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## Phytopesticides of Indian origin

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#### Abstract

Worldwide, synthetic pesticides are extensively used as pest control agents but they are regarded as ecologically unsafe. Their excessive application promotes speedier evolution of resistance in insect pests, destroys natural enemies, harms non-target species and contaminates food. Concern about harmful environmental implications has led to a surge of research into safer alternative methods. To alleviate these problems pesticidal formulations based on plant products have attracted because of their target specificity to insect pests, their eco-friendly and biodegradable nature and their potential for commercial application. These properties of Phytopesticides have provided an alternative measure to synthetic pesticides because of their low environmental pollution, low toxicity to humans and various other advantages. This leads to increased development of Phytopesticides based on the models of naturally occurring toxins of biological origin. This review outlines the current state of knowledge on the potential use of Phytopesticides in insect pest management.

**Keywords:** Phytopesticides, eco-friendly, insect pest management, biodegradable

#### Introduction

The revolution in the insect pest management leads worldwide concern on the environmental and health hazards posed by the persistence of synthetic pesticides. They have received wide public apprehension as intensive use of synthetic pesticides produce various toxicological risks like environmental pollution, resurgence of pest species, insecticide resistance, toxic hazards to humans and non-target organisms. Their indiscriminate use to combat insect pests also leads to the destabilization of the ecosystem and enhanced resistance to insecticides in pests <sup>[1]</sup>. These threats leads to the increased global interest towards the development of alternative using eco-friendly, economical strategies.

Phytopesticides provide a necessitated possible measure for the control of insect pests because they are relatively safer and have a narrower spectrum of activity than synthetic pesticides. Their application has lack of persistence and bioaccumulation in the environment and low toxicity to humans and non-target animals which makes them good alternative. Several such plant products have also been used for insect pest control. There are about more than 2000 plants species have been known to produce chemical factors and secondary metabolites having value in pest control programs <sup>[2]</sup>. Among these, 344 plants species produce products which have been reported to show toxic activities against mosquitoes <sup>[3]</sup>. Plants are the rich source of organic chemicals known as secondary metabolites. Since time immemorial these secondary metabolites of plants have been exploited by man to produce medicines, cosmetics, dyes and pesticides. The plants derivatives extracted from the whole plant or specific part of the plant using different solvents. They have been studied and screened for their biological activities against economically important pests, assessing their toxic effects, repellent, antifeedant, growth regulation, fumigant and deterrent to oviposition <sup>[4, 5]</sup>. The phyto insecticides affect only target insects without destroying beneficial natural enemies and provide residue-free food and safe environment <sup>[6]</sup>. Various researchers have been reported the effectiveness of plant extracts or their essential oils as an efficient mosquito larvicides <sup>[7, 8, 9, 10]</sup>, growth regulators, ovipositional deterrent <sup>[11, 12]</sup> and repellents without posing toxic hazards to humans <sup>[12, 13, 14, 15]</sup>. In this review paper we discuss the Phytopesticides of Indian origin in insect pest control.

#### Phyto pesticides preparation

Phytopesticides are the formulations of aqueous and organic solvents based on different parts of plants (crude extracts) which are prepared in powder or liquid concentrates forms. The processed form (crude extract) of plants is the purified and isolated substances from plants through a series of extraction and distillation.

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These crude extracts can be incorporated into talc or clay for application either concentrated or diluted in a solvent such as water, methanol, hexane, ethanol and petroleum ether etc. [16]. These products consist of large number of active ingredients having different chemical nature [17].

### Toxins of plants

The numerous chemicals produced by plants have a variety of medicinal and pesticidal properties. Plants of different families, genus and species are very rich source of bioactive organic chemicals. More than 400,000 secondary metabolites may be present in the plant kingdom which makes upto 1% of world's pesticide market [17]. Several groups of phytochemicals such as alkaloids, steroids, terpenoids, sesquiterpene, flavonoids, liminoids, coumarins, stilbenes, essential oils and phenolics of different plant origin have been reported previously for their insecticidal activities against a wide range of insect pests [18, 19]. The Knowledge of the toxic plants, their principles of toxicity and biological activity is of paramount importance. This will not only to enable plants to be utilized as natural insect pest control agents and replace the commercial synthetic pesticides but also to enable us to understand the nature of their toxicity against humans and non-targeted animals.

### Promising plant families

India has rich bio-diversity providing a wide source of naturally occurring Phytopesticides which can be effectively used in agriculture at a large scale. They are safer to humans and environment than synthetic pesticides and having minimal residual effects. Approximately, 6000 plant species have been screened and among them more than 2500 plant species belonging to 235 families were found to produce metabolites of value in pest control programmes. It has been found that only 10% of the plant species have enormous scope for further work in Phytopesticides production [20]. The most

important plant families containing the phytopesticidal plants are *Asteraceae*, *Euphorbiaceae*, *Apocynaceae*, *Myrtaceae*, *Fabaceae*, *Meliaceae* (*maximum*), *Ranunculaceae* and *Rosaceae* [21]. The members of the plant families- *Solanaceae*, *Miliaceae*, *Asteraceae*, *Cladophoraceae*, *Labiatae*, *Oocystaceae* and *Rutaceae* have various types of larval, adulticidal or repellent activitie [22]. Some of the other promising families are *Annonaceae*, *Apiaceae*, *Lamiaceae*, and *Asteraceae*.

### Commercial status of Phyto pesticides

The large-scale commercialization of the plant products as insecticides has begun in the 1950s with the introduction of rotenone from *Lonchocarpus* sp, nicotine from *Nicotiana tabacum*, derris from *Derris elliptica*, and pyrethrum from flowers of *Chrysanthemum cinerariaefolium* [16]. They are among the first compounds used to control insects of medical and agricultural importance [23, 24]. Recently, phytochemicals make up to 1% of world's pesticide market [25]. The pyrethrins are one of the phyto pesticide which accounts for about 80% of global use of botanicals. Most common Phytopesticides used in market are listed in Table 1.

### Safety measures of phyto pesticides

The application of plant compounds in the form of pesticides has many advantages and some of them are inherently effective, eco-friendly, less hazardous to human and animal health, economical, less toxic to non-target species and restrict resistance development in the target organism [19]. In addition Phytopesticides prevent the dumping of thousands of tons of synthetic pesticides on the earth. Thus, they are safer to the user and environment because they are biodegradable and break down into harmless compounds in the presence of sunlight within hours or days. Thereby, largely results in avoiding the pollution problems.

**Table 1:** List of Some of the common plant products as commercial phyto pesticides

| Plant Name                               | Plant product used as phyto pesticides   | Target pests  |
|--|--|---|
| Citrus trees                             | d-Limonene and Linalool  | Fleas, aphids, mites, fire ants, several types of flies, paper wasps and house crickets   |
| <i>Azadirachta indica</i>                | Azadirachtin/Neem oil<br>Neem cake<br>Neem powder<br>Bionimbecidine(GreenGold) | A variety of sucking and chewing insect (caterpillars, aphids, thrips, maize weevils), nematodes  |
| <i>Chrysanthemum Cinerariaefolium</i>    | Pyrethrum / Pyrethrins   | Ants, aphids, roaches, fleas, flies, and ticks  |
| <i>Lonchocarpus spp Derris elliptica</i> | Rotenone   | Leaf-feeding insects, such as aphids, beetles (asparagus beetle, bean leaf beetle, Colorado potato beetle, cucumber beetle, flea beetle, strawberry leaf beetle, and others) leafhopper, red spider mite, caterpillars, fleas and lice on animals |
| <i>Ryania speciosa</i>                   | Ryania   | Caterpillars (European corn borer, corn earworm and others), beetles, bugs, aphids and thrips   |
| <i>Shoenocaulon officinale</i>           | Sabadilla  | Bugs, thrips, caterpillars, leaf hoppers, blister beetles and flies   |
| <i>Nicotiana tabaccum</i>                | Nicotine   | Aphids, thrips, mites, bugs, leafhoppers  |

### Conclusion

In conclusion, Phytopesticides have expanded impetus in insect pest management programme owing to health hazards and perpetual toxicity of conservatively applied deleterious synthetic pesticides. They are effective, biodegradable, barely leave residues in the environment, less harmful to humans or animals, have resistance management potential and environmental safety benefits. Further research on plants continues to be the area of maximum interest and with lot of

still unexplored potential and development of pest control methods must be given priority and common people and agriculturists must be educated about the handling and use of such control measures. Thus, naturally occurring Phytopesticides have prominent role in the development of future commercial pesticides.

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