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Seed and Seed Storage

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Seed Storage Seeds are uniquely equipped to survive, as viable regenerative organisms until the time and place are right for the beginning of a new generation. However like other form of life, they cannot retain their viability indefinitely and eventually deteriorate and die. Fortunately neither nature nor agricultural practice ordinarily requires seeds to survive longer than the next growing season, though the seeds of most species are able to survive much longer under the proper conditions. Objective of seed storage is to maintain initial seed quality viz., germination, physical purity, vigour etc., all along the storage period by providing suitable or even better conditions. Depending on the longevity of seeds during storage, seeds can be divided into two categories;

1. Orthodox Seeds: Orthodox seeds are long-lived seeds. They can be successfully dried to moisture contents as low as 5% without injury and are able to tolerate freezing temperatures. Most orthodox seeds come from annual temperate species adapted to open fields. At physiological maturity they contain moisture content of 30 – 50%.

2. Recalcitrant Seeds: They are short-lived seeds, which cannot be dried to moisture contents below 30% without injury and are unable to tolerate freezing. They are difficult to store successfully because of their high moisture content encourages microbial contamination and results in more rapid seed deterioration

Types of storage

1. Storage at ambient temperature and humidity:

Seeds can be stored in piles, single layers, sacks or open containers, under shelter against rain, well ventilated and protected from rodents and store at least for several months.

2. Dry storage with control of moisture content but not temperature:

Orthodox seeds will retain viability longer, when dried to low moisture content (4-8%) and then stored in a sealed container or in a room in which humidity is controlled, than when stored in equilibrium with ambient air humidity. Cool condition is especially favourable.

3. Dry storage with control of both moisture content and temperature:

This is recommended for many orthodox species which have periodicity of seeding but which are planted annually in large scale a forestation projects. A combination of 4-8% moisture content and 0 to 5° temperature will maintain viability for 5 years or more.

4. Dry storage for long-term gene conservation:

Long-term conservation of gene resources of orthodox agricultural seeds is -18°C temperature and 5±11% moisture content.

5. Moist storage without control of moisture content of temperature:

Suitable for storage of recalcitrant seeds, for a few months over winter. Seeds may be stored in heaps on the ground, in shallow pits, in well drained soils or in layers in well ventilated sheds, often covered or mixed with leaves, moist sand, peat or other porous materials. The aim is to maintain moist and cool conditions, with good aeration to avoid overheating which

may result from the relatively high rates of respiration associated with moist storage. This may be accomplished by regular turning of the heaps.

6. Moist cold storage, with control of temperature:

This method implies controlled low temperature just above freezing or less commonly, just below freezing. Moisture can be controlled within approximate limits by adding moist media e.g., sand, peat or a mixture of both to the seed, in proportions of one part media to 1 part seed by volume, and re-moistening periodically or more accurately by controlling the relative humidity of the store. This method is much applicable to temperate recalcitrant genera.

7. Cryopreservation:

It is also called as cryogenic storage. Seeds are placed in liquid nitrogen at -196°C. Seeds are actually placed into the gaseous phase of the liquid nitrogen -150°C for easy handling and safety. Metabolic reactions come to a virtual stand still at the temperature of liquid nitrogen and the cells will remain in an unaltered state until the tissues are removed from the liquid nitrogen and defrosted. Therefore, little detrimental physiological activity takes place at these temperatures, which prolongs the storage life of seeds. It is not practical for commercial seed storage, but is useful to store the valuable germplasm.

Factors influencing the life span of seeds:

1. Genetic factors: The storage is influenced by the genetic make-up of the seed. Some kinds are naturally short lived e.g. Onion, Soybeans, Ground nut etc., Based on the genetic make-up seeds are classified into Micro biotic - short lived Meso biotic - medium lived Macro biotic - long lived As a general rule starchy seeds can be stored considerably for a longer period compared to proteinaceous or oily seeds because of their hygroscopic nature.

2. Initial seed Quality: The physical condition and physiological state of seeds greatly influence their life span. Seeds that have been broken, cracked deteriorate more rapidly than undamaged seeds. Several kinds of environmental stresses during seed development and prior to physiological maturity can reduce the longevity of seeds. For example deficiency of minerals (N, K,Ca), water and temperature extremes. Immature small seeds within a seed lot do not store as well as mature and large seeds within a seed lot. Hard seediness also extends seed longevity.

3. Seed Moisture: Moisture content of the seed is one of the important factors influencing the viability of seed during storage. Over the moisture range, the rate of deterioration increases with increase in moisture. In general for every 1% decrease in moisture the store potential of the seed doubles (when the seed moisture is in the range of 4 – 14%). If the seed moisture content is in the range of 12-14 %, losses occur due to increases mould growth and if the moisture content is above 18-20% due to heating of the seed. Moreover within the normal range, biological activity of seeds, insects and moulds further increases as the temperature increases. The higher the moisture content of seeds the more they are adversely affected by both upper and lower ranges of temperature. At very low moisture content of 4 per cent seeds may be damaged due to extreme desiccation, or breakdown of membrane structure hastens deterioration. This probably a consequence of reorientation of hydrophilic cells membranes due to loss of water molecules necessary to retain their configuration. Since the life span of seeds largely depends on the moisture content it is necessary to dry it to safe moisture limits before storage. For cereals in ordinary storage conditions for 12-18 months the seeds should be dried to 10 – 12 % moisture content. However for storage in sealed containers (Hermetic packing) the seeds should be dried to 5 to 8 per cent moisture content.

4. Relative humidity and Temperature: the most important factors that influence the life span of seeds are relative humidity and temperature. The effects of R.H. and temperature of the storage environment are highly interdependent. Most crop seeds loose their viability at R.H. approaching 80% and temperatures of 25-30oC but can be kept for 10 years or longer at

R.H. of 50 % or less and a temperature of 5 oC to lower (Toole 1950). According to Harrington, 1973 because of interdependency the sum of the percentage of RH plus temperature in of should not exceed 100 for safe storage.

Harrington suggested the following thumb rules regarding optimum storage conditions.

1. For every 1% reduction in seed moisture the storage life of seed doubles
2. For every 10oF reduction in temperature doubles the life span of the seed.
3. The sum of relative humidity in percentage and temperature in of should not exceed 100.

The thumb rule applies to only when the seed moisture is in-between 4 and 14 %.

5. Provenance: It has already been stated that a number of factors operating before and during harvest can affect seed viability. The samples obtained from different sources may show differences in viability behaviour. The seeds harvested from regions of high relative humidity and temperature at the time of maturation or harvesting store less than the seed harvested from the regions of low relative humidity with moderate temperature.

6. Pre and post-harvest conditions: Environmental variations during seed development usually has little effect on the viability of seeds, unless the ripening process is interrupted by premature harvesting, weathering of maturing seeds in the field, particularly in conditions of excess moisture or freezing temperature results in a product with inferior storage potential. Mechanical damage inflicted during harvesting can severely reduce the viability of some seeds e.g. certain large seeded legumes. Cereals are largely immune from mechanical injury presumably because of the protective lemma and palea. Small seeds tend to escape the injury during harvest and seeds that are spherical tend to suffer less damage than do elongated or irregularly shaped ones. High temperatures during drying or drying too quickly or excessively can dramatically reduce viability.

7. Oxygen Pressure during storage: Increase in oxygen pressure during storage tends to decrease the period of viability. Use of antioxidants has increased the storage period in some of the crops. If seeds are not maintained in hermetic storage at low moisture contents or even under conditions of constant temperatures and moisture the gaseous environment may change as a result of respiratory activity of the seeds and associated micro flora.

8. Effect of storage conditions on the activity of organisms associated with seeds in storage: There are six main types of organisms associated with seeds in storage. They are bacteria, fungi, mites, insects, rodents and birds.

Bacteria: Bacteria probably do not play a significant role in seed deterioration. As germination is rarely reduced unless infection has progressed beyond the point of decay. Since bacterial populations require free water to grow, they cannot grow in stored seeds as the seeds are dry.

Fungi: Two types of fungi invade the seeds; field fungi and storage fungi. The field fungi invade seeds during their development on plants in the field or following harvesting while the plants are standing in the field. They cannot invade seeds during storage. Field fungi associated with wheat or barley in the field. They infect seeds only under storage conditions and are never present before, even in seeds of plants left standing in the field after harvesting. Major deleterious effects of storage fungi are to decrease viability, cause discoloration, produce mycotoxins, cause excessive heat and develop mustiness and caking.

Insects and Mites: Deterioration of seeds by insects and mites is a serious problem, particularly in warm and humid climates. Weevils, flour beetles or borers are rarely active below 8% moisture content and 18-20 oC, but are increasingly destructive as the moisture content rises to 15% and the temperature to 30 – 35oC. Mites do not thrive below 60% RH, although they have temperature tolerance that extents close to freezing. Hence for protecting the seeds from insects and mites the seeds should be stored at a moisture content of less than 10%, at a temperature of less than 20oCand the R.H. of less than 60%.

Rodents and Birds: Birds are constant source of seed loss in even small openings exists. All openings should be sealed or screened, if needed for ventilation. Rats and other rodents are more serious problems. Rodents can be prevented from entering the store by elevating the floor by 90 cm above the ground level, and it should have a lip like structure of 15 cm around the building at 90 cm level.

9. Other factors: Besides the above factors storage life is affected by number of times and kind of fumigation, effect of seed treatment etc.

General principles of seed storage

1. Seed storage conditions should be dry and cool
2. Effective control of storage pests
3. Proper sanitation in seed stores
4. Before placing seeds into storage they should be dried to safe moisture limits, appropriate for storage system.
5. Store only high quality seed i.e. seeds which are well cleaned, treated, with high germination and vigour.
6. Determine seed storage needs in view of period or length of storage time and preveling climate of the area during storage period. Long-term storage requires more exacting conditions of seed storage than short-term storage. Similarly, the regions with favourable storage climate, i.e., one where relative humidity is rather low, require less sophistication than areas of high relative humidity.