

Ecofriendly approaches for management of insect pests of maize in small scale storage

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Inadequate post-harvest storage practices have serious impact in food and nutrition security of small scale farmers. More than one-third of food produced is wasted during post-harvest operations. As a result, fulfilling food demand remains major global concern. During storage, the most important factor responsible for loss of food is damage caused by insect pests. Maize is attacked by large number of insect pests if stored improperly under high moisture conditions. Adopting better agricultural and storage practices in maize such as right time of harvest, proper sun drying, storing in improved storage structures and application of botanicals through novel methods can reduce the losses to a greater extent leading to significant improvement of small scale farmers economy.

Key words: Ecofriendly harvesting, Insect-pests, Maize, Storage pests

MAIZE is one of the most important cereal crops which is used for food, feed and array of industrial purposes. It is grown in diverse environmental conditions representing both tropical and temperate regions. At farm level, commonly maize is stored for the purpose of consumption, as seed for planting and for selling when prices are favourable. In India, according to recent estimate by Ministry of Food Processing, agricultural produce worth ₹ 580 billion gets lost every year during storage. Management of post-harvest losses is challenging in tropical and sub-tropical regions because of the prevalent climatic conditions. In India, post-harvest losses of food grains are estimated to be around 10% from farm to market level.

In case of maize at farm level, the losses were estimated to be around 3.02 kg/ quintal at various operations. Maximum losses were observed (2.55%) during storage particularly due to insect pests. The most economically important storage pests of maize are rice weevil (*Sitophilus*

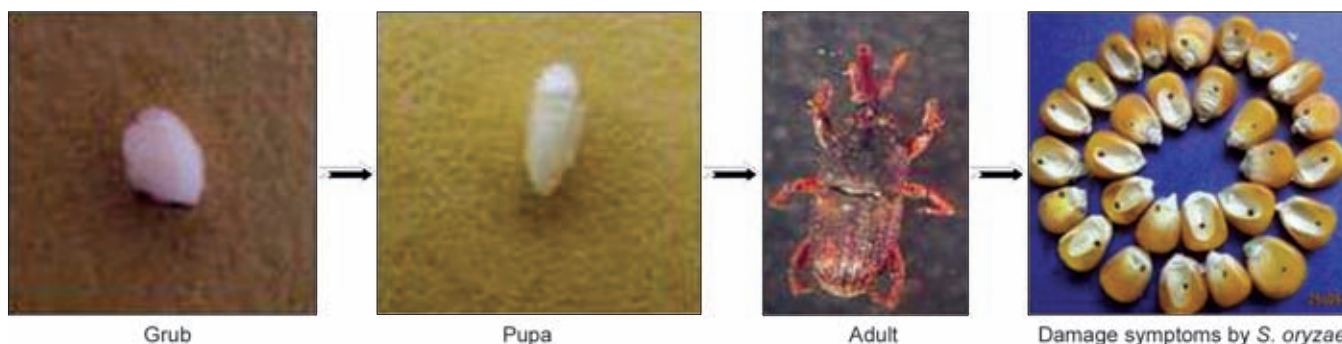
oryzae L. Coleoptera: curculionidae), angoumois grain moth (*Sitotroga cerealella* (Oliv.) Lepidoptera: Gelechidae), rice moth (*Corcyra cephalonica* Stainton Lepidoptera: Pyralidae), lesser grain borer (*Rhizopertha dominica* Bostrichidae: Coleoptera) and red flour beetle (*Tribolium castaneum* (Herbst.) Lepidoptera: Tenebrionidae). Among them, *S. oryzae* is the most destructive pest causing both quantitative (weight loss, economic loss) and qualitative (chemical changes, seed viability, contamination, nutritional deterioration) losses by feeding on the kernels. This weevil can infest crop at maturing stage in the field itself or during storage as well. The 55.30% damage and weight loss of 14% is observed due to *S. oryzae* attack within four months of storage. Though, post-harvest losses can be reduced by the use of synthetic insecticides during storage these are not recommended due to chances of food contamination, development of insecticide resistance, environmental hazards, chemical residues in food and side effects on non-target

organisms.

In India, generally farmers store maize in mud bin, bamboo reed bin, Thekka, metal drums, jute bags and under ground storage in Khattis particularly in dry regions. However, such storage practices do not provide complete protection from storage pests. Improved storage structures like Pusa bin, coal tar drum bin, Peri, (bamboo structure plastered inside with cow dung and clay), Domestic Hapur Bin, Chittore Stone Bin, polyethylene lined bamboo bin, community storage structures, silos, brick built godowns etc., though available but not frequently used by the farmers mainly due to lack of awareness.

Management practices of Storage Pests

The use of pesticides in storage of grains is practically not advisable due to food contamination and uneconomic nature of the practice. Further, there is possibility of development of resistance against pesticides over long term uses. Often pesticide application during storage



reduces germination ability of maize seeds. Hence, eco-friendly practices are to be practiced to address the issues.

Cultural Practices

The time of harvesting of maize cobs is important as the infestation starts from the field itself. Late harvesting is to be avoided to prevent the grains from higher weevil infestation. Harvesting of maize is to be taken when husk cover turns yellow and leaves slightly yellowish. After harvesting, cobs can be dried under sun for 2-4 days to decrease the moisture of kernels. This is followed by shelling. Shelling can be done with simple hand sheller, which is fabricated with metal or by automated maize cob shellers. This is followed by proper drying of harvested grain to safe moisture levels (<12%). Proper drying reduces storage losses to a large extent. This is the most important pre-storage pest management strategy to be followed by the farmers, which will reduce both insect and fungal damage substantially. Most commonly shelled grains are dried under sun by spreading on tarpolene sheets or quite often on roads. This opens up the change of grains to accumulate dirt as well as moisture, particularly if the weather is dampy. Such grains are prone to fetch low price and fungal and insect infestation during storage. Maize grain dries are available but not very common among maize farmers. During storage, cleanliness and sanitation are the second most important practice towards prevention of insect infestation. Dusts, grain, and chaffs should be removed from transport trollies, storage area as well as threshing yard before new produce are brought for

storage. Sun drying at weekly intervals from 11.00 AM to 3.00 PM (till the moisture content of grain reaches 9-10%) is one of the most promising stored pest management strategies and has potential role in disinfestations. However, on large scale this is not practical to adopt such interventions.

Use of Botanicals

Botanicals are plants or plant derived products containing rich source of bioactive molecules. These are cheaply available, biodegradable and environment friendly. Treating maize grains with certain botanicals before storing in traditional containers are found effective. Plant materials can be used for small scale storage for protection of stored grains. They reduce the survival rates of larvae, pupae and adult emergence of storage pests. Leaves of botanicals are added in layers or they may be dried and ground into powder. Certain

botanicals are burnt into ash and mixed with grain. Dried leaves protect the stored grain for 2 to 4 months against insect attack without any adverse effects. The leaf powders of *Vitex negundo*, *Adathoda vasica*, *Catharanthus roseus* and *Lantana camara* at 5% w/w are very effective in reducing rice weevil infestation. Treatment with the leaf extracts of *A. vasica*, *L. camera*, *V. negundo* @ 2% also provide protection from weevil damage. Application of paste of repellent plant materials between the layers of double gunny bag is the most effective and safe method as there will be no direct contact of grain with plant material.

Advantages of Botanicals

1. Rapid degradation which reduces the risk of residues
2. Relatively harmless to human beings and non target organisms
3. Slow development of resistance
4. Cost effective

Plants possessing biological activities against *Sitophilus oryzae*

Common name	Hindi name	Scientific name	Plant name
Five leaved (chaste tree)	Nirgundi/ Sindvar	<i>Vitex negundo</i>	leaf
Malabar Nut (tree)	Safed Vasa	<i>Adathoda</i>	leaf
Periwinkle	Sadabahar	<i>Catharanthus roseus</i>	leaf
Guduchi	Gulancha	<i>Tinospora cordifolia</i>	leaf
Goat weed	Jangli pudina	<i>Ageratum conyzoides</i>	leaf
Veldt Grape	Hadjod	<i>Cissus quadrangularis</i>	leaf
Garden Cress	Chandras-(hoor)	<i>Lepidium</i>	leaf
Jungle Flame	Rangan	<i>Ixora coccinea</i>	leaf
Indian Aloe	Gruth	<i>Aloe vera Kumari</i>	leaf
Neem	Neem	<i>Azadirachta indica</i>	leaf
Indian Coral Tree	Pangaar	<i>Erythrina indica</i>	leaf
Quaker button	Bailewa	<i>Strychnos nux vomica</i>	leaf

Disadvantages of Botanicals

1. Rapidly degraded by UV light
2. Non availability of plant materials throughout the year
3. All botanicals are not less toxic.

Hermetic Storage in Combination with Botanical

Hermetic storage is a sealed storage system in which outside air and water cannot touch the stored grain. The use of hermetic storage for control of storage pests in cereals is gaining popularity as it offers residue free storage system. Maize stored in these air tight bags will develop a modified atmosphere of low oxygen and high carbon dioxide content,

created by respiration of living organisms such as insects and fungi. Storing of maize treated with leaf powder of *Ageratum conyzoides* @2% w/w in High density polyethylene (HDPE) and Doubled layered Polythene (DLP) bags are most effective in controlling rice weevil. However, this technology is most effective when only dried grain (moisture content <12%) is stored.

SUMMARY

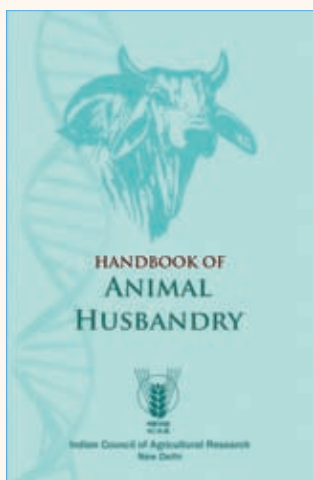
Right execution of pre-storage activities will help farmers by reducing the risk of insect pest infestation from field stage to storage. Utilization of botanicals alone and in

combination with different packaging materials reduces rice weevil infestation and its associated losses. Also, application of botanicals through novel methods protects the stored grain without any adverse effects. Implementation of preventative measures and appropriate use of botanicals in hermetic storage helps in strengthening food security and higher returns to small scale farmers.

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TECHNICAL SPECIFICATIONS

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