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Insect Pest Management in Organic Farming

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SUMMARY

The first line of defence against pest attacks is ecosystem management through changes in cultural practices such as crop rotation and soil quality management through the addition of organic amendments, followed by the use of curative methods such as predators, parasitoids, plant products, and ecologically safer chemicals as the following line of defence. Apart from conventional fungicides and microbial biocontrol agents, plant products or extracts are very effective in organic agriculture. Biological control agents, botanicals, entomopathogens, antagonists, microbial, and organic pesticides, as well as other permissible pesticides, can be used to effectively manage pests using a variety of strategies, including crop rotation, soil health management, and the use of disease resistant plants, among others.

INTRODUCTION

Organic farming represents a comprehensive production management system that promotes the agroecosystem's health, encourages the use of biological processes and soil health, avoids chemical inputs, fosters biodiversity, aligns with nature, and blends traditional knowledge, science, and innovation. It's a set of farming practices aimed at reducing environmental impacts by minimizing the use of non-renewable resources and supporting soil health. Organic farming contributes to ecosystem sustainability by reducing fossil fuel consumption, conserving biodiversity, maintaining soil fertility, and preserving landscapes. In the context of pest management in organic agriculture, it takes a holistic approach, relying on the biodiversity and ecological dynamics within the agricultural ecosystem. Pest management in organic agriculture is guided by the principle of coexistence, wherein different ecological aspects like competition, predation, parasitism, and resource limitations play a pivotal role in maintaining equilibrium. Preserving biodiversity is a fundamental tenet of organic farming, and pest control in this context is achieved through biological control, bio-pesticides, and botanical pesticides. These strategies follow four principles: prevention, avoidance, suppression, and monitoring.

Organic pest management

The challenges posed by pest insects in agriculture are shaped by three key elements within the farming system. Farmers can manipulate all of these elements to control pest species: the types and varieties of crops grown, their growth characteristics, and the overall structure of the agricultural system. Various farming practices, including crop rotation, timely planting and harvesting, plant spacing, fertility and water management, tillage, mulching, sanitation, and companion planting, all play a role in influencing insect populations in the field. The structure of the agroecosystem, including field borders, natural vegetation, and other crop production areas, also plays a significant role in supplying lots with both pest insects and beneficial species when crops are replanted. For insects to thrive and reproduce, they need specific essential resources. Production methods that deprive a pest species of at least one critical element required for their survival can effectively maintain pest populations at levels that do not cause significant economic damage over extended periods. However, cultural control methods are often insufficient for achieving long-term pest management, particularly for those insect species that are well-adapted to agricultural systems. In such cases, the populations of troublesome insect species tend to increase within a given production system while the numbers of less well-adapted species decline (Linker et al., 2018). In organic farming, farmers employ various cultural methods and grow diverse crops. The complex interplay of these interacting components on pest populations is challenging to predict and typically requires research and practical experience to understand fully.

Cultural practices

a) **Higher seed rate**: A higher seed rate will help to maintain the needed plant population even after pests such as shoot borer and stem borer have uprooted and destroyed the interested plants.

b) **Planting distances**: Rice with broader row spacing has less BPH.
c) **Use of trap crops**: Okra can be used as a trap crop in cotton (10:1) to help trap bollworms and stem weevils; similarly, Castor can be used as a trap crop against *Spodoptera* in groundnut and tobacco; and Marigold can be used as a trap crop in tomato (16:1) to help reduce the incidence of *Helicoverpa* spp.
d) **Fertilizer usage**: Fertilizer usage that is excessive results in succulent and sensitive circumstances for insect pests and illnesses. As a result, using too much nitrogen fertilizer in most crops would exacerbate the pest issue, but using organic manures will increase pest and disease resistance. (Topagi, 2016).
e) **Crop Variety**: High DIMBOA in leaves will prevent European corn borer in Maize, high gossypol, tannis, and silica against Cotton bollworms.

Mechanical practices

a) **Collection and destruction of insect pests**: Handpicking insects or pulling weeds is one of the most basic manual or mechanical pest management methods. When the problems are visible and easily accessible, this strategy is most effective.
b) **Destruction of stubbles and agricultural residues**: Sorghum and maize stubbles provide shelter to stem borer larvae, which reproduce after the summer. As a result, the stem borer larvae and pupae will be killed if such stubbles are burned or buried in the soil
c) **Pheromones and other attractants**: They are mainly utilized for monitoring purposes. Pheromones and other chemical attractants can be employed in various ways, including monitoring pests, disrupting mating, mass capturing, spreading insect disease, and luring nuisances to eat poisoned bait. Any attractant-baited trap must be utilized with caution. The pheromones and traps may be employed in three ways: to monitor insect populations, disrupt mating, and mass trap.
d) **Companion planting or intercropping**: Growing pest-repellent plants alongside pest-prone plants can help minimize pest burden. (Field & Handbook, n.d.)

Biological methods

Biological methods are the use of beneficial organisms that can be used in the field to reduce insect pest populations. Biological control is grouped into three categories: importation or classical biological control, which introduces pest's natural enemies to the locations where they do not occur naturally, augmentation involves the supplemental release of natural enemies, boosting the naturally occurring population; and conservation, which involves the conservation of existing natural enemies in the environment. The role of beneficial species on pests is of relatively greater importance in organic agriculture than in conventional agriculture, because organic growers do not have recourse to highly potent insecticides (such as synthetic pyrethroids) with which to tackle major pest problems Source. Mohan, *et al.*,2013.

S.NO.	Biological agents	Pest	Crop
1.	*Trichogramma brassiliensis*- 1.0 cc/ac. once in 10 days, (Egg parasitoid)	Lepidopteran, Heliothis sp	Cotton, Tomato
2.	*Trichogramma chilonis* - 2 cc/ac once in 15 days	Borers	Sugarcane, paddy, pulses, Vegetables
3.	Nuclear Polyhedrosis Virus (NPV) 100-200 LE/ac	Spodoptera sp & Heliothis sp	Vegetables
4.	*Chrysoperla Sp* 5000 - 10000 eggs /ha, 3 - 4 times in 15 days, (Green lace wing)	Prudenia, Caterpillars, White flies, thrips, aphids	Vegetables
5.	*Beauveria bassiana* - 1.0% Affects the young stage	Helicoperva, spodoptera, borers, hairy caterpillars, mites, scales, etc	Vegetables, cereals, fruits
6.	*Metarhizium anisopliae* - 0.5 - 1.0 % affects all stages	White grubs, Beetle grubs, caterpillars, Semiloopers, mealy bugs, BPH	Sugarcane, groundnut, rice, potato, cotton, cereals
7.	*Verticillium lecanii* - 0.5 - 1.0 % affects all stages	All sucking soft bodies insects	Sugarcane, groundnut, rice, potato, cotton, cereals

8.	*Bacillus thuringiensis var kustaki* 0.3 - 0.4 %	Helicoperva, spodoptera, borers, hairy caterpillars, mites, scales, etc	Vegetables, cereals, fruits.

Use of botanicals and crude extracts

Botanicals act to poison insects through their digestive systems or to repel insects with strong odours and tastes. Some interrupt life cycle stages with hormone-like substances. The highest percent mortality of white grub, *Leucopholis burmeisteri*, was noticed in the treatment of Karanj cake (44.8%) (Padmanabam, 1997). Parthenium and neem leaves are taken in equal quantities, crushed and soaked in water for 24 hours. The extract is sprayed @ 20 ml/ 10 litres of water cause considerable reduction in *H. armigera* damage in chilli (Kumar, 2007). Neem (non-synthetic extracts and derivatives) is a restricted material that can be used as a pest lure, repellent, or as part of a trap, or as a disease control. It may be used for other pesticide purposes only if nonchemical practices documented in the organic system plan are insufficient to prevent or control insect pests. Neem products are generally formulated as emulsifiable concentrates. Boomathi *et al*. (2006) conducted lab experiment to study the combined action of cow excreta with nem seed kernel extract (NSKE) on the biological activities of *H. armigera*. NSKE 5% + cow dung extract 5% treatment was the best in exhibiting toxic effect on eggs and larvae of *H. armigera*.

Plant protection products authorized in organic farming

Name of the product	**Purpose and specifications of use**
Beeswax	Used as protectant for treatment of cuts and wounds after pruning or in grafting
Plant oils	Used for control of small-bodied insects such as thrips, aphids, and whiteflies
Laminarin (from *Laminaria digitata*) or kelp or brown algae seaweed	A polysaccharide from the group of the glucans, used to protect plants against fungi and bacteria. Kelp should be grown according to the organic standards
Ethylene	Insecticidal fumigant against fruit flies
Paraffin oil	Used as insecticide against small bodied insects
Fatty acids (soft soaps)	Insecticide against mite, thrips, and aphids
Naturally occurring aluminum silicate (kaolin)	As insect repellent against a wide range of insects at a rate of 50 kg/ha
Pyrethrins from the leaves of *Chrysanthemum cinerariaefolium*	Used as insecticide
Spinosad from the soil bacterium *Saccharopolyspora spinosa*	Used as insecticide

Constraints/limitation for adoption of organic approach to plant protection

- The significant constraints of plant protection in organic farming, like the high cost of organic pesticide inputs, no market for organic pesticide products, unavailability of organic pesticide inputs, low yield, and no price advantage for organic products, are the significant constraints.
- Natural insecticides are generally less stable than synthetic materials and degrade quickly in the environment, meaning that they are also less potent and have shorter residual periods than their synthetic counterparts. Therefore, satisfactory arthropod pest management can only be achieved when insecticide use is integrated with other strategies.

CONCLUSIONS

Crop protection in organic farming is more preventive than curative. Thus, husbandry practices such as crop rotation, fertilization, cultivation, use of resistant varieties, and preservation of natural enemies play an essential role in pest management. Plant protection products (PPPs) permitted in organic farming should only be used when cultural and biological controls fail to suppress pest populations below economic damage levels. Floral and faunal diversities represent the cornerstone in the strategy of managing pests and diseases under organic production system. An increase in our understanding of pest biology and population dynamics underpins long term improvements in sustainable pest management and so further research is required for the discovery and innovation of better management techniques.

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