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Insects Management for Safe Seed Storage

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INTRODUCTION

Seed possesses maximum vigour at the time of physiological maturity. There after the seed gradually ages and declines in viability and vigour. The loss of vigour precedes loss in germination. The seed of a particular harvest is not used immediately for sowing the following crop, so the fresh seed has to be stored for 6-9 months after harvest. Seed ageing leads to reduction in seed quality, performance and stand establishment. Every seed operation has a purpose. The purpose of seed storage is the maintenance of high seed germination and vigor form harvest until planting. It is important to get adequate plant stands in addition to healthy and vigorous plants. In today's input intensive agriculture, seed acts as a dynamic tool and lays down the foundation for realizing higher crop production and productivity. Quality seed has been reported to contribute upto 20 per cent towards productivity, as it ensures the optimum production efficiency of other inputs viz., fertilizers, irrigation, pesticides and field operations. The tropical and subtropical climate also provides congenial conditions for the survival and multiplication of insects which influence the seed yield and its quality. The problem of storage of food grains and seeds are similar except that of germination. Insect infestation in seed stores involves two fold risks wherein seed quality (germination, vigour, viability or seedling vigour) may be influenced either due to direct insect feeding or from the chemical treatment applied to manage the insects.

The seed quality is affected on the basis of insect damage to endosperm or embryo. If embryo portion is damaged, seed fails to germinate and if endosperm is damaged, seed may germinate and develop into a seedling but the vigour of seedling will depend upon the extend and intensity of the damage. The important sources of insect infestation of stored seeds are: Field infestation, infested godowns, infested stock, infested gunny bags and containers, infested transport, natural sources of infestation, and machinery used in harvesting and post harvesting operations.

Insect pests of seed stores: A large number of insect species are associated with seeds during storage. These insects mostly belong to order Coleoptera (beetles/weevils) and Lepidoptera (moths). Depending upon their ability to damage sound seeds, these can be divided into Primary (feed on sound seeds) and Secondary (feed on broken/damage seeds) seed feeders. Based on feeding behaviour, the insects can be grouped into two categories:

External feeders- completing all the life stages outside the grain and the infestation caused can be known on visual examination.

Internal feeder- completing all immature stages inside the grain and the infestation is invisible and is known as 'hidden' or 'latent' infestation.

Major insects which cause damage the seed during storage are: Rice weevil (*Sitophilus oryzae*), Khapra beetle (*Trogoderma granarium)*, Lesser grain borer (*Rhyzopertha dominica)*, Pulse beetle (*Callosobruchus chinensis*), Rust red flour beetle (*Tribolium castaneum*), Rice moth (*Corcyra cephalonica*), Grain moth (*Sitotroga cerealella*), Warehouse moth (*Ephestia cautella*), Indian meal moth (*Plodia interpunctella*), Cigarette beetle (*Lasioderma serricorne*), Drug store beetle (*Stegobium paniceum)*, Tamarind beetle (*Caryedon serrate)*, Saw toothed grain beetle (*Oryzaephilus surinamensis*), Flat grain beetle (*Cryptolestes ferrugineus*), Long headed flour beetle (*Latheticus oryzae*)

Detection of insect infestation for management of stored seed pests

Detection of visible infestation:

Sieving: Sieving the grains on 10 or 16 mesh sieves make the insects present in the grain mass get collected below the sieve. Eggs, larvae and pupae that complete their development inside a kernel cannot be separated out by this method.

Agitation of sacks : If bags of grains are thrown up and down several times and then left for 10 to 20 min., adults of granary weevil, rice weevil or maize weevil will often walk out on the bag surface-this occurs even when the adult population level is quite low. Surface infestation can be detected by examining walls, ceiling and floors of godowns/storage structures and also interspaces between the bags in case of bag storage.

Disturbance of stack or bulk surfaces: A long stick can be moved over vertical stack surfaces, or surface may be struck to disturb resting adult moths. Moving among the stacks also disturb the such adults.

The feel of grain in bulk: Walking over a bulk of grain with bare feet gives an excellent guide to its condition. If it is cool and free flowing, then there is no cause for immediate concern, however, if a hot spot is found or fairly solid patch, which is indicative of high dust content.

Traps: Use of traps is a relatively new method of detecting insects in bulk stored grain or in bag storage. The following types of traps have been developed.

Probe trap: This trap is kept in the grains vertically with the white detachable plastic cone downside. The top cap must be at the level of the grain. Insect will move towards air in the main tube and enter through the hole. Once the insect enters the hole, it falls down into the detachable white cone at the bottom from where it cannot escape. Such insects can be collected and destroyed once a week.

Fit fall trap: Three types of fit fall traps (a) 12 cm diameter and 9 cm slope (b) 9cm diameter and 7 cm slope and (c) 15 cm diameter and 12 cm slope have been developed by Tamil Nadu Agril. University for trapping of beetles infesting pulses. Such a trap can be placed in metal bin, small tin container, utensil and plastic bucket used for storage of pulses. Beetle once trapped on greasy or sticky slope of trap cannot escape and die after some time.

Two in one model trap: This is a combination of probe trap and cone shaped pit fall traps. It is best suited for pulse beetles which are captured alive, which may further facilitate release of pheromone and there by attract more insects.

Indicator device: It consists of a cone shaped perforated cup with a lid at the top. The cup is fixed at the bottom with a container and circular dish, which are to be smeared with sticky material like Vaseline. Farmers, before storing their pulses, should take 200g of pulses to be stored and put them in the cup. When the field carried over beetles start emerging, due to their wandering behaviour, they enter the perforations and get slipped off and fall into the trapping portion. As they stick on to the sticky materials, farmers can easily locate the beetles and can take out the bulk-stored pulses for timely sun drying. The device with 2mm perforation can be used for cereals and 3mm perforation for pulses.

Automatic insect removal bin: TNAU insect removal bin can remove insect automatically. The structure has 4 major parts namely outer container (2 kg to 500 kg capacity), inner perforated container, collection vessel and the lid. The space between inner and outer container provides good aeration for the insects. Insects, while wandering enter the perforation to reach the aerated part and while doing so, get slipped off and fall into the collection vessel through a pitfall mechanism provided in the collection vessel. A majority of the insects (more than 90%) can be removed from the grain in a short span of time.

Light trap for grain storage godowns: The UV light trap having an ultra-voilet source (4 W germicidal lamp) produces rays of peak emission around 250 nano meter. The source of light is fitted at the centre of a funnel of 310 mm diameter at the top and 35 mm diameter at the bottom. To hang the unit at desired points, three hooks have been provided at the periphery of the funnel. The UV light trap can be placed in seed storage godowns at 1.5m above ground level. Normally 2 numbers of UV light trap per 60x20m (LxB) godown with 5m height is suggested.

Detection of insect infestation in seed: Many seeds contain hidden larvae through no adult insects are detected at the time of inspection. These hidden infestations can cause serious implications during storage and transportation of seeds. Several procedures have been developed to identify internally infested seeds. These include staining seeds to detect weevil egg plugs, density separations, crushing kernels between ninhydrin impregnated paper, detection of carbon dioxide produced by insects, detection of uric acid by using high performance liquid chromatography nuclear magnetic resonance spectroscopy, X-ray analysis of seeds, acoustical sensors to detect insect feeding within seeds, enzyme-linked immune sorbent assays (ELISA) of seed extracts and near infra red reflectance spectroscopy. All these procedures can detect internal insects of seeds with varying degrees of success.

Precautions during storage of seeds: Among the various methods of insect control, following are the important methods which can help in safe storage of seeds particularly at farmer's level.

1. Preventive measures and 2. Curative measures

Preventive measures: Prevention is better than cure''. Hence the following preventive measures are recommended:

i. Hygiene or sanitation: Threshing floor/yard should be clean, free from insect infestation and away from the vicinity of villages/granaries.

ii. All the cracks, crevices and holes present in the floor, wall and ceiling of the store should be filled up with cement.

iii. The dirt, broken infested seeds and sweeping of the stores should be removed before new seed is stored.

iv. Before storage seed must be dried to a safer moisture level.

v. Use new bags as for as possible. If the old bags are to be used, these should be disinfested by dipping them in 0.5% malathion, 0.01% cypermethrin and 0.01% fenvalerate solution for 15 minutes. About 20% of the room

should be left free between the top layer of the bags and ceiling.

vi. Disinfestations of stores/receptacles: before the use, the receptacles/store rooms should be disinfested with approved residual insecticides preferably by spraying malathion 50% EC.

vii. Never mix fresh seed and carry over seed.

viii. Seed stores should be constructed where transport facilities are easily available.

ix. Seed stores should not be constructed in areas near seashore. Relative humidity in these areas results in fast seed deterioration. So it should be constructed in places where atmospheric RH is low, free circulation of air is possible; sunlight is adequate and elevated in nature.

x. Seed stores should not be constructed in low lying water stagnating areas.

xi. The ventilators should be provided for air circulation and thses ventilators should be used when the relative humidity of surrounding air is less than the relative humidity of store.

xii. It should be moisture proof and ground moisture should not reach the floor.

xiii. Seed store should be rat proof with wire mesh. Pesticides, fungicides, fertilizers, rejects should not be stored with seed.

The following thumb rules by Harrington are useful measures for assessing the effect of moisture and temperature on seed storage. These rules are as follows.

- ✓ For every 1% decrease in seed moisture content, the life of the seed doubles. This rule is applicable between moisture content of 5-14%.
- ✓ For every 5°C decrease in storage temperature, the life of the seed doubles. This rule applies between 0°C to 50°C temperature.
- ✓ Good seed storage condition is achieved when the sum of relative humidity (%) and the storage temperature in degrees Fahrenheit is one hundred provided that contribution of temperature should not exceed 50° F.

Curative measures: The infestation of stored seed insect pests can be controlled by the following methods.

Ecological control measures: The infestation of stored seeds from insect pests largely depends on the proper management of three factors *viz.* temperature, moisture content of seed and availability of oxygen.

Temperature ranging from 20°C to 40°C accelerates the development of insects but above 42°C and below 15°C retard reproduction and development, while prolonged temperature above 45°C and below 10°C may kill the insects. Moisture is the critical factor in safe storage of seeds. Seeds stored at around 10% moisture content escapes from the attack of insects (except khapra beetle). In storage, oxygen is consumed by grains and insects during respiration and carbon dioxide is produced. Thus, O_2 levels will reduce below 1% and CO_2 level will automatically increase which will be lethal to all the stages of insects. The storage atmosphere can be modified by low oxygen atmosphere (2 to 4%) generated by purging the nitrogen and high carbondioxide atmosphere developed by the addition of CO_2. It has been found that at about 9.0 to 9.5% CO_2 in air is lethal to all the insects.

Chemical control measures Seed lots can be fumigated with Aluminium phophide @ 7-10 tablets (3g each) per 1000 m^3 in air tight condition for 7 days. Never keep the fumigant at the bottom as Aluminium phophide release phosphine gas which is heavier than the air and move downward and can penetrate upto 8 feet.