



Plant Products as a Potential Stored Product Insect Management Agents

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ABSTRACT

To manage insect pest problem in storage synthetic chemicals are recommended but their use may create many problems like resistance, residues, harm to natural enemies etc. As an alternative of this age old practices of using plant products offers a safer alternative. As it is safer to farmers, users, environmentally sound and free from residues problem. So there is a great need to propagate such method of plant protection.

Keywords: Stored product insect pests, botanical insecticides

Conservation of reserved food grain stocks is very necessary to ensure a continuous supply at stable price. Losses due to insect pest infestation are the most serious problem in grain storage, particularly in the developing countries like India. Where poor sanitation and use of inappropriate storage facilities all encourage insect attack. It was estimated that more than 20000 species of field and storage pests destroy approximately one-third of the world's food production, valued annually at more than \$100 billion, among which the highest losses (43% of Potential production) occur in developing Asian and African countries. The efficient control and removal of stored grain pests from food commodities has long been the goal of entomologist throughout the world. Synthetic pesticides are the major tools for crop protection in developed countries. However, considerable problems may arise from the continued application of these insecticides, including genetic resistance of insect species, toxic residues in the grains, handling hazards, health hazards to operative and pest resurgence. These problems lead to rapidly rising application and marketing costs. Continuous and heavy usage of synthetic insecticides results in direct toxicity to non-target organisms such as beneficial parasites, predators and others. Certain chemicals may also be concentrated in food chains. Therefore, it may be worthwhile to see insecticide supplements of natural origin.

The research for more selective and biodegradable insecticide in a promising field within stored-product pest management strategies. The *Azadiractia indica*, hold particular promise as insecticide of botanical origin. They have no known mammalian toxicity, act at low concentrations and are easily biodegradable. Tissues of higher plants contain arrays of biochemicals that are thought to be defensive in function. They include alkaloids, steroids, phenolics, saponins, resins, essential oils, various organic acids and other compounds. Because of their metabolic roles in the plant were mainly obscure, they are generally known as "Secondary Plant Chemicals" or "allelochemicals" produced as metabolic by products with possible defense functions. It is well known that secondary plant metabolites may act as kairomones, allomones, stimulants or deterrents of feeding and oviposition and as antifeedants, insecticides and insect hormone mimics. During last three decades, many plant allelochemicals including nicotine, pyrethrins, azadirachtin and rotenoids have been

isolated, characterized and developed as commercial insecticides. Some plant derived insecticides consist of a mixture of biologically active compounds and hence insects are not exposed to the same selection pressure as with conventional insecticides and develop resistance slowly.

Insecticide resistance in stored product pests

The incidence of insecticide resistance is a growing problem in stored product protection. Resistance to one or more insecticides has been recorded in at least 507 species of insect and mites. The development of cross and multi resistant strains in many important insect species is a serious concern all over the world. These stored grain pest were found to be resistant against different insecticides including the cyclodienes, carbamates, chlorinated hydrocarbons etc.

Alternative Strategies for stored products pest management

The increasing serious problems of resistance to pesticides and of contamination of biosphere associated with the long scale use of broad spectrum synthetic pesticides have directed the need for effective, biodegradable pesticides with greater selectivity. This awareness has created a worldwide interest in the development of alternative strategies, including the discovery of new types of insecticides. However, new insecticides will have to meet entirely different standards. They must be pest specific, non toxic to mammals, biodegradable, less prone to pest resistance and relatively less expensive. This has led to reexamination of the century old practices of protecting stored products using plant derivatives, which have been known to resist insect attack. Plant derived materials are more rapidly biodegradable, less likely to contaminate the environment and less toxic to mammals. Therefore, today, researcher are seeking new classes of naturally occurring pesticides that might be compatible use of bioactive plant materials in storage pests management systems might be economic and environmentally friendly. The manipulation of natural product chemicals, such as insect attractants, repellents, stimulants, antifeedants and arrestants, which are normally encountered by insects, may fulfill the required criteria.

Traditional uses of bio-potential Plant Products:-

Since the dawn of human history, they tried to protect their harvest produce against arthropod pests. The Egyptian farm-

ers used to mix the stored grain with fire ashes. The ancient Romans used false hellebore (*Veratrum album*) as a rodenticide and the chimes are credited with discovering the insecticidal properties of *Derris* species. Pyrethrum was used as an insecticide in Pessia and Delmatia and tobacco plant preparations have been similarly used for nearly two centuries. In many areas of the world, locally available plants are currently in wide use to protect stored products against damage caused by insect infestation. Indian farmers use neem leaves for the control of stored grain pests, while various Nigerian tribes use roots, stems and leaves of locally available weed plants. The farmers of Togo protect harvested cowpeas by adding a mixture of sand and plant or ashes and ground paprika. In Northern Cameroon, cowpeas are traditionally mixed with sieved ash after threshing and the mixture put into a mud granary or a clay jar. In East Africa, the leaves of *Ocimum Suave* and the cloves of *Eugenia aromatica* are traditionally used as effective stored grain protectants. In some South Asian countries food grains such as rice or wheat are traditionally stored mixed with 2% turmeric powder. The use of oils in stored products pests control is also an ancient measure. Botanical insecticides such as pyrethrum, derris, nicotine, oil of citronella and other plant extracts have been used for centuries. Indian villagers traditionally protect their stored pulses from insect attack simply by coating them with a thin film of edible oil. More than 150 species of forest and road side trees in India produce oilseeds, which have been mainly used for illumination, medicinal purposes and as insecticides from ancient times to early 20th century.

Prospects of bio-potential plant products

Over the last three decades, there has been much work on the isolation and identification of a wide array of biologically active natural products that in same way affect the behavior, development and/or reproduction of pests including insects. The increasing attempts to replace synthetic insecticides with less expensive and locally available pest control means have been undertaken especially in the tropics.

Pesticidal plants are utilized in two main ways:-

1. The active compounds are isolated identified and chemically synthesized if feasible. These compounds or their active analogues are synthesized and marketed by the chemical industry.
2. The second approach is suitable for organic farming. Plant tissues or crude products of the plant, such as aqueous or organic solvent extracts, are used directly. These practices are labour intensive, but are often economically and ecologically sound and do not require sophisticated technology.

Classification of bio-potential plant products:-

On the basis of physiological activities on insects, the plants compounds are conventionally classified into 6 groups (Jacobson-1982) namely: - repellent, feeding deterrents (Antifeedants), toxicants, growth retardants, chemosterilant and attractants.

Repellents: - The repellents are desirable chemicals as they offer protection with minimal impact on the ecosystem, as they drive away the insect-pests from the treated materials by stimulating olfactory or other receptors of insects. An insect repellent is a chemical stimulus, which causes the insect to make oriented movements away from the source of stimulus. Repellents from plant origins are considered safe to pest control operations as they minimize pesticide residues, ensure safety of the people, food, environment and wildlife. The plant extracts, powders and essential oil from different bioactive plants were reported as repellent against different economically important stored product insects. The essential oil of *Artemisia annua* was found as repellent against *Tribolium castaneum* and *Callasobruchus maculatus*.

Antifeedants/Feeding deterrents: - Antifeedants which are sometimes referred as "feeding deterrents" are defined as chemicals that inhibit feeding, although do not kill the insect

directly. They are also defined as chemicals, which retard or disrupt insect feeding by rendering the treated materials unattractive or unpalatable. Antifeedants are of great value in protecting stored commodities from insects. Insects remain on treated food indefinitely and eventually starve to death without eating. Some naturally occurring Antifeedants, which have been characterized, includes, glycosides of steroidal alkaloids, aromatic steroids, hydroxylated steroid meliantriol, triteroene hemizectal, etc. The screening of several medicinal herbs showed that the root bark of *Dictamnus dasycarpus* possessed significant feeding deterrence against stored-product insect pests.

Toxicants: - Toxicants are specific types of chemicals, which directly kill insects. They are also referred as insecticides. Worldwide reports on the toxicity of different plant derivatives showed that many plant products are toxic to stored product insects. Talukder (2005) listed the use of 43 plants species expressing toxicant effects of different species of stored product insects. The list of these plant products is given in Table-1.

Table-1: List of some plant species used against stored grain pests

Plant Species	Plant Species
<i>Acorus calamus</i>	<i>Eruca sativa</i>
<i>Allium sativum</i>	<i>Eucalyptus globulus</i>
<i>Annona squamosa</i>	<i>Glycine max</i>
<i>Azadirachta indica</i>	<i>Jatropha gossypifolia</i>
<i>Bassia longifolia</i>	<i>Lantana camera</i>
<i>Brassica juncea</i>	<i>Ocimum sanctum</i>
<i>Brassica napus</i>	<i>Piper nigrum</i>
<i>Calotropis procera</i>	<i>Pongamia glabra</i>
<i>Curcuma longa</i>	<i>Ricinus communis</i>
<i>Cocos nucifera</i>	<i>Sesamum indicum</i>
<i>Convolvulus arvensis</i>	<i>Tagetes ereta</i>
<i>Coriandrum sativum</i>	<i>Tagetes patula</i>
<i>Datura alba</i>	<i>Vitex negundo</i>

Grain Protectants: - from the very early time the material obtained from plants have been used as a kind of natural protectant to protect the stored grains. Various parts of the neem tree i.e. leaves, crushed seeds, powdered fruits, oil etc., are most traditional example in this regards (Jotwani and Sircar, 1967). The dried leaves of *Azadirachta indica* have been mixed with stored grain for protection against insect in various parts of India. Grain protectant potential of different plant derivatives including the plant oil against major stored product pests were also found very promising and could reduce the risk associated with the use of insecticides. When the leaf, bark, seed powder, oil extract mixed with stored grains it reduces the oviposition rate and suppress adult emergence of stored product pests and also reduce the seed damage.

Insect growth and development inhibitors:- Plant extracts showed deleterious effects on the growth and development on insects and reduced larval pupal and adult weight significantly and lengthened the larval and pupal period and reduced pupal recovery and adult eclosion. The crude extract also retarded development and caused mortality of larvae, cuticle melanization and high mortality in adults. Plant derivatives also reduce the survival rates of larvae and pupae and also adults in many cases.

Conclusion:- The worldwide research carried out in last three decades have significantly extended our knowledge about the role of plant products in stored grain pest management. It is very clear from the above discussion that it is possible to develop methods of stored-products protection without or with reduced use of chemical insecticides. Many plant products can be used in the practical control of the stored product insect infestations. The main advantages of the botanical pesticides lie in their relative specificity, safety to natural enemies, etc. many of these products are available in locally and in many cases right at the site of their usage, so as to be relative inexpensive.

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