Management of Sorghum and Pearl Millet Pests in Bulk Storage

Project Executing Agency (PEA)

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International Crops Research Institute for the Semi-Arid Tropics

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Global Theme on Crop Improvement

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Contents

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Introduction

The storage of harvested farm produce, especially grains, is an important aspect in the post-harvest scenario. The harvested produce needs to be stored safely and scientifically in order to maintain its original quality while avoiding any spoilage by storage pests. The storage insects and pests cause enormous damage to the stored grains resulting in the spoilage of quality. These pests feed on grain, bore the kernel, destroy the germ portion and thus cause heating and deterioration of grains in storage. These insects are not generated denovo in the grain. Most of the insects lay tiny eggs, which mostly escape visual detection by the farmers. The insects pass through the egg, larval, and pupal stages before maturing into adults. The losses due to insect pests of stored grain are estimated to be 2.55%. In addition, they are also responsible for the qualitative losses in food grains.

Sources of insect-pest infestation:

Different factors affect the level and intensity of infestation or the activity of the insects in the stored grains. Following are the main sources for insect infestation.

(1) Moisture content
(2) Temperature
(3) Time or period of storage
(4) Field infestation
(5) Cracks and crevices
(6) Containers/ Bags
(7) Trucks, trolleys and bullock carts

1. Moisture Content

Grain moisture content ranging between 8 to 9% will not support insect activity. Some of the insect pests such as rice weevil or granary weevil cannot breed in grains with moisture content below 9%, and the adults soon die in dry grains (Cotton, 1963). On the other hand, high moisture content in the grains still cannot support insect activity if the temperature is not in the optimum range.

2. Temperature

Stored grain insects are capable of functioning only in a certain temperature range, because of their inability to maintain a constant body temperature. Grain temperature is probably the most significant factor affecting the distribution of stored insects and these insects will become inactive and eventually die of starvation at temperatures between 50° to 60°F (Whitney and Pedersen, 1961).

3. Time

Infestation also depends on the duration of storage and as the storage duration increases the possibilities of infestation also increases.

4. Field infestation

Field level infestation is one of the important sources of infestations. Insects like Bruchids and *Sitotroga spp*, fly from stores to fields and lay eggs upon maturing grains. These eggs hatch out to larvae in favorable conditions when the grains reach the stores. This is termed as 'hidden infestation'.

5. Cracks and crevices

The existence of cracks and crevices in the storage structures may harbor several insects and pests. This can happen when the empty storage structures (godowns/containers) are not cleaned properly/ thoroughly on being emptied after the disposal of the stored grains, thus leaving behind some of the grains in the cracks and crevices. The insects present in the grains in the crevices keep feeding and multiplying and if fresh stocks are kept in such stores, the same get infested. Insects from the old stores can crawl/ fly to fresh stocks and infest them. This process is called 'cross infestation'.

6. Containers/Bags

The gunny bags used for storage and transportation of grains are usually reused for different grains. Generally, the farmers keep these gunny bags without cleaning them after the previous use. Many times these empty bags are also not stored properly by the farmers and they are used in the next season. The grains that remain in the bags act as source of food for the insects and the insects thrive on these leftover grains. During off-season they feed on the grain fragments sticking to the bags. Apart from this, eggs and larvae of insects remain hidden in the seams and mesh of these gunny bags. Whenever the grains are filled up in such bags, infestation soon reappears on the fresh grains.

7. Trucks, trolleys and bullock carts

While transporting the grains from the fields, after harvesting and threshing activities, to the godowns by trucks, trolleys or bullock carts, the infestation can occur from the pests that remain in these transport carriers. Insects present in the joints or corners or crevices of the carriers migrate to the new food grain lots and cause infestation. These are important sources of cross infestation.

Important storage insect-pests

Various insects and pests affect the stored grains of sorghum and pearl millet. These insects cause major damage to the stored grains and reduce the quality of the stored produce. The important storage pests of sorghum and pearl millet are described here.

1. Rice Weevil/Black Weevil (*Sitophilus oryzae)*

There are three types of rice weevil

1. Rice or black weevil
2. Maize weevil
3. Granary weevil

Adult

Larvae

Grains attacked:

Rice weevil mainly affects stored food grains such as wheat, rice, maize and sorghum.

Nature of damage:

The damage to the grains is mainly caused by two stages of this insect

(1) Larvae
(2) Adults

Due to infestation by the above stages of the insect, the grains are hollowed out and in some cases the kernels are reduced to mere powder. Rice weevil and maize weevil are also known to cause infestation right from the field. Adult insects cut circular holes in the grains. When the intensity of infestation increases it results in heating, referred to as dry heating.

Damaged Grain

Identification:

The insect can be identified easily by the following criteria:

- Size is around 3 mm
- It possesses characteristic beak or snout
- Antennae are elbowed and slightly clubbed
- Hind wings are present except in granary weevil
- The color ranges from reddish brown, chocolate to almost black
- The maize weevil is the largest amongst the three species.

Other information:

Grains with less than 10% moisture are not attacked by the insect. The life cycle of the insect is completed in about 26 days at 30°C and 75% relative humidity (RH). The optimum climatic conditions, especially the temperature for development, ranges from 26°C to 30°C.

2. Khapra (*Trogoderma granarium)*

This is another important pest that causes major damage in bulk storage conditions.

Damaged Grain

Nature of damage:

This pest damages the grain starting with the germ portion, surface scratching and devouring the grain. Actually, it reduces grain into frass. Excessive moulting creates public discrimination, loss of market appeal due to insanitation caused by the cast skins,

frass, and hair. Crowding of larvae leads to unhygienic conditions in warehouses. Damage is confined to peripheral layers of bags or 30–45 cms in bulk storage.

Grains attacked:

This insect attacks the grains of wheat, maize, sorghum, pulses and oil seeds.

Identification:

- Adult size is 1.5 to 3 mm.
- Convex, oval in shape with practically no distinct division of head, thorax and abdomen.
- Abdomen size is comparatively larger.
- Males are smaller in size than females.
- The larvae are straw colored.
- They have the hair with dark brown in color and the hairy bands are present on each segment and typical posterior tuft forming a tail of long hair. Size 4–5 mm.

Adult

Larvae

Dark brown hairy bands are present on each segment, with a typical posterior tuft forming a tail of long hair.

Other information:

This insect can thrive at temperatures ranging from 23°C to 40°C. Under optimum conditions the insect can complete about 12 generations in a year. On starvation, the larva moults and reduces in size and becomes active again on availability of grain.

Hiding habits: The insect hides in cracks and crevices and is most distinctive. It is very difficult to kill these hidden insects even with contact insecticides.

3. Saw Toothed Grain Beetle *(Oryzaephilus surinamensis)*

There are two types of saw toothed grain beetle that affect the stored grains,

1. Saw toothed grain beetle
2. Merchant grain beetle

Nature of damage:

Adults and larvae cause roughening of grain surface and offensive odor. Grains with higher percentage of brokens, dockage and foreign matter sustain heavy infestation, which leads to heating.

Grains attacked:

The insect causes damage in the grains of rice, wheat, maize, oil seeds and dry fruits.

Damaged Grain

Identification:

- It is narrow and flattened.
- Length ranges from 2.5 to 3.0 mm.
- Thorax has six teeth like serrations on each side.
- Antennae clubbed.
- Elytra cover the abdomen completely.

Adult

Larvae

Other information:

The female lays eggs in cracks of storage receptacles or godowns. At 30°C temperature and 75 per cent relative humidity, the life cycle of the insect takes about 3 weeks. Maximum longevity of the adult is about 3 years. Generally, it survives for about 6-10 months. Multiplication is faster in the rainy season.

4. Warehouse Moth (*Ephestia cautella*)

The warehouse moth is also known as fig moth or almond moth.

Nature of damage:

The stage of the insect that causes most of the infestation is only the larval stage. The larvae mainly feed on germ portion leaving the rest of the kernel undamaged. In bulk infestation, its damage is limited to peripheral top layers only. Web formation covers the bags, floor space and mill machinery thereby resulting into clogging in mills.

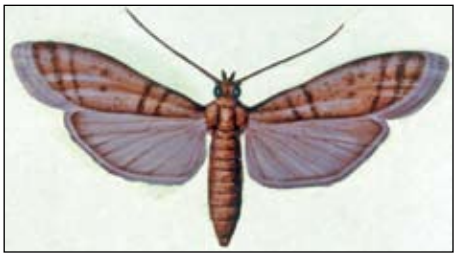
Damaged Grain

Grains Attacked:

Warehouse moths affect the grains of wheat, rice, maize, sorghum, groundnut and spices.

Identification:

- This insect is about 13 mm in size.
- The wings can expand to a width of 2 to 2.5 cm.
- Wings are dirty white to grayish in color.
- The wings also have distinct black bands about 4 mm from the head.
- It rests with sloped wings over the body almost like the slanting roof of warehouses.
- The insect is nocturnal in nature, resting in dark areas of storage structures during the daytime.
- Usually the insect is active at dusk and dawn when temperature and relative humidity fluctuations occur, though it can fly during the daytime also.



Adult

Larvae

Other information:

The insect has the capacity to lay about 200–250 eggs in 3–4 days time. The eggs are laid preferably in grains exposed at the sampling tube spots in jute bags. The larval stage is the most damaging, while the adult stage of the insect is harmless.

5. Grain Moth (*Sitotroga cerealella*)

The grain moth is commonly known as Angoumois grain moth.

Nature of damage:

It is a primary pest. Only the larval stage is damaging while the adult stage is harmless. Grains are hollowed out. The infestation can occur in the field also. In stored bulk grain, infestation remains confined to upper 30 cms depth only. The hole made by the insect is circular in shape with characteristic 'flap' or 'trap door'.

Damaged Grain

Grains Attacked:

Grain moth affects mainly the grains of paddy, maize and sorghum. The insect cannot attack milled rice or other cereal products.

Identification:

- Size of the insect ranges from 8 to 10 mm
- Moth has dirty yellowish brown color
- The wings are completely folded over the back in a sloping manner
- The wings can expand to a width of 10–14 mm
- The hind wings have a sharp pointed apical end, bearing a heavy fringe of bristles
- The insect leaves small dirty specks on windowpanes and walls.

Adult

Larvae

Other information:

The female lays singly about 100 white eggs in stores or field on the surface of damp grains, which soon become red. In grains with less than 12 per cent moisture content there is practically no development. The insect is quite susceptible to low temperature ranges. Thus the damage of this insect is more serious in the grains of *Kharif* crops only. It can also attack *rabi* crops when grains are affected by rain before harvest or immediately after harvest.

6. Indian Meal Moth

The Indian meal moth is also called the meal worm moth.

Nature of damage:

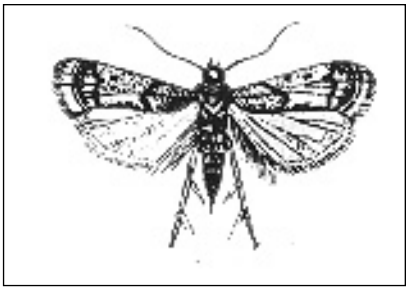
This pest causes serious damage to the panicles and grain, contaminates the grain with excrement, cast skins, webbings, dead individuals and cocoons. The insect prefers to feed on the germ portion, hence the grains lose viability.

Grains attacked:

The important crop grains attacked by this insect include maize, cereals, groundnuts and cereal products.

Identification:

- The basal half of the fore wing is silver white or grayish in color, the outer 2/3 portion has reddish to copper bronze luster with irregular bands.
- Hind wings are long silvery grey with silky fringes.
- Thorax is slightly darker and has reddish scales.
- When the insect is at rest, the antennae cross 2/3 of the body size and rest on the wings.



Indian meal moth

Other Information:

Cold temperature is not favorable for the development of this insect.

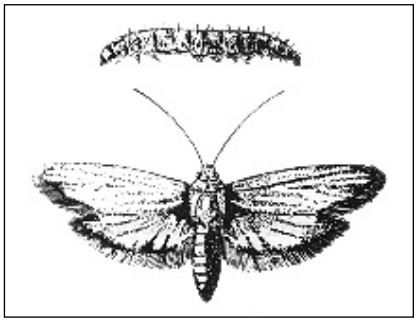
7. Rice moth

Nature of damage:

The larval stage of this insect is responsible for damage. It pollutes food grains with frass, moults and dense webbing. In the case of whole grains, kernels are bound into lumps of upto 2 kg.

Identification:

- Spot free uniformly pale buff brown color
- Wing expanse 25 mm
- Fore wings have dark veins
- Cocoons are dense white and tough
- Larvae with conical prolegs on abdominal segments.



Rice moth

Grains attacked:

Rice, jowar, other millets, whole cereals, cereal products, *dals*, processed products of cereals, pulses, oil seeds, nuts, dry fruits and milled spices are damaged by this insect.

Other information:

Larval stage is the most harmful stage in the insect life cycle. In optimum conditions (temperature 28°C to 32°C and relative humidity 75%) formation of adult from egg takes 4–5 weeks. It is more confined to rice growing areas of the country and attacks *rabi* grains very rarely. It is more common in dark stores. Infestation is normally limited to upper 45 cms only in bulk grains. The adult insect is not harmful.

8. Grain Lice

This is also called as book lice. This is more common in the rainy season.

Nature of damage:

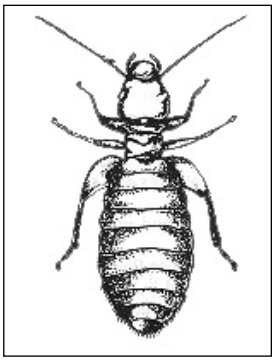
The infestation of this pest occurs when unhygienic conditions exist in damp warehouses, where aeration is ignored and is usually associated with high infestation or moldy conditions. Infestation of **psocids** persists even after fumigation when other pests are controlled, thus causing irritation or nuisance besides contamination. Otherwise these are scavengers affecting only germ portion in heavy infestation. Normally, they thrive on insect fragments and broken grains.

Grains attacked:

The insect infests all starchy material. Grains with high moisture (inherent or acquired during storage due to wet/dry heating or insect infestation) are infected by this.

Identification:

- Small in size
- Very active in nature
- The color ranges from pale grey or yellowish white
- Larvae have filiform antennae
- The shape is more oblong than roundish.



Grain lice

9. Grain Mite

This is also called the flour mite or forage mite. This insect is active in the postrainy season.

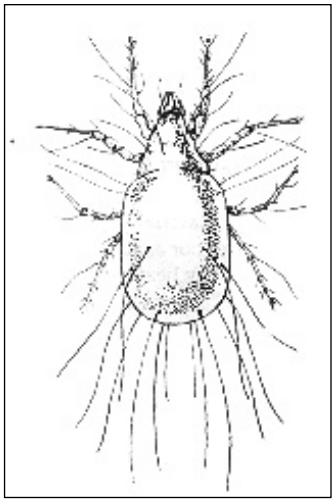
Nature of Damage:

Important economic pest, it eats only the germ portion and imparts taint to the cereals.

Grains attacked:

Cereal grains, flour and other eatables.

Identification:



Grain moth

- Very small in size
- Just visible to eye particularly when moving
- Translucent shiny round body
- The color ranges from pale straw to dark reddish brown
- If observed under magnified conditions, it is notable that these are not insects on account of following distinctive features:
  i) Four pairs of legs present
  ii) No wings and antennae
- The formation on floor is typical of mite infestation and in bagged storage dust formation is characteristic.
- If an infested sample is kept on the palm of your hand, an itching sensation indicates the presence of mites.
- Another method is to keep a teaspoonful of the material in a white enameled plate in a heap. Even a slight movement of mites would disturb the heap.

Other information:

A female lays approximately 100 eggs. The infestation is more in pit storage and in coastal areas.

10. Flour Beetle *(Tribolium castaneum)*

There are two types:

1. Rust red flour beetle
2. Confused flour beetle

Damaged Grain

Nature of damage:

Adult as well as larval stages of this insect feed on milled products but can also attack broken grains if present in bulk storage. Flour beetles are secondary pests of all grains and primary pests of flour and other milled products. In grains, embryo or germ portion is preferred.

Commodities attacked:

Broken grains/mechanically damaged grains, germ portion and milled products. Heavy infestation causes stinking odour in the flour, adversely affecting the dough quality. It is a significant pest of mill machinery.

Identification:

- Oblong, flat in shape, 3–4 mm in size and brown in color
- The distinction between rust beetle and confused beetle is that compound eyes are completely notched and antennae are not gradually thickened in the latter whereas in the former the notch is not complete and antennae have a clear three-segmented club
- Rust red beetle is more common, compared to the confused beetle.

Adult

Larvae

Other information:

400–500 eggs are laid in stored grain at random. Ten eggs are laid per day for several months. Adults are active in the rainy season. They feed on broken grains and grain products. They are known to live for one to one and half year. In the rainy season, the multiplication is very fast.

Management of storage pests

Management of insect-pests in bulk storage is a challenge in handling the post-harvest farm produce. Improper management, inadequate storage facilities and procedures may contribute to the loss of grain quality and decrease in the value of stored grain in the market. The loss of grain quality can occur from spoilage caused by molds, insects, rodents and other storage pests. The storage insect-pests not only consume grain but also cause heating, spoilage and reduction in grade if measures are not taken to manage them. It is possible to manage these insects in bulk storage by reducing storage temperatures or frequent inspections and by fumigations. Since insect infestation is a cycling problem, repeated use of chemical fumigants may cause problems more severe than insect contaminated grain. Enough care should be exercised in using fumigants since some can create serious residue hazards. Most of the fumigants are lethal or acutely toxic to human beings at concentrations effective against insects and elaborative safety precautions must be observed at all times.

Amongst the different methods of insect-pest management, the following are the important methods that can help in safe storage of food grains at farmer's level.

1. Preventive management measures
2. Curative management measures

1. Preventive Management Measures

The following preventive management measures are very important in overcoming the problems associated with insect-pest attack on the stored grains.

(i) Hygiene or sanitation:

Hygiene or sanitation is the first and foremost aspect in preventive management. To ensure proper hygiene, the following steps need to be considered.

- Threshing floor/ yard should be clean, free from insect infestation.
- It should be away from the vicinity of villages/ granaries.
- The harvesting and threshing machines need to be thoroughly cleaned before use.
- Trucks, trolleys or bullock carts, used for transportation of food grains, need to be cleaned and made free from insect infestation.
- The storage structures/godowns need to be cleaned properly before storage of newly harvested produce.
- All dirt, dust, rubbish, sweepings and webbings etc. should be removed from the dryers, stores and dumped/ destroyed.
- All the cracks, crevices, holes existing in the floors, walls, ceiling should be neatly and permanently plastered with mud or cement .
- Rat burrows, if existing, need to be closed with a mixture of broken glass pieces and mud and then plastered neatly with mud/ cement.
- White wash of the storage structure prior to the storage of food grains is very useful.
- The food grains should be stored in godowns, which are rat and moisture proof.

Proper stacking of bags also helps in grain protection.

(ii) Disinfestation of storage structures/ godowns:

Disinfection of the storage structures is yet another important preventive mode of managing insect-pests. There are traditional and scientific methods of doing it.

- Before use, the godown/storage structure should be disinfected with approved residual insecticides preferably by spraying malathion 50% EC, with dilution of 1:100 and applied at the rate of 3 lit/100 m^2.

2. Curative Management Measures

These methods are followed when the infestation has occurred in the stored grains. The infestation of stored grain insect-pest can be managed by the following methods.

1. Non-chemical management measures.
2. Chemical management measures.

1. Non-chemical management measures:

Measures that do not use chemicals for the management of insect-pests of stored grains are:

a. Ecological measures:

The safety of stored grains from insect-pests largely depends on the following three factors viz.

i. Management of temperature
ii. Management of moisture content of grain
iii. Availability of oxygen

Temperature, moisture content in grain and oxygen are required for rapid development and multiplication of insects. By proper manipulation and management of these factors through design

and construction of storage structures/ godowns and proper storage practices, ecological conditions unfavorable for attack by various insects can be created.

It is not advisable to heat the grain above 45°C because the grains may get affected and lose their viability.

i. Management of temperature:

Temperature ranging from 20°C to 40°C accelerates the development of insects but above 42°C and below 15°C retards reproduction and development, while prolonged temperature above 45°C and below 10°C may kill the insects. Heating of grains to 50°C will be lethal for insects.

Khapra beetle can still attack the grain at this reduced moisture content.

***ii.* Management of moisture content of grain:**

Moisture is another critical factor in safe storage of food grains. Grains stored at around 10 per cent moisture content escape from the attack of insects.

iii. Availability of oxygen:

In storage, grains and insects consume oxygen during respiration and carbondioxide is produced. Insects respire at the rate of 20,000 to 1,30,000 times than that of the same weight of the grains. Thus oxygen level will reduce below 1% and carbondioxide level will automatically increase which will be lethal to all the stages of insects.

a. Mechanical management measures:

Amongst various methods of insect-pest management, mechanical methods are quite practicable.

i. Screening of grain:

Broken and cracked grains promote attack by stored grain pests. Hence, screening/sieving out of such grains reduces the insect infestation and gives a better appearance to the lot. Of course the grain does not become free from insect. Following points help in making the screening more effective.

- Screening should be done regularly and away from the stores to avoid any re-infestation.
- Immediate destruction of screenings.
- Bags used for carrying the screenings should not be used again without disinfestation.

Keep in mind that very rapid drying or over drying may damage seeds, develop wrinkles, cause cracking of seed coat and destroy vitamins and seed viability.

ii. Engineering control measures:

In grains having moisture content below 10%, most of the insect species do not survive/ multiply. In villages the grain are dried by spreading a thin layer in the Sun or by dryers.

2. Chemical measures of insect-pest management:

Amongst the present methods of insect management, usage of chemicals is the most popular and perhaps the most effective one. The term insecticide may be applied to all these chemicals, which are used to kill or control or manage the insects. They may be used for both types of treatments:

a. Prophylactic treatment

b. Curative treatment

a. Prophylactic treatment:

Prophylactic treatment methods are used to prevent insect infestation and cross infestation by spraying insecticides. These insecticides should not, however, be sprayed on food grains directly. Some of the insecticides and their concentrations suggested for prophylactic treatments of stored grain are given below:

Sl.no	Name of the insecticide	Concentration of spray solution (%)	Preparation & Dosage	Frequency of treatment
1	Malathion 50% EC	0.50	1:100 @ 3 lit/100 M^2	15 days
2	Pirimiphosmethyl 50% EC (Actellic)	0.50	1:100 @ 3 lit/100 M^2	15 days
3	Pyrethrym with 2.0% Pyrethrin EC	0.02	1:100 @ 3 lit/100 M^2	15 days
4	Deltamethrin 2.5% WP (K-othrine)	0.10	40 gm/lit 3 lit/100 M^2	90 days

Source: Manual on grain storage at farm level

i. Calculation of insecticides dosages:

Preparation of spray: There are a very few insecticides which are marketed in ready to use form. The concentrated formulations are diluted with water to make field strength concentration for spray. A simple formula is given below by which the unknown value can be worked out from the known values.

$$QP = \frac{QS \times CD}{CP}$$

where QP – Quantity of proprietary product required
QS – Quantity of spray material required
CD – Concentration of dilution desired
CP – Concentration of proprietary product given.

Example: To calculate the amount of 50% malathion emulsifiable concentrate required to produce 100 lts of 0.50% solution using the above formula.

$$QP = \frac{100 \times 0.5}{50} = 1 \text{ liter}$$

ie, 1 liter of malathion 50% EC should be made up with 100 liters of water to produce 0.50% strength spray.

ii. Calculation of surface area of a stack:

$$(L+B) \times H \times 2 + (L \times B)$$

where L = Length
B = Breadth
H = Height

for calculating the actual requirement of spray solution of pesticide add 20% to the total areas.

b. Curative treatment:

In spite of regular prophylactic treatment, infestation develops due to hidden infestation or cross infestation. It can be managed by the use of following insecticides and fumigants.

i. Knockdown chemicals:

Those insecticides which are capable of immobilizing or killing insects quickly are called as knock-down chemicals. They are usually aimed against flying insects but may kill the insects on surfaces as well as in cracks and crevices. Such chemicals are Pyrethrum spray, lindane smoke generator or fumigant strips.

ii. Grain protectants:

Mixing of chemical dusts with the food grains meant for human consumption is not recommended. However, they can be mixed with the grains meant for seed purposes only. Pyrethrum dust, DDT and BHC dusts etc. are normally used as seed protectants.

iii. Fumigants:

A fumigant is a chemical which at required temperature and pressure can exist in the gaseous state in sufficient concentrations to be lethal to a given pest organism. Nowadays a good number of fumigants are used for the control of insects. One of the effective fumigants is given below.

- Aluminum phosphide:
  This is a solid fumigant available in the market in the form of tablets of 3 gm each packed in sealed tubes. Of course, it is one of the very potent fumigants and can be used practically on all food grains, milled products etc. The active ingredient is phosphide gas, which is an acute toxic poison. When the tablet comes in contact with the moisture of the atmosphere, it liberates ammonia, carbon dioxide, and phosphide. Phosphide gas being highly toxic, it should be handled with great care and by trained staff only. However, tri-laminated envelope packaging of aluminum-phosphide, which is comparatively tamper proof, is permitted for manufacture, stocking, open sale and use in India.

Procedure:

The fumigatorium or storage structure with grain in bulk is made sufficiently airtight by plastering cracks, crevices etc., leaving one or two openings for application of the fumigant. It is applied at the rate of 2 tablets (3 gm each)/ tonne or Tri-laminated envelope packaging at the rate of 6 gm/ tonne to the food grains. In case of bagged storage, ½ of the required quantity of the fumigant is distributed

at top layers of bags and the remaining ½ on peripheral bags. The stack is then immediately covered with gas proof cover. The edges are plastered with mud or weighed down by sand snakes.

Fumigation with aluminum phosphide should not be undertaken by untrained personnel. It should be done only when the storage structure is away from living rooms.

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Whitney WK and **Pedersen JR** 1961. Physical and mechanical methods of stored product insect control. Proc. Conf. Stored grain insects and their control. Kansas State University.

Inauguration of the storage structure in Andhra Pradesh.

Training on safe storage of grains.

About CFC

The Common Fund for Commodities (CFC) is an autonomous intergovernmental financial institution established within the framework of the United Nations. The Agreement Establishing the Common Fund for Commodities was negotiated in the United Nations Conference on Trade and Development (UNCT AD) from 1976 to 1980 and became effective in 1989. The first project was approved in 1991.

The CFC forms a partnership of 106 Member States plus the European Community (EC), the African Union (AU) and the Common Market for Eastern and Southern Africa (COMES A) as institutional members. Membership is open to all Member States of the United Nations or any of its specialized agencies, or of the International Atomic Energy Agency, and intergovernmental organizations of regional economic integration, which exercise competence in the fields of activity of the Fund.

CFC's mandate is to enhance the socio-economic development of commodity producers and contribute to the development of society as a whole. In line with its market-oriented approach, the Fund concentrates on commodity development projects financed from its resources, which are voluntary contributions, capital subscriptions by Member Countries. Through cooperation with order development institutions, the private sector and civil society, the Fund endeavors to achieve overall efficiency in and impact on commodity development.

About FAO

The Food and Agricultural Organization (FAO) of the United Nations is an autonomous intergovernmental organization established in 1945, which leads international efforts to defeat hunger. Serving both developed and developing countries, FAO acts as a neutral forum where all nations meet as equals to negotiate agreements and debate policy. FAO is also a source of knowledge and information to modernize and improve agriculture, forestry and fisheries practices and ensure good nutrition for all. The main functions of FAO include collection, analysis, interpretation and dissemination of information relating to nutrition, food and agriculture. It promotes, disseminates and, where appropriate, recommends national and international action with respect to scientific, technological, policies, marketing and distribution, conservation of natural resources, social and economic research relating to nutrition, food and agriculture. It also undertakes the function of to furnishing technical assistance to the governments on request, in cooperation with the governments concerned.

About ICRISAT®

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a nonprofit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Future Harvest Centers of the Consultative Group on International Agricultural Research (CGIAR).

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