

## Scope of Natural Pesticides in Cultivation of Medicinal Plants



### Medical Science

**KEYWORDS :** Natural Pesticides, Toxic effects, Insecticide.

\* **Dr. Satej Tippanna Banne**

Department of Dravyaguna, KLEU Shri BMK Ayurveda Mahavidyalaya, Belgaum, Karnataka. \* Corresponding Author.

**Yogesh H. Girigaon**

HOD, Department of Dravyaguna, KLEU Shri BMK Ayurveda Mahavidyalaya, Belgaum, Karnataka,

### ABSTRACT

*Pesticides are chemical compounds that are used to kill pests, including insects, rodents, fungi and unwanted plants (weeds). Pesticides are used in public health to kill vectors of disease, such as mosquitoes and to damage crops. By their nature, pesticides are potentially toxic to other organisms, including humans, and need to be used safely and disposed of properly. So development of natural pesticides is required in present era. Plants have been much more successfully exploited as sources of pesticides for pests other than weeds. This is probably due to several factors. The selection pressure caused by pathogens and herbivores has probably been more acute and intense than that caused by plant competitors. A plant species can effectively compete with plant foes in many ways other than by poisoning them and having to cope with auto toxicity. The molecular complexity, limited environmental stability and low activity of many biocides from plants, compared to synthetic pesticides are discouraging. However, advances in chemical and biotechnology are increasing the speed and ease with which man can discover and develop secondary compounds of plants as pesticides.*

### INTRODUCTION:

Chemical pesticides date back 4,500 years, when the Sumerians used sulfur compounds as insecticides. The Rig Veda, which is about 4,000 years old, also mentions the use of poisonous plants for pest control. It was only with the industrialization and mechanization of agriculture in the 18<sup>th</sup> and 19<sup>th</sup> century, and the introduction of the insecticides pyrethrum and derris that chemical pest control became widespread. In the 20<sup>th</sup> century, the discovery of several synthetic insecticides, such as DDT, and herbicides boosted this development. Chemical pest control is still the predominant type of pest control today, although its long-term effects led to a renewed interest in traditional and biological pest control towards the end of the 20<sup>th</sup> century.<sup>1</sup>

Pesticide an active ingredient means any ingredient which will prevent, destroy, repel, control or mitigate pests. Pest control is an ongoing problem for all of us. For years, we have depended on the use of pesticides to eliminate unwanted pests<sup>2</sup>. Pesticides are harmful chemicals that have been linked to illness and disease. Due to this more emphasis is being given to natural products. Many Plants have been reported to exhibit insecticidal/insect-repellant effects. In 2010, WHO commemorated 50 years of its Pesticide Evaluation Scheme (WHOPES), established with the approval of the World Health Assembly in 1960. For more than half a century, the programme has been serving as a reference for setting norms and standards for public health pesticides and their life-cycle management<sup>3</sup>.

The WHO Pesticide Evaluation Scheme (WHOPES) was set up in 1960. WHOPES promotes and co-ordinates the testing and evaluation of pesticides for public health. It functions through the participation of representatives of governments, manufacturers of pesticides and pesticide application equipment, WHO Collaborating Centers and research institutions, as well as other WHO programs, notably the International Program on Chemical Safety. In its present form, WHOPES comprises a four-phase evaluation and testing program, studying the safety, efficacy and operational acceptability of public health pesticides and developing specifications for quality control and international trade. WHOPES collects, consolidates, evaluates and disseminates information on the use of pesticides for public health. Its recommendations facilitate the registration of pesticides by Member States.<sup>4</sup>

### PLANT-DERIVED COMPOUNDS WITH PESTICIDAL POTENTIALS:

#### Herbicides:

Inhibition of plant growth and production of phytotoxic symptoms by certain plants and their residues is a well-established phenomenon. In searching for potential herbicides from plants, screening of compounds known to function in plant-plant interactions is a logical strategy. All plants produce secondary compounds that are phytotoxic to some degree. However, in only a relatively few cases it has been established that particular compounds provide the producing species a competitive advantage over other species that are less tolerant to the compound. Only a few of these all chemicals have been actively pursued as herbicides and in these cases, the natural compound has been modified.

#### Insecticides:

Throughout history, plant products have been successfully exploited as insecticides, insect repellents, and insect antifeedants. Probably the most successful use of a plant product as an insecticide is that of the pyrethroids. The insecticidal properties of the several Chrysanthemum species were known for centuries in Asia. Even today, powders of the dried flowers of these plants are sold as insecticides. After elucidation of the chemical structures of the six terpenoid esters (pyrethrins) responsible for the insecticidal activity of these plants, many synthetic analogs have been patented and marketed. Synthetic pyrethroids have better photo stability and are generally more active than their natural counterparts.

#### Fungicides:

Without an immune system to combat pathogenic microorganisms, plants rely primarily on chemical protection with secondary compounds. Compounds that inhibit the establishment of and growth of plant pathogens are termed phytoalexins. Many of these secondary compounds have been chemically characterized and proof is developing that these compounds have such a role in plant disease prevention and control. In fact, there is some evidence that certain synthetic fungicides used in plant protection act by inducing the production of phytoalexins in plants.

#### Nematicides and Molluscicides:

Many plant species are known to be highly resistant to nematodes. The well-documented of these include marigolds (*Tagetes* spp.), rattlebox (*Crotalaria spectabilis*), chrysanthemums (*Chrysanthemum* spp.), castor bean (*Ricinus communis*), mar-

gosa (*Azadiracta indica*), and many members of the family Asteraceae (family Compositae). The active principle(s) for this nematocidal activity has not been discovered in all of these examples and no plant-derived products are sold commercially for control of nematodes. In the case of the Asteraceae, the photodynamic compound alpha-terthienyl has been shown to account for the strong nematocidal activity of the roots.

The plant-derived saponins are generally highly toxic to snails. Cyanogenicglucosides are responsible for resistance of certain legumes to snails and slugs. No plant-derived natural products are commercial products are available for control of snails and slugs.

**Rodenticides:**

Plants produce a myriad of compounds that are poisonous to mammals. Some of these, such as strychnine are used in commercial rodenticides. The chronic poison warfarin and several analogues are coumarin derivatives, this chemistry led to discovery of indanediones and 4-hydroxy-2H-1-benzopyran-2-ones as rodenticides.

**FACTORS INFLUENCING DEVELOPMENT OF NATURAL PESTICIDES:**

**Discovery:**

The secondary compounds of plants are a vast repository of compounds with a wide range of biological activities. This diversity is largely the result of coevolution of hundreds of thousands of plant species with each other and with an even greater number of species of microorganisms and animals. Thus, unlike compounds synthesized in the laboratory, secondary compounds from plants are virtually guaranteed to have biological activity and that activity is highly likely to function in protecting the producing plant from a pathogen, herbivore, or competitor.

**Development:**

Few pesticides that are found to be highly efficacious in testing are ever brought to market. Many factors must be considered in the decision to develop and market a pesticide. An early consideration is the patentability of the compound. A patent search must be done for natural compounds as with any synthetic compound. Prior publication of the pesticidal properties of a compound could cause patent problems. Compared to synthetic compounds, there is a plethora of published information on the biological activity of natural products. For this reason, patenting synthetic analogues with no mention of the natural source of the chemical family might be safer than patenting the natural product in some situations.

Before a decision is made to produce a natural pesticide for commercial use, the most cost-effective means of production must be found. Although this is a crucial question in considering the development of any pesticide, it is even more complex and critical with natural products. Historically, preparations of crude natural product mixtures have been used as pesticides. However, the potential problems in clearing a complex mixture of many biologically active compounds for use by the public may be prohibitive in today's regulatory climate. Thus, the question that will most probably be considered is whether the pure compound will be produced by biosynthesis and purification or by traditional chemical synthesis.

**Table 1: Scope of pesticides**

Synthetic Pesticides		Natural Pesticides	
Advantages	Disadvantages	Advantages	Disadvantages
Easy to procure	Toxic effect	Hypoallergenic	Slow acting
Easy to apply	Contamination of environment	Protecting kids, pets, & environment	Critical application

Fast acting	Damage to beneficial insects	Less toxic	Suppress rather than eliminate
Uniform dosage	Accidental poisoning		Short shelf life
Less quantity	Vegetable contamination		

**Table 2: Some examples of pesticides**

Sr. No.	Pesticide	Use	Adverse Effects
1	DDT	wide variety of insects, including domestic insects	Chronic liver damage endocrine and reproductive disorders
2	Endosulfan	as a broad spectrum Insecticide	Effects kidneys, developing fetus, and liver Immune-suppression, decrease in the quality of semen
3	Aldrin	Effective against wireworms and to control termites	Lung cancer, liver diseases
4	2,4-D	Herbicide	Non Hodgkin's Lymphoma
5	Butachlor	controls annual grasses and some broad leaved weeds	Weight loss reduced brain size together with lesions
6	Captafol	It is a protective, wide spectrum foliage and soil fungicide.	Potential to cause cancer

**Table 3: Some examples of natural pesticides**

Sr. No.	Plants used as Pesticide	Active components	Pest	Activity
1	<i>Acorus calamus</i> Linn. Family: Araceae	Trans-asarone	Athaliaproxima	Anti-feedent, Repellent
2	<i>Adhatoda vasica</i> Nees Family: Acanthaceae	---	Lepidopterous	Toxicant
3	<i>Allium sativum</i> Linn. Family: Amaryllidaceae	Tri-sulphide	Culex	Anti-feedent, Repellent
4	<i>Annona squamosa</i> Linn. Family: Annonaceae	Annonidines	Scopoli	Moderately toxic
5	<i>Azadirachta indica</i> A.Juss. Family: Meliaceae	Limonides, Azadirachtin,	Helicoverpaarmigera	Oviposition deterrent, Physiological Disturbances
6	<i>Calotropis procera</i> (Ait.) R.Br. Family: Asclepiadaceae	---	Flies, Termites	Anti-feedent
7	Citrus lemon Linn. Family: Rutaceae	Limonin	Helicoverpazea	Anti-feedent
8	<i>Datura metel</i> Linn. Family: Solanaceae	Alkaloids	Spodopteralitura	Toxic
9	<i>Mentha spicata</i> Linn. Family: Labiatae	Carvone	Crassus snyder	Anti-feedent

10	Nerium oleander Linn. Family: Apocynaceae	Oleandrin, Neridine	S.gregaria	Toxicant
11	Nicotiana tabacum Linn. Family: Solanaceae	Nicotine	Aphis craccivora	Stomach poison
12	Ocimum sanctum Linn. Family: Labiatae	Alkaloids	Fruit fly	Attractant Antiinsects
13	Parthenium hysterophorus Linn. Family: Compositae	Leaf extracts	S.litura	Growth inhibitor
14	Piper nigrum Linn. Family: Piperaceae	Piperine	H.zea	Oviposition Deterrent
15	Pongamia pinnata Vent. Family: Fabaceae	Karanjin	P.demoleus	Toxicant
16	Ricinus communis Linn. Family: Euphorbiaceae	Ricinine	E.fabia	Oviposition Deterrent
17	Vinca rosea Linn. Family: Apocynaceae	Vinine	S.litura	Toxicant
18	Vitex negundo Linn. Family: Verbenaceae	Bicucine	House fly	Repellent
19	Zingiber officinale Family: Roscoe Family: Zingiberaceae	---	Triboliumcastaneum	Anesthetic

**DISCUSSION:**

Plants contain a virtually untapped reservoir of pesticides that can be used directly or as templates for synthetic pesticides. Numerous factors have increased the interest of the pesticide industry and the pesticide market in this source of natural products as pesticides. These include diminishing returns with traditional pesticide discovery methods, increased environmental and toxicological concerns with synthetic pesticides, and the high level of reliance of modern agriculture on pesticides. Despite the relatively small amount of previous effort in development of plant-derived compounds as pesticides, they have made a large impact in the area of insecticides. Minor successes can be found as herbicides, nematocides, rodenticides, fungicides, and molluscicides. The number of options that must be considered in discovery and development of a natural product as a pesticide is larger than for a synthetic pesticide. Furthermore, the molecular complexity, limited environmental stability and low activity of many biocides from plants, compared to synthetic pesticides are discouraging. However, advances in chemical and biotechnology are increasing the speed and ease with which man can discover and develop secondary compounds of plants as pesticides. These advances, combined with increasing need and environmental pressure, are greatly increasing the interest in plant products as pesticides.

**CONCLUSION:**

Pesticide residues in agricultural commodities are being the issue of major concern besides their harmful effect upon human life, wild life and other flora and fauna. Equally worrying thing is about development of resistance in pest to pesticides. The only solution of all these is use of 'Natural Pesticides' that can reduce pesticide risks. Natural Pesticides are best alternatives to conventional pesticides.

**REFERENCE**

1. Available from [http://en.wikipedia.org/wiki/Pest\\_control](http://en.wikipedia.org/wiki/Pest_control) date 20/09/14 | 2. General Accounting Office, U.S. Agriculture: Status of the Farm Sector, GAO/RCED-95-104FS, March 1995, p. 12. | 3. Arnason, T., G.H.N. Towers, B.J.R. Philogene and J.D.H. Lambert 1983. The role of natural photosensitizers in plant resistance to insects. Amer. Chem. Soc. Symp. Ser. 208:139-151. | 4. Available from <http://www.who.int/whopes/en/>, date 20/9/14. | 5. Duke, S.O. 1990. Natural pesticides from plants. p. 511-517. In: J. Janick and J.E. Simon (eds.), Advances in new crops. Timber Press, Portland, OR. Available from <https://www.hort.purdue.edu/newcrop/proceedings1990/v1-511.html>, date 20/9/14. |