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Seed Storage - Biological Aspects

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SEED STORAGE - BIOLOGICAL ASPECTS

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Seed are living organisms. They must remain alive and in reasonably good condition if they are to produce the plants we want. This then becomes the objective of storage, to maintain seed in a good physiological condition until it is planted in the field. Since seed are alive, the many biological processes that maintain life are active in seed. The environment in which the seed is stored, the condition of the seed at the time it is placed in this environment and the species are the primary factors determining the length of time seed will remain alive and in good condition. The environmental factors, moisture and temperature have the most profound effect on the physiological quality of the seed because of their relationship to the biological processes in the living tissue and to the organisms associated with the seed in storage.

Seed reach maximum germination and a peak in quality when they reach physiological maturity or when they reach maximum dry weight. From this point on, the processes that lead to eventual death are active. We generally lump these processes together and call it deterioration. Although, we know little about the causes of deterioration, we are able to recognize and measure some of the effects, as well as recognize and control some of the causes.

The end result of deterioration is death, the complete loss of germination. However, seed may become virtually worthless for planting long before death occurs. We generally refer to this decline as a loss of vigor. Observable and/or measurable changes in seed as a result of deterioration are reduced growth rate, increased permeability, a reduction in the level of activity of at least some enzymes, increased susceptibility to stress conditions both hot-wet and cold-wet, changes in respiration, changes in food reserves or chemical changes, changes in color, changes in the rate of synthesis of compounds, increases in chromosomal damage.

The sequence of the deteriorative changes are diagrammed in Figure 1. You will recognize some of the above as the basis of proposed vigor tests. Reduced growth rate is the basis for first count, speed of germination, root and shoot growth tests. Increased permeability, that allows more materials to leach out of seed, is the basis for measuring the electrical conductivity or resistance of water in which seeds have been soaked. Changes in enzyme activity is the basis of the tetrazolium test and glutamic acid decarboxylase activity (GADA) tests. Cold test and accelerated aging tests are based on increased susceptibility to stress conditions. Free fat acidity changes are the results of changes in food reserves.

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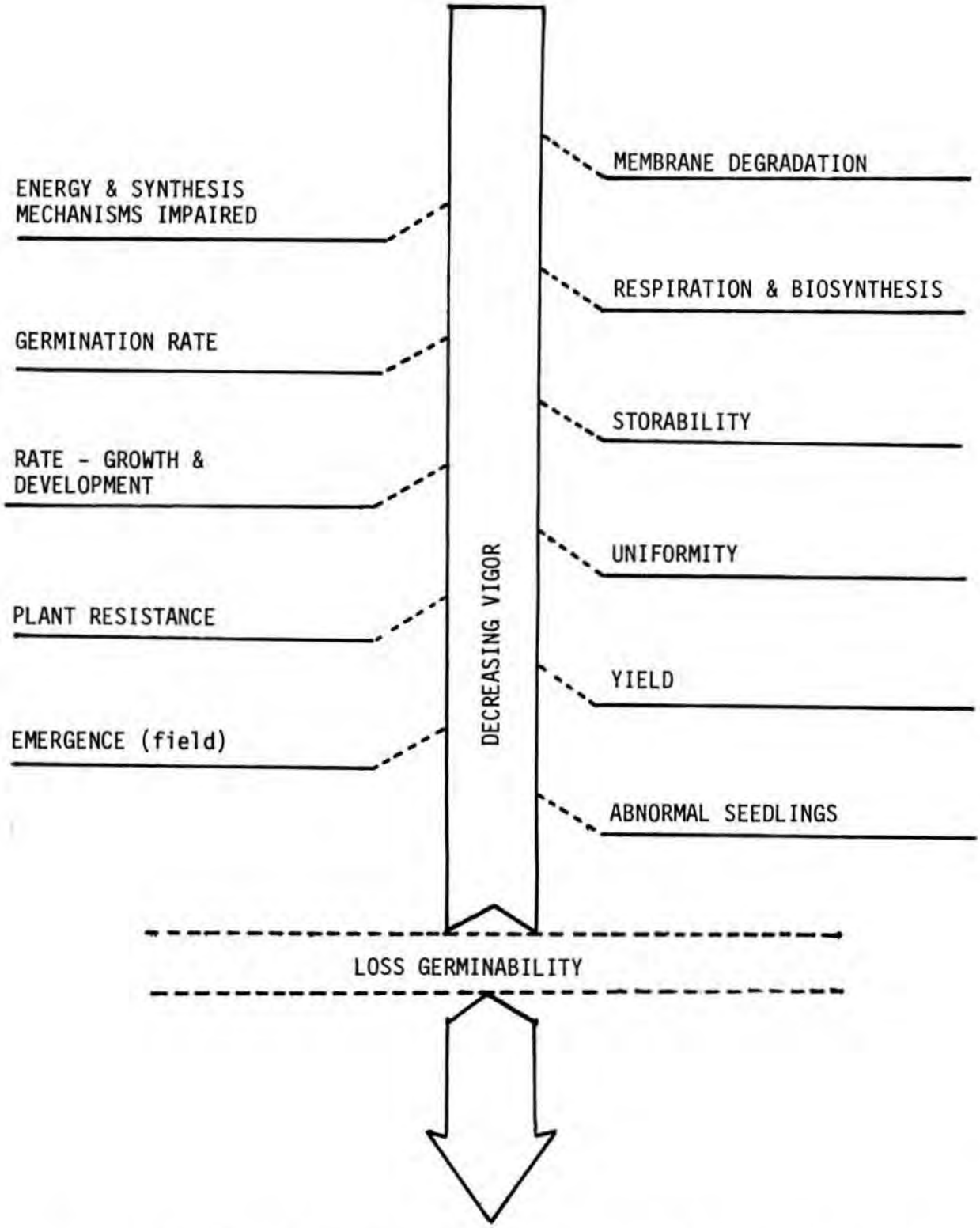

Figure 1. Probably sequential changes in a seed which result in its loss of vigor and death.

So, our ability to recognize and to some extent to measure the consequences of deterioration has been and will continue to be put to use in attempts to more accurately measure the value of seed for planting purposes.

Our aim is to keep deterioration to a minimum during the storage period. To accomplish this we must begin the storage with the highest quality seed possible. Since seed reach maximum quality at physiological maturity, we should allow seed to mature before harvesting. Not often do we harvest immature seed but when we do we should at least recognize that seed harvested before reaching physiological maturity will not be of the highest quality as was the case of much of the cottonseed harvested in the Southeastern United States in 1974.

Deterioration begins shortly after a seed becomes physiologically mature. This means that the process begins in the field before the seed are actually ready for mechanical harvest, and certainly before they can be stored without drying. The adverse affects of field exposure on the quality of seed is common knowledge to most of us.

The alternate wetting and drying of seed or raising and lowering the moisture content has a detrimental affect on seed quality. From a practical standpoint, seed should be harvested as soon as possible after physiological maturity to keep field exposure to a minimum thus minimizing deterioration prior to storage. There are many variables that influence harvesting decisions; equipment for harvest, time of the year, weather conditions, storage facilities and drying facilities to mention a few.

The two environmental factors having the most influence on seed quality in storage are relative humidity, which determines seed moisture content, and temperature. Seed moisture content is more influential than temperature. After a seed reaches physiological maturity, it begins to lose moisture. As the moisture content decreases, the rate of biological activity declines. The desired moisture content for safe storage depends on the species in question and the conditions under which the seed are to be stored. For ordinary storage conditions where temperature and relative humidity are not controlled and seed are not to be stored for an extended period (i.e. from harvest to planting or at most to a second planting season) a moisture content of 10 to 14 percent is considered safe for seed of most species. If seed are to be stored for extended periods, reduction of temperature and relative humidity will be necessary. If seed are to be stored in moisture proof or sealed containers, they must be 2 to 3 percent drier than for conventional storage.

Moisture content is important for two reasons. As seed moisture content increases, the level of biological activity increases thus increasing the rate of deterioration. If seed are stored above 12 to 14 percent moisture, fungi will be active. Insects will be active and reproduce. The activity of fungi and insects can lead to heating of seed, thus further accelerating the deterioration process. Seed above 18 to 20% moisture will heat regardless of the presence of fungal activity,

unless the temperature is kept quite low. Even then, deterioration at this moisture content is quite rapid.

The second problem concerning moisture content is getting seed too dry. Excessive drying can cause physical or a "mechanical-type" damage, especially in seed like soybeans. Extreme desiccation can cause damage to individual cells. It also can remove the protective layer of water at the subcellular level causing chemical breakdown that results in a loss of quality and viability.

As temperature increases the level of biological activity increases, although, the rate of deterioration due to temperature increases is not as dramatic as it is when seed moisture content increases. Dry seed, 10 to 12 percent moisture, can withstand most conventional storage temperatures if they retain this moisture level. Still, lowering the temperature of the seed mass helps maintain quality or retard deterioration. Seed mass temperature can be lowered rather easily by aeration where harvest occurs in the fall and aerating can be done on cool, dry days. Lowering seed mass temperature to around 50F to 55F is desirable. Periodic aeration throughout the storage period will not only keep temperatures in the desirable range but will also prevent moisture migration, thus keeping moisture evenly distributed throughout the seed mass. This prevents moisture accumulation in areas of the stored seed. Moisture accumulation will cause an increased rate of deterioration and could cause heating.