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## Development and Boosting of Integrated Insect Pests Management in Stored Grains.

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### Review Article

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#### ABSTRACT

Stored grain insect pests normally cause as much loss of grains in storage after harvest as crop pests cause damage during the growing season. The adults and larvae of these insects damage and contaminate grains or their products by burrowing into grain and eat out the starchy portion in the interior. This article summaries integrated pest management (IPM) in stored grains including cereals, oilseeds and pulses, which is complex operation due to diversity of grains and pests requirements. The management of stored grains necessitates the utilization of different methods to guarantee that the attributes of the grains incoming to the storehouse environment do not degenerate during storage time period. These activities involve; regular sampling, sanitation measures, storing sound and dry grains, bringing of proper temperature and aeration, and exploitation of chemical protectants and fumigants. However, the prevention against pests is the only satisfactory means to hold up the good grain quality. Bin installations play a crucial part in deciding whether grain quality is maintained and the stock is inspected regularly. A powerful linkage of researchers and food industry can expedite the acceptance of IPM exercises, and improvement and publicity of fresh and reinforced control operations for forthcoming pest situations.

#### INTRODUCTION

Insect pests can cause substantial damage to stored grains and are obnoxious by their simple existence in a food commodity throughout the world, but also make kernel damage and may leave webbing or an unwanted odor in the grain. The existence of insects in stored grains impacts grains in two styles, first of all, the occurrence of insects in the specific numbers leads to price reduction and credence of the grain by customers. Secondly, the larvae of certain insects cut into the grain kernels where they mature to adulthood exhausting the greater portion of the grain kernels resulting in dry matter losses <sup>[1, 2]</sup>. More than 60 species of insect pests infest stored grains in storehouse. Lesser grain borers, rice weevils, maize weevils, cadelle beetles, flat grain beetles, rusty grain beetles, saw-toothed grain beetles, foreign grain beetles, mealworm beetles, red four beetles, confused four beetles, Indian meal moths, book lice, and grain mites are considered to be the 14 main pests in storehouse. Of the 14 pests listed, Indian meal moths are the most common <sup>[3]</sup>. The stored grain pests psocids (booklice) and grain mites infest stored grains sometimes, but these are not of regular occurrence. The abundance of these soft bodied pests often indicates a more important problem of mold-related deterioration of the grain <sup>[4]</sup>. The profit from stored grain is not only gained by their selling, but also depends upon maintaining grains quality. The harvest and storage of grains do not guarantee an end of the possibility of losses origination by insects and pathogens. Until the grain is removed from the storage installation, the damage due to stored grain insect pests remarkably turns unmarked. The ample numbers of the small insects that infest grain can be harbored in very small amounts of debris and initial population can produce million of insects in few generations

Stored grain insect pests Infestations can instantly cut down grain's weight and nutritional amount, in addition to indirectly causing mold and other contaminants development. Direct feedings damage due to insects bring down grain's weight, nutritional value, and germination of stored grains. Infestations also cause contamination, odor, mold, and heat-damage problems that trim down the attribute of the grain and may make it unsuitable for processing for human or animal foods. Commercialized grain purchasers may pay a reduced price of

contaminated grain or refuse to get bringing of insect damaged grain in storage. Specifically, the pulse crops are at greatest risk, followed by oilseeds and then the cereal grains. Pesticides are considered a fundamental grain pest management tool and have profited considerably as pest control measures, but in general these chemicals should have to be integrated into an operational system [5]. Now a day, multidisciplinary approach to stored grain research has also been stressed, commonly involving Entomology and Food sciences, but impressive combination of skillful methods is frequently deficient, perhaps due to several of the much practical subject areas. Integrated pest management (IPM) may add to grower's net income resulting reduction in the use of pesticides. Integrated management of stored grain pests could be enforced to gain to get whole income from productivity. In this context, insect pest management for stored grains comprises suchlike pre-harvest pest management and to manage generally the enclosed storage environment in such a way that insect pests are prevented from multiplying or effectively eliminating from storage. Thus, management of grains in storage to prevent insect damage is more important than managing the crop while it is growing in the field [6, 7]. Because of the possible shortage of grains in the world during the coming times, in modern agricultural production, the scientific management of stored grains is one of the most important parts of grain production system. The overall objective of this article is to provide information to integrate the methods for designing and implementing an advanced stored grain management system relating to stored food industry.

### Categories of Stored Grain Insect pests

Different species of insects may infest grain in storage, but the main pests that cause damage are the larval stage of moths, and adults and larvae of beetles. Every pest stages may be a trouble due to their presence either alive or dead bodies in grains which are to be prepared for food. Cereal grains include wheat, barley, oats, triticale, sorghum and millets. The almost common insect pests of stored cereal grains are, weevils (*Sitophilus* spp.), lesser grain borer (*Rhyzopertha dominica*), rust red flour beetle (*Tribolium* sp.), sawtooth grain beetle (*Oryzaephilus* sp.), flat grain beetle (*Cryptolestes* sp.), indian meal moth (*Plodia interpunctella*) and angoumois grain moth (*Sitotroga cerealella*). Another dozen of beetles, psocids (booklice) and mites are sometimes present as pests in stored cereal grains. Oilseeds include canola, linseed, safflower and sunflower, whereas the most common pests in stored oilseeds are, flour beetles, sawtoothed grain beetles and moths. Pulses include faba beans, chickpea, cowpea, field pea, mung bean, soybean and pigeon pea. The most common insect pests of stored pulses are bruchid beetles and moths [8]. Regarding thresholds of grains, specifically, it is recommended to treat wheat, rye, or triticale if one live insect is found per quart sample. For corn, sorghum, barley, oats, or soybeans if one live weevil or five other insects are found per quart sample, control measure or fumigation is advisable.

**Primary Grain Insects:** Primary grain insects also known as "internal feeders" involve group of insects that attack undamaged and whole grains, feed within intact kernels and the damage from these pests results in an insect damaged kernels. The immature stages of these insects are found inside of the grain where spotting is more difficult. The larvae of these species grow within individual kernels, consuming grain material and leaving cast exoskeletons and other insect filth inside a kernel of grain. When the adults come out from a kernel, a characteristic orifice is formed. Internally infested kernels also lead to insect filth in the flour prepared. The primary insects include the rice weevils, bean weevils, granary weevil, maize weevil and lesser grain borers, and the larvae of angoumois grain moth.

**Secondary Grain Insects:** This unit refers to as insect's complex that feed on grains and cereals fragments, and mostly feed on broken kernels or grain dust and grain debris. They are also called external feeders which usually feed on cracked kernels without entering in the kernel. They can be different grain moths, mites, psocids, and several beetles including red and confused flour beetles, sawtoothed grain beetles, flat grain beetle and rusty grain beetles. Other species, such as the foreign grain beetle and hairy fungus beetle, feed on molds or fungi growing on grains.

### Grain Insect Pests Management

Every grain growers holding grains in their storage require keeping a great administration system that includes correct grain handling, regular grain inspections and pest control. One of the strategies is to assure that initial insect population is depressed and that the physical conditions in the storage bin are not contributory to insects due to preventative sanitation practices (storing clean grain, insect-free structures with clean surroundings) and drying grain before loading into storage to maintain a low moisture content (12-13 percent) which can reduce insect growth.

**Site and store management:** Control of the storage environment is an essential element in grain storage pest management. It involves, primarily, the controls of storage climate and infestation pressure which can be achieved by technically sound store design and construction method. Evenly of importance is, nevertheless, the climatic control attainable by scientific management of the commodity to ensure that the stored grain is itself both dry and cool when loaded in the store. The maintenance of conditions favorable to natural control are through cooling and where practicable by insect parasites and pathogens or thermal dis-infestation by solar heat or

treatment with traditional additives if sufficiently available. Possibly, at a temperature below 55 °F, insects are mostly the inactive which is a reliable pest management practice.

**Commodity management:** Commodity management is the treatment with synthetic insecticides, if effective and suitable formulations are sufficiently available in the store. To a considerable extent, commodity management can also control the initial insect infestation level in the stored grain. However, in tropical countries, where pre-harvest infestation by storage insects is hardly ever completely preventable, the ideal loading of insect-free grain into the store is not often attainable. Special facilities to completely dis-infest the grain before loading may not prove cost-effective. The common alternatives, if early dis-infestation is required, are to treat the grain at intake point, with a suitable admixed insecticide or to dis-infest the loaded grain in store by fumigation. Surely, several livelihood farmers can use this form of commodity management moderately efficaciously. Certainly, one can observe sometime the grain stocks for any initial or established insect population, which might permit the rapid increase of insect damage later on after some months of storage.

**Sanitation practices:** Grain cultivators should consider about taking preventative activities before crop harvest to protect grain attributes. Control of grain quality before storage, to minimize the intake of heavily infested and badly damaged or un-cleaned grain is feasible that is commonly practiced to a considerable extent. At farm level it is possible to segregate the crop at harvest, especially with maize on the cob and un-threshed sorghum and millet, to select comparatively unimpaired material with great storage potential. The more apparently infested grains can be set aside or if there is no other decision making, the damaged material, may be at least utilized at first. By this way, the rate of impairment referable to insect infestation can be substantially assured in the primary stored grain stock.

Sanitation in and around stored grain installations is the almost efficacious and profitable administration exercise to prevent insect infestations in stored grain. This is the most essential IPM practice for storing and protecting grain because a successful sanitation is 80 percent of an effective IPM program in stored grains. Withdrawing of any potential pests and their food ahead filling of grain storage can largely enhance any future management activities. Always take off old grain and clean bins earlier to add fresh grain, and never store new grain on top of existing grains. Before harvest and storage of new grain, cleaning equipments for handling grain like harvesters, vehicles, aeration fans, etc. is required. Taking off any grain or grain dust from inside the bins by cleaning empty bins and brushing down walls is essential. Getting rid of any spillage grain close to the external of the bin and storage installation is requisite. Cautiously examining storage bins and fastening or sealing of any gaps or openings which may be expected entry spots for rodents or insects is requisite. Looking for and reparation of assert-able wetness entering openings in the roof are necessary. Removing of any flora from within 10 feet of storage containers vicinity to admonish insects from launching is needful.

**Grain cleaning and storage:** Other valuable IPM tool for stored grain pests is becoming confident that the kernels are cleaned before storing. Un-cleaned grains can prevent satisfactory flow of air and homogeneous aeration. Dirty grains add the possibility for spoiling because broken kernels and other debris frequently spoilage at advisable moisture levels of storing grains. With clean grains, any grain top dressings or protectants (*Bacillus thuringiensis*, Pirimifosmethyl, Silicon dioxide, Chlorpyrifos) can be applied to grains stored longer than 12 months or fumigation can be more effectual. Grain protectants kill insects as they crawl just about or feed on the treated grain.

**Empty bin treatments:** After careful cleaning of store, the inner walls and floors should be treated with a residual insecticide. The external walls up to 15 feet and external base of grain storage bin may also be treated. The area beneath the perforated, drying floor should also be cleaned and treated with a residual insecticide. Treating empty bins is most effective when insect activity is probable by applying chemicals products (Beta-cyfluthrin, Deltamethrin, S-Methoprene) four to six weeks before grains enter storage.

**Grain monitoring:** Regular monitoring of grains is help to ensure that grain quality is to be maintained at the highest possible level. Scouting or monitoring of storage should not only be limited in the field, but a regular monitoring program should be continued until the grain is leaving the farm. When the grain stock is above 50 degrees F, it should be inspected for insects after every two weeks. Samples should be taken from several depths and locations, paying particular attention to the grain mass surface, central core and any developing hot spots. The grain sampling at the rates of 0.5 kg per 2000 to 3000 bushels specially used for wheat are adequate for characterizing the grain quality [9].

Of course one of the major prerequisites of storage pests' management is a proper insect's identification which is important to determine their damage potential and control options. The process essentially involves the observing and identifying insects as based on simple observation and control measures should be implemented immediately to protect grain quality. Correct insect identification will allow for more targeted pest control options and helpful to make decisions about managing insect pests in stored. For this purpose, sampling from the top and bottom of grain stores for early pest detection is necessary. For grain pests identification, if the arthropod has six

legs, it is most likely an insect, and if eight legs, then most likely it is looking a mite. If the insects can walk up the side of a glass vessel and have a snout, it is weevil otherwise saw-toothed grain beetle. For other group of the insects which cannot walk up the side of a glass container; if the insect is cylindrical and dark brown, it is lesser grain borer, otherwise, flattish, red-brown, less than 3 mm long and long antennae is of flat grain beetle, while, longer than 3 mm bearing short antennae is in flour beetle [10, 8].

Grain spoilage is mainly due to microorganisms which are using the nutrients inside the grain for their personal growing and development. During this operation they generate heat and enhance the temperature of the surrounding grain, which may result in hot spots. Heat damage significantly cuts down grain quality. If environmental conditions in the grain are accurate, the major storage mold species *Aspergillus*, *Fusarium* and *Penicillium* may produce mycotoxins such as aflatoxin, fumonisin, and zearalenone, which may cause serious illness and even death when consumed by human or livestock. To prevent the growth of microorganisms and insects, the almost crucial management factors include temperature, moisture, length of storage and the condition of the grain when placed in storage. Temperature and moisture management of stored grain is vital. It is crucial that the grain mass temperature be reduced to 50 degrees F and the moisture may be below 12-13 percent soon after storage. Colder temperature can slow development of insects and inhibit molds, and extend insecticide residuals [11, 12, 13].

Host Grain Resistance: The host grain resistance as one of measures to prevent the infestation of stored products has been developed in recent years. The seeds of highly resistant varieties may serve as stock material in stored grain environment for designing and implementing an optimal management system. Certain studies have been conducted on the host grain resistance and its effects on the grain in pulses [14], oilseeds [15] and cereals [16] which are quite helpful to minimize pest invasions. The legumes such as chickpea [17] and cowpea [18], quite significantly vary in their inherent resistance or susceptibility to post-harvest insect attack in storage by the more recognized grain storage insects. In different storage systems where adequate pest control techniques are not employed due to rapid turnover of stocks or huge volume stored, the advantages of varieties less susceptible to damage and loss inflicted by storage insects become very obvious.

## CONCLUSION

This paper reveals a framework of activities regarding the multiple and economical controls options of insects control in stored grains. For holding the best stored grain quality, it necessitates an integrated approaching by the stored grain administrator which integrates a number of implements and pesticides to prohibit quality impairment. Therefore, conclusions could be drawn that selected control strategies must be integrated for effective management of stored grain insects. The primary information on the control of stored-grain pests presented in the paper might be of greater help to those who are interested in stored-grain pests management. At the same time, the integrated control strategy has safety to human and animals, no pollution to the stored grain and long lasting control effectiveness. The stored grains should be examined monthly and stored-grain insect pests can be managed most effectively by area-wide pest management (AWPM) practices.

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