 hours and the egg inclines so that operculum touches the plant surface and facilitates easy movement of nymphs after the emergence. Immediately after emergence first nymphal instar crawl from egg laid sites towards abaxial surfaces of developing leaves and insert their stylets of mouthparts into the stomata and settle there itself and feeds on primordial parenchyma cells in mesophyll region. These parenchyma cells become metabolically active and multiplies enormously by hypertrophy and hyperplasia and produces gall chamber around the nymph.

The adaxial epidermal leaf cells accommodating nymphs reacts actively by production of cylindrical trichomes, those trichomes are completely filled by polyphenols. Mesophyll cells nearer to trichomes shows enormous hypertrophy and hyperplasia and its leads to labial growth occurs around the nymph. Within the week period, cone shaped labial growth occurs around the nymph and meets at abaxial side without joining the tip in the form of cone encloses the nymph, meeting along the abaxial side of the host leaf, though there is no fusion at the tip. In the due time nymphal chambers are organized by bordering its inner perimeter with parenchyma cells. Mesophyll parenchyma cells around the gall, filled with polyphenolic substances, especially on leafs adaxial side. When the nymph undergoes moulting to second instar, growth in the galls mesophyll region and the gall size increases rapidly.

The nutritive parenchyma cells are rich in cytoplasm and contain prominent nuclei. Following the moult to the third instar, the gall attains the final shape including the prominent conical covering growth along the abaxial side and distinct bulge along host plant leaf adaxial side. At this stage, the nymph feeds on vascular phloem shifting from parenchyma cells. Moulting to fourth nymphal stage marks a number of vital

morphogenetic changes in the gall. The erstwhile nutritive parenchyma cells in their neighborhood begin to accumulate starch and polyphenols either as crystalline or viscous inclusion. Such cells are distributed rather irregularly in the gall mesophyll. Cells bordering the narrow space in the conical edge proliferate at random points thereby the widening pathway is narrowed. This can be seen as an adaptation in the gall system to prevent the possible entry of predator. Synchronizing with the moulting of fifth nymphal instars, the adaxial region of the gall expands laterally either by producing new growth centres that divides or expands.

Gall ready for bursting includes 10-12 rows have horizontally distributed sclerite elements and the sclerification of parenchyma cells snaps off the plasmodesmatic connections between the cells. Consequently, the parenchyma cells lying close to the nymphal chamber shrink and degenerate. This results on widening of the ostiole in the abaxial cone and it enables the escape of the final nymphal instar for moulting into adult outside *T. arjuna*. Adults male and females at emergence are pale brown with black terminal antennae segments, but a progressive colour changes to deep brown follows with maturation. Matting occurs 3 to 4 days after emergence and matted female lays eggs on newly emerged leaves and petiole host plants.

INTEGRATED GALL MANAGEMENT

Gall insect can be minimized by combination of several management practices. Cultural: Pruning has to be done 4-6 ft height and the pruning schedule should be post-phoned to end of April to minimize gall infestation. It is a most convenient way to nipping the pest infestation in the bud. Some regular farming practices *viz*. weeding, inter-cultivation, pruning and pollarding ensure further reduction in the gall population. Biological control of gall insect two important parasitoids *Trechnites secundus* Girault (Encyrtidae: Hymenoptera) and *Aprostocetus niger* (Eulophidae: Hymenoptera) have been screened from the plantation of *Teminalia arjuna* and *Terminalia tomentosa*. In some cases even after successful adoption of these management practices, gall infestation was recorded up to 45 percent. Soil application of neem cake and foliar application azadiractine 6 ppm, Dimethoate (Rogar 30 EC), or Monocrotophos 36 EC or Malathion 50 EC or Fenitrothion 50 EC at 0.09 percent helpful to minimize the gall infestation effectively.

REFERENCE

Chris Hodgson, Rosy Mary dos Santos Isaias and Denis Coelho de Oliveira. (2013). A new gall-inducing genus and species of Eriococcidae (Hemiptera: Sternorrhyncha: Coccoidea) on Sapindaceae from Brazil. *Zootaxa* 3734(3):317-30.

Datta OM , Tomar S and Dhiman S.C. (2019). Morphology of foliar galls on *Trewia nudiflora* induced by *Trioza fletcheri* crawford with a comment on life cycle of the psyllid. *World Journal of Pharmaceutical Research*, 2019; 8 (6): 864-869.

Mukherjee S, Kumari D, Singh J, Lokesh G and Sinha A. 2017. Morphology of gall insect, *Trioza fletcheri* minor Crawford and gall infected leaves of tasar food Plants. *Journal of Entomology and Zoology Studies*, 2017; 5(3): 261-263.

Singh RN, Sinha MK, Bajpeyi CM, AK Sinha and Tikader A. 2014. Tasar Culture. *A.P.H. Publishing Corporation*, 4435-36/7 Ansari Road Darya Ganj, New Delhi-110002.

Sudhir Singh. (2016). Description of a New Species of *Psyllaephagus Ashmead* (Hymenoptera: Encyrtidae) Parasitizing Pit Gall Forming Psyllid, *Trioza fletcheri* (Hemiptera: Psylloidea: Triozidae) on *Terminalia arjuna* from India. *Annales Zoologici* 2016; 66(3): 393-402.

Mango Seed: A potential source of nutrition from waste

A. K. Rai[1]*, H. Das[2], S. R. Dash[1] and S. Behera[3]

[1]Krishi Vigyan Kendra, Malkangiri, OUAT, Odisha-764045
[2]RRTTSS, Kalimela, Malkangiri, OUAT, Odisha- 764045
[3]College of Agriculture, OUAT, Bhawanipatna, Odisha-766001
**Corresponding Author: anujrai62@gmail.com*

Mango (*Magnifera indica*) is a perennial crop of the family Anacardiacea. It is grown practically all over tropical and sub-tropical regions of the world and most popular fruit of India. In Hindi, it is called Aam, Amba and Ambra. India is the largest producer of mangoes with 44.14% of the total world production (Kusuma and Basavaraja, 2014). The fruits are egg-shaped or kidney shaped with smooth, leathery skin and the colour ranges from light or dark green to clear yellow when ripe. As mango is seasonal fruit, about 20% of fruits are processed for products such as puree, nectar, leather, canned slice, chutney, juices, ice cream, fruit bars and pies. During the processing of ripe mango, its peel and seed are generated as waste, which is approximately 40-50% of the total fruit weight.

Mango Seed

Mango seed is an important part of fruit. After utilization of mango, considerable amount of the seeds are discarded as waste and generating a source of pollution. However, nutritionally seed is the most enriched part of fruit because it acts as a storage site of nutrients. The seed is solitary, ovoid or oblong, encased in a hard, compressed fibrous endocarp. Mango seed consists of a tenacious coat enclosing the kernel. Mango seed also known as *Guthali* in Hindi and it is edible, nutritious and non-toxic. The kernel is helpful in balancing deranges *Kapha* and *Pitta* inside the body. It is sweet, acrid, astringent, refrigerant, anthelmintic, constipating, haemostatic and tonic.

Nutritional Value

Apart from their wonderful flavor, mango seed is a good source of nutrients, vitamins and minerals. Mango seed kernel contains average of 6% protein, 11% fat, 77% carbohydrate, 2% crude fiber and 2% ash (Zein *et al*., 2005). Mango seed kernels have a low content of protein but they contain the most of the essential amino acids, with highest values of leucine, valine and lysine (Table-1). Variance in nutritional composition may be due to varieties, climate, maturity, variety of plant, harvesting time of seeds and extraction technique used.

Table-1. Amino acid profile (g/100 g of protein) of mango seeds

Amino acid	Quantity
Histidine	2.31
Isoleucine	3.23
Lysine	3.13
Leucine	8.4
Phenylalanine	4.46
Methionine	1.04
Threonine	2.04
Valine	3.8
Tyrosine	3.17
Alanine	6.4
Aspartate	6.33
Arginine	5.17
Cysteine	2.3
Glycine	3.5
Glutamate	13
Serine	2.93
Proline	3

Source: Fowomola, 2010

Vitamins

Mango seed is a good source of vitamins. It contains 15.27 IU vitamin A and B1, B2, B6, B12 and C as 0.08, 0.03, 0.19, 0.12, and 0.56 mg/100 g of dry weight, respectively (Fowomola, 2010). It can be used as an alternative source of these antioxidant vitamins. Antioxidant vitamins help to reduce oxidative processes and prevent cardiovascular diseases and cancer.

Table-2. Comparison of vitamin content of mango kernel with other staple foods (mg/100g dry weight)

Vitamin	Mango kernel	Grains	Nuts	Legumes
K (mcg)	0.59	2.3	8.56	4.57
E	1.3	1	9.94	3.34
C	0.56	0	0.26	7.88
B6	0.19	0.4	0.17	0.22
B2	0.03	0.3	0.3	0.25
B12	0.12	0	0.04	0.0024
B1	0.08	0.5	0.42	0.24
A (IU)	15.27	10.8	0	980.02

Source: Patel and Kheni, 2018

Minerals

Mango seed kernel is high in potassium, magnesium, phosphorus, calcium and sodium (Table- 3). Potassium is an essential nutrient and has an important role in the synthesis of amino acids and proteins. Calcium and magnesium plays a significant role in carbohydrate metabolism and binding agents of cell walls. Calcium assists in teeth development. Magnesium is essential mineral for enzyme activity and plays a role in regulating the acid-alkaline balance in the body.

Table-3.Some mineral contents of mango seeds

Mineral	Composition (mg/100 g)
Na	21.0
K	22.3
Ca	111.3
Mg	94.8
Fe	11.9
Zn	1.10
Mn	0.04

Source: Fowomola, 2010

Phenolic Compounds

Mango seed kernel is a potential source of natural antioxidants. It contains tannin, gallic acid, cinnamic acid, ferulic acid, mangiferin, vanillin and caffeic acid as 20.7, 6.0, 11.2, 10.4, 4.2, 20.2 and 7.7 mg/100 g of dry mango seed kernel, respectively (Abdalla *et al*., 2007).

Antioxidant activity of mango seed kernel is higher among variety of fruit seeds such as jackfruit, tamarind and avocado due to its high polyphenolic content. Mango seed kernel also contains phytosterols such as campesterol, stigmasterol and bsitosterol and Tocopherol. Mango seed kernel showed antioxidant result due to polyphenols, phytosterols and microelements such as zinc, copper and selenium. Therefore, it is the reason for industrial utilization of mango seed kernel as a functional food ingredient (Nunez, 2005).

How to use?

Mango Seed Flour-

Mango seed kernels may be use as the supplementation of staple foods through processed into flour. Several value added products can be developed from different combination of mango seed kernel flour with other flours.

- ✓ Incorporating mango seed flour upto a level of 30% with refined wheat flour for the preparation of nutri-rich biscuits (Kaur and Brar, 2015).
- ✓ Composite flour bread with the mango seed flour upto 10-13% is good source of nutrition for the preparation of bread (Menon, *et al*., 2015).

- ✓ For the preparation *idli*, addition of mango seed flour upto10% level is good for nutrition (Kaur and Brar, 2017).

Mango Seed Oil

- ✓ Mango seed oil has been used in the cosmetics industry as an ingredient in soaps, shampoos, and lotions because it is a good source of phenolic compounds (Soong and Barlow, 2004) including microelements like selenium, copper, and zinc (Schieber and Carle, 2005).
- ✓ Mango seed can help to get rid of dandruff. Take mango seed butter and apply it on hair for luster and strength. It can also mix with mustard oil and leave it out in the sun for few days. Application of this mixture can control alopecia, hair loss, early greying, and dandruff.
- ✓ Mango kernel fat is used as a potential substitute for tallow and cocoa butter.

Health Benefits

- ✓ Dry mango seeds are effective in fighting acidity and improves digestion. Since it is rich in phenols and phenolic compounds which are actually known for being a good antioxidant, they help in improving digestion.
- ✓ Mango seeds are outstanding for lowering the levels of blood sugar and in the treatment of diabetes.
- ✓ Mango seed powder is very effective in treating throat inflammation and cough.
- ✓ Antioxidants present in mango seed help to prevent cardiovascular diseases and cancer.

REFERENCES

Abdalla, A.E., Darwish, S.M., Ayad, E.H., El-Hamahmy, R.M. (2007). Egyptian mango by-product 1. Compositional quality of mango seed kernel. *International Journal of Food chemistry*. 103(4):1134-1140.

Fowomola, M.A. (2010). Some nutrients and anti-nutrients contents of mango (*Magnifera indica*) seed. *African Journal of Food Science*. 4(8): 472-476.

Patel, G.N. and Kheni, J. (2018). Mango seed kernel, a highly nutritious food, should we continue to trash or use? *Journal of Pharmacognosy and Phytochemistry*. 7(4): 04-07.

Kaur, A. and Brar, J.K. (2015). Use of Mango Seed Kernels for the Development of Antioxidant Rich Biscuits. *International Journal of Science and Research*. 6(8): 319-7064.

Kaur, A. and Brar, J.K. (2017). Use of mango seed kernels for the development of antioxidant rich *idli* and *mathi. International Journal of Home Science.* 3(2): 715-719.

Kusuma, D.K. and Basavaraja, H. (2014). Stability Analysis of Mango Export Markets of India: Markov Chain Approach. *Karnataka Journal of Agricultural Sciences.* 27(1): 36-39.

Menon, L., Majumdar, S.D. and Ravi, U. (2015). Development and analysis of composite flour bread. *Journal of Food Science and Technology.* 52: 4156–4165.

Nunez, S.A.J. (2005). Antioxidant therapy: myth or reality? *Journal of the Brazilian Chemical Society*. 16(4): 699-710.

Schieber, A., and Carle, R. (2005). Occurrence of *carotenoid cis-isomers* in food: technological, analytical, and nutritional implications. *Trends in Food Science & Technology*. 16(9): 416–422.

Soong, Y. and Barlow, P. J. (2004). Antioxidant activity and phenolic content of selected fruit seeds. *Food Chemistry.* 88: 411-417.

Zein, R.E., EL Bagoury, A.A., Kassab, H.E. (2005). Chemical and nutritional studies on mango seed kernels. *Journal of Agricultural Science.* 30: 3285-3299.

Need of the Hour: Solar Power

***Davinder Singh, Vikram, SumitDeswal and Amit Kumar**

CCS Haryana Agricultural University, Hisar
***Corresponding Author: davinderr184@gmail.com*

Solar energy is an alternative renewable energy source that is becoming famous due to its cost feasibility and higher efficiency. It is simple, reliable and long lasting source of energy which can fulfil the energy demand of the rural and urban areas. India's power network is under-developed and it's a great hurdle to rural India's development because most of the daily practices dependent on mechanical power.As most of the rural population depend on agricultural work so solar power generated from solar energy can be used to operate agricultural tools like tractors, watering systems, rotator, roller, planter, sprayers, broadcast etc. In farming system, the battery power is replaced with solar power, so that the usage of electricity from renewable sources of energy can be increased with sustainable use of non-renewable resources.

ROLE IN AGRICULTURAL FIELD:

Solar water: Large number of agricultural equipment's can be operated with solar power just to decreases the cost of cultivation for poor and marginal farmers of India. One out of these equipment's is solar water pumping systemthat is consists of solar panels, a control, tracking mechanism, and a motor pump. This system essentially uses SPV cells that can convert solar energy into electric current and its capacity can range around 200 watts to 5KWp (kilowatt-peak). Before selecting and installing a solar pump one should kept in mind the daily water requirement, water source and geographic location of the land area. A system with 1,000Wp capacity can irrigate about 2 acres of land, pumping approximately 40,000 litters of water per day and costs around INR 439,000.

In protected cultivation

Farmers can get huge market price by cultivating vegetables in off season but it can be possible when farmers use protected structures like greenhouse just to provide proper environmental conditions in off season. Solar Greenhouses make optimum use of solar energy for providing heating and insulation. Specialized solar greenhouses can collect and store energy for night-time use or during cloudy weather. SPV cells can be used to collect solar energy for additional insulation in colder climates. Such greenhouses using passive solar technology have been built for costs starting at INR30,000 in Ladakh.

SOLAR POWERED ELECTRIC FENCES

Now days it's difficult for farmers to save their crop from vagabond animals. They have to install fence around their field which put extra cost on the farmers but solar powered electric fences are highly effective and dependable for large fields. These fences typically consist of a SPV unit as a source of power, an energizer that produces high voltage impulses (8kv) emitted in intervals of 0.9 to 1.2 seconds, along with a 12V battery. Battery operated solar fences may cost approx. 20,000 per acre have been developed using locally made materials in some places in India.

Solar Milking Machine

Milking machines for cows operated on solar power instead of diesel. A SPV module mobile milking machine along with solar panels and battery backup is available for INR70,000.

ADVANTAGES

At present, most of the electricity generated using non-renewable fossil fuels as source of energy. These fossil fuels are not permanent so with the time these will exhaust from the earth. The alternate method for electricity production is the solar energy generation and that solar energy can be used in the farming system. Solar farming is not only environmentally friendly, but also reliable and cost effective as it's like one time investment. It is pollution free because no emission of harmful gases. It's available every day of the year; even cloudy days produce some power for home appliances. The financial benefits of solar panels are the main reason that so many rural and urban communities are moving to solar technology. The Indian government is also helping farmers by providing subsidies and loans to acquire solar powered agricultural tools. The time has come to switch to solar power on Indian farms and to save non-renewable sources of energy for our next generation.

Solar powered fence

Solar powered mill

Solar milking machine

Solar powered sprayer

Solar powered poly-house

Solar powered water pump

Achievements:

With about three hundred clear and sunny days in a year, the calculated solar energy incidence on India's land area is about 5000 trillion kilowatt-hours (kWh) per year.The daily average solar-power-plant generation capacity in India is 0.20 kWh per m^2 of used land area. The country added 3.01 GW of solar capacity in 2015-2016 and 5.525 GW in 2016-2017 which was the highest of any year.

By 30 September 2006 a total of 7,068 solar photovoltaic water pumping systems were installed,and by March 2012 7,771 were installed.

By 2012, a total of 4,600,000 solar lanterns and 861,654 solar-powered home lights were installed, replacing kerosene lamps.

In Rajasthan 2016-17, 91 villages have been electrified with a solar standalone system and over 6,200 households have received a 100W solar home-lighting system.

According to report in December 2016, the cost of solar power in different countries fell to about one-third of its 2010 price which indicated that the solar energy is the cheapest form of renewable energy.

Government support

1.The **Ministry of New and Renewable Energy** provides a 70-percent subsidy of the installation cost of a solar photovoltaic power plant in the north-eastern states 2.Haryana government recently announced that it would provide subsidy to the tune of 15,000 to consumers for installingsolar home systems under the **'ManoharJyotiYojana'** which aims to promote renewable energy in the state.

Our Duty as Indian citizen

At present,Indian industry is dependent on non-renewable resources of energy and for this we import over 80 % of oil to fulfil our energy demand. This puts significant stress on Indian population. India is targeting to increase its GDP growth and to accomplish it, our energy demands are also likely to go up. Therefore, it is necessary to look at clean energy like solar power which don't disturb environmental factors, but can also reduce local pollution levels.

Climate Resilient Agriculture: A Strategic way to fight Agrarian Distress

Kalyan Mandi[1] and Jeeban Jyoti Behera[2]

[1]*Ph.D. Scholar, Dept. of Agricultural Extension, ICAR-NDRI, Karnal*
[2]*Ph.D. Scholar, Dept. of Agricultural Extension, OUAT, Bhubaneswar*
**Corresponding Author: kalyan.mandi@gmail.com*

ABSTRACT

Climate change impacts on agriculture are being witnessed all over the world, but countries like India are more vulnerable in view of the huge population dependent on agriculture, excessive pressure on natural resources and poor coping mechanisms. The warming trend in India over the past 100 years has indicated an increase of 0.60°C. The projected impacts are likely to further aggravate field fluctuations of many crops thus impacting food security. There is already evidence of negative impacts on the yield of agronomic crops in parts of India due to increased temperature, water stress and reduction in the number of rainy days. Significant negative impacts have been projected with medium-term (2010-2039) climate change, e.g. Yield reduction by 4.5 to 9%, depending on the magnitude and distribution of warming. Since agriculture makes up roughly 15% of India's GDP, a 4.5 to 9.0% negative impact on production implies cost of climate change to be roughly at 1.5% of GDP per year. Enhancing agricultural productivity, therefore, is critical for ensuring food and nutritional security for all, particularly the resource-poor small and marginal farmers who would be affected most. In the absence of planned adaptation, the consequences of long-term climate change could be severe on the livelihood security of the poor.

Keywords: climate, change, impact, crops, agriculture

INTRODUCTION

Climate Resilient Agriculture can be defined as 'agriculture that reduces poverty and hunger in the face of climate change, improving the resources it depends on for future generations.' (Christian Aid, Time for Climate Justice, 2015). Climate Resilient Agriculture wants to transform the current systems and has a wider perspective than increased production only. It supports food production systems at local, regional and global level that are socially, economically and environmentally sustainable. Climate-Smart Agriculture is defined as "an approach that guides actions needed to transform

and reorient agricultural systems to effectively support development and ensure food security in a changing climate". It aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible (FAO, 2016). The main criticism on the concept of Climate-Smart Agriculture is that it also includes large-scale, high external input food production, without properly accounting for social and environmental aspects, such as inclusion of small-scale producers and focus on ecosystem management. The impacts of climate change on agriculture are being witnessed all over the world, but countries like India, with >80% of small and marginal farmers with poor coping mechanisms, are more vulnerable in view of their dependence on agriculture and excessive pressure on natural resources. In recent years, there has been a significant rise in the frequency of extreme weather events affecting farm-level productivity and impacting the availability of staple food grains at the national level. Within a season, severe droughts and floods are being experienced in the same region, worsening the plight of all stakeholders.

Since climate change poses complex challenges like multiple abiotic stresses on crops and livestock, shortage of water, land degradation and loss of biodiversity, focused and long term research is required to find solutions to the problems specific to our country. For meeting the new challenges, the Indian Council of Agricultural Research (ICAR) initiated a mega project titled "National Initiative on Climate Resilient Agriculture (NICRA)" in 2010-11 with the objectives of enhancing the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies; demonstrating site-specific technology packages on farmers' fields for adapting to current climate risks; thereby building up the capacity of scientists and other stakeholders in climate-resilient agricultural research and its applications.

ADAPTATION TO CLIMATE VULNERABILITY

Planned adaptation is essential to increase the resilience of agricultural production to climate change. Several improved agricultural practices evolved over time for diverse agro-ecological regions in India have potential to enhance climate change adaptation, if deployed prudently. Management practices that increase agricultural production under adverse climatic conditions also tend to support climate change adaptation because they increase resilience and reduce yield variability under variable climate and extreme events. Some practices that help adapt to climate change in Indian agriculture are soil organic carbon build-up, in-situ moisture conservation, residue incorporation instead of burning, water harvesting and recycling for supplemental irrigation, growing drought and flood-tolerant varieties, water-saving technologies, location-specific agronomic and nutrient management, improved livestock feed and feeding methods. Institutional interventions promote collective action and build resilience among communities. Capacity building by extensive participatory demonstrations of location-specific agricultural practices helps farmers gain access to knowledge and provides confidence to cope with adverse weather conditions. In this

project, an effort is made to marshall all available farm technologies that have adaptation potential and demonstrate them in farmers' fields in most vulnerable districts of the country through a participatory approach.

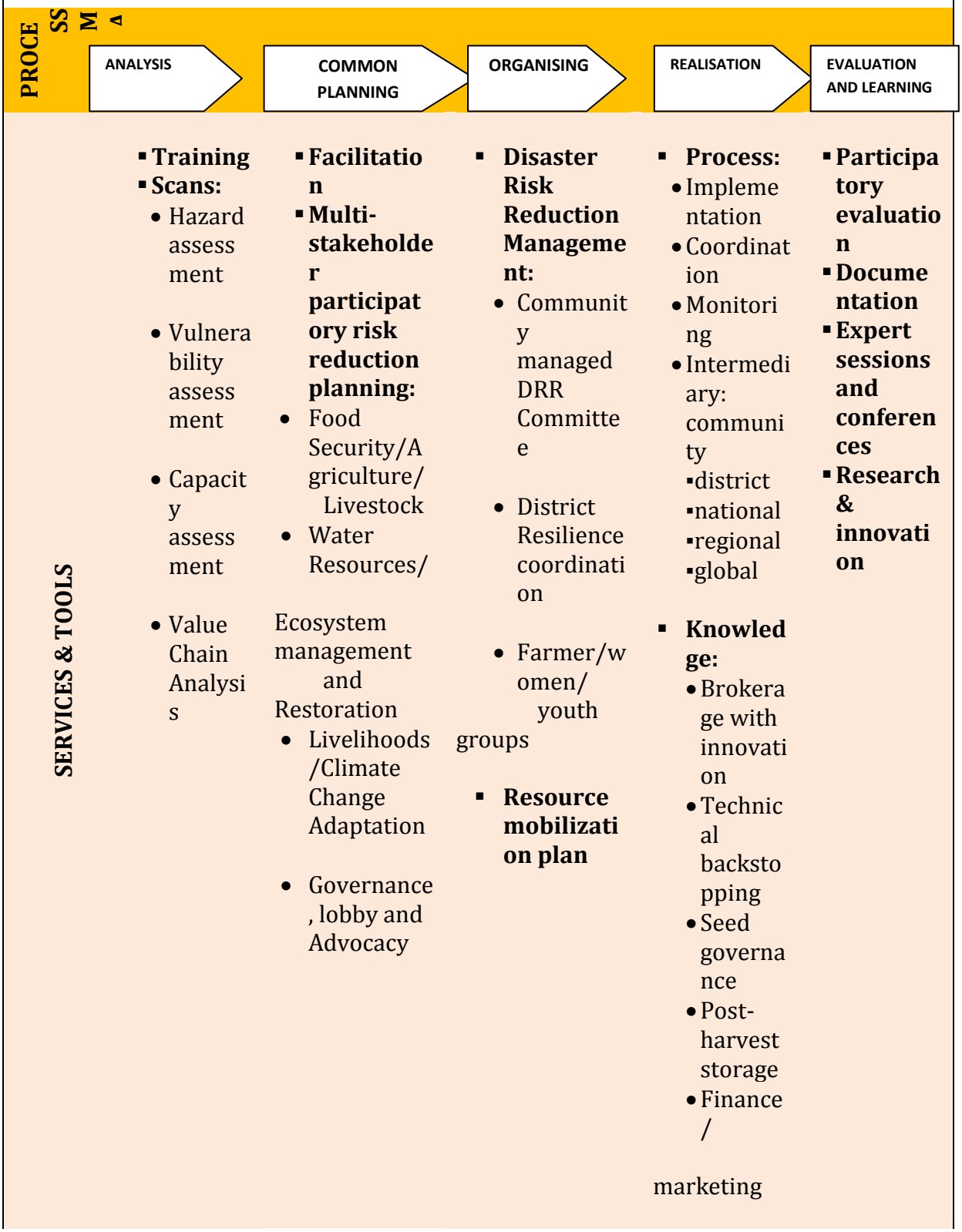
Village level interventions towards climate-resilient agriculture:

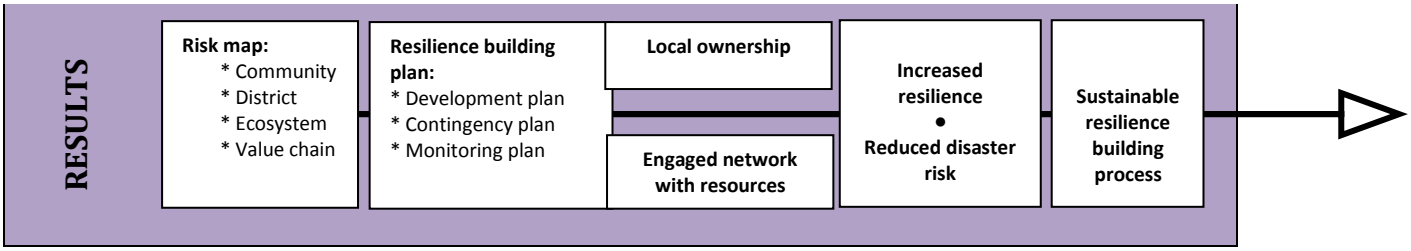
1. **Building resilience in soil:** Soil health is the key property that determines the resilience of crop production under changing climate. A number of interventions are made to build soil carbon, control soil loss due to erosion and enhance water holding capacity of soils, all of which build resilience in soil. Mandatory soil testing is done in all villages to ensure balanced use of chemical fertilizers. Improved methods of fertilizer application, matching with crop requirement to reduce nitrous oxide emission.
2. **Adapted cultivars and cropping systems:** Farmers in the villages traditionally grow local varieties of different crops resulting in poor crop productivity due to heat, droughts or floods. Hence, improved, early duration drought, heat and flood-tolerant varieties are introduced for achieving optimum yields despite climatic stresses. This varietal shift was carefully promoted by encouraging village level seed production and linking farmers' decision-making to weather-based agro-advisories and contingency planning.
3. **Rainwater harvesting and recycling:** Rainwater harvesting and recycling through farm ponds, restoration of old rainwater harvesting structures in dryland/rainfed areas, percolation ponds for recharging of open wells, bore wells and injection wells for recharging groundwater are taken up for enhancing farm-level water storage.
4. **Water-saving technologies** Since climate variability manifests in terms of deficit or excess water, major emphasis was laid on the introduction of water-saving technologies like direct-seeded rice, zero tillage and other resource conservation practices, which also reduce GHG emissions besides saving of water.
5. **Farm machinery (custom hiring) centers:** Community managed custom hiring centers are set up in each village to access farm machinery for timely

sowing/planting. This is an important intervention to deal with a variable climate like delay in monsoon, inadequate rains needing replanting of crops.

6. **Crop contingency plans:** To cope with climate variability, ICAR/CRIDA has developed district-level contingency plans for more than 400 rural districts in the country. Operationalization of these plans during aberrant monsoon years through the district/ block level extension staff helps farmers cope with climate variability.
7. **Livestock and fishery interventions:** Use of community lands for fodder production during droughts/floods, improved fodder/feed storage methods, feed supplements, micronutrient use to enhance adaptation to heat stress, preventive vaccination, improved shelters for reducing heat/cold stress in livestock, management of fish ponds/tanks during water scarcity and excess water are some key interventions in livestock/fishery sector.
8. **Livestock and fishery interventions:** Use of community lands for fodder production during droughts/floods, improved fodder/feed storage methods, feed supplements, micronutrient use to enhance adaptation to heat stress, preventive vaccination, improved shelters for reducing heat/cold stress in livestock, management of fish ponds/tanks during water scarcity and excess water are some key interventions in livestock/fishery sector.
9. **Livestock and fishery interventions:** Use of community lands for fodder production during droughts/floods, improved fodder/feed storage methods, feed supplements, micronutrient use to enhance adaptation to heat stress, preventive vaccination, improved shelters for reducing heat/cold stress in livestock, management of fish ponds/tanks during water scarcity and excess water are some key interventions in livestock/fishery sector.
10. **Village Climate Risk Management Committee (VCRMC)** A village committee representing all categories of farmers including women and the landless is formed with the approval of Gram Sabha to take all decisions regarding interventions, promote farmers' participation and convergence with ongoing Government schemes relevant to climate change adaptation. VCRMC participates in all discussions leading to finalizing interventions, selection of target farmers and area, and liaison with gram panchayat and local elected representatives and maintain all financial transactions under the project.

Fig 1. CORDAID'S RESILIENT LIVELIHOODS PROCESS MANAGEMENT





CONCLUSION

Farmers need to intelligently adapt to the changing climate in order to sustain crop yields and farm income. Enhancing the resilience of agriculture to climate risk is of paramount importance for protecting the livelihoods of small and marginal farmers. In the context of climate change and variability, farmers need to adapt quickly to enhance their resilience to increasing threats of climatic variability such as droughts, floods and other extreme climatic events. Efficiency in resource-use, environmental and social safeguards, sustainability and long-term development of agriculture has greater importance to fight against climate change.

Insect Pests of Stored Oilseeds and their Management

P. Duraimurugan, Borkar Sundar and M.Surya Prakash Reddy

ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad 500 030, Telangana
**Corresponding Author: duraimuruganp@rediffmail.com*

ABSTRACT

Oilseeds as well as oilcakes/meals are rich in proteins and fats and hence, are vulnerable to infestation of stored-product insects resulting in weight loss, contamination and deterioration in quality and flavour. Oilseeds constitute second largest agricultural commodity after cereals in India occupying 13-14% of gross cropped area. Though it has the largest cultivated area under oilseeds in the world, the growth in the domestic production of oilseeds has not been able to keep pace with the growth in the demand in the country. In past, efforts have been made largely for improving the yields rather than enhancing the post-harvest management of the commodity. There is a sizable quantitative and qualitative loss of oilseed crops during storage due to insect pests. Hence, major insect pests of oilseeds at storage and their management practices are described in this article.

Keywords: Storage insect pests, Oilseeds, Management

INTRODUCTION

Oilseeds are the second largest agriculture commodity in India after cereals occupying about 13-14% of gross cropped area. Nine annual oilseeds, which include seven edible oilseeds *viz*., rapeseed-mustard, soybean, groundnut, sunflower, sesame, safflower and niger and two non-edible crops *viz*., castor and linseed are the major source of vegetable oil in the country. Presently, annual oilseeds are grown on an area of 28 million hectares with 30 million tonnes production and productivity of 1037 kg/ha during 2018-19. Seed being the basic and the most critical input for agriculture, keeping healthy seed for good crop is a challenge. Among biotic and abiotic factors which affect seeds/grains in storage, insect pests play a major role in the deterioration of seeds causing both quantitative and qualitative losses. Hence, the information on storage insect pests of major oilseed crops and their management practices are detailed below.

(1) Storage insect pests of groundnut and their management

The major insect pests of stored groundnut are groundnut bruchid (*Caryedon serratus*), rice moth (*Corcyra cephalonica*) and red flour beetle (*Tribolium castaneum*).

The management strategies for the safe storage of groundnut seed/produce are detailed below

- Ensure earthing-up soil around the plants before peg initiation
- Harvest the produce at right maturity stage
- Avoid heaping the produce in field itself
- Prefer sun drying of pods for reducing seed moisture content to the safe level (< 9%) as well as reducing carryover of pest infestation from field to store
- Avoid drying near alternate host trees (Tamarind, Acacia, Pongamia)
- Sort out and dispose any damaged or broken seeds (kernels/pods) from the seed lot for reducing attack by secondary pests
- Clean and fumigate godowns and storage structures as well
- Clean storage bags / containers thoroughly and expose them to sunlight for couple of days before storing groundnuts
- Treat pods with neem seed powder (0.25%) or annona seed powder (0.5%) or neem oil (5% v/w) or pongamia/castor oil (10% v/w)
- Storing groundnut kernel with dried neem leaves (about 500 g of leaves for 10 kg kernel) in any sealed container can be effective
- Attapulgite-based clay dust (ABCD) can also help to minimize storage insect problems in kernels
- Store pods in air tight polythene bags or three layered polypropylene bags or galvanized metallic / PVC seed bins

(2) Storage pests of sesame and their management

Insect pests *viz*., rice moth (*Corcyra cephalonica*), khapra beetle (*Trogoderma granarium*), rice weevil (*Sitophilus oryzae*), red flour beetle (*Tribolium castaneum*), dried fruit beetle (*Carpophilus obsoletus*) and almond moth or tropical warehouse moth (*Ephestia cautella*) are reported to attack sesame seed and cake under storage conditions. Inadequate drying causes serious storage losses due to insects, fungi, moisture, overheating, discolouration etc. which lead to deterioration in quality of oil and consequently higher refining cost. Careful sanitation, maintenance of optimum seed moisture content (<8%), sorting out and disposal of any broken/damaged seeds, storing in clean gunny bags lined with polythene or metal drums or improved bins (Pusa Kothi, Nanda bins, PKV bins, PAU bins, Hapur Kothi, Chittore stone bins) and dusting with an inert substance such as attapulgite-based clay dust (ABCD) helps to minimize storage insect problems in sesame.

(3) Storage pests of sunflower and their management

Storage insect pests *viz*., saw toothed grain beetle (*Oryzaephilus surinamensis*), red rust flour beetle (*Tribolium castaneum*), Indian meal moth (*Plodia interpunctella*), rice moth (*Corcyra cephalonica*) and merchant grain beetle (*Oryzophilus mercater*) reported to damage sunflower seeds. Harvesting of sunflower at correct stage (back of the head turns to lemon yellow colour and the bottom leaves start drying and withering) helps in reducing the yield losses due to bird damage, lodging, seed shattering and rodents in the

field. If sunflower seeds are stored with high moisture in uncleaned bins and gunny bags for longer period, infestations are very common and cause enormous loss. The seeds are then erect under sun to bring down the moisture content to 9-10%. For this air driers operated with solar energy may also be used alternatively. Polythene bags are used normally while mud pot and metal bins are also considered to be safe for storage. Certain fungi begin to grow in sunflower seeds stored at 11% moisture. The place of storage should be dry and have good aeration till it is taken to marketing or oil mills. Stored grain pests can be effectively managed by preventing initial infestation following proper sanitation; routine inspection for insects and also hot and moist spots; aeration to bring the grain temperature down to 5^{o}C or less will prevent insect activity. *Bacillus thuringiensis* can be used for the management of Indian meal moth.

(4) Storage pests of safflower and their management

Insect pests *viz*., rice moth (*Corcyra cephalonica*), red flour beetle (*Tribolium castaneum*), cigarette beetle (*Lasioderma serricorne*), biscuit beetle (*Stegobium paniceum*) and almond moth (*Ephestia cautella*) damage safflower seeds in storage. To prevent infestation of stored grain pests, always store healthy, unbroken and complete sun dried seeds with a moisture of 5-8% and store new grains in the clean godowns or receptacles and plug all cracks, crevices and holes in the godowns thoroughly and grain bins are quite safe for storage.

(5) Storage pests of soybean and their management

Insect pests are very attractive to soybean because of its high protein and fat content. Cigaratte beetle (*Lasioderma serricorne*), lesser grain borer (*Rhizopertha dominica*), saw-toothed grain beetle (*Oryzophilus surinamsis*), groundnut borer (*Caryedon* sp.) and khapra beetle (*Trogoderma granarium*) are reported to attack soybean under storage conditions. Soybean should be stored in moisture-proof bags to avoid absorption atmospheric humidity which causes seed deterioration. Studies were conducted at CIAE, Bhopal to evaluate various farm level storage structures *viz*., gunny bags, earthen pitchers, polyethylene lined mud bin, Hapur bin, Pusa bin and wooden bin with their varying from 50 to 500 kg. The level of insect infestation was not very high from the beginning of the storage period in various storage structures. However, gunny bags and wooden bin recorded more infestation compared to others.

(6) Storage pests of rapeseed-mustard and their management

Insects do not directly damage the mustard seeds stored in godown/storage. Therefore, no curative treatment is needed for control of infestation in case of such oilseeds. But insects *viz*., confused grain beetle (*Tribolium castaneum*) and saw toothed grain beetle (*Oryzophilus surinamensis*) are seen on the bags of mustard seeds and floor of godown which deteriorates the hygienic condition of the godown and mustard seed bags. In the experiment conducted at JNKVV, Jabalpur to study the development and survival of insects, effect of different moisture levels and storage structures on storability of mustard seeds, it was observed that initial moisture content of 12% followed by 10 and 8%, was on the whole, favourable for completing the

life cycle of almond moth (*Ephestia cautella*) in less number of days. As far as time required for development of insects was concerned, 60.5, 65.3 and 69 days, respectively were required for seeds stored at 1 2%, 1 0% and 8% moisture levels during storage of mustard seed in gunny bags. Baked earthen pitcher and plastic container, development of some webbed masses were also reported. However, mustard seed was least susceptible to attack of almond moth. It was concluded that mustard with 6% moisture content does not allow insect development in plastic container due to air tightness and moisture proofness compared to earthen pitcher and gunny bags.

Conclusion

Damage of stored grains/seeds is very serious problem in South-East Asia and throughout the globe. The infestation is carried to the storehouses from the infested field crops with the seeds/grains and spread rapidly. Further, damage is supported by environmental factors such as humidity, temperature and light. Hence, seeds/grains stored in houses or godowns must be clean all around; dirt, egg shells and dead larvae and infested broken grains are removed and burnt before new grains are stored before storage. In addition, both biological and non-biological factors and their effects must be evaluated to check the possible infestation during storage and selected control strategies must be integrated for effective management of storage insect pests.

REFERENCES

Nataraja, M.V., Poonam Jasrotia, Harish, G. And Ram Dutta. 2010. Bruchid: A major storage pest of groundnut. ICAR-Directorate of Groundnut Research, Junagadh, Gujarat. 6 pp.

Ranga Rao, G.V., Rameshwar Rao, V. and Nigam, S.N. 2010. Post-harvest insect pests of groundnut and their management. Information Bulletin No. 84, International Crops Research Institute for the Semi-Arid Tropics, Patancheru. 20 pp.

Sharma, S.M. 2003. Vegetable Oils - Sources & Enhancement Research in India. Jain Brothers, New Delhi. pp.676.

Shukla, B.D., Srivastava, K.P. and Gupta, R.K. 1992. Oilseeds processing technology. Central Institute Central Institute of Agricultural Engineering, Bhopal. 268 pp.

Varaprasad, K.S. and Duraimurugan, P. 2016. Post harvest technology of oilseeds. *Udyogprerana*, **11**(2): 40-45.

Agronomic Practices for Management of Insect Pests in Oilseed crops

P. Duraimurugan, Borkar Sundar and M.Surya Prakash Reddy

ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad 500 030, Telangana
**Corresponding Author: duraimuruganp@rediffmail.com*

ABSTRACT

Oilseed crops are gaining a much more importance in the country due to its increasing demand. One of the immediate ways to realize the enhanced production is by minimising the losses due to insect pests. The dilemma of more production of vegetable oils for incessantly expanding population, on one hand and desire for clean, safe and ecologically sound environment, on the other, demands careful planning for eco-friendly management of insect pests. Agronomic practices that farmers incorporate into their farm management systems also provide a strong base for an ecologically oriented insect pest management system. Hence, the information on agronomic practices available to minimize yield losses due to insect pests of oilseeds is discussed.

Keywords: Agronomic Practices, Insect Pests, Oilseed crops, Management

INTRODUCTION

Agronomy deals with the principles and practices of soil, water and crop management. Agronomic practices are aimed at increasing the production and productivity while minimising the cost of production without jeopardizing the environment. It also deals with preparation of soil in accordance with crop demands, enriching the soil with organic matter and plant varieties, choice of crops and varieties to fit for the climate, crop rotations, intercropping, appropriate time of sowing, irrigation management, weed management, harvesting and processing. Agronomic practices provide a strong base for an ecologically oriented pest management system. These measures do not cost extra time or money as these involve slight modification of agronomic practices. Some of the agronomic practices are detailed below that help to manage insect pests in major oilseed crops.

Agronomic Practices for Management of Insect Pests of Oilseeds

Deep summer ploughing: Deep ploughing during summer season exposes grubs/larvae and pupae of groundnut white grub and pupae of tobacco caterpillar, capitulum borer, linseed bud fly and sesame leaf webber and capsule borer to the

natural enemies like predatory birds and scorching sun. Deep ploughing the soil destroys eggs of painted bug infesting rapeseed and mustard.

Clean cultivation: Crop residue/refuge destruction is one of the important methods of destroying the insect pests. It is most effective against cutworms that over winter or lay their eggs in crop residues. Winter survival of army worms increases if crop residue is undisturbed. Keeping field bunds and crop free of weeds avoid high insect pests load on the main crop. Clean cultivation by weeding, hoeing and destroying of debris in and around the field reduces painted bug infestation in mustard. Removal of *Parthenium* reduces thrips incidence in sunflower. Burying of infected sunflower stalks to a depth of 15 cm in the soil arrests adult emergence of stem weevil in the following season.

Host plant resistance: Cultivation of resistant varieties/hybrids is best way of reducing/avoiding the insect pests problem in many oilseed crops. The resistant/tolerant varieties or hybrids of major oilseed crops are listed below

Host	Insect	Tolerant/ Resistant cultivars
Rapeseed and mustard	Aphid	RH-7846, RH-7847, RH-9020, RWAR-842, Coral-432, NRCHB 5-6, NPJ 112 (Pusa Mustard 25), NRCDR 601, RYSKS-2 and DMH-1
Soybean	Major insect pests	JS 93-05, JS 95-60, MACS-118
Groundnut	Sucking pests	Prutha (Dh 86), Abhaya (TPT 25), Kadiri 7, Kadiri 8, Ratneshwar (LGN 1)
Castor	Leafhopper	GCH-4, GCH-7, GCH-8, DCH-519, ICH-66
Sunflower	Capitulum borer	Phule Raviraj
Sesame	Capsule borer	RT-351 and TKG-308
Safflower	Aphid	NARI-NH-1 (PH-6), MRSA-521, SSF-658, JSF-97, JSF-99, A-1, Bhima

Sowing time: Time of sowing of a crop to avoid a pest/disease is based on the hypothesis that the crop is not subjected to high amount of inoculums when it is in a susceptible stage of growth. In rapeseed-mustard, early sowing reduces the loss due to aphids but increases painted bug incidence. Effect of date of sowing on insect pest incidence in oilseed crops is detailed below:

Host	Insect	Response
Rapeseed and mustard	Aphid	Early sowing (before 15th October) escaped aphid infestation
	Painted bug	November-December planting had less infestation
Groundnut	White grub	Early sowing (pre-monsoon, irrigated) crop allow roots to get established and evade from white grub attack
Soybean	Stem fly	Avoid pre monsoon sowing
Sesame	Leaf webber and capsule borer	Early sown (June) crop is less infested than late sown crop
Safflower	Aphid	Early sowing (1st week of October) escaped aphid

		infestation
	Seed weevil	Late planting increases seed weevil incidence
Niger	Aphid	Early sowing reduces aphid incidence

Method of sowing and spacing

Important low monetary agronomic practice which ensures maintenance of optimum crop stand, efficient utilization of natural resources like light, space, water and nutrients by the crop canopy thus higher productivity besides saving of seed and reduction in cost of cultivation. Sunflower grown on ridges (6-8 cm height) reduces the damage due to cut worms (*Agrotis* sp.). Soybean as strip crop in groundnut reduces leaf folder/miner incidence. Growing paired rows of mustard to every 25 cabbage rows reduces the damage caused to cabbage by diamond back moth, leaf webber and aphids. Use optimum seed rate and plant spacing are recommended for the management of stem fly in soybean.

Plant nutrition/Soil fertility

Balanced fertilization helps for better crop growth and quality. Sound fertilization program is very important for health and productive growth so that they resist/tolerate pest attack. If used in excess, it will prolong the growing period thus may invite pests. Application of more N with less of P and K reduces factor productivity, nutrient use efficiency besides increasing succulence thus attracts more pests. Excess N increases aphid infestation in rapeseed-mustard and safflower and lepidopteran population in castor. Adequate application of fertilizers (40 kg N and 30 kg P/ha) reduced capitulum borer incidence in safflower. Higher nitrogen application (120 kg N/ha) enhanced the attack capitulum borer incidence in sunflower. Application of K increases resistance to pests and disease. K application reduced the incidence of leaf caterpillars and pod borer in soybean. Application of neem cake, karanj cake, mahua cake @ 1g/kg soil will reduce nematode population.

Crop rotation: This strategy is very effective against insect pests that over winter as egg or larvae and against pests that have limited ability to disperse. Crop rotation of oilseed crops with leguminous crops reduces pests menace and mitigate the attack of monophagous and oligophagous insect pests. Groundnut rotation with non-leguminous crops like sorghum, millets, or cowpea reduces the population of leaf miner. Rotation of groundnut with soybean and other leguminous crops should be avoided for management of leaf miner.

Intercropping/cropping system: The practice of intercropping can reduce pest problems by making it more difficult for the pest to find a host crop. Intercropping of urdbean and maize in soybean reduces tobacco caterpillar infestation. Intercropping of sorghum in soybean reduces whitefly infestation. Pearl millet as intercrop in groundnut enhances parasitisation of *Goniozus* sp. which effectively manages leaf miner incidence. Intercropping of sesame with cowpea, pigeonpea, pearl millet, mungbean, urdbean and moth reduces infestation of leaf webber and capsule borer and other insect pests.

Mustard intercropped with cabbage will attract more parasitoids like *Cotesia* sp. that reduces diamond back moth infestation. Intercropping of castor with cluster bean or black gram or groundnut or cowpea (1:2 ratio) reduces semilooper and capsule borer infestation and builds up natural enemies (*Microplitis*, coccinellids and spiders) population. Intercropping of safflower with sorghum, wheat and coriander reduces aphid and capitulum borer infestation, while intercropping of safflower with chickpea increases capitulum borer infestation.

Trap crops and decoy crops: Planting of a second crop in the vicinity of principal crop to divert a pest, which would otherwise attack the principal crop. Growing cowpea as trap crop in groundnut reduces leaf miner infestation. Growing of castor as a trap crop in soybean and groundnut reduces the damage by tobacco caterpillar. Sowing of cowpea or cucumber all along the field borders of castor attract the migrating caterpillers and facilitate mechanical killing of red hairy caterpillar by jerking them off into kerosinised water. The twigs of Jatropha, Ipomea or Calotropis can be placed on the field borders to attract migrating red hairy caterpillars. Since they continue to feed on twigs for 2-3 days, it is possible to go for mechanical killing.

Irrigation management: Method and amount of irrigation influence the pest population by altering the microclimate of crop. Application of irrigation in seedling stage in mustard is crucial to control sawfly through drowning effect. Application of first irrigation during 3-4 weeks after sowing of the crop to reduces the painted bug attack in rapeseed and mustard.

Weed management: On an average, weeds account for 30% loss in Agriculture if uncontrolled. They act as alternate hosts for pests and diseases thus increases cost of cultivation. Hence, they should be controlled either by physical/mechanical/chemical methods of weed control during critical period of crop-weed competition.

Biological/physical barriers for animal control: Wild boars generally damage the food crops like groundnut and sunflower. However, it doesn't attack castor crop due to its' non-edible nature. Hence, castor can be easily and safely grown in an area where wild boar is the problem. But, Neelgai (Blue bull) eats away entire castor spike which is a serious problem in North Indian castor growing states, however, it is absent in South India. Hence, in South India castor growing zones, castor can be grown as border crop in 4-5 thick rows around groundnut/sunflower crops to reduce wild boar menace. Safflower can also be grown as border crops to protect groundnut from wild boar. Diamond mesh fencing/link jolly fencing/fencing with J-wire around groundnut crop will also help overcome wild boar problem.

CONCLUSION

In spite of increase in production of oilseeds, the import of edible oil is increased due to increase in consumption levels creating huge demand and supply gap. This gap can be decreased by increasing the production and productivity of oilseed crops. Vulnerability of oilseed crops to insect pests continues to be one of the major factors responsible for the lower productivity and wider fluctuations in production. Various agronomic practices can be used to achieve maximum benefit in pest management and thereby to

increase the crop yields. Hence, there is an urgent need to circumvent the insect pest damage following agronomic/cultural management strategies to get more productivity in these energy rich crops.

REFERENCES

Basappa, H. and Duraimurugan, P. 2018. Management of Pests of Oilseed Crops. *In*: Pests and Their Management, Omkar (Ed.), Springer Nature, Singapore, pp. 223-240.

Kumar, G.D.S., Duraimurugan, P., Sharma, A.K., Dhiraj Singh, Billore, S.D. and Jain, N.K. 2015. Handbook on Technologies for Oilseeds Production in Rajasthan. ICAR-Indian Institute of Oilseeds Research, Hyderabad, 108 pp.

Lakshminarayanamma, V., Dharma Reddy, K. and Vishnuvardhan Reddy, A. 2013. Integrated pest and disease management practices in oilseeds – a critical review. *Indian Journal of Entomology*, 75: 34-56.

Singh, H., Basappa, H., Chander Rao, S. and Prasad, R.D. 2002. IPM in Oilseed Crops. Directorate of Oilseeds Research, Rajendranagar, Hyderabad, pp. 25.

Varaprasad, K. S. and Duraimurugan, P. 2018. Integrated Pest Management - Minor Oilseeds Crops. *In*: Handbook of Integrated Pest Management, Chattopadhyay C, Tanwar RK, Sehgal M, Birah A, Kanwar V, Ahmad N and Mehta N (Eds.), Indian Council of Agricultural Research, New Delhi, pp. 557-577.