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Article :

Seed viability and factors affecting seed storage

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For most seed technologists and commercial seedmen, viability means that a seed is capable of germinating and producing normal seedlings. Viability denotes the degree to which a seed is alive, metabolically active and posses enzymes capable of catalyzing metabolic reactions needed for germination and seedling growth. This meaning deals with tissue viability as well as viability of the entire seed. Seed viability is probably highest at the time of physiological maturity though environmental conditions on the apparent plant may not permit germination. After physiological maturity, the viability of seed gradually declines.

Numerous Tests exist for determining seed viability, these are as follows:

Tetrazolium test (TZ test):

The tetrazolium tst distinguishes between viable and dead tissues of embryo axis on the basis of their relative respiration rate in hydrated state.

Vital coloring methods

i) Enzyme activity method.
ii) Oxidase method-I catalyse
iii) Oxidase method-II peroxidase
iv) Conductivity test
v) Excised embryo test
vi) X-ray tests
vii) Free fatty acidity tests

Majority of seed species are orthodox and confirm to certain thumb rules predict well to pattern of loss of viability in relation to storage environment. The basic viability equations are reasonably accurate for predicting viability percentage from a few days to several years.

Factors affecting seed viability :

Cultivars and Harvest Variability :

Different cultivars and harvest of a species may show different viability characteristics under the same storage conditions. Significant differences in viability period exist between genotypes within a species.

Initial viability :

It has been established that healthy, well mature seed with high initial germinating capacity will retain viability for longer period than that of seeds having low initial germinating capacity.

Preharvest and post harvest conditions:

The stage of maturity at harvest was found to influence both viability and longevity of the seed . The seeds harvested at pre milk stages were inferior in most instances in both viability and longevity to seeds harvested in e4ither the dough or mature stages.

Treatment to which seeds are subjected around harvest time may affect subsequent loss of viability. Mechanical injuries inflicted during harvesting can severely reduce the viability of some seeds e.g. Large seeded legumes.

The presence or absence of surrounding structures of the seed during storage itself can influence viability. E.g. Cereal grains with intact hulls retain viability longer than those threshed before storage.

Injuries those to vital parts of the embyo0nic axis usually bring bout more rapid loss of viability during storage than the injuries that located elsewhere.

Elevated temperature during drying too quick or excessively can reduce viability. It is often necessary to resort to artificial drying before storage if viability is to retain for a long period.

Moisture content of the seed at the time of storage is a very important factor that affects seed viability. The general range specified for the safe moisture content for various orthodox seeds is 9 to 12% accept paddy, which should be at 15%.

At higher moisture content storage fungi and store grain pests will attack it or at very low moisture content seed may loss its viability.

At low temperature and moisture content in the seed, the metabolic activity of the seed particularly respiration

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and is likely to increase in storage. Therefore the treatment of fungicides and insecticides at recommended rate under good storage condition will give significant effects.

Short wave treatment:
It is reported to be an easy and rapid method for destroying insect pests of stored seed. Germinating capacity of treated seed being unimpaired and sometimes even stimulated by such treatment.

Herbicides:
The seeds should not be stored where they will be exposed to vapors from the volatile esters of 2,4-D as these may adversely affect the germination of seeds e.g. maize, mustard. The life span of seeds can be prolonged by light treatment e.g. cabbage, cauliflower.

Seed treatment with solution of 4,6-biws-chloromethyl xylene (DCB) in propylene glycol dipropionate (PGDP) in 1:8 by weight will reduce the formation of free fatty acids during storage.

Tarr (1953) in Sudan found than cottonseeds steeped for 1 day has controlled reducing rate of germination.

Symptoms of Seed Deterioration:
Advanced stages of seed deterioration are evidenced by visible symptoms during germination ad seedling growth.

Physiological symptoms of Deterioration:
Loss of enzyme activity:
The most sensitive tests for measuring incipient seed deterioration are those, which measure activity of certain enzymes associated with the breakdown of seed reserves or biosynthesis of new tissue.

Reduced respiration:
Respiration is composite expression of the activity of large group of enzymes, which used together in breaking down seed reserves.

Increase in seed leachates:
A frequently observed symptom of deteriorated seeds is their increase leachate content when soaked in water. The degree of deterioration is associated with the concentration of seed exudates, which may be found in the steep solution.

Increased in free fatty acid content:
The increase in fatty acid of the seed is largely due to the invasion by fungi and is a major symptom of deterioration only at seed moisture contents above twelve percent.

Performance Symptoms:
Delayed seedling emergence is among the first noticeable symptom followed by a slower rate of seedling growth and development and decreased germination. Loss of field emergence potential is another frequently observed symptom of deterioration.Another symptom of deteriorated seeds is decreased resistance to environmental stresses during germination and early seedling growth.

Reduced storability as a sympto9m of deteriorated seed has came into focus in recent years. The relative performance of various seed lots offers a good indication of their storability under normal conditions.

Another subtle erect of seed deterioration with practical consequences is their reduced yield potential. This may occur even in the absence of the more obvious symptoms accompanying germination and seedling establishment.

The ultimate performance symptom of seed deterioration is the complete loss of germ inability and death of the seed.

Colour changes Associated with Ageing:
The seed coats of many species become brown with age especially when exposed to light. One study notes that aging is accompanied by browning of the embryo data were presented that indicted relationship between seed coat colour germination and vigor. Similar colour changes were used to distinguish between high and low viability seeds of crimson colour as a consequence of aging. In groundnut also seed colour changes with ageing.

Possible causes of seed Deterioration:
Seed deterioration occurs from a combination of several causes.

Depletion of Food Reserves:
This is one of the oldest theories of seed deterioration however it is not survived critical scrutiny. We know that the biochemical degradation process in dry seeds are almost imperceptibly small and could not occur for depleting the food reserves within the life span of most seeds.

Starvation of Meristematic Cells:
Respiration may deplete the tissues involved in the transfer of nutrition from reserve storage areas and prevent them from reaching the embryo. Nothing that meristematic cells, even though only a few cells away from abundant reserves of energy may die from lack of food or from injury.

reduced and growth of mould get inhibited. At temperature 17.2 to 23.9 0c moulds increase with increasing moisture contents above 15% while the viability of the seed is decrease.

Causes of seed deterioration in storage:
The optimum storage conditions for storing all seeds that endure air dryer or further desiccation ad adequate drying followed by sealed storage in absence of oxygen and at a low temperature and moisture content will maintain the seed viability. The storage requirement for the maintenance of viability varies for different types of seeds not only in relation to their genetical constitution but also with climate and length of storage. It can be said in general that under idea storage conditioned both the relative humidity and temperature are kept low.

Reduction of the moisture content of seeds to approximately 4-55 of their dry weight before placing them in sealed storage was effective in prolonging their life.

Storage in sealed container:
Many seeds retain their viability better in sealed containers than in open storage.

Oxygen concentration effect during storage:
Reduction in oxygen concentrations may increase longevity, which is either achieved by vacuum or by raising partial pressure of carbon dioxide, Nitrogen, Argon and Helium. In barley the deleterious effect of oxygen are more marked at higher moisture content and the advantages of oxygen free environment decreases as other storage conditions are improved under low temperature and low moisture content conditions. Controlled atmosphere is not much advantageous. But there may be advantages for short-term storage in conditions of high temperature and M.C. The insects and microorganisms, which normally cause deterioration of dump grain are killed by depletion of oxygen and production of carbon dioxide3 in inter granular atmosphere.

Storage gas:
In an atmosphere of nitrogen viability is considerably higher then seeds place in replenished air or oxygen e.g. peas, barley beans. Increase in storage life has been reported also for other seeds kept in atmosphere of carbon dioxide. E.g. maize, onion.

Micro flora infestation:
The bacteria are not involved in seed deterioration during storage, as they require free water to grow. The storage fungi are mainly species of the genera *Aspergillus* and *Penicillium*. They thrive only under storage conditions.
The major effect of storage fungi are to :
i) Decrease viability, ii) Cause discolorations, iii) Produce mycotoxins, iv) Cause head production, v) Development of mustiness and cracking.

Deterioration by insects and mites:
There is little or no activity of weevils flour beetles, and borers below 8% moisture content. But moisture content up to 15% and temperature of 30^{o}C insects activity is increase mites do not survive of insects infesting the grain and storage fungi. Whenever moulds are active, seeds lose viability rapidly.

Chemical changes in seed:
The accumulation of free fatty acids within seeds are responsible for their loss on viability as the long chain in saturated fatty acids cause swelling of isolated mitochondria and impairment of their normal functions.

Deteriorative changes in grains fat in storage may be either oxidative or hydrolytic.

The deterioration is generally of hydrolytic nature resulting in the production of free fatty acids and glycerol mainly in high temperature and moisture content and increase mould growth and causes deterioration. E.g. wheat, maize, cotton.

Respiration:
Any storage condition, which reduces the respiratory activity, tends to prolong seed viability. Higher rate of respiration is found to decrease the seed viability the accumulation of carbon dioxide has depressing effect on respiration.

Seed treatment related to storage:
Cereal seeds are sometimes dressed with fungicides such as organ-mercury preparations prior to storage. It is important for reducing attack of storage fungi. It should be applied at recommended rate, if some excessive quantities of it is retain open seed either it will kill the seed or produce abnormal seedlings. It has been noted that before storage if seed are treated with higher rate of ceresin it will decrease seed viability. Now a day's seed dressing organo-mercury compounds is banned being hazardous effect on human health. Fungicides like thirum are recommended.

Insecticides:
The insecticides has no effect on germinating capacity of the seeds, but the treatment of BHC creates hazards

Accumulation of Toxic Compounds:

Under low moisture storage the reduced respiration and enzyme activity may be responsible for the accumulation of toxic substances that reduce seed viability. Production of electrons during respiration affects the cell membrane permeability leading to death of cell.

Breakdown in mechanisms for Triggering Germination:

A strong case has been make for the breakdown of various triggering mechanisms as a cause of seed deterioration. It has been also noted that gibberllic acid also improved the germination and vigor of partially aged celery seeds.

Inability of Ribosome to dissociate:

Recent evidences indicate that dissociation of polyribosomes must occur before attachment of the preferred RNA can occur and lead to protein synthesis for the germinating seedling. In non-viable seeds the ribosome do not dissociate so no protein synthesis can occur.

Enzyme degradation and inactivation:

Decline in enzyme activity is a measurable symptom of aging but it is only a reflection of more basic changes in the enzymes themselves.

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