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Botanical Insecticides Trend in Sustainable Agriculture

Misal M. R.[1] and Khaire P. B.[2]
[1]Assistant Professor, Department of Entomology, SSJPs, COA, Khandala, Vaijapur, Parbhani (M.S.)
[2]Ph.D. Scholar, Department of Plant Pathology ,PGI, MPKV, Rahuri, (M.S.)

SUMMARY

Calls for efficient and cost-effective pest management strategies have intensified because of the toxicity, durability and non-biodegradability of chemical pesticides. A natural solution to conventional pesticides is offered by biopesticides. The use of biopesticides in agrarian countries such as Nigeria, however, remains limited, resulting in increased use of chemical pesticides.

INTRODUCTION

In nature more than 2,400 plant species are reported to have pesticidal properties. Recent decades have witnessed major growth in the use of agrochemicals worldwide for maximizing the food production for a rapidly growing human population. However, the indiscriminate use of these substances especially the pesticides has led to the accumulation of toxic residues in food, air, soil and water, as well as the development of resistance in pests. Moreover, pesticides affect soil enzymes, which are essential catalysts that govern soil quality. In order to meet the food security, it is necessary to produce more food, sustainably and safely, in a diminishing area of available arable land and with decreased water resources. Given this situation, there is an increased interest in the use of alternative substances to synthetic agrochemicals that present less risk to the environment and human health while increasing the food safety. Promising results have been obtained using compounds derived from aromatic plants for the control of agricultural pests. Such compounds of botanical origin can be highly effective, with multiple mechanism of action, while at the same time having low toxicity towards (Beneficial) non-target organism. However, the large-scale application of these substances for pest control is limited by their poor stability and other technological issues. In this backdrop, the present work discusses perspectives for the use of compounds of botanical origin, as well as strategies employing the encapsulation techniques that can contribute to the development of systems for use in sustainable agricultural practices.

Plant Family	Number of Plants Having Pesticidal Property
Meliaceae	More than 500
Myrtaceae	72
Asteraceae	70
Euphoirbiaceae	65
Leguminosae	60
Fabaceae	55

1. Neem Tree : *Azadirachta indica*

Neem is an Indian and a Burma native. A mixture of Azadirachtin, Melantriol, Salannin, Nimbin and Nimbidin are the active ingredients and all belong to the tetranotriterpenoid (limonoid) group. Azadirachtin, which is present in seeds and leaves and ranges from 2-4 mg / g of Kernal, is the key active ingredient with possible insecticidal activity present in Neem. There are several stereoisomers in Azadirachtin, but 7 stereoisomers, namely AZA (A-G), have been identified so far. 85 percent of Azadirachtin A is followed by almost 14 percent of Azadirachtin B. Neem has different effects on insects, viz., antifeedant action, regulatory activity of insect growth inhibits juvenile hormone synthesis, deterrent oviposition, repellent action, adult life span reduction and intermediates are formed, giving rise to intermediates for larval-pupal, nymphal-adults and pupal-adult. Neem-based goods are Ultra Violet light, i.e. de43 grade when exposed to sunlight. Different concentration of Azadirachtin ranging from 300ppm (0.03%) to 50000ppm (5%) viz., Azadirachtin 0.15%EC, Azadirachtin 0.3%EC, Azadirachtin 1%EC, Azadirachtin 5% Neem extract concentration containing both neem seed kernel based EC formulation and Neem oil based EC formulations have been registered and being used in agriculture for various insect pests management viz., sucking pest complex (thrips, aphids, jassids, white flies) in

tomato, cotton, Brinjal, okra, *H.armigera* in cotton, tomato, Bengal gram, stem borer and leaf folder in rice, red spider mites in tea etc.

2. Nicotine:

Nicotine, Nicotiana tobaccum and N are derived from tobacco plants. To the degree of 2-8 percent rustica (Solonaceae). In the nerve synapse, action mimics acetylcholine, inducing tremors, lack of control, and ultimately death. It is highly fast-acting, causing serious nervous system damage and collapse. It is used in greenhouses for fumigation. This functions as a contact poison. It is successful against sucking pest like thrips, mealy bugs, leaf hoppers and leaf miners. Commercially sold as a fumigant (Nicotine) or as a dust (Sulphate of nicotine). It is available on the market as a 40% nicotine sulphate (Black Leaf 40) and is only produced for export purposes in India.

3. Pyrethrum :

Pyrethrum' refers to powdered Chrysantheum cinerarifolium dried bulbs. Both the poisonous elements in the pyrethrum flower are "Pyrethrins" and the synthetic pyrethrin analogue is "Pyrethroid." Chrysantheum cinerarifolium comes from the hills of Dalmatia, Croatia. Pyrethrins are esters formed by the addition of two acids, namely pyethrolone, cinerolone and jasmolone, which are chrysanthemic acid and pyrethric acid with three alcohols. Pyrethrin 1, cinerin 1, jasmolin 1 are the esters of chrysanthemic acid which are collectively known as pyrethrins 1. The mode of operation of Pyrethrins is similar to DDT and has a knock down effect of quick acting. It breaks down from the sunlight rapidly. Piperonyl butoxide (PBO) is a widely used synergist for pyrethrin synergies. Kenya is the biggest pyrethrum manufacturer.

4. Limonene and Linanool:

These are extracts from citrus peel that induce insect paralysis. In the environment, they evaporate easily and are used to combat aphids, mites and fleas.

5. Ryanodine:

It is an alkaloid originating from the Ryania speciosa (Flacourtaceae) woody stems of southern American shrubs. Activity: By preventing the conversion of ADP to ATP in striated muscles, ryanodine serves as muscular toxin. It acts as slow release stomach poison and causes insects to stop feeding after they eat it. It is reportedly effective against thrips and worms. It is used as dust (20-40 percent).

6. Sabadilla:

It is an alkaloid detected in the seeds of the Schoenocaulon officinale (Liliaceae) tropical lily. Cevadine and veratridine, the major alkaloids, serve as nerve poisons. It is a contact poison, mainly. Sabadilla is toxic to honey bees (pollinators).

7. Rotenone:

It is a resin produced from the roots of Lonchocarpus spp., a legume herb. Derris eliptica (Malaysia) and (South American plant). It's a wide contact spectrum and stomach poison. In insects, it damages nerve and muscle cells and rarely causes insects to stop feeding. Respiratory metabolism is hindered. It is used as a 0.75-1.5 percent rotenone containing dust and is effective against beetles and caterpillars.

Table: Botanical Insecticides and field pest controlled in Crops.

SN	Plant name	Product/ trade name	Group/mode of action	Targets
1	*Lonchocarpus* spp. Derris elliptical	Rotenone	Insecticidal	Aphids, bean leaf beetle, cucumber beetles, leafhopper, red spider mite
2	*Chrysanthemum cinerariaefolium*	Pyrethrum/ Pyrethrins	Insecticidal	Crawling and flying insects such as cockroaches, ants, mosquitoes, termites

3	*Nicotiana tabaccum*	Nicotine	Insecticidal, antifungal	Aphids, mites, bugs, fungus, gnat, leafhoppers
4	*Azadirachta indica*	Azadirachtin/ neem oil, neem products, Bionimbecidine	Repellent, Antifeedant, Nematocide, Anti-fungal	Nematodes, sucking and chewing insects (caterpillars, aphids maize weevils)
5	Citrus trees	d-Limonene Linalool	Contact poison	Fleas, aphids, mites, paper wasp, house cricket
6	*Shoenocaulon officinale*	Sabadilla dust	Insecticidal	Bugs, blister beetles flies, caterpillars, potato leafhopper
7	*Ryania speciosa*	Ryania	Insecticidal	Caterpillars, beetles, bugs, aphids
8	*Adenium obesum (Heliotis sp)*	Chacals Baobab (Senegal)	Insecticidal	Cotton pests

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