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A Brief Overview of Insect Pests of Aromatic Crops in India and their Management

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SUMMARY

Aromatic plants belong to economically important group of plants which are known for their characteristic flavor and fragrance due to the production of essential oil in different parts of the plants. Besides contributing in the food, perfumery and cosmetic industries, they also provide some health benefits. Because of significant contribution to human health and beauty as well as in the global trade, protection of these crops is of utmost importance. However, there are several insects like stem borers, caterpillars, aphids, thrips, cutworms, termites, white grubs, etc. which attack these crops and cause drastic reduction in the essential oil yield. Apart from these insects, some other biotic agents like nematodes and mites are also responsible for the economic damage to the crops. But to manage these harmful pests, relying only on extensive application of synthetic insecticides causes serious ill-effects to human health and environment. So an integrated management approach is the best way to proceed. This article deals with overviews of identification of different insects and integrated pest management strategies for dealing them in a sustainable, economical and eco-friendly manner.

INTRODUCTION

Aromatic plants represent a large group of economically important plants which are mainly used for aroma and flavour (Pandey, Kumar, Saxena, & Maurya, 2020). They are the species of different botanical families (given in Table 1) and characterized by presence of volatile compounds known as essential oil. Essential oils have characteristic flavour and fragrance properties, and many also possess other biological activities. For these reasons essential oils find extensive application in flavour, perfumery, cosmetic, and pharmaceutical industries (Ramya H.G., Palanimuthu V, & Rachna, 2013). Sometimes aromatic plants are considered under medicinal plants category due to their medicinal property and collectively they are known as Medicinal and Aromatic Plants (MAP) (Pandey, Kumar, Saxena, & Maurya, 2020). Some of the major aromatic plants which are being cultivated in different parts of India for commercial production of essential oils are patchouli, mints, citronella, lemongrass, eucalyptus, geranium, lavender, vetiver, palmarosa etc. Asia provides the favourable climatic conditions suitable for the growth and development of such plants and that is why it is well known throughout the world as 'the land of aromatic plants' (Ramya H.G., Palanimuthu V, & Rachna, 2013). According to the final estimates of 2020-21 released by the Department of Agriculture and Farmers Welfare, aromatic and medicinal crops have registered an increase of 12.4% in production, from 0.73 Million Tonne in 2019-20 to 0.83 Million Tonne in 2020-21. But the production decreased in 2021-22 (first advance estimate) as compared to the previous year (Source: Ministry of Agriculture and Farmers Welfare, 2022). Involvement of different biotic factors (insects, diseases, nematodes) and abiotic factors (climatic variation, lack of irrigation, nutrient deficiencies etc.) might be the one of several reasons behind this dip in the production. Similarly exports of essential oils and resinoids in India decreased to 2018.96 USD Million in 2022 from 2227.82 USD Million in 2021 which was increased from 380.44 USD Million in 2020 (Source: Ministry of Commerce and Industry, India, 2023) . "In the Financial Year (FY) 2020-21, many businesses suffered due to the pandemic but essential oils business in India witnessed growth in the export of pure natural essential oils, because of their medicinal properties. India is the second largest producer and exporter of Menthol and Mint essential oil in the world and has been one of the top exporters of essential oils for decades. On the other hand, it is also one of the biggest importer of essential oils" (Chaudhuri, 2021).

Uses and health benefits:

"About 90% of global essential oil production is consumed by the flavour and fragrance industries. This is mostly in the form of cosmetics, perfumes, soft drinks and food. Therapeutically these are used as antiseptic, stimulant, carminative, diuretic, anthelmintic, analgesics, anti-rheumatic, and counter irritant" (Ramya H.G., Palanimuthu V, & Rachna, 2013, p. 244). The major uses and health benefits from different aromatic crops are enlisted in **Table 1** below.

Table 1: The major uses and health benefits from different aromatic crops

Aromatic Crops Common Name and Botanical Name	Botanical Family	Economic Plant Part	Uses	Health benefits
Patchouli *Pogostemon patchouli*	Lamiaceae	Leaf twig and tender stem	Perfumery, soap, cosmetics, flavouring non-alcoholic beverages	Anti-depressant, Anti-septic, treatment of eczema, dermatitis, psoriasis and sores etc.
Vetiver *Vetiveria zizanoides*	Poaceae	Roots	Perfumery, cosmetic, food flavour	Relieving stress, inhaled as aroma therapy for nervousness, insomnia, joint and muscle pain etc
Citronella *Cymbopogon winterianus*	Poaceae	Grass	Perfumery, cosmetic, soap	Anti-inflammatory properties, prevents stomach disorders, mosquito repellent etc.
Geranium *Pelargonium graveolens*	Geraniaceae	Leaf twig	In all kinds of scents	Good astringent and reduce the wrinkles, has diuretic properties, treat acne, dermatitis and other skin diseases, reduce depression etc.
Lemon grass *Cymbopogon flexuosus*	Poaceae	Fresh herbs/grass	Fresh scent in soaps, candles, disinfectants and insect repellents	Pain reliever, fever reducer, anti-inflammatory effects etc.
Palmarosa *Cymbopogon martini var. motia*	Poaceae	Flowering tops	Flavouring tobacco, soap, perfumery	Antiseptic, digestive, stimulant, wound healing, reduce fever etc.
Mint *Mentha arvensis*	Lamiaceae	Leaf twig	Flavouring toothpastes, candies, ointments	Treat indigestion, boosts immunity, beats stress and depression etc.

(Modified from Baby P. Skaria et al., 2007)

Insects Pest of Aromatic Crops in India

The quality and quantity of the end products of aromatic crops are significantly reduced by the involvement of biotic factors like insects, pathogens, and nematodes etc. which cause economic damage to the crop plants. Among these insects and nematodes are the major constraints to the cultivation of aromatic crops. But knowledge on the life cycle of pest species and their proper identification is very much necessary for adopting suitable management strategies to protect the crops. Indiscriminate use of chemical pesticides might interfere with the quality of the end products, so adoption of integrated pest management approach is highly recommended. So here we have discussed some of the major insect pest of different aromatic crops growing in India.

A list of aromatic crops and their specific major and minor pests are given in Table 2 below.

Aromatic Crops	Pests of crops
Lemon grass (*Cymbopogon flexuosus*)	**Stem borer** (*Chilotrea sp.*); **Whitefly** (*Trialeurodes sp.*); **Nematodes** (*Tylenchorhynchus vulgaris*, *Rotylenchulus reniformis*, *Helicotylenchus spp*. and *Pratylenchus spp.*)
Mint (*Mentha arvensis*)	**Leaf roller** (*Syngamia abruptalis);* **Red pumpkin beetle** (*Aulacophora foevicolis);* **Cutworm** (*Agrotis flammata);***Red hairy caterpillar** (*Spilosoma obliqua*); White fly (*Bemisia tabaci*); **Termites** (*Microtermis obesi, Odontotermis obesus);* **White grub** (*Holotrichia consaguinea);* **Red spider mite** *(Tetranychus urticae);***Root knot nematodes** (*Meloidogyne incognita, M. javanica)*
Palma rosa (*Cymbopogon martini*	**Aphids** (*Aphis gossypii);* **Thrips** (*Haplothrips sp.*); **White grub** (*Holotrichia consanguinea);* **Termite** (*Microtermis sp.*)

***var. motia*)**	
Patchouli (*Pogostemon patchouli*)	**Aphids** (*Aphis gossypii);* **Thrips** (*Haplothrips sp.*); **Mirid bug** (*Pachypeltis sp.*); **Red spider mite** *(Tetranychus urticae);* **Root knot nematode** (*Meloidogyne incognita)*
Geranium (*Pelargonium graveolens*)	**Termites** (*Microtermes obesi*, *Odontotermes obesus*, *Termes taprobanses);* **Root knot nematodes** (*Melodogyne incognita* and *M. hapla)*
Citronella (*Cymbopogon winterianus*)	**Termite** (*Microtermus obesi);* **White grub** (*Holotrichia consanguinea);* **Shoot borer** (*Chilo infuscatellus);* **Aphids** (*Macrosiphum miscanthii);* **Army worm** (*Mythimna separate);* **Grass hopper** (*Colemania sphenariodes)*
Vetiver (*Vetiveria zizanoides*)	**White grubs** (*Phyllophaga serrate);* **Stem borer** (*Chilo sp.)*

Integrated Pest Management (IPM) in Aromatic Crops

Cultural Methods

- **Stem borer:** Destruction and removal of crop residues (stubbles) from fields help to eliminate pest overwintering sites and thus reduce the spread of infestation. The diapausing larvae in the crop residues can be destroyed through tillage practices after harvesting of crop, followed by flooding (Prakash, et al., 2014).
- Time of sowing may be delayed so that the peak emergence of **moths** does not coincide with the susceptible stage of the plant.
- Deep ploughing is helpful in minimizing the infestation of **cutworms, hairy caterpillar, white grubs** etc. as it exposes immature stages to predators and sun.
- Flooding of field has been recommended for reducing the attack of **cutworms, termites, white grubs** etc.
- Weeds also act as alternate host for insect pests and also serve as oviposition site of many insect pests. Therefore, weed must be cleaned from the field in order to reduce the pest population.
- Injudicious application of nitrogen fertilizers should be avoided to prevent **aphid** reproduction. Instead, application of slow-release fertilizers (e.g. organic fertilizers) are recommended (Flint, 2013).

Mechanical Methods

- Collection of egg masses and larvae of pest to be placed in bamboo cages for conservation of bio control agents (Prakash, et al., 2014).
- Removal and destruction of pest infested plant parts (Prakash, et al., 2014).
- Clipping of the tips of stem borer affected plants helps to reduce the population of **stemborer** (Prakash, et al., 2014).
- **Caterpillar, hairy caterpillar, stem borer larva** etc. can easily be handpicked and destroyed.
- **Aphids, Whitefly:** Use yellow sticky trap @15/ha.
- **Hairy caterpillar, leaf roller and stem borer moths:** Light trap can be used to attract and kill these adult moths. An electric bulb or a lamp is placed in the wide flat vessel containing kerosinized water in which the moths get drowned and killed. Pheromone traps at 12/ha can be installed to attract male moths.

Biological Methods

- Grubs of beetle ***Phyllophaga serrata*** have also been reportedly infesting vetiver roots. These can be controlled by broadcasting neem cake @ 5 t/ha before final ploughing (Smitha, Varghese, & Manivel, 2014).
- Application of neem cake @ 5 t/ha are also found effective in controlling **nematode** (Smitha, Varghese, & Manivel, 2014).
- **Aphids:** Natural enemies play very important role for controlling aphids. Among the most important natural enemies are various species of parasitic wasps that lay their eggs inside aphids. Many predators also feed on aphids. The most well-known are lady bird beetle adults, lacewing larvae and syrphid fly (Flint, 2013).
- **Thrips:** Entomopathogenic fungus like *Lecanicillium lecani*, *Beauveria bessiana* @ 5gm/ lt of water can be effective.

Chemical Methods

- **Stem borer:** Filling of each hole in affected branches with solution of dichlorovos (0.05%) and plugging them with wet soil can be effective. Spray any one of the following based on ETLs: Quinalphos 25 EC 1000 ml/ha or Phosphamidon 40 SL 600 ml/ha or Profenophos 50 EC 1000ml/ha (PRAKASH, 2012).
- **Hairy caterpillar, caterpillar and leaf roller:** Application of mercaptothion at 0.05% or carbaryl 50WP at 4 g/l or DDVP 100 EC at 2 ml/l effectively controls pest.
- **Root knot nematode:** Furadan @ 20 kg / ha (3% a.i.) or Dasanit 150 kg /ha (5% a.i.) can work very effectively as nematicide. Pre planting application of the nematicide is recommended as first dose and the second dose can be applied one year after transplanting (Aroma Plants: National Horticulture Board).
- **Mint leaf roller:** Two to three sprayings of Thiodan @1.5ml/litre of water is recommended at weekly intervals control this pest (Aroma Plants: National Horticulture Board).
- **Aphids:** Spray with methyl demeton (Metasystox) or dimethoate (Rogar) @ 2ml /lit. As the aphids appear first on the borders of the crop, only the infected strip should be sprayed to check further spread (TNAU).
- **Thrips:** Spraying with systemic insecticides like Dimethoate @ 2 ml/lt or Imidacloprid @ 3ml/10 lt of water is recommended to control the pest.
- **Cutworms, Hairy caterpillar:** To control these pests poison baits should be allowed comprising of carbaryl 50 WP 1.25 kg, rice bran 12.5 kg, jaggery 1.25 kg and water 7.5 lit/ha.
- **Termites:** The soil should be mixed with chlorpyriphos 5% dust @ 35 kg/ ha at the time of sowing and chlorpyriphos 20% EC @ 4 litre/ha should be sprayed on standing crop.
- **White grub:** Imidacloprid 17.8SL @ 1.5 ml/lt or monocrotophos 36SL @ 1.6 ml/lt can be applied during the evening hours on trees and shrubs to control the adults. To control the grubs, soil application of carbofuran 3CG @ 33.0 kg/ha or phorate 10CG @ 25.0 kg/ha is recommended prior to sowing. Seed treatment with chlorpyriphos 20EC @ 6.5-12.0 ml/kg or imidacloprid 17.8SL @ 2.0 ml/kg seed can also be effective (Nataraja MV, Jadon, Dutta, & Savalia, 2015).

CONCLUSION

Apart from food, perfumery, cosmetic and therapeutic industries, aromatic crops and their essential oils have also established immense role in agriculture as anti-feedants, repellents, botanical insecticides, natural herbicides and growth boosters which provides a lot of scope for further research. Because of a large spectrum of usage, aromatic crops have made their position irreplaceable. However, different borers, defoliators, sap sucking pests cause severe damage in the crops and to protect the crop from those harmful pest, farmers spray insecticides indiscriminately. As a result of it, cost of cultivation goes on increasing which makes the package of practice economically unfeasible. So to reduce the extensive use of synthetic insecticides, a new integrated management approach must be adopted which include different cultural practices (use of pest resistant/tolerant cultivars, early sowing, judicious application of fertilizers etc.); use of light trap, pheromone trap; utilization of natural enemies; use of botanical insecticides and so on. Therefore, package of practices should be based on principles of integrated pest management only which is cost effective and eco-friendly too.

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