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Safe storage of food grains

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ABSTRACT

Proper Storage of food grains is the third important aspect in agriculture after production and marketing. Farmers store enough grains to supply the household for a considerable period of time from production till consumption. Such quantities of food take up a great deal of space and require specialized storage facilities. Proper storage of food grains prevent spoilage, increases its usability and durability. Due to lack of storage facilities and lack of knowledge about proper storage conditions we are suffering huge storage losses. India itself, suffers 10-25% losses in case of food grains. Storage losses are caused by incidence of stored grain insect pest, temperature, moisture, rats/rodents and birds. High temperature and high moisture affect grain quality in storage and cause rapid decline in germination, colour, oil composition, and many other characteristics. Insects and fungus impair the quality of grains directly by their feeding and development, and indirectly by generating heat and moisture. The future requirement is to synthesize the status of knowledge and to provide directions in order to minimize the post-harvest losses of grains in different regions of the world.

Key words: Food Grains, Rats, Birds, Storage Insect-Pests

WHY WE STORE FOOD

1. For household consumption
2. As seed for next year

3. To get good market price.

REASONS CAUSING STORAGE LOSSES

1. PHYSICAL REASONS:

a. Temperature
b. Humidity
c. Moisture

During storage many changes occur which depends upon seed moisture and temperature. Due to high seed moisture and temperature fat, acidity, enzymes, color and vitamins content can change which deteriorate seed/grain quality. Seed respire during storage releasing water, carbon dioxide and heat, which increases temperature and invites fungal infections and renders food grain unfit for human consumption. Therefore food grains should be stored in dry conditions with proper moisture content (Shukla and Patil, 2003).

a) Multiplication rate of insect populations related to temperature

Temp °C	**Multiplication rate / month**
15	**0**
20	**10**
25	**50**
30	**100**
35	**30**
40	**0**

b) Insect Population Development Influence of moisture content on insect population of rice weevils (*Sitophilus oryzae*)

Moisture content	**No. of Progenies**
9	**0**
10	**326**
11	**885**
12	**9661**
13	**10267**
14	**13551**

Microorganisms need a moist environment to grow in. The water requirements of microorganisms are described in terms of **water activity** (represented by the symbol a_W), a measure of how much water is present. The water activity of pure water is $a_W = 1.00$. Most foodborne pathogenic bacteria require a_W to be greater than 0.9 for growth and multiplication.

c) **The optimum moisture content of different crops is as below**: -

S. No.	Crop	Moisture Content (%)
1.	Wheat	12
2.	Paddy	13
3.	Maize	13
4.	Soybean	11
5.	Barley	13
6.	Moong , Lentil, Mash & Gram	10

2. BIOLOGICAL REASONS

a. Insects
b. Rodents
c. Birds
d. Microorganisms etc.

INSECTS

Among these factors largest proportion of avoidable losses is due to insects, rodents. About 21 species of insects reported from India causing damage to food grains during storage. Khapra beetle (*Trogoderma granarium*), lesser grain borer (*Rhizopertha dominica*), rice weevil (*Sitophilus oryzae*), flour beetle (*Tribolium castaneum*) and grain moth (*Sitotroga cerealella*) are serious pests of wheat, jowar, rice, barley and maize. These pests lead to loss of nutritive value and germination capacity, besides weight of the food grains (Grover and Singh, 2013).

Rice weevil Flat grain Beetle Sawtooth grain beetle Red rust flour beetle Lesser grain borers Angoumois grain moth

Khapra beetle

Khapra beetle larvae

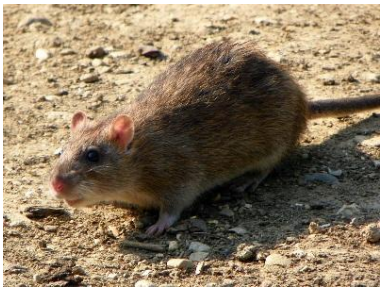
Moong Dhora or Pulse beetle

RODENTS

Rats have been estimated to damage more than 1% of the world cereal crops and, in developing countries, estimates of 3–5% have commonly been reported. There are around 50 diseases which can be transferred to humans by rodents, including typhoid, paratyphoid, and scabies. In addition, rodents may be vectors of a large number of diseases affecting domestic animals. As rodents prefer food rich in proteins and vitamins and feed mainly on the embryo, they cause particular damage to the nutritional value and germination ability of seeds.

The three most important rodent species are:

- Black rat or House rat *(Rattus rattus)*
- Norway rat or Common rat *(Rattus norvegicus)*
- House mouse *(Mus musculus)*



Brown rat

Black Rat

House rat

BIRDS

House crows

sparrow

Pigeons

parrots

Birds, in general, are both useful and harmful to agriculture. Even the same species may be beneficial or problematic in different situations. Only a few of about 300 species of birds of Punjab cause problems in crop fields and granaries. The Rose-ringed Parakeet is the only bird that seems to be exclusively harmful to farmers' interests. Harmful Birds: Parakeet is the major bird pest causing serious damage to almost all cereal and fruit crops. It is particularly harmful to sunflower. House crows damage sprouting wheat, maize and sunflower. House Crows also damage maturing maize and sunflower. Doves and pigeons damage pulses. Sparrow and weaver birds damage stored grains at shellers and godowns. Sparrows and weaver birds also damage rice nurseries and maturing bajra and sorghum.

Spoilage by microorganisms Infectious agents (bacteria, viruses, fungi and yeast) are microorganisms that cause spoilage of food depending on extrinsic and intrinsic factors. extrinsic factors are factors in the environment *external* to the food, which affect both the microorganisms and the food itself during processing and storage. Extrinsic factors include temperature, humidity and oxygen. Intrinsic factors exist as part of the food product itself. For example, meat has certain characteristics that may promote the growth of certain microorganisms. The common intrinsic factors affect the growth and multiplication of microorganisms in foods are pH and Moisture content and nutrient content.

Technical

a. Storage conditions
b. Methods
c. Duration of storage

GRAIN STORAGE AND MANAGEMENT OF STORED GRAIN INSECTS

1. STORAGE OF WHEAT

(a) Home consumption : Improved storage structures of various capacities are now available. For indoor use, PAU metal bins of 1.6, 3.5, 7.5, 10 and 15 quintal capacity are available. The air-tight bin is so constructed that it does not allow entry of any outside insects and rodents and the insects present in the grain do not get favorable atmosphere to

develop. It is also economical, portable and simple to fabricate. For filling and using the metal bin,
the following storage practices are recommended:
(i) Clean the bin thoroughly and do not allow the left-overs of the previously-stored grains to remain in the bin. Inspect the covers to ensure that the gaskets are intact.
(ii) Clean and sort the grains of all impurities. Broken kernels and other impurities lead to insect attraction and, hence, should be separated.
(iii) Do not mix the new grains with old stock as the latter may be infested with insects.
(iv) Never store infested grains, or grains with high moisture content. Dry the grains out in the sun, cool it and fill in the bin later in the evening. The moisture content of the grains should not be higher than 9 per cent.
(v) Fill-in the bin to full capacity and tight the lid properly.
(vi) Do not open the bin for the first 30 days and thereafter open it fortnightly. The cover should be replaced immediately after use.
(vii) Inspect the grains frequently.

(b) Commercial Purposes :

For storing wheat for commercial purposes, the farmers should make use of the facilities provided by the following agencies.

(i) State Warehousing Corporation in the State and its regional offices.
(ii) (ii) Central Warehousing Corporation and its regional offices.

RECOMMENDATIONS

Preventive measures

1. Dry the grains properly before storage.
2. Plug all cracks, crevices and holes in the godowns thoroughly.
3. Store new grains in the clean godowns or receptacles.
4. Use new gunny bags.
5. Disinfect empty godowns or receptacles by spraying 0.05% malathion emulsion (100 ml Malathion 50 EC in 10 liters of water) on the floor, walls and ceiling or fumigate the godowns using 25 tablets of aluminum phosphide/100 cum of empty space before storing the grains. Exposure 7 days.
6. Against Dhora, cover the pulses stored in bulk with 7 cm layer of sand or sawdust or dung ash.

Curative measures

Phostoxin or Delicia or Celphos (aluminium phosphide) one tablet of 3 g/tonne or 25 tablets/100 cum space. Exposure 7 days.

CAUTION/LIMITATION

- Before storing, the metal bins should be cleaned and placed in the sun for 2-3 days.

- Grains stored in metal bin also get infested if not treated with any insecticide. Control this infestation by giving fumigation.
- Where there is infestation of Khapra, use double the dose of aluminium phosphide.
- The fumigant should be only used in air-tight stores or under tarpaulins in the open by specially trained persons because these fumigants are deadly poisonous.
- Stack the gunny bags atleast 40-50cms from the walls to allow inspection, fumigation and to avoid the grains from absorbing moisture from the walls.
- Always stack the bags on wooden platforms to prevent the grains from absorbing moisture from floor and for proper circulation of air.
- Fumigants should be placed at the top of the grains in the bins as the gas is
    - heavier than air and travels downwards.
- Aluminium phosphide should not be used near living quarters

Therefore, proper storage techniques if followed by the farmers can prevent excessive wastage of food grains, improve quality and storage life of the seed. So, it is farmers should use all the storage methods correctly for beneficial results.

RATS CONTROL

Management of Rodents Rats and mice are the most serious pests of crops and must be controlled. By virtue of their extremely adaptable nature, highly intelligent patterns of behaviour and tremendous potential to multiply, they maintain their large populations which cause extensive damage in crop fields and other premises. They cause more damage at seedling and ripening stages of the crops (Malhi, 1998). The performance of different control methods vary in different situations and at different stages of the crop.

METHODS OF CONTROL :

i. Mechanical Control • Killing: During irrigation of vacant harvested fields, rats coming out of flooded burrows may be killed with sticks. • Trapping: In crop fields place 16 traps/acre covering runways, damage and activity sites of rodents. In houses, godowns, poultry farms etc., set traps (1 trap/4-8 m^2 area) along the walls, in corners, behind the storage bins and boxes etc. Kill the trapped rats by drowning in water and the interval between two trappings at the same location should not be less than 30 days.

ii. Chemical Control Poison Bait Preparation The acceptance of poison baits by rats and mice depends upon the quality, texture, taste and odour of the baiting materials, therefore, bait should be prepared as under:

• Zinc phosphide bait (2%): Take 1 kg of bajra or sorghum or cracked wheat or their mixture and mix it thoroughly with 20 g of edible vegetable oil, 20 g of powdered sugar and 25 g of 80% zinc phosphide powder.

Caution: Never allow water to mix in zinc phosphide bait and always use freshly prepared bait. Minimum interval between two baitings of zinc phosphide must be 2

months. To increase the acceptance and efficacy of zinc phosphide bait, do pre- baiting without poison.

Bromadiolone bait (0.005%): Take 1 kg of bajra or sorghum or cracked wheat or their mixture or flour and mix it thoroughly with 20 g of edible vegetable oil, 20 g of powdered sugar and 20 g of 0.25% bromadiolone powder. Poison bait placement and timings Baiting in lean period (May-June).

iii. Rodent Proof Storage Structure For rodent proofing of cover and plinth (CAP) storage structure under outdoor bulk grain storage conditions, built plinth at a height of 2.5 feet from ground level and extend platform by one foot in all the four sides of a plinth.

MANAGEMENT TECHNIQUES FOR HARMFUL BIRDS

I. Mechanical Control • Use crackers to scare the birds at different intervals. • Fixing of scare crows .The height of the scare crow should be 1 meter above from the crop height. • Use automatic bird scarers by shifting their position periodically. The other simplest method is the use of rope crackers. It involves tying of sets of small fire crackers at a distance of 6-8 inches apart and igniting it from the lower end.

II. To reduce bird damage to maize, reflective ribbons of polyester strips with metallic coating of red color on one side and silver on the other having 1.5 cm width should be used. Reflective ribbons should be installed about 30 cm above the crop canopy in parallel rows at 5 m distance in north-south direction at the milky stage of the crop.

III. Alarming Calls Playing of CD available to distress or flock calls of parakeets and crows respectively at peak volume for ½ hr twice each in the morning between 7.00 to 9.00 a.m. and in the evening at 5.00 to 7.00 p.m. respectively, with a pause of 1 hour, scare the birds or halt their activities for full day in the freshly sown, emerging or maturing crops fields and in orchards. Use of distress or flock calls remain effective for 15-20 days.

IV. Conservation of useful Birds: Predatory birds like owls, falcons, hawks, eagles, kites etc. eat large number of rats and mice. A single owl normally eats 4-5 rats a day. Insect eating birds like drongo, babblers, shrikes, lapwings, mynas and many other small birds eat away numerous insect pests.

CONCLUSION

According to World Bank Report (1999), post-harvest losses in India amount to 12 to 16 million metric tons of food grains each year, an amount that the World Bank stipulates could feed one-third of India's poor. Out of these post-harvest losses storage -insects alone account for 2.0 to 4.2 per cent followed by rodent's 2.50 per cent, Birds 0.85 per cent and moisture 0.68 per cent (Gustavsson *et al*, 2011). Through proper dissemination of knowledge to farmers and by use of proper and modern storage facilities these losses can be reduced and self sufficiency in food grains can be achieved.

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