



FACTORS AFFECTING GRAIN STORAGE

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FACTORS AFFECTING GRAIN STORAGE

1. Abiotic Environmental Factors

Temperature

Moisture

Oxygen Content

2. Biotic Environmental Factors

Micro-organisms(Mould, Yeast, Bacteria)

Insects

Coleopterans

Lepidopterans

Rodents and Mites

3. Storage methods

Bags

Bulk

Abiotic Environmental Factors

- Temperature and moisture (store and grain) are responsible for the accelerating or delaying biochemical processes within grain (especially the "breathing" of the grain) which exhibits the origin of grain degradation. Different biochemical changes of grain due to infestation will also induce excessive heating.
- Furthermore, they have a direct influence on the speed of development of insects and microorganisms (moulds, yeasts and bacteria).
- Stored products pests breed within the temperature range of about 15-42°C but the most important pest species breed within 18-38°C. Within this range the optimum temperature range falls between 25-33°C. The conditions beyond the minimum and maximum will either result in cold or heat stress.
- Temperature and humidity both are inter-related (higher the temperature, the lower must be the moisture of the grain). Most of the stored grain pest species breed faster under the humid condition, typically 60-80 % which in term of grain moisture content is roughly equivalent to 13-15 %. At higher humidity, the mould growth will result. Generally drier the condition (grain and store), less will be the pest infestation.

Duration of Grain Storage (in days)

	TEMPERATURE					
MOISTURE	5°C	10°C	15°C	20°C	25°C	30°C
13%				180	115	90
14%			116	100	50	30
15%			100	50	30	15
16%		130	50	30	20	8
17%		65	35	22	12	5
18%	130	40	25	17	8	2
19%	70	30	17	12	5	0
20%	45	22	15	8		
21%	30	17	11	7		
22%	23	3	8	6		
23%	17	10	7	5		
24%	13	8	4	4		
25%	10	8	6	3		

Moisture Contents of Stored Grain Recommended for the long storage

GRAIN	MOISTURE	GRAIN	MOISTURE
PADDY	14.0%	SUNFLOWER	9.0%
RICE	13.0%	WHEAT	13.0%
MAIZE	13.0%	MILLET	16.0%
SORGHUM	12.5%	COFFEE	13.0%
BEANS	15.0%	COCOA	7.0%
GROUNDNUT	7.0%	COPRA	7.0%

LOW OXYGEN CONTENT

- Like grain and micro-organisms, insects are living organisms that need oxygen.
- Storage of grain in places that are low in oxygen causes the death of insects, cessation of development of micro-organisms, and blockage, or slowing down, of the biochemical processes of grain degradation. This favours the conservation of grain, but may affect its germinating power.

Biotic Environmental Factors

Micro-organisms

- Micro-organisms (moulds, yeasts, bacteria) are biological agents present in the soil which, when transported by air or water, can contaminate products before, during and after the harvest.
- Their presence and growth cause severe changes in the nutritive value and the organoleptic features of grain (taste, smell etc.).
- Furthermore, they are responsible for the alteration of important germination properties of seeds (vigour and capacity to germinate) and, in the case of moulds, for the potential formation of dangerous poisons (mycotoxins).
- If greater the impurities, and cracked or broken grains, then faster the development of micro-organisms.
- Furthermore, temperature and humidity have a determining influence on the growth rate of these degradation agents.
- It has been observed that micro-organisms develop at temperatures between -8°C and $+80^{\circ}\text{C}$, when the relative humidity of the air is over 65 percent.
- On the contrary, atmospheres that are low in oxygen help in checking the development of these degradation agents.

INSECT PEST FACTOR

- Insect infestations can occur either in the field, before the harvest, or in grain stores
- In some cases, these infestations are difficult to observe with the naked eye, since the damage is provoked by the larvae developing inside the grain.
- The insects most likely to infest stored products belong to the following major groups:
 - Coleoptera (damage by larvae and adult insects)
 - Lepidoptera (damage only by larvae).
- Insects can be responsible for significant losses of product either by direct feeding or by infesting the grain with their body part or products or body secretions. Furthermore, their biological activity (waste material, respiration, etc.) deteriorates the quality and commercial value of the stored grain and faster the development of micro-organisms due to their excessive heat and moisture production.
- Insects can live and reproduce at temperatures between +18°C and +38°C.
- On the contrary, low humidity slows or even stops their development, and a low supply of oxygen rapidly kills them.

INSECT PEST FACTOR

Different Important stored grain insect pests are:

Red Flour Beetle

Lesser Grain Borer

Rice Weevil

Khapra Beetle

Dhora Beetle/ Seed Beetle

Saw Toothed Grain Beetle/ Silvanid Beetle

Angoumois Grain moth

Rice Moth/ Pyralid Moth

All these either act as Primary stored grain insect pest or secondary insect pest, thus exhibiting the quantitative or qualitative losses to grains. They may also produce foul or bad smell or off taste in the grain or in milling cereals.

RODENTS

- Rodents include rats, mice and are omnivorous thus feeding on grains, vegetables, fruits, meat etc.
- They cause serious damage not only to stored grains but also to packaging and even to storage buildings. They contaminate the grains with their excreta, urine, body hairs in addition to their grain consumption.
- The rodents that attack stored products, belong to the following species:
 - Black rat, also called roof rat (*Rattus rattus*),
 - Brown or Norway rat, also called sewer rat (*Rattus norvegicus*),
 - Mouse (*Mus musculus*).
- Prolonged attack by these pests results in serious quantitative and qualitative losses of stored products. They damage the 20 times the amount they actually consume.
- This contamination is as important from the marketing standpoint as it is for hygiene and health.

Mites

- These are small, tiny microscopic creatures that cause qualitative and quantitative losses to the stored grains.
- They reduce the germination ability of the seed.
- They may produce toxins to the stored food.

Storage Methods

- There are basically two methods of storage: in bags and in bulk.
- Bags can be stored either in the open air or in warehouses; bulk grain is stored in bins or silos of various capacities.
- The choice between these methods depends upon the objective of the storage, duration of the storage and amount of grain under storage (Storage at micro or macro level).
- The method selected may affect the grain storage or even the storage conditions which ultimately result in favour the attack of different stored grain pests.

General Instructions for the Storage of Cereals/ Pulse Grains in order to reduce spoilage and pest infestation

1. Cleaning/Grading/Sieving of Grains
2. Sun drying/ Heat Treatment
3. Treatment of grains with different plant extracts
4. Treatment of Storage structures/Stores
5. Superheating of stores
6. Cleaning of stores and plugging of crevices.
7. Maintaining the unfavorable/non-conducive conditions for the pest development
8. Fumigation with Al-Phosphide (Phosphine Tablets)
9. Regular monitoring of stores