Journal of Advances and Scholarly Researches in Allied Education
Vol. 16, Issue No. 7, (Special Issue) May-2019, ISSN 2230-7540

A Study on the Use of Essential Oils in the Management of Insect Pests Stored

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Abstract – Essential oils (EOs) are potential alternatives to conventional pesticides, among plant extracts used as insecticides. EOs are generated by plants and play a significant function in plant signaling, including the appeal for pollinators and beneficial insects Plant species that produce essential oils are referred to as aromatic plants and dispersed over the globe. Our study seeks to analyze research publications on usage of EOs in stored product protection published during the past 15 years, examining diverse elements of insect pest control. Study on insect pests of stored grain, Damage, essential oils on insect pests Process Effectiveness of essential oils as insect control fumigants for stored product insects, Mode of action of essential oils possible, ESSENTIAL EARLY MODE OF ACTION, Checking insect pests stored in grain, Physical methods for the control of stored grain, Control and their negative effects of stored grain using chemical pesticides, Natural products control of stored grain, Preservation of laboratory insect culture.

Keyword – Insect Pests, Essential Oils, Management.

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INTRODUCTION

The ecotoxicological and environmental as well as social implications of extensive usage in agriculture have driven researchers to identify more ecologically friendly and sustainable alternatives than synthetic chemicals. In this context, both academics and consumers have an interest in the use of pesticides based on plant extracts. Essential oils (EOs) are a viable option among pesticide plant extracts because to their global availability and comparable cost efficiency.

Essential oils are secondary plant-synthesized metabolites that play significant role in plant protection (both against biotic and biotic stressors) and in signaling, including pollinator attraction and beneficial insects.

Essential oils are secondary metabolites, prevalent in fragrant crops including labiates, conifers, transfers and myrataceous plants. They are hydrogen donors in oxidation reduction processes and also play a function in plant protection against insect attacks and pathogens. They also help to avoid excessive evaporation. On the other side, they may encourage pollination by particular insects. Essential oils include several ingredients. Monoterpenes are the primary chemicals, dividing them in three groups - acyclic, monocyclic and bicyclic. As a consequence of plant ripeness, temperature, soil conditions, etc., the content of essentials oils might vary in the same plant species. Most essential oils include, but also include a restricted number of small molecules which may play a substantial part in olive fragrance and biological activity. Due of its persistence and detrimental effects on non target species, synthetic toxic pesticide usage have caused several difficulties for human health and the environment. There is now an urgent need for safe alternatives that may be used simply and easily to replace harmful substances. The insecticidal actions and low toxicity of mammals are known to be photochemical such as essential oils and thus provide excellent prospective applicants in the management of plagued animals. In addition, most terpenoids and phenols in plant substance oils have little toxicity in vertebrates, and have been shown by the United States Food and Drug Administration to be flavoring agents in foods and drinks. Although a variety of insects have revealed that many essential oils are poisonous or repellant, structure-activity studies on insect species give little, if any insights into how these molecules work.

The Y labyrinth test and the pitfall test are the most utilized for measuring the olfactory preference. The pitfall test is without sure the simplest test to build, and it matches to a large part the qualities of traps employed on the ground. The Y labyrinth is a benchmark for testing the choice of different animals. These two tests seldom track the movement of insects continuously throughout the test. Moreover an insect is either caught in a pitfall or removed from the movement after the decision has been made (the Y maze test), so the choice cannot be altered. Such methodologies do not take exploratory conduct into consideration which might lead to random decisions and hence introduce data noise. The approach provided in this article tackles the problem via enabling the insect freely exploring the test chambers while continually tracking their whereabouts. This approach can improve the quality of the data obtained on the olfactory preference and, at the same time, provide additional information describing movement parameters (speed, distance travelled etc.) which may indicate an overall physiological response to the test substances. This approach can be based on easily accessible hardware and free software. Four commercially available essential oils have been examined in the article provided. The possible synergistic effects of several tests on micro-organisms and insects were investigated independently for each oil and mixes. They were evaluated. When designing insecticide recipes, the synergistic effect may drastically lower the number of ingredients necessary and their prices.

Stored-grain insect pests

Insect pests from stored grain are those pests that have experienced and damaged store grain and agricultural products that are unfit for human consumption. These pests are split into two groups: insects of main grain and insects of secondary grain. The principal grain insects attack whole grains without injury. The embryonic stage of these insects takes place inside grains, while secondary grain insects feed on grain and grain pieces.

Coleopteran, comprising of almost 3, 30,000 species, is the biggest order not just among Arthropods, but in the whole Kingdom. They are tailored to different lifestyles and are usually dissimulated. Several Coleopteran members include vegetable pests, wood pests, furniture, clothing, cereal stores and medicine products and are of considerable financial significance (Table-1)

Table 1: Common stored-grain insect pest

Common name	Species	Order	Family
Lesser grain borer	*Rhyzopertha dominica*	Coleoptera	Bostrichidae
Bean weevil	*Acanthoscelides obtectus*	Coleoptera	Chrysomelidae
Pea weevil	*Bruchuspisorum*	Coleoptera	Chrysomelidae
Cowpea weevil	*Callosobruchus chinensis*	Coleoptera	Chrysomelidae
Broad-nosed granary weevil	*Caulophilus oryzae*	Coleoptera	Curculionidae
Granary weevil	*Sitophilus granarius*	Coleoptera	Curculionidae
Rice weevil	*Sitophilus oryzae*	Coleoptera	Curculionidae
Maize weevil	*Sitophilus zeamais*	Coleoptera	Curculionidae
Khapra beetle	*Trogoderma granarium*	Coleoptera	Dermestidae
Rusty grain beetle	*Cryptolestes ferrugineus*	Coleoptera	Laemophloeidae
Flat grain beetle	*Cryptolestes pusillus*	Coleoptera	Laemophloeidae
Flour mill beetle	*Cryptolestes turcicus*	Coleoptera	Laemophloeidae
Merchant grain beetle	*Oryzaephilusmercator*	Coleoptera	Silvanidae
Sawtoothed grain beetle	*Oryzaephilus surinamensis*	Coleoptera	Silvanidaevv
Longheaded flour beetle	*Latheticus oryzae*	Coleoptera	Tenebrionidae
Red flour beetle	*Tribolium castaneum*	Coleoptera	Tenebrionidae
Confused flour beetle	*Tribolium confusum*	Coleoptera	Tenebrionidae
Large flour beetle	*Tribolium destructor*	Coleoptera	Tenebrionidae
Cadelle	*Tenebriodes mauritanicus*	Coleoptera	Trogossitidae

Damaging process

Since time immemorial, stored grain insect pest has damaged millions of tones, resulting in considerable economic losses, of agricultural storage and food grained goods. Such insect pests are responsible for significant losses of stored grain products, particularly in tropical and semi-tropical regions (Madrid et al., 1990). Insects are causing enormous losses in stored grains and grain products, representing 5-10% losses in temperate and 20-30% losses in tropical areas. Approximately 10 to 12 per cent of overall output was decline of food grain during stocking at farm level in India. The overall losses of rice, 15.3 % in wheat and 12.6 percent in maize throughout the different post-harvest procedures in Pakistan, It is estimated that in nations where modern storage systems have not been deployed, total damage of stored grain may amount to 10 percent to 40%. At the same time, a continual expansion in the human population, particularly in impoverished and emerging nations, also faced a major challenge of food shortage. In India, human population growth is approaching agricultural growth and, owing to urbanization and industrialization, crop agriculture is declining day by day. There have been many methods and methods of increasing food production in recent years, but little attention has been devoted to the proper preservation of these foodstuffs. Therefore, it takes time not only to produce more but also to decrease the losses between harvest and eating in food commodities. It is important to remember that a conserved grain is a grain generated.

Essential oils activities on insect pests

It has been widely proven that essential oils are poisonous to many insect pests. Evaluative action is being carried out against different insects and fungal agents in essential oils such as clover, eucalypt and Lemon grass, pennyroyal, thymes, citrus and cinnamon. Essential oils are also resistant to pest damage caused by plants. For instance, conifer resistance such as the Scotches' Pine was identified in the barks associated to the high quantity of essential oils (Callidium violaceum) and the flat bog (Aradidae). Several essential oils are also repulsive to certain insects. All of them have been reported to repel mosquitoes, including camphor, cinemole, thymol, myncene, and limonene and methyl eugenol. Sitophilus zeÈME is repelled by Ocimum sauve and lippia sp., which are native to Kenya. Artemisia tridentate and Chrysothamnus nauseosus essential oils have been discovered to have anti-food effects on the Colorado potato beetle, while Acarus calamus oil has been discovered to be anti-feeding and to be growth inhibitors in the Peridroma saucia.

Efficacy of essential oils as fumigants for the control of stored product insects

For the safe and consistent supply of food and feed it is vital to preserve agricultural goods while being stored against attacks by insects. Current procedures are mainly dependent on toxic fumigants and contact insecticides to prevent pest infestations on grain and dry food items, posing potential health problems for the warm-blooded animal as well as a danger of environmental pollution. In recent years, the number of pesticides accessible has dropped as public authorities have considered regulating the use of hazardous substances in food and other items for health and the environment.

The protection of stored food, foodstuffs and other agricultural commodities from pest infestation is still a most efficient way of fumigation. There are now just two fumigants: methy l bromide and phosphorus. The United Nations' 1995 World Meteorological Organisation recognised methyl bromide as a factor to ozone depletion and is being eliminated in most industrialised nations. With respect to phosphine which is frequently employed nowadays, resistance of storage pests to this fumigant is increasingly reported. In the near future, resistance will likely force phosphine cessation as a fumigant.

The United States Environment Agency has identified a further substance 2-2 dichlorovinyl dimethyl phosphite as a potential human carcinogen, which is often used as a fog fumigant for bug control in vacuum structures. Furthermore, contemporary trends have put additional restrictions on the use of harmful substances in dietary goods under international food law. Similarly, the public demand is growing in healthy, natural foods devoid of chemical toxicants. These arguments underline the need for safe, simple and easy solutions that can replace hazardous fumigants and other pesticides.

Traditional agriculture in the poor world has devised efficient ways to manage insect pests using botanical products for ages, owing to its restricted access to modern pesticides. Many aromatic plants have volatile substances (allelochemicals) known to have insecticidal effects, decrease offspring and are insect-repelled. Their toxicity was established in the laboratory for both German and American cockroaches (Blatella germanica) and for Periplaneta americana, as well as their effectiveness in combating ectoparasites. The principal essential oils of these alllochemicals are monoterpenes and related substances. Especially essential oil derived from Pogostemon hyneanus, Ocimum basilicum and Eucalyptus, formerly Sitophilus oryzae, Stegobium paniceum, Tribolium castaneum and Callosobruchus chinensis, demonstrated insectizid activity. D-limonene, terpineol and linalool have also been shown to be hazardous to the use of postharvest products against coleopterans. Also identified in Sitotroga Cerealella moth and the bean weevil Acanthoscelides obtectus, a certain amount of essential oils and monoterpenoids were reproductive inhibitions. In Sitophilus granarium, Tribolium confused and appealing Paralyzed Oil has been discovered to be harmful in Tanacetum vulgare, as well as in Rhyzopera Dominica to be unpleasant. A complete examination of the usage of plant substances to preserve the leguminous seeds stored against seed beetles is provided by Boeke et al.

In addition to a photochemical composition of the essential oils, the degree of oil absorption in the treated goods, the lower the concentration of oil in the inter-granular air, and the pathway (whether the oil is inhaled, ingested or absorbed by the skin) are other factors which help to identify the toxicity of the oil.

Possible mode of action of essential oils

Polygen and SEM are very poisonous to various product insects that have been kept. In our trial, they have been analyzed to reveal their way of action for acetyl cholinesterase and for insect pulmonary systems. At our investigations with acetyl cholinesterase, it was shown that SEM76 was only noticeable in high doses (10-3M) and cannot effectively explain for low dosage mortality reported in vivo with acetyl cholinesterase activity. The lack of the monoterpenes induces the postulation of the major site action for these monoterpenes to create a robust inhibition of enzymes in vivo and in vitro.

Octopaminergic systems in insects are also a prospective objective of essential oil neurotoxicology. Octopamine is a multifunctional, naturally occurring biogenic amine with a similar to epinephrine's role in vertebrates that plays a major role as a neurotransmitter, neurohormone and neuromodulation in invertebrate systems. The occurrence of octopamine receiver subtypes in various tissues and animals has been substantiated by a range of pharmacological, biochemical and physiological evidence.

Mode of Action of Essential Oils

The plant and animal tissue are mostly cytotoxic, producing a significant decrease in the number of undamaged mitochondria and golgi bodies, limiting respiration and photosynthesis and lowering the permeability of cell membranes. Simultaneously they are volatile and they function for insects and other creatures as chemical messengers. Moreover, most monoterpenes act as a very brief signal and are particularly suited for alarm pheromones and synomones. For human and other vertebrate safety, the dosage and mechanisms of essential oils required to eliminate insect pests are potentially relevant. The target locations and method of action for monoterpenoids were not clearly explained and this subject has been studied in just a few studies.

Control of stored-grain insect pests

These stored grain insect pests may be controlled in several ways.

1. Control of stored-grain by Physical Methods

Temperature treatment of stored grains is the greatest approach to effectively kill insects during a number of life stages. The temperature also influences the reproductive performance of insect pests contained in grains. It also drastically decreases fertility, egg to survival for adults and the development of adult offspring.

In many countries, 70-90 percent of the food grain is still stored at farmer level for 6 months to a year in traditional store housing constructions made of locally available materials such as paddy straw, divided bamboos, shingles, moulds, bricks etc., despite improved storage structures and modern chemical and physical control techniques employed in the safe storage of stored grain. Grain is occasionally treated with sand, calk or ash in certain countries to provide physical impediments to insect travel through grain and minimize deposition of eggs. The storage capacity on farm might vary from a few hundred kilos and a number of tones. Gunny bags are not the most effective method to store food grains and are susceptible to pesticide assaults, since they are extensively employed. The prophylactic chemical products and physical therapies, such as ventilation, radiation, cooling, or heating or hermetic storage, in regulated nitrogen environments or carbon dioxide gaseous environments are not only prohibitively costly.

2. Control of stored-grain by chemical pesticides and their side effects

Several synthetic fumigants have been employed in the past to remove insect pests in stored grain. Few other fumigants are utilized for killing termites, cockroaches and mites, such as sulfuryl fluoride, ethyle formats and carbonyl sulphite and ethane dinitrile. Dichloride ethylene and carbon tetrachloride (3: 1 ratio) are used to destroy eggs, larvae and adult insect pests in the form of empty fumigations. In addition, some of the most frequent fumigants are employed to control the grain insects that are kept include carbon disulphide, carbon tetra chloride, ethylene dichloride, and methyl bromide, chloropicrin.

Increased application costs, pesticide strength and deadly effects on non-target species, and user toxicity, also have the usage of synthetic fumigants. While methyl bromide has been used as fumigant for over 70 years in the management of insect pesticides in durable and perishable goods, concern over its involvement in ozone depletion shows that the list of few remaining items able to prevent food and other commodities damage will ultimately be deleted. The Industrialized Nations of the world thus decided at the 1997 Montreal Protocol meeting to phase out the fumigant methyl bromide by 2005 because of the ozone depletion issue, while poor countries committed themselves to reducing consumption by 20% in 2005 and gradually by 2015. In addition, phosphine resistance to insects is very worrisome. The quantity of pesticide residues in food is becoming widespread issue.

In order to reduce the pest threat, a number of synthetic insecticides were employed and were employed with major disadvantages for many years . Residues of such pesticides in food chains tolerance at various tropical levels build. The increased risk of neurotoxicity, cancer, Teratogenic and Mutagenic consequences in non-target animals has been shown to be chronic pesticide exposure. Biodeterioration was confined to the use of synthetic chemicals after collection owing to their teratogenicity, high and high residual toxicity, hormonal imbalance, a lengthy period of degradation, environmental pollution and harmful effects on food and human consequences. Synthetic chemicals as antibacterial agents have surely boosted plant protection, but environmental quality and human health have deteriorated somewhat (Cutler and Cutler, 1999). Its unabated and indiscriminate usage not only led to resistant strains but also to the buildup of harmful residues in food grains used for human consumption.

Furthermore, a number of other familiar issues have arisen from the irresponsible and indirect usage of synthetic pesticides. Some of them include pollution of food, soil, soil, groundwater, rivers, lakes, sea and air etc. Misuse of extremely poisonous synthetic compounds results in many non fatal as well as non-fatal mishaps. A increasing sensitivity in toxicological and environmental difficulties connected in the use of synthetic pesticides is the natural result of the unwanted side effects of these products. This awareness has steadily moved towards an environmentally more sustainable agriculture with low or no input of toxic synthetic pesticides and other agricultural chemicals, and has led to the development of substitutes for synthetic insecticides in order to safeguard the grains stored from insect pest infestation and to protect the environment and human health. This circumstance motivated researchers and demands of synthetic pesticides that reduce the reliance on these tactics to find alternate solutions.

3. Control of stored-grain by natural products

In recent years, the emphasis was on researching natural items for the creation of novel pesticides in agrochemicals and labs. The finding of more selective and less lasting active chemicals will benefit both consumers and agricultural goods, but it may be presumed that natural goods are risk-free. In many nations suffering from limited storage facilities and climatic circumstances that encourage the degradation of food commodities, the protection of agricultural goods against pests is crucial. Apart from environmental problems, the spraying of chemical pesticides may not be successful since insects have tolerance to them. Therefore, researchers interested with the development of integrated insect control systems have taken a major interest in alternatives to the typical synthetic pesticides, such as predators, parasitoids, microorganisms and natural plant products.

In recent times the utilization of higher plant products as new chemotherapists for plant protection has been given consideration in various regions of the globe. As plant products have the potential to have value in pest control due to non phytotoxicity, systemicity, facile biodegradability and stimulating nature of host metabolism. The plant kingdom is the most efficient compound manufacturing facility with various structures, characteristics and modes of action. The relationship of plants and insects is chemically mediated by secondary products that may be seen in part as arms to protect plants against pests and illnesses that have been in competition with them from time immemorial.

Maintenance of insect culture in laboratory

The insecticide capabilities of basic oils were determined by the stored grain insect pests of the red flour beetle tribolium castaneum and rice weevil Sitophilus oryzae. Tribolium castaneum and Sitophilus oryzae rice weevil have been gathered from several shops in Gorakhpur, Uttar Pradesh, and the local market. We have picked these kinds of stored grain insect pests since they play a key role in harming the stored grain in huge numbers. At 12 to 13 % moisture in laboratory crops kept in the dark by the incubator at 30±20C and 75±5 percent relative humidity and 10:14 (L: D) hours by photopoeia, the insects were grown without any insecticides at Entomological Laboratory at the D. D. U. Gorakhpur University of Gorakhpur on flour and grain from weed (Tricum aestitivum L.) and rice (Oryza sativa) The insecticidal ability of essential oil was assessed using ten days old adults.

CONCLUSION

The use of toxic insecticides as a toxic pesticide is a variety of difficulties including environmental and human health safety, pest resistance development, residual persistence and negative impacts on populations of the target species. These difficulties have caused governments to explore limiting the use of some present pesticides, resulting in the quest for safe alternatives for insect and other pest management. In view of the PI, citronella EO works greatest at 10 percent, whereas vanilla and citronella mixtures are the strongest mixes of the 1.1. (the most potent effect in the entire experiment was observed at the concentration of 10 percent). The combination of three EOs (vanilla, citrus fruit and lemonella) was similar to the most efficient EOs and combinations at a concentration of 10 per cent (15.000 PI). For vanilla and citronella EOs, 0.1 and 1 percent were the lowest concentrations with significant effects. The lowest effective concentration drop and increase in the repellent effect were reported in the case of a mixture of three EOs. In compared to the other combinations, such a result was unusual. In the studies studied, EOs often demonstrated considerable acute toxicity to target insects (i.e. death). This appears an unprecedented result as plants manufacture these compounds so that they may also be protected against insects. The issue arises thus whether the characteristic depends on the dosage. And it looks like that. Given the frequent spontaneous growth of many plants used for EO extraction in diverse natural environments, the cultivation of these plants should take account of their extensive usage, in order to minimize detrimental effects on the ecosystems. Furthermore, the composition of essential oils might impact several variables. For instance, the phonological stage and/or section of the plant might alter the relatively high quantity of bioactive molecules that make up EOs via yearly climatique fluctuations and exposures. Thus, numerous tests should be performed in order to confirm the insecticidal activity of EO and their potential for active components for commercial pesticides.

REFERENCE

1. Saeidi K, Mirfakhraie S (2017) Chemical composition and insecticidal activity Mentha piperita L. essential oil against the cowpea seed beetle Callosobruchus maculatus F. (Coleoptera: Bruchidae). J Entomological and Acarological Research. 49: pp. 127-134

2. S. E. I. Osman, M. H. Swidan, D. A. Kheirallah, and F. E. Nour (2016). “Histological effects of essential oils, their monoterpenoids and insect growth regulators on midgut, integument of larvae and ovaries of khapra beetle, Trogoderma granarium everts,” Journal of Biological Sciences, vol. 16, no. 3, pp. 93–101.

3. R. Pavela (2015). “Essential oils for the development of eco-friendly mosquito larvicides: a review,” Industrial Crops and Products, vol. 76, pp. 174–187.

4. D. R. Walters (2010). Plant Defense: Warding off Attack by Pathogens, Herbivores and Parasitic Plants, Wiley, Hoboken, NJ, USA.

5. M. Zuzarte and L. Salgueiro (2015). “Essential oils chemistry,” in Bioactive Essential Oils and Cancer, pp. 19–61, Springer, Cham, Switzerland.

6. Z. Zebec, J. Wilkes, A. J. Jervis, N. S. Scrutton, E. Takano, and R. Breitling (2016). “Towards synthesis of monoterpenes and derivatives using synthetic biology,” Current Opinion in Chemical Biology, vol. 34, pp. 37–43.

7. Rajendran S, Sriranjini V (2008). Plant products as fumigants for stored product insect control. J Stored Products Research 44: pp. 126-135

8. Ayvaz A, Sagdic O, Karaborklus J, Ozturk I (2010). Insecticidal activity of the essential oils from different plants against three stored-product insects. J. Insect Sci. 10: pp. 211-213

9. Saeidi K, Shahab-Ghayoor H. (2015). Evaluation of botanical insecticides against lentil weevil, Bruchus lentis under laboratory conditions. Agric. Commun. 3: pp. 23-27.

10. E. Asbahani, K. Miladi, W. Badri et. al. (2015). “Essential oils: from extraction to encapsulation,” International Journal of Pharmaceutics, vol. 483, no. 1-2, pp. 220–243.

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