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Rice is the major commodity in Philippine agriculture. It is the staple food of the Filipinos and a major source of livelihood. However, it is estimated that around 15 percent are lost in harvested paddy (BPRE, 1996). Reasons cited include lack of good facilities, and inappropriate postharvest practices, among others.

With the aid of modern equipment like mechanical dryers coupled with adoption of recommended postharvest practices, significant reduction of losses in harvested grains can be realized.

PADDY POSTHARVEST LOSSES

Percentage of paddy losses

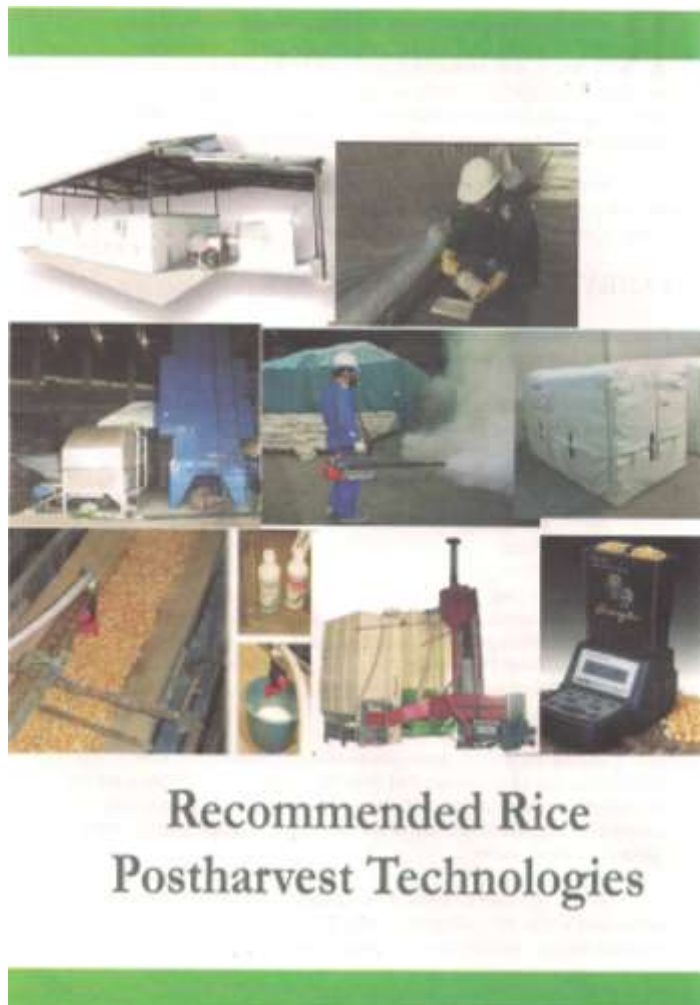
Because of improper postharvest practices

The over-all percentage of paddy loss in postharvest operation reached an average of 14.8 percent (BPRE, 1996). In general, it is estimated that 1.13 percent to 31.9 percent were lost in paddy in the following operations.

| | |
|-------------------------|----------------------|
| Harvesting | 1.8 % |
| Piling | 0.5 % |
| Threshing | 2.2 % |
| Drying | 4.5 % |
| Storage | 2.7 % |
| Milling | 3.1 % |
| Total Percentage | 1.13 % -31.9% |
| Average | 14.8 % |

During the past 30 years, postproduction losses have been identified as one of the causes that limit food supply. Thus, there is a need for a continuous monitoring of the quantitative and qualitative losses incurred during postharvest and at the same time re-identify where these losses continue to occur.

BPRE and the Philippine Rice Research Institute (PhilRice) are conducting a national postharvest Paddy loss assessment to come-up with an extensive and updated postharvest loss data.



BPRE FLATBED DRYER WITH BIOMASS-FED FURNACE



This dryer is easy to install, operate and maintain. It is made of precast (panelized) reinforced concrete walls and perforated metal floor and provided with a shed. It can dry 6 tons of grains at 24 percent down to 14 percent moisture content at 40 to 45 C within 10 to 12 hours.

Specifications:

Drying bin: Inside dimension: L = 24' – 0"
 W = 12 – 0"
 H = 5' – 0"

- Grain depth – 18'
- Holding capacity – 6.0 tons
- Made of precast reinforced concrete walls not less than 1.5" thick using class "A" concrete
- All panelized wall section construction
- Complete with perforated metal sheet flooring of 3/32" diameter perforations and supported with steel framing
- All knockdown and bolted construction.

Heat source: Biomass furnace, direct or indirect type using rice hull/ corn cobs as fuel

Blower:

- Tube axial fan with 10,500 CFM capacity at 30 mm H₂O static pressure
- Fan rpm of 1,600 rpm driven by diesel engine (12.5 hp) thru belt and pulley
- Tube-housing 30 inch diameter
- All steel construction made of heavy gage steel material

BPRE MULTI-FUEL BIOMASS FURNACE



This is another furnace the agency has developed to optimize the use of mechanical dryers. It is designed for rice hull and corn cobs as fuel. It is equipped with temperature controller and an automatic feeder. It can provide the heat source for mechanical dryers, sufficient enough to dry paddy in an LSU type 6-ton capacity mechanical grain dryer from 26 percent to 14 percent moisture content in 8 hours of operation.

Specifications:

Heating system:

Heating system: Indirect-fired

| | |
|---------------------------------|---|
| Heat exchanger material: | Fire tubes |
| Furnace material: | Refractory bricks |
| Fuel feed: | Twin auger |
| Temperature control: | PID temperature controller connected to fuel feed motor |
| Ash disposal: | Auger and pneumatic system |
| Fuel: | Corn cobs or rice hull |
| Power requirement: | 220v, 1.98 kw, single phase |
| Dimensions: | Approximately 3m x 1m x 2m (LxWxH) excluding chimney |

Features:

- Convenient to operate and requires less operator attention
- Provides clean hot air without smoke or ash entering the dryer
- Uses multiple fuel such as rice hull, corn cobs, wood chips or sawdust
- Environment friendly. The technology meets the carbon monoxide and nitrogen oxide emission limits set by the Department of environment and Natural Resources-Environment Management Bureau (DENR-EMB)



BPRE RICE HULL-FED FURNACE SYSTEM

Developed to provide a cheaper alternative heat source for mechanical dryers as it uses rice hull as fuel. Its original and patented temperature controller-prime mover interlocking system design ensures fully automatic operation with excellent drying air temperature control. It is environment friendly having equipped with gas emission and particulates scrubber system. The furnace is a 2-in-1 renewable energy machine (REM) as it serves as heater and rice hull carbonizer at the same time.

Specifications:

| | |
|---|---|
| Fuel consumption: | (6-ton capacity batch recirculating dryer) 23 to 24 kg/h for 1-batch recirculating dryer 40.7 to 47.5 kg/hr for 2-batch recirculating dryer |
| Type of furnace: | indirect-fired (through the use of heat exchanger) |
| Type of dryer it Can be retrofitted: | * batch recirculating dryer * Flatbed dryer * Cabinet dryer for HVCC |
| Total Power: | 1.125 kW, 1 phase, 220 v |
| Drying temperature: | 60 °C to 70 °C for 6-ton capacity batch recirculating dryer |
| Dimension: | 1524 mm x 1269 mm x 1789 mm |
| Labor requirement: | 1 operator |

Features:

- **Simple and compact design**
- **Fully automatic operation**
Synchronized fuel feeding and ash discharge
Excellent temperature control (on-off-operation) for any heating application
Regulates and maintains uniform temperature

- **Clean air output (indirect heating through heat exchanger)**
Suitable heat source for drying and dehydration of fruits, vegetables, cereals etc.)
Space heating and other needs
Environment friendly
- **Two-in-one machine**
Heater (for any heating application)
Rice hull carbonizer

BPRES GRAIN MOISTURE METER



This equipment is BPRES designed and locally manufactured. It is handy, affordable and easy to operate. It can also average 99 samples, and detect system errors.

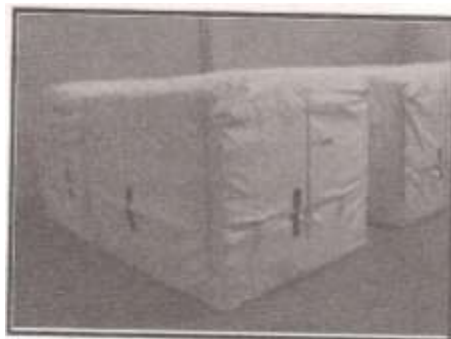
Specifications:

| | |
|---------------------------|---|
| Measurement range: | for paddy -10 to 26 percent MC on wet basis for corn-10 to 28 percent MC on wet basis |
| Resolution: | 0.1 percent MC reading accuracy of ± 0.5 percent of true value of MC wet basis. |
| Repeatability: | 99 percent |
| Power: | four AA batteries |

Special features:

- Built-in data averaging up to 99 readings
- Auto-power off
- Commodity menu key control for paddy and corn
- Self diagnostic and auto calibrating and pre-loaded screen messages
- Real time clock
- Casing with tactile key control

HERMETIC STORAGE



BPRES promotes this technology in collaboration with Agricultural Research Organization (ARO) Volcani Center of Israel. This technology uses gastight frameless flexible envelopes (GrainPro Cocoon TM) to store dried grain stocks. It is considered an alternative storage technique that farmer or farmers'

groups, government and private institutions can use to store their produce safely during peak seasons. It also promotes organic way of protecting grains.

Specification of GrainPro Cocoon

| | |
|----------------------------|--|
| Plastic material: | Polyvinyl chloride (PVC), Food grade liner, UV resistant |
| Color: | White/ opaque |
| Fabrication; | Heat sealing/welding |
| Thickness: | 0.80/0.85 mm |
| Available capacity: | 5, 10, 20, 50, 150 and 300 MT |
| Closing device: | Polyurethane zipper (double tongue and groove type) and tension straps and buckles |

GRAIN ADMIXTURE



BPRE recommends this technology to prevent possible pest infestation in grains to be stored for long periods. The technology refers to the direct mixing of specific insecticide mixtures like pirimiphos methyl with deltamethrin and piperonyl butoxide to the grains. The treatment is only applicable to new stocks of grains. The treatment is only applicable to new stocks of grains with 14 percent moisture content and without pest. Diluted insecticide is applied at a rate of 1 liter per ton of commodity. Depending on the concentration applied, protection from infestation is estimated for up to 12 months.

INTEGRATED PEST MANAGEMENT



This refers to complementary prevention and control techniques to prevent the attack of pests such as insects, birds, rodents, fungi and pathogens with good housekeeping and sanitation as basic strategic concept. It involves the combination of physical, biological and chemical controls. As much as possible the use of botanicals and beneficial insects are recommended in specific areas.

Control Measures for Stored Product Pest of Rice

Structural Application of Insecticides



Structural application includes residual sprays on walls, floors, other structures inside the warehouse including wooden pallets. The residual deposits on the treated surfaces will kill crawling insects and pests. Example insecticides are Permethrin, Cyfluthrin and Pirimiphosmethyl.

Fumigation



Fumigation is a process of introducing a volatile pesticide that exerts its toxic action in the gaseous or vapor phase. Fumigants can diffuse and penetrate into places where other forms of control are inadequate.

Fumigants are generally applied at the rate of 1 to 2 tablets per ton. Exposure period of at least 7 days is recommended. Phosphine generating fumigants are available in the local market.

Bag stack Spraying



The layer by layer spray technique is the effective control measure for storing paddy and milled rice. The periphery of the stack is sprayed. After spraying, the whole stack is fumigated. The stack would last for one year for paddy and 6 months for milled rice without insect infestation.



Recommended Postharvest Practices

HARVESTING



If the grains are fully mature, it is now ready to harvest. Harvesting can be done by either cutting the mature panicles and collecting them in basket or cutting a handful of plants, laying them on the stubble, and gathering and stacking the cut plants near the threshing area.

Four Stages of grain maturity

- Milk stage
- Soft dough
- Hard dough
- Mature

Methods of harvesting paddy

- Cutting of panicle using sickle
- Cutting of the stalk using sickle
- Using mechanical harvester

The paddy must be harvested at the right time. Mature paddy manifest the following characteristics:

- It has 20 to 24 percent of moisture content (MC)
- Around 75 to 80 percent of the grains is golden yellow
- The endosperm of the grain is hard

Untimely harvesting of paddy results to the following:

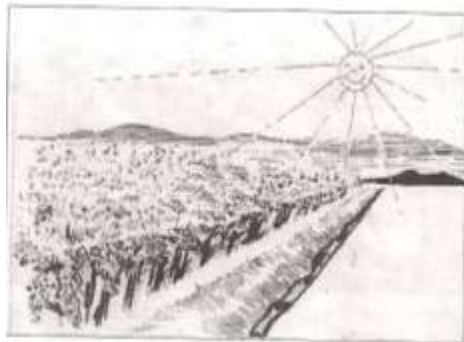
- If harvested early, not all grains are fully matured, some grains become chalky when dried and milled
- Delayed harvesting results to more falling of grains and more rice husks will be produced when milled.

Do's in harvesting paddy

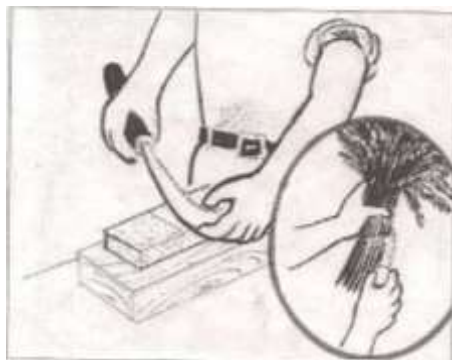
- Harvest the paddy if 75 to 80 percent of the grains are golden yellow



- Make sure the field is drained or dry before harvesting paddy. This will prevent the grains from getting wet when laying them on the stubble.



- Use sharp farm implement like sickle when harvesting paddy.



- If harvesting grains are still unstuck, avoid too much exposure to the sun to prevent over drying. Properly dried grains will have minimal cracking.



- Thresh immediately the harvest paddy



- If threshing will be delayed, pile the paddy in small stacks near the threshing area.



THRESHING

Threshing is the process of separating the grains from the panicle of the paddy.



Methods of paddy threshing

1. **Manual threshing**
 - **Trampling or treading** – threshing is done by the farmer animals or tractor by passing along the bundles of paddy.
 - **Beating** – threshing is done by hand-beating the bundles of paddy against a bamboo or wooden rack or tub.

2. Mechanical threshing

- **Mechanical threshing** – this is a method of threshing using mechanical threshers.



Reminders in paddy threshing

- Thresh immediately the harvested paddy. Use mechanical threshers.



- Fix the blower of the thresher to properly blow off and remove the dirt or any foreign matter.



- Fix the drum speed of the mechanical thresher to recommended rpm to avoid damaging the grain.



DRYING



Drying is a process of removing the excess moisture of the grains. Delayed drying can cause grain deterioration which results to big amount of losses.

Different methods of drying

- Sundrying when sunshine is favorable
- Air drying inside buildings or sheds
- Using mechanical dryers like batch type flatbed dryer, batch recirculating type dryer, continuous flow dryer, etc.

Disadvantages of sundrying

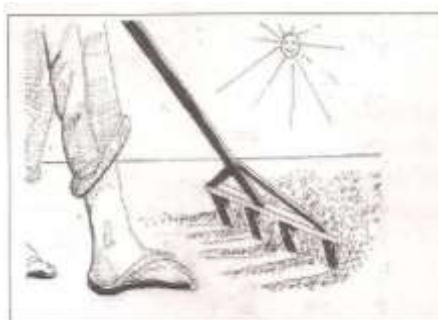
- Grains are unevenly dried.
- It requires more laborers and wide space for drying.
- Drying cannot be done during rainy season
- It requires long hours of drying and frequent mixing.
- Dirt and other impurities tend to mix with the grains when dried in the open.
- Huge losses are incurred if highway or roads are used as drying pavements.

Advantages of mechanical drying

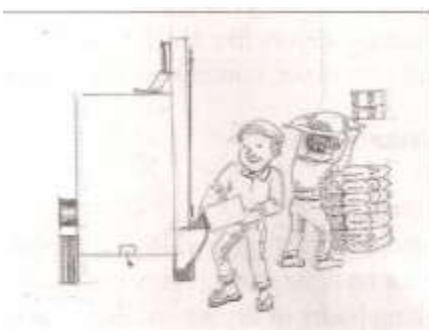
- Wet grains can be dried in one operation, even during rainy period.
- Drying can be done anytime of the day, even during rainy days.
- It does not require many laborers.
- Drying time can be reduced.
- Farmers can allot their time to other field activities because of less labor and drying time requirement.

Do's in paddy drying

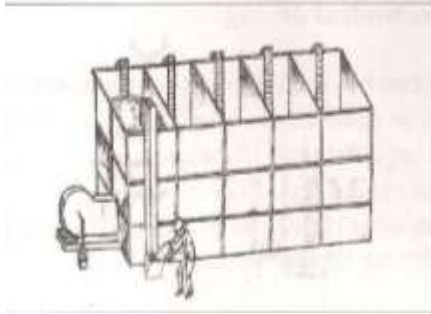
- In sundrying, mix the grain every 5 to 10 minutes to avoid over drying.



- In mechanical drying, use appropriate mechanical dryers.



- Two-stage drying offers an alternative result. This is slow drying using a flash dryer (18%) and an in-store dryer (14%). This technology could help achieve better quality grains.



- Do not dry on highways to avoid cracking of the grains.

RICE MILLING



Rice milling is the removal of outer covering of the paddy.

It is one of the crucial step in the postproduction operation of rice. It has to be done with utmost care to prevent breakage of the kernel and ensure higher milled rice recovery of the paddy. The basic objective of a rice milling system is to remove the husk and the bran layers, and produce an edible, white rice kernel that is sufficiently milled and free of impurities.

Methods of Milling

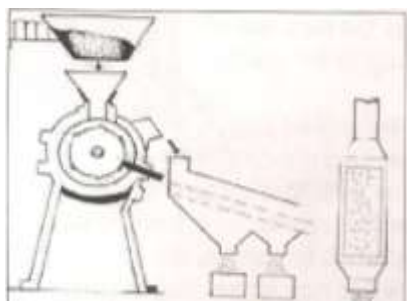
1. **Manual** –employs impact and friction. This is done using mortar and pestle. While the paddy grain is hit, the peeling, dehulling and removal of rice bran simultaneously occur
2. **Mechanical** –this is done using mechanical milling facilities

Disadvantages of manual Milling

- More grains are cracked
- Most of the time, the cracked grains are mixed the paddy husk and rice bran
- Low milling recovery
- Limited output
- Time consuming

Types of mechanical milling facilities

1. **Engelberg steel huller or “kiskisan” mill.** It is commonly called a one pas mill because it accomplishes dehushing and whitening simultaneously in one passing. It has a small capacity and low milling recovery.



2. **Single pass rubber roll mill.** This employs only one hulling (rubber roll) and whitening machine. It is commonly found in rural communities and are used for custom service milling paddy of farmers for home consumption. It could be stationary or mobile (roving).



3. **Cono multi-pass rice mill (cono type).** This is characterized by the use of the under-runner stone disc huller for hulling and 1 to 3 cone whiteners for the whitening process.



4. **Modern multi-pass rice mill (Japanese system)** – This system is more sophisticated than the “cono” system. It has the capacity ranging from 1 to 10 tons per hour. It combines the rubber roll huller for the hulling operation with two or more abrasive and friction whiteners for the whitening process.

It also employs mist polisher to brush off remaining bran dust, thus making a glossy characteristics on the milled rice. Mist polishers apply a controlled amount of water mist, resulting in highly polished grain. It also improves the storability of milled rice because of the complete removal of the bran.



Process of mechanical milling

- Pre-cleaning and de-stoning
- Paddy grading
- Hulling/dehusking
- Sifting
- Husk aspiration
- Separation of paddy and brown rice
- Brown rice grading
- Conditioning of brown rice
- Abrasive whitening
- Friction whitening
- Rice polishing/refining
- Rice grading
- Sorting

- Glazing
- Blending
- Weighing
- Packaging

Causes of milling losses

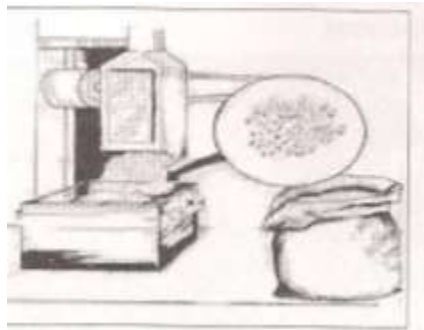
- Lack of operator's technical knowledge on the operation and maintenance of the milling facilities especially on the repair and maintenance of the machines.



- Lack of proper maintenance and incorrect combination of different parts of the milling equipment.

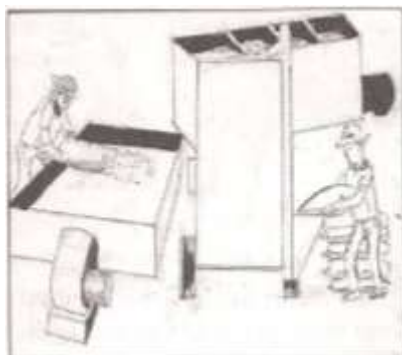


- Incorrect adjustment of different parts of the machines
- Improper drying can cause cracking of grains resulting to losses. The paddy should have 14 percent of moisture content before milling.



Do's in grain milling

- Make sure that the grains are properly dried at 14 percent moisture content before milling, During the drying process, care should be done to prevent heat or temperature stress that causes fissuring of the grain. Fissuring grain will break in the milling process.



- Always maintain the cleanliness in the rice mill



- To ensure safety of the area, place the milling facilities in a wide space.



- Use rubber roll huller to lessen and prevent the cracking of the grains.



- The good quality grain will result to a well-milled grain. Good quality paddy means uniform sized grain and sized grain starts from high quality certified seeds and good agronomic practices.
- Darkening of the endosperm is also caused by delays in threshing and drying. It cannot be corrected during the milling process.
- Clean paddy before milling to remove half filled or empty grains.

STORAGE



Storage is the process of keeping grains in structures like the warehouse to protect the grains from inclement weather and pests for a short or long period of time.

Storage is done to conserve the grain supply of food and feed throughout the year; to provide reserve for contingencies; and to speculate on a good price.

Types of Storage

1. On-field Storage

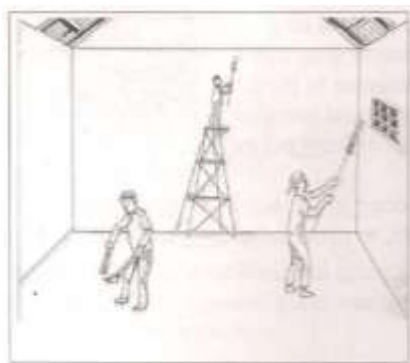
- **Barn/granary (kamalig)** this is made of cement and concrete materials. It can load an average volume of sacked grains.
- **Holder/Receptacle (Sisidlan)** like crates, boxes, drums, tin cans, etc.

2. Commercial Storage

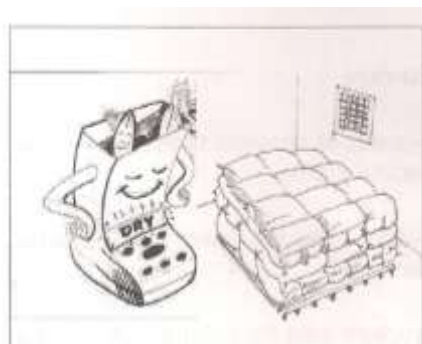
- **Warehouse** – made of concrete materials and can contain large volume of sacked grains
- **Flat Store** – this is like the warehouse, however, the grains are spread on the floor.
- **Silo** – is a structure used for storing bulk materials. Silos are used in agriculture to store grains or fermented feed known as silage

Tips in grain storage

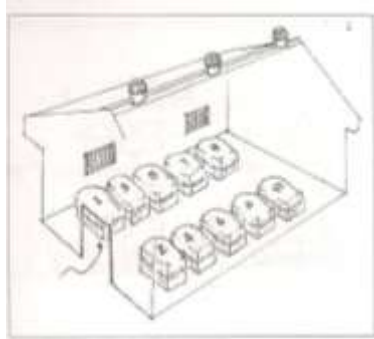
- Maintain the cleanliness. Allow free air circulation inside the warehouse. Clean the wall, ceiling and floor before storing grains.



- Ensure that the stacked grains are dry and clean.



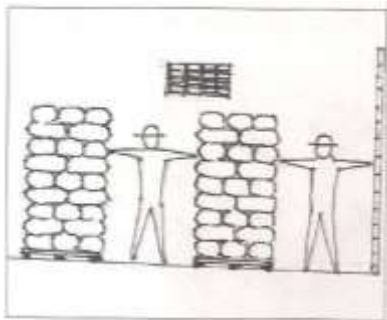
- Observe the “first in, first out” method.



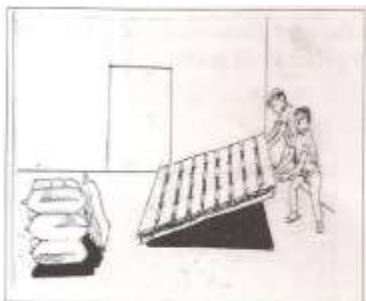
- Check regularly the warehouse to ensure that no birds, rodents and other pests are attacking the stored grains.



- Check roof of warehouse for leaks and if found, seal to prevent wetting of stored grains.
- Make one meter distance of the stacked grains from the wall and in between the stacked grains.



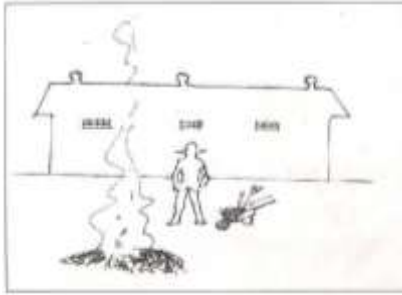
- Use a base/pallets in every stacked grains to avoid moisture migration.



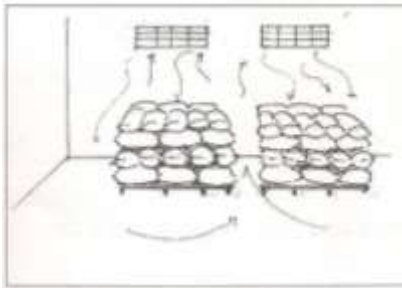
- Separate the stored grains free of pests from grains infested with pests.



- Burn or bury the grains affected by insects. Do this away from the warehouse.



- Ensure that the air is continuously flowing or circulating inside the storage to prevent increase of temperature of stored grains.



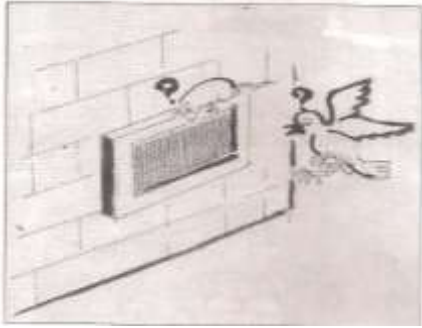
- Once there is insect/ pest infestation spraying, fogging, and fumigation, should be done.



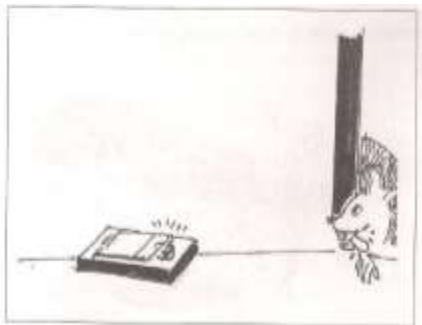
- Rodents footprints and birds dung/feces on the sacks of stored grains indicate infestation of these pests inside the warehouse. Control measures have to be done.

Tips to lessen pests

- Cover all possible entry points of birds and rats.



- Use live or snap traps and foot tangle to catch rats.



- Rodenticides can also be used with baits to kill the rats



- Use nests, screens in the windows or use avescide to control entry of birds.

