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Botanical Pesticides in Agriculture: need and benefits over synthetic pesticides

Abran Singh Kushwah[1] and Vikrant Khare[2]*

[1]Division of agricultural chemicals ICAR-Indian agricultural Research Institute New Delhi
*[2]*Nuclear Agriculture and Biotechnology, Division, Bhabha Atomic Research Centre, Mumbai*

**Corresponding author. vickykhr@gmail.com*

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Abstract
The area of managing pests is facing significant financial and ecological problems due to the extensive use and excessive dependence on chemicals. The necessity of substituting chemical pesticides with environmentally friendly and cost-effective alternatives must be addressed immediately due to the non-target poisoning, long-lasting impacts, and challenging biodegradability of these chemicals. Awareness in environmentally friendly pesticides based on plants as a pest management strategy has increased due to growing worries about risk to the environment. Botanical pesticidal substances can effectively treat a wide range of dangerous pests and illnesses. More importantly, they are inexpensive, easily accessible, quickly biodegradable, generally available, and hardly dangerous to the agents that use them. Variations in the phytochemical composition of different species of plants account for the diverse ways in which they fight diseases and pests.

Key words: botanical pesticides, ecofriendly, pest control

Introduction

The bioaccumulation of pollutants in food chains, which are extensively dispersed in both terrestrial and aquatic habitats, is one of the hazardous impacts of synthetic pesticides on human life. During the Green Revolution technological age of the 1950s and 60s, crop production was increased significantly by the use of inputs like synthetic pesticides, artificial fertilizers, and genetically engineered organisms to meet the need for food in countries with low incomes. Alternative methods of managing pests are now required due to the negative effects of improper and excessive usage of synthetic pesticides. Prior to the invention of synthetic pesticides, botanical pesticides were widely used for thousands of years in both commercial and subsistence cultivation. The chemical derivatives of plants that are naturally occurring and function as growth inhibitors, attractants, repellents, and antifeedants are known as botanical pesticide ingredients. Numerous plants, including wild plants and herbal remedies, have produced hundreds of botanical pesticidal chemicals that have been identified. In addition to numerous compounds of plant secondary metabolites, such as alkaloids, terpenoids, and flavonoids that exhibit pesticidal actions, many plants belonging to the Rutaceae, Compositae, Meliaceae, Leguminosae, Araceae, Platycodoniaceae, Solanaceae, Chenopodiaceae, Zingiberaceae, Labiatae, Loniceraceae, Umbelliferae, Polygonaceae, and Euphorbiaceae have pesticidal properties.

Table1. List of plants responsible for bioactivities

Sl no.	Plant (scientific name)	Family	part used	Activity against pest
1	*Acorus calamus L.*	Acoraceae	Leaf, Rhizome, Stem	*Microsporum gypseum, Penicillium marneffei, Trichophyton rubrum, Sitophilus zeamais*
2	*Allium cepa L.*	Alliaceae	Seed	*Alternaria solani, Cochliobolus heterostrophus, Phytophthora infestans,*
3	*Annona squamosa L.*	Annonaceae	Seed	*Fusarium wilt, Phytophthora blight, Rhizoctonia solani*

4	*A. indica*	Meliaceae	Leaf, Bark, Root, Seed, Fruit	*Echinochloa crusgalli, Fusarium oxysporum, Geotrichum candidium, H. armigera, Meloidogyne incognita, Meloidogyne javanica, Rhizopus stolonifer, Sitophilus zeamais*
5	*Chrysanthemum cinerariaefolium L.*	Compositae	Flower	*Blatta orientalis, Isoptera spp., Lasius niger, Myrmecia gulosa*
6	*Lantana camara*	Verbenaceae	Leaf, Stem, Fruit	*A. flavus, A. niger*
7	*Derris elliptical*	Fabaceae	Root	*Aphis spp., Cerotoma trifurcata, Diabrotica undecimpunctata, Erythroneura variabilis, Tetranychus urticae*
8	*Ocimum basilicum L.*	Labiatae	Leaf	*A. solani, Alternaria heveae, P. infestans*
9	*Ricinus communis L.*	Euphorbiaceae	Leaf	*R.solani, Fusarium wilt*
10	*Salvia officinalis L*	Lamiaceae	shoot	*aurantiogriseum, Verticillium dahlia*
11	*Thuja orientalis L.*	Cupressaceae	Leaf	*Watermelon mosaic virus*
12	*Withania somnifera L.*	Solanaceae	Leaf	*Trichothecium roseum, B.tabaci, Caliothrips fasciatus, Colletotrichum lindemuthianum,*
13	*Zingiber officinale*	Zingiberaceae	Rhizome	*Fusarium lycopersici, F. oxysporium, F. solani, Phaeoisariopsis, griseola, P.infestans, P. oryzae, P. digitatum*
14	*Rhododendron molle*	Ericaceae	Flower	*Pieris rapae*
15	*Psidium guajava L.*	Myrtaceae	Leaf	*Chromobacterium violaceum, P. carotovorum, Pseudomonas aeruginosa, S. aureus, S. marcescens*

Table2. Current status of botanical pesticides in India

Sl no	**Major uses of bio-insecticides**	**Crop**	**Target pests**
1	Azadirachtin 0.15% EC w/w	Rice	Thrips, Stem borer, Brown plant hopper, Leaf folder
2	Azadirachtin 00.30% EC (3000 PPM)	Cotton	American bollworm
3	Azadirachtin 01.00% EC Min. Neem Based	Cotton	Bollworm
4	*Bacillus thuringiensis* var. *kurstaki*	Cotton	Bollworm
5	*Beauveria bassiana* 1.15% WP	Cotton	Bollworm
6	*Beauveria bassiana* 1.15% WP. ($1x10^8$ /gm min) Strain BB-ICAR-RJP, Accession No – MCC 1022	Rice	Rice leaf folder (*Cnaphalocrocis medinalis*)
7	*Metarhizium anisopliae* 1.15% WP ($1x10^8$ CFU/gm min) Accession No. MTCC – 5173	Rice	Brown plant hopper (*Nilapavata lungens*)
8	*Pseudomonas fluorescens* 1.0% WP (Strain No. IIHR-PF-2, Accession No. ITCC- B0034)	Tomato , Brinjal, carrot, okra	Root-knot nematodes (*Meloidogyne spp*.)
9	*Trichoderma harzianum* 1.0% WP (Strain No. IIHR-TH-2 Accessions No. ITCC 6888)	Tomato , Brinjal, carrot, okra,	Root-knot nematodes (*Meloidogyne*

		gerbera ,carnation ,banana, acid lime, papaya	*incognita*)
10	*Trichoderma viride* 1.5% WP (Strain No. IIHR-TV-5 Accessions No. ITCC 6889)	Tomato , Brinjal, carrot, okra	Root-knot nematodes (*Meloidogyne spp*.)
	Verticillium chlamydosporium 1.0% WP, ($2x10^6$ CFU/gm min) Strain – IIHR-VC-3	Tomato , Brinjal, carrot, okra	Root-knot nematodes (*Meloidogyne spp*.)
	Verticillium lecanii 1.15%WP, ($1x10^8$ CFU/gm min)	Citrus, cotton	Mealybug (*Planococcus citri*), White flies
	Nuclear Polyhedrosis Virus of *Helicoverpa armigera* 0.43% AS ($1x10^9$ POB/ml)	Tomato, cotton	*Helicoverpa armigera*

Source:https://ppqs.gov.in/sites/default/files/6. major use of pesticides biopeticides insecticides as on 01.06.2023.pdf

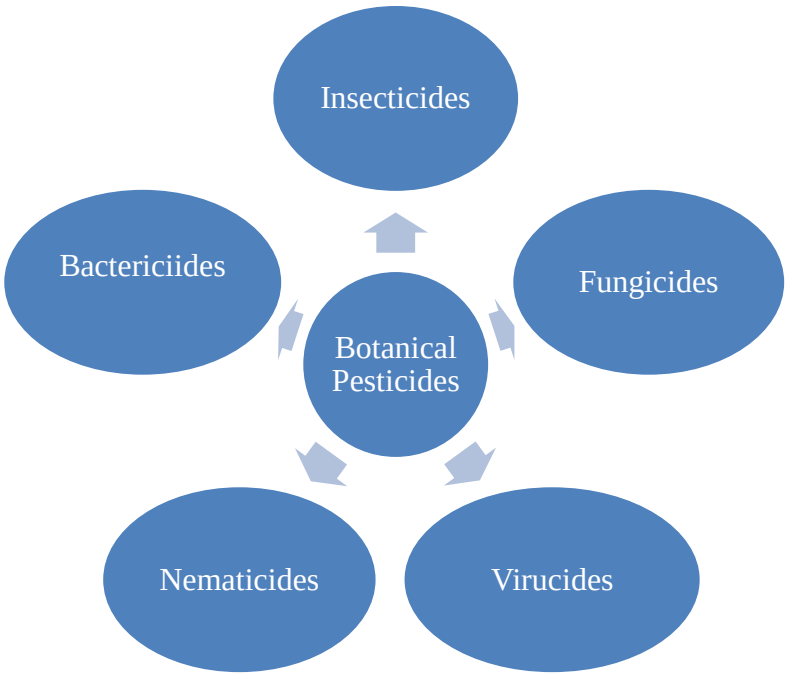

Figure1. Depiction of botanical pesticides application in agriculture

Summary

The ability of plant-based pesticides to control economically important pests in agriculture is essential because of their regenerative nature, high safety for the environment, and positive effects on human health. The majority of low-income and developing countries utilize plant-based pesticides to manage pests due to its affordability, accessibility, availability, and ease of application. However, study on the active components of pesticidal plants is still in its early stages. The current efforts to improve the characterization of effective phytochemicals and the quantities of these compounds in finished goods are difficult since standardization and precision are still major obstacles, because the characterization of phytochemicals are difficult due to involvement of high cost instrument like LC-MS/MS, NMR, FTIR etc., still ample of opportunities are waiting ahead.

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