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# A REVIEW: PLANTS WITH INSECTICIDAL POTENTIALS AS PROTECTANTS FOR STORED GRAINS

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**Abstract**

Herbs with insecticidal potentials have over the years proved to be very useful to man for the protection of identified crops. The insecticidal potentials are present in various parts of plants in varying proportions which when used determines to a large extent the efficacy of the plant in the control of pests. Man has continued to identify and put into use those parts that have proved to be effective in the control of insect pests for the protection of his crops. The activity of these herbal plants has proved not to be injurious to man if consumed deliberately or by accident during the course of being used as protectants for crops. The purpose of this paper is to review the importance of major plants with insecticidal potentials used for mitigating the effect of insect pests on pulses and cereals and to underscore the negative effect of the continuous and reckless use of synthetic pesticides on man and his environment in a bid to protect and preserve our crops for future use.

**Keywords**: Insecticidal activity, botanicals, plants, Crops, Synthetic, insecticide, Insect, Protection

## Introduction

Crops such as maize, rice, millet, sorghum, soybeans, cowpeas and groundnuts are considered to be staple foods in most parts of Asia, Africa and South America. Insects and pests have been in existence with man since creation, and they have always contended with man for food. So, man has always sought for better ways for preserving his food both in the field and in storage (Dawodu *et al*., 2022). Such methods of preservation include development of pesticides and genetically altered insect- resistant crops (Niroumand *et al*., 2016). All over the world huge losses caused by insect pest, phytopathogens and mollusks are recorded on an annual basis from field to storage and this has significant effect on the growth and sustainability of the world populace (Abdulazeez *et al*., 2023, Gula, 2023). According to FAO, 2022, 55% of these food crops are lost to insects on the field and 14% in storage annually which in monetary value is in excess of $300 million dollars. So, the production of these crops is grossly affected by insects and pests (Dawodu *et al*, 2021). Thus, if these insects and pests are eliminated, it will go a long way to reducing the losses recorded from these food crops. (Babarinde *et al*., 2021). It was noted that, between 500 BC and the 20th century, pesticides were used to control pests Burr, 2014). Synthetic pesticides such as Dichlorodiphenyltrichloroethane (DDT) have been used for agricultural purpose after the outbreak of World War II (Azzouz,*et al*., 2021). However, these organic pesticides have been reported to be harmful to non-target organisms such as man and animals, shown to have several negative effects such as toxicity to animals, residue problems, environmental pollution and insecticide resistance [Copping and Menn, 2000; Isman, 2006; Dawodu *et al*., 2021; Azzouz *et al*., 2021). This led to the ban of DDT in 2004 (Label review manual, 1998). Most of the developed pesticides have been restricted, probably due to adverse environmental effect, high cost, non- bio-degradable nature and increasing insecticidal resistance (Zhou *et al*., 2025). Although, researchers have tried to obtain alternative synthetic pesticides, but not many have been accepted by potential users probably due to the high cost, non-specificity, ineffectiveness, development of resistance by target insect pests (Label review manual, 1998; Dawodu *et al*., 2021; Zzouz *et al*., 2021). The aim of this review work is to highlight some of the identified plants that possess insecticidal activity against stored products and the main bioactive phytochemicals present in these botanicals.

**Methodology**

Materials for this review work were obtained from university libraries and websites, and cover the period 1998-2025.

**Discussion**

Synthetic chemicals are toxic and hazardous to living organisms. These chemicals can affect non-target organisms, accumulate in the environment, pollute soil, ground water and wildlife (Gasto *et al*., 2020). This shows that the indiscriminate use of synthetic pesticides has seriously impacted on both biotic and abiotic components of the ecosystem. Before the advent of synthetic chemicals man has always relied on plants for his sustenance, and that include the use of plant parts for preserving his food. The use of bio-pesticides are less hazardous and ecofriendly (Kumar *et al*., 2021). In recent years, researchers have shown interest in the use of plant parts as a source for pesticides [Babarinde *et al*., 2017; Dawodu *et al*., 2022). These plant materials can be used in form of extracts, oils or as dusts formulations that have the potential of killing the pests or mitigate their effects (Tozlu *et al*., 2011; Babarinde *et al*., 2017; Purba and Muliarta, 2024). Perzada *et al*., 2025; Dawodu *et al*., 2024, examined some extracts from different species of plants used in agricultural farms which had maximum mortality level on *Callosobruchus maculatus* and *C. chinensis* within 72 hours of exposure while (Dawodu, 2022) report was based on Nigeria based plants for insecticidal activity against *Sitophilus zeamais* Motsch, and *C. maculatus* F. (Maize weevil and Cowpea weevil respectively). A number of plants screened for insecticidal potentials have been reported to exhibit broad insecticidal activity (Adebola and Yusuf). According to Lengai *et al*., 2020, the insecticidal activity is distributed across the different parts of the same plant, although the active components present in each plant part may vary thereby resulting in the plant part exhibiting different lethality rates (Ahmad, *et al*., 2017).

Several plants have been identified to possess bioactive compounds that make them active against pests (Mbadiko *et al*., 2023). Bio- pesticides are very effective, selective and have little potential for developing resistance to target pests and minimal effect on non-target organisms [Essiedu *et al*., 2020; Samada *et al*., 2020). Most bio-pesticides have favorable eco-toxicological properties such as rapid degradation, reduced environmental impact and low human toxicity [Cosimi *et al*., 2009]. *Chrysanthemum* is a plant found in Kenya and has been reported to possess high insecticidal activity due to the presence of the active constituent pyrethrins (Lengai, 2020). The pyrethrum obtained from this plant has broad spectrum insecticidal activity, kills and repels insects depending on the plant parts used and it's highly effective. The plant *Azadirachta indica* is used in Nigeria and in India to control over 25 different species of insects (Ahmad *et al*., 2017). It was noted that the active ingredient in this plant is azadirachtin which is abundant and found to be highest in the kernel (Adeusi, 2022). The plants *Milletia pachycarpa* Benth, *Tripteryguim forrestii* locs and *Rhododendron molle* G. Don are found in China. Their finely ground powder exhibited high insecticidal activity against aphid, pendahmids, leaf beetles, caterpillars, bud lice and plant lice (Knnak, 2012). Among these three plant species, it was noted that *R. Molle* exhibited high level of toxic specificity against the larvae of lepidopterous pests and leaf beetles (Bairos, 2010). The active component in the plant was revealed to be rotenone which is a plant flavonoid (Lisa, 2014). The researchers (Kaliamurthi and Selvaraj, 2014; Shekhar, 2024) investigated three Sri Lankan plant species *Pleurostylia opposite* (Wall.) atston (Celastraceae), *Aegle marmelos* Correa (Rutaceae) and *Excoecaria agallocha* (Euphorbiaceae) for insecticidal property. They noted these plants possess insecticidal property and that the compounds found in *E. agallocha* and *Daphnene orthoesters* are responsible for the insecticidal activity (Tan *et al*., 2024). *Asimina triloba* (American pawpaw tree) found in many African and American communities possess pesticidal and antifeedant activities. The bioactive compound found in this plant is asimicin which is located in the seeds and bark. The compound has been found to be active against blowfly larvae, melon aphids and Mexican bean beetle (Tan *et al*., 2024). The plants *Cassia nigracens* V, *Cymbopogon schoenanthus* S. and *Cleome viscose* L. from Burkina Faso were reported to possess insecticidal activity. These plants are more active for storage crops than field application since they are most effective by inhalation. They are potent as stomach and as contact toxicants on 1$^{st}$ instar larvae (Duran-Ruiz *et al*., 2024). The powdered leaves of *Dalbergia saxatilis* were active against cowpea bruchid, *C. maculatus*. It exhibited a protectant activity of the cowpea crop. The insecticidal activity has been attributed to the presence of compounds such as Cubenol, Caryophyllene oxide, Isoaromadandrene epoxide (Mbadiko *et al*., 2023). From the genus *Piper*, about 112 genera have been screened for pesticidal activity (Koma and Fakunle; 2014; Lima *et al*., 2020). The most significant ones are those of *Piper guineense*, *P. longum* and *P. retofractum* which were shown to be active against *C. maculatus* and the garden insect *Zonocerus variegatus* L, (Mgbeahuruike *et al*., 2017; Stojanovic-Radi *et al*., 2019). Some plants known to possess pesticidal activity are presented in Table 1.

Table 1: Some plant species with insecticidal activity

| **Species** | **Families** | **Parts** |
|---|---|---|
| *Abrus precatorius* L. | Fabaceae | Leaf, Stem |
| *Aegle marmelos* | Rutaceae | Leaves |
| *Allium sativum* L. | Alliaceae | Leaves, Bulbs, Flowers |
| *Allium sepa* | Alliaceae | Bulbs |
| *Anacardium occidentale* L. | Anacaddiaceae | Leaves |
| *Annona senegalensis* Pers | Asteraceae | Stem, Bulbs |

| | | |
|---|---|---|
| *Artemisia annua* L | Asteraceae | Leaf, Bulbs |
| *Azadirachta indica* A. Juss | Meliaceae | Leaves. Roots, Bark, Fruits |
| *Balanites aegyptiaca* Linn Bel | Zypophyllaceae | Roots |
| *Bidens Pilosa* L | Asteraceae | Leaves |
| *Brassica juncea* | Brassicaceae | Leaves, Seeds |
| *Butea monosperma* | Leguminosae | Flowers |
| *Cannabis sativa* L. | Cannabaceae | Leaves, Seeds, Stem, Fruits |
| *Capsicum frutescens* L. | Solanaceae | Fruits |
| *Carica papaya* L. | Caricaceae | Fruits, Seeds, Leaves |
| *Senna ariculata* | Fabaceae | Leaves. Seeds |
| *Chrysanthemum coccineum* Wild | Asteraceae | Leaves, Fruits |
| *Chrysanthemum indicum* | Asteraceae | Leaves, Roots |
| *Clausena anisate* | Rutaceae | Leaves, Roots |
| *Catharanthus roseus* | Apocynaceae | Leaves, Roots |
| *Curcuma domestica* | Zingiberaceae | Rhizomes |
| *Dalbergia saxatilis* | Fabaceae | Leaves, Bulbs |
| *Datura stramonium* | Daturaceae | Leaves |
| *Dennettia tripetala* | Annonaceae | Leaves |
| *Eucalyptus globules* | Myrtaceae | Leaves, Bulbs |
| *Eucalyptus occidentalis* | Myrtaceae | Leaves |
| *Gmelina aborea* Juss | Verbenaceae | Leaves |
| *Glyricidia sepium* | Leguminosae | Leaves |
| *Hyptis suaveolens* Poit | Labiate | Shoots |
| *Khaya senegalensis* A. Juss | Meliaceae | Sap, Fruits, Shoots |
| *Jatropha curcas* L | Euphorbiaceae | Bulbs, Shoots |
| *Linnea acilia* | Anacardiaceae | Bulbs, Leaves |
| *Lawsonia inermis* | Lythraceae | Leaves |
| *Lantana camara* | Verbenaceae | Leaves |
| *Madhuca indica* | Sapotaceae | Seeds |
| *Melia azadarach* L | Meliaceae | Leaves, Roots, Bulbs |
| *Mitracarpus scaber* Zucc | Rubiaceae | Shoots |
| *Nicotiana tabacum* L. | Solanaceae | Leaves |
| *Nerium oleander* | Apocynaceae | Leaves |
| *Ocimum gratissimum* | Lamiaceae | Leaves |
| *Parkia biglobosa* Keay | Leguminosae | Shoots, Bulbs |
| *Phytolacca dodecandra* I'Herit | Phytolaccaceae | Leaves, Fruits |
| *Piper guineese* Shum & Thonn | Piperaceae | Fruits |
| *Piliostigma thonningii* | Fabaceae | Roots, Bulb |
| *Pongamia pinnata* | Leguminosae | Roots, Leaves, Flowers, Seeds |
| *Prosopis Africana* Linn | Mimosaceae | Bulbs, Shoots |
| *Psidium guajava* | Myrtaceae | Leaves and roots |

| | | |
|---|---|---|
| *Ricinus communis* | Euphorbiacea | Leaves, Seeds |
| *Spenoclea zeylanica* Gearth | Sphenocleceae | Shoot |
| *Sapnidus mukorossi* | Sapnidaceae | Fruits |
| *Tagetes minuta* L. | Asteraceae | Leaves |
| *Tagetes erecta* | Asteraceae | Flowers |
| *Tephrosia vogelii* Houc. | Fabaceae | Leaves |
| *Venonia armygdalina* | Asteraceae | Leaves |
| *Vitex negundo* | Verbenaceae | Leaves |
| *Zingiber officinale* | Zingiberaceae | Tubers |

Essential oils obtained from aromatic plants have been shown to possess different types of effects on stored-product insect pest [Papachristos and Stamopoulos, 2002]. According to Cosimi *et al*., 2009, they may possess fumigant activity, penetrate inside the insect body, act as repellant, anti-feedant or may affect some biological parameters such as growth rate, life span and reproduction. These researches showed that essential oils obtained from *Laurus mobilis*, *Citrus bergamia*, *Foeniculum vulgare* and *Lavandula hybrida* possess repellant activity against *Sitophilus zeamais* and *Cryptolestes ferrugineus* adults and *Tenebrio molitor* larvae. Investigation of the chemical composition of these compounds revealed that *L. mobilis* has a high quantity of oxygenated monoterpenes; *C. bergamia* has limonene as the main constituent followed by linalyl acetate, γ-terpinene and linalool while *L. hybrid* has linalool and linalyl acetate as its main contituents; and phenyl propanoids in *F. vulgare.* Oils obtained from *Cupressus sempervirens* L., *Eucalyptus saligna* Sm. (Tapondjou *et al*., 2005), *Evodia rutaecarpa* Hook f. et Thomas (Liu and Ho, 1999) and *Cleome hirta* Oliv. (Ndungu *et al*., 1999) were shown to possess repellent activity against *S. zeamais*. Nerio *et al*., 2009 determined the insect repellent activity of some plants and noted that essential oils from the plants *Lippia origanoides*, *Eucalyptus citriodora* and *Tagetes lucida* have activity against *Sitophylus zeamais*. This activity was attributed to the presence of the phytochemicals known as thymol, and citronella which is found in *E. citriodora*. The essential oil from *T. lucida* was found to exhibit activity against bruchid pests of stored products (Pascual and Ballesta, 2003). Other plants that have been reported to exhibit insecticidal activity are given in Table 2.

Table 2: Plants that possess essential oils that have insecticidal activity

| **S/N** | **Plants** | **Refs** |
|---|---|---|
| **1** | fennel | Bilia *et al*.,2002; Coelho *et al*., 2003; Ren *et al*., 2006; Jaffary *et al*., 2006 |
| **2** | lavandin | Svidenko and Rabotyagov, 2006; Arabaci *et al*., 2007 |
| **3** | Bay laurel | Flamini *et al*., 2007 |
| **4** | Bergamot | Padin et al., 2000; Wang *et al*., 2001; Papachristos and Stamopoulos, 2002 |

## Conclusion

Synthetic chemicals were produced in order to prevent and/or reduce wastage of grains in the farms and stores. These chemicals were effective in controlling those pests and diseases that caused wastage of food grains. But continuous usage has led to its accumulation in the soil and development of resistance by the pest and pathogens leading to its deleterious effect on humans and other animals. This led to search for alternative ways of managing loss of grains both in the farm and store. Botanical pesticides have been found to be effective alternative to synthetic pesticides due to their being less harmful to man and the environment. These botanical pesticides have been used for centuries and were abandoned during the advent of chemical pesticides. However, most of the phytochemicals that are present in these botanicals and the active ingredients have been identified by several researchers. The main issue to be contended with in the formulation of botanical pesticides is that soil, environmental and climatic factors play vital roles in the composition of these plants. Therefore, proper evaluation of the quantity of the active compound(s) in the botanicals is important in order to obtain the desired results.

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