



Protection of grains during storage by Natural plant products – A review based study

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Abstract

Botanical insecticides in general can render non-pollutant, animals and other pests which could be safe for the human beings. Generally, different botanical products have led to an increase in income of the farmers in the rural areas and this would promote a healthy and safe life among them. This has increased the number in the revenue generated by the farmers and this had led to a better life. Botanical products have opened up a new horizon for the farmers and this has led to control destructive diseases and pests, also avoid desertification deforestation and reduce erosion. But, there has been a negative effect through spermicide which could lead to reduction in human beings population. There are different other constraints which need to be overcome and also doubts related to them should be clarified even before potential is realized.

Keywords: Natural, protectant, plant products, storage, grains

Introduction

Pests are destroying a lot of food production globally and highest losses have been reports in Asian countries. It has been determined by an author that more than 83 percent wheat grain was lost during a period of 360 days when it is stored even properly. The qualitative and quantitative losses to stored grains and other products by insect pests would range from 20 to 30 percent in tropical while 5-10 percent in temperate zone [Rajashekar *et al*, 2010] [6]. Out of 250 million tonnes of food grains production in our country during 2010-11, more than 20-25 percent food grain got damaged by insect pests. Major pests in stored pulses and grains of Indian subcontinent can be categorized into mainly two groups, primary pests that have capability to penetrate and infest intact kernel of grains and have different immature stages that could develop kernel of grain like rice weevil (*Sitophilus oryzae* (L.)), *Rhyzopertha dominica* (F.), lesser grain borer, *Trogoderma granarium* (Everts), granary weevil, *Khapra* beetle, *Sitophilus granaries* (L.) and pulse beetle i.e. *Callosobruchus chinensis* (L.). Secondary pests that cannot initiates infestation and infests whole grains that feed on debris, broken kernels, weed seed and other grains that get damaged by certain primary pests like rust-red flour beetles, *Cryptolestes ferrugineus* (L.), *Tribolium castaneum* (Herbst), sawtoothed grain beetles, rusty grain beetles etc. Generally, immature stage of secondary pest specie have been found to be external to a grain.

Protection of Grains

▪ Stored grain losses by insect pests

Heavy percent of infestation in grains can be caused due to different insect pest when they are stored and this could lead to heavy losses to the food grains and the grains might develop germination capacity which will make them unfit for consumption. Based on a survey, there was loss of food grains production which was around 2.5 percent in Punjab. In other reports, there was a mention of loss of 10.8 percent in Pakistan and it was caused mainly by rats, moulds and insects. While food grains are being stored there always risk of destruction of grains by pests and hence it is important that people take proper care of food grains.

▪ Pesticide adverse effects as grain protectant

The pesticides that are being used to protect food grains also have certain harmful effects. Different fumigants and insecticides were used by people for storing food grains and it was important that the harmful effects should be easily understood. There has been use of pesticides indiscriminately and uninterruptedly and this has led to health issues among human beings. Food gains can be stored in the best possible way and they should be protected so that there is no harm to the grains and the person eating them should also do not face any problem while consuming them.

▪ Plant products as alternative to synthetic compounds

There are certain serious threats like sometimes insects develop a kind of resistance towards insects and even have a residual effect, this could be harmful and might lead to certain health issues. Contamination of Biosphere is associated to use of chemicals which have a broad spectrum, mainly which make use of synthetic pyrethroids which led to the need of selective and effective biodegradable chemicals. An author has mentioned in the study that *neem* kernel powder at 1.0-2.0 percent acts as a very effective protectant as against *C. chinensis*. There has been a survey which indicated that neem actually helped in protecting food grains and based on the study, pigeon pea and grams were protected with the help of neem.

Classification of botanicals

Since many years from Since 1960s, efforts have been made to sharpen the focus on toxicants and grains protecting activities of extracts, oils and constituents. Another author has observed that different plant families such as Asteraceae, Annonaceae, Labiatae, Canellaceae, Rutaceae and Meliaceae are considered to be grain protectant and they are being used conventionally for protecting plants [Onu & Aliyu, 1995] [5]. Different botanicals that are obtained from plants include insect repellents, growth inhibitors, feeding deterrents, chemosterilants, insect toxicants and attractants that are based on physiological effect in insects.

1. Natural grain protectants

Products derived from plants are used for formulation of powder or oil or liquid formulations.

a. Powder formulations

An author considered as first powder in India which is made from *neem* kernel. It helps in protecting wheat grains from *S. oryzae* and *R. dominica* and such protectants help in protecting food grains for a period of upto 320 days. Another study reported use of kernel powder which are said to be highly effective and give protection from creating any feeding damage by *S. oryzae*. Another study reported that powder made from *neem* kernel when admixed to wheat can give effective protection from infestations by *Khapra* beetle, *R. dominica* and *S. oryzae*. It was revealed that drupes of *M. azadirach* being very effective against *T. castaneum* when they are administered on wheat [Saramma & Verma, 1971] [7].

b. Oil formulations

It was discussed that use of *neem* oil at 1.0 percent which is said to be a very effective pest that acts as grain protectant and protects food grains against various pests like different pests like *R. dominica*, *C. chinensis*, *T. castaneum* and *S. oryzae*. Verma *et al.* (1983) [9] mentioned in the study that the use of cakes and oil of neem, mustard and castor need to be effective enough and they would help in reducing adult emergence, hatching and fecundity in *Sitotroga cerealella* (Olivier). Studies indicated that there is no such adverse effect associated with oil treatment based on seeds viability. *Neem* oil has been realized as a very important product which helps in solving problems associated with adult emergence and reduction in fecundity.

2. Insect repellents

Such chemicals help in protecting stored food grains or other commodities from infestation of pests when there is less impact from the environment with the help of simulation of different receptors. In different studies there has been a mention about attributes about anti-feedant and insect repellent actions from neem which are mainly because of the presence of triterpenoid azadirachtin as well as other such compounds. *Neem* oil at the level of 0.1 percent can lead to effective repellent effects against *T. confusum* which was mainly on stored corn. In another report, there was a mention about repellent activity which exists due to *neem* leaf powder that are based on stored grain pests [Mohiuddin *et al.*, 1987] [4].

3. Insect toxicants

Different studies have screened in their study about plant species in the southeastern Spain based on insecticidal activities against *T. castaneum* and they have also revealed various other species in the study. Different essential oils constituent from garlic *Allium sativum* which includes diallyl trisulfide and methyl allyl disulfide and these are having potent fumigants and toxicant against *T. castaneum* and *S. zeamais*. In another study, it was revealed that nicotine which is considered to be a very strong organic poison which acts as contact-stomach poison that has insecticidal properties. Such a compound is said to be toxic in nature for the human beings. Essential oil vapors that get distilled from cumin, eucalyptus, cumin, rosemary and oregano were also considered to be fumigants that caused 100 percent

mortality in eggs of *Ephesia kuehniella* and *T. confusum* [Tunc *et al.*, 2000] [8].

4. Chemosterilants

There are different plant parts, extracts, oil and powders which when admixed to grains lead to reduction in insect's oviposition, progeny production, egg hatchability and postembryonic development. The studies also discussed about 43 plant species that were reported to be reproduction inhibitors for controlling storage pests. There are different oils that are plant based and they could cause mortality of insect's eggs. The study also mentioned that many parts of plants, oils, vapor and extracts were reported to have suppressed pests that exist [Asawalam & Adesiyan, 2001] [1].

5. Feeding deterrents

Chemicals that inhibit feeding or disrupting insect's feeding through rendering of different materials that are unpalatable or unattractive are referred to as anti-feedants/ feeding deterrents. In another article there is a mention about assessment of relative efficacy of different anti-feedants as well as deterrents against *S. cerealella* and *R. dominica* infestation which is found in paddy that is stored. There is also mention of natural feeding deterrents that have been characterized including glycosides of aromatic steroids, triterpene hemiacetal, steroidal alkaloids, hydroxylated steroid meliantriol etc. Different constituents of essential oils like α -terpineol and citronellal thymol which are most effective as feeding deterrents which are against *Spodoptera litura* synergism and tobacco cutworm. Khan & Marwat (2002) [2] tested deterrent effects of bark powder of *neem*, seed and leaf. *Oleander* (*Nerium oleander*) against *neem* leaves and *R. dominica* seeds which was found best for register highest percent mortality in insect.

6. Insect growth inhibitors (IGRs)

Crude extract that was found effective retard insect development and it might cause cuticle melanisation, high adult mortality and larvae mortality. Plant has derived extract that have caused deleterious effect on development and growth of reduce larval, adult weight and pupal and that have prolonged pupal and larval periods, thereby there has been reduction in adult eclosion and pupal recovery. Another study revealed plant extract and effective for complete storage insect like *S. oryzae*. Plant derivatives has been effective to inhibit development of immature and eggs stage of insects inside that are grain kernels. Products that are based on plants were found to be effective in reducing survival rate of pupae, adult and larvae emergence [Koul *et al.*, 2008] [3].

Major constraints to the use of botanical insecticides

There are many products that are derived from plants for e.g. neem, castor, oils, powders, eucalyptus and many more, that are being used in grain protectants that contain secondary metabolites which can have control effectively from different pests. Botanical insecticides in general can render non-pollutant, animals and other pests which could be safe for the human beings. Generally, different botanical products have led to an increase in income of the farmers in the rural areas and this would promote a healthy and safe life among them. This has increased the number in the revenue generated by the farmers and this had led to a better

life. Botanical products have opened up a new horizon for the farmers and this has led to control destructive diseases and pests, also avoid desertification deforestation and reduce erosion. But, there has been a negative effect through spermatocide which could lead to reduction in human beings population. There are different other constraints which need to be overcome and also doubts related to them should be clarified even before potential is realized. There is a need to put in efforts for solving several obstacles such as lack of appreciation and experience in efficacy as an agent which could help in controlling pests, slows down the action and also reduces knockdown effect, tough registration, patenting and genetic variation in plant species at many locations. There is lack in standardization and it should be well maintained and even this would help in handling various problems, competition that exists in synthetic pesticides which are not widely available and rapid upgradation. Lot of data is not available and has long term effect on the mammals for certain botanicals which are having high tolerance limit for certain botanicals and also this lead to uncertainties associated with usage of new benefits that are based on certain resources. There is a need to put in scientific efforts for assessing practical application of botanical pesticides.

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