## ASPECTS OF SEED QUALITY *Earl W. Belcher 1/*

Seed quality is, in simplest terms, the regenerative value of the seed. The aspects of seed quality discussed in this presentation will include the indices by which quality is measured, their relationship to the biological processes of living seeds, proposed categories of seed quality and the best use of these categories.

### Quality Indices

Seed quality may be derived through the combination of three indices: germination capacity, germinative energy (also called vigor) and yield potential (also called survival) (Justice and Bass). Germination capacity and energy are generally measured in laboratory tests to provide a reproducible estimate of seed quality. The true planting value is obtained through the product of laboratory estimates and field survival counts. Quality, then, is a measure of the seed capacity and energy to germinate under given environmental conditions.

### BIOLOGICAL PROCESS

Seed is at its greatest quality at maturity (Justice and Bass). From that point on quality decreases due to the aging process until death is reached (fig. 1). The rate of decline is conditioned by many factors, some of which man can manipulate. Although the deterioration process can be prolonged, no way has been found to stop it. Thus, once deterioration has begun in a seed lot, it is on a steady course toward death.

Unfortunately, the initiation of deterioration often begins during seed processing, if not before. Seed lots at harvest contain much extraneous material, most of which is removed by cleaning. However, some fungi, bacteria, viruses and insects are not removed. These pathogens, along with mechanical damage due to poor handling, improper use of equipment or high extraction temperatures cause or hasten seed deterioration. In addition, chemical treatments to control fungi, insects and rodents may also affect germination and longevity.

Many of the storage fungi are actually osmophilic and grow best under relatively dry conditions. Some can invade seeds with moisture contents of 13 and 14 percent (Justice and Bass). Thus, lots which increase to these levels while in storage may become the result of accelerated deterioration where none had been previously observed. This is especially true if weak and dying seed are a part of the storage lot. Seed subjected to such conditions may become worthless for planting purposes long before death (Moore).

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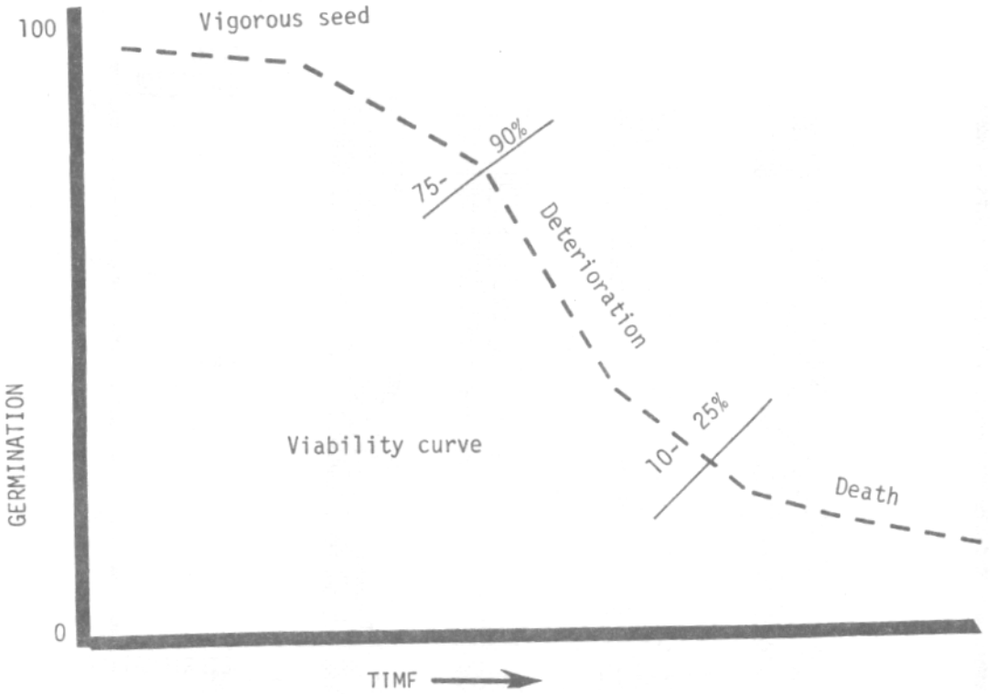

Figure 1. Aging of seed (Justice and Bass).

This then brings up a consideration which many seedsmen overlook. That is, the fact that some of the apparently sound seed are in a state of deterioration (fig. 2). Theoretically, we may assume the amount to be proportionate to that which is already dead. For example, seed which germinate 90% have 10% dead seed. Therefore, we may expect that 10% of the 90% sound seed (or 9%) is in some stage of deterioration. Likewise seed which germinate 30% possess 70% dead seed and we may therefore assume that 70% of the apparently sound seed (or 21%) is in some stage of deterioration. Obviously, by this assumption the lower the viability the weaker the seed.

In reality, this is a conservative but *very* close estimate of the true planting value. Actual laboratory and field measurements (table 1) are illustrated in Figure 3 with relationship to the theoretical approach. These measurements show that field results are slightly lower on high germinating seed and slightly higher on low germinating seed. However, in all cases the true planting value is below that of laboratory estimates and the poorer the seed quality the greater the difference. In turn, growth of seedlings from seed with low quality is also poor. Thus, with low quality seed there is a reduction in plant density as well as a decrease in the plant growth rate. Such plants are also more susceptible to environmental stresses following out planting and will produce lower field survival (Ovcharov).

Quality Categories

In reality, there is no one quality of seed but rather a series (fig. 4) between vigorous and nonvigorous seed (Heydecker). The best seed is eventually subjected to the aging process while damaged seed looses vigor immediately and dies soon after. These classes reflect the measurements of germination capacity and energy under different environmental conditions. Since survival is dependent on the strength of the seed and how quickly the seed can germinate, this series of vigor classes can be grouped into four basic categories (table 2) (Belcher).

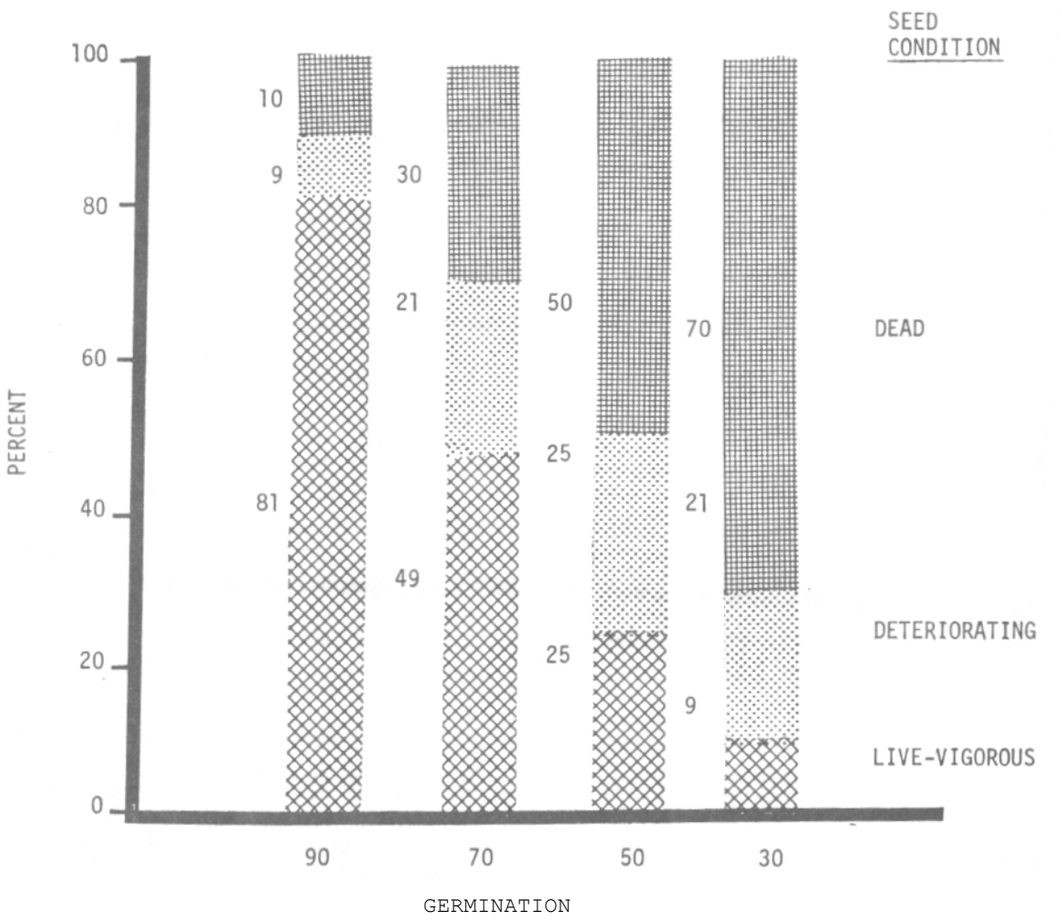


Figure 2. Seed Condition. The upper portion of the bars indicates the percent of the seed lot that is dead, the middle portion shows the percent of the sound seed which is in some stage of deterioration and the bottom portion gives the sound, vigorous seed.

Table 1. Maize plants germinated from seeds of varying quality. (Ovcharov)

| | | | | | |
|---|---|---|---|---|---|
| Energy of Germination (%) | 98 | 91 | 81 | 59 | 37 |
| Laboratory Germination (%) | 98 | 96 | 66 | 80 | 49 |
| Field Germination (%) | 78 | 77 | 54 | 40 | 11 |

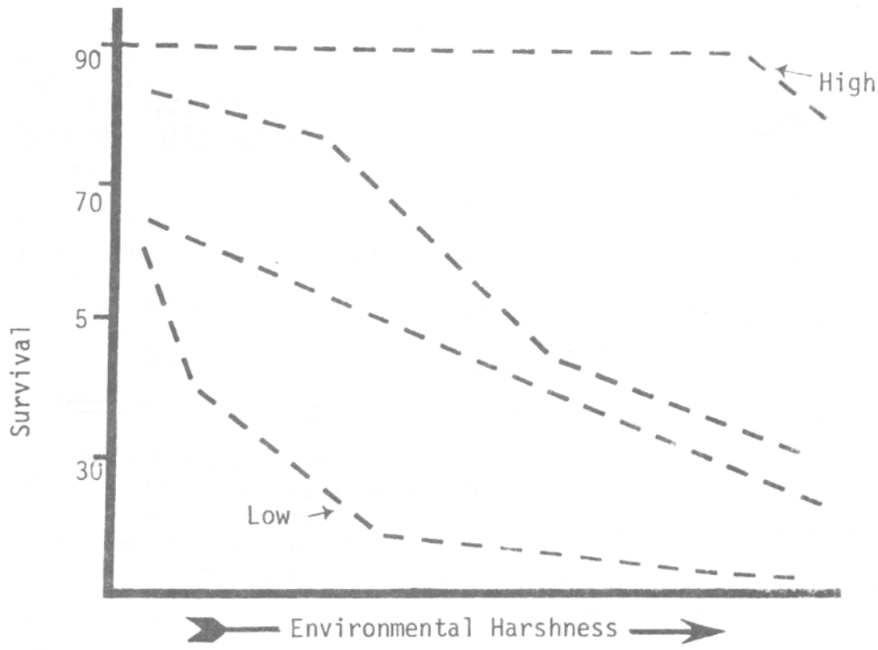


Figure 3. Relationship of lab and field measurements with theoretical seed quality measurements.

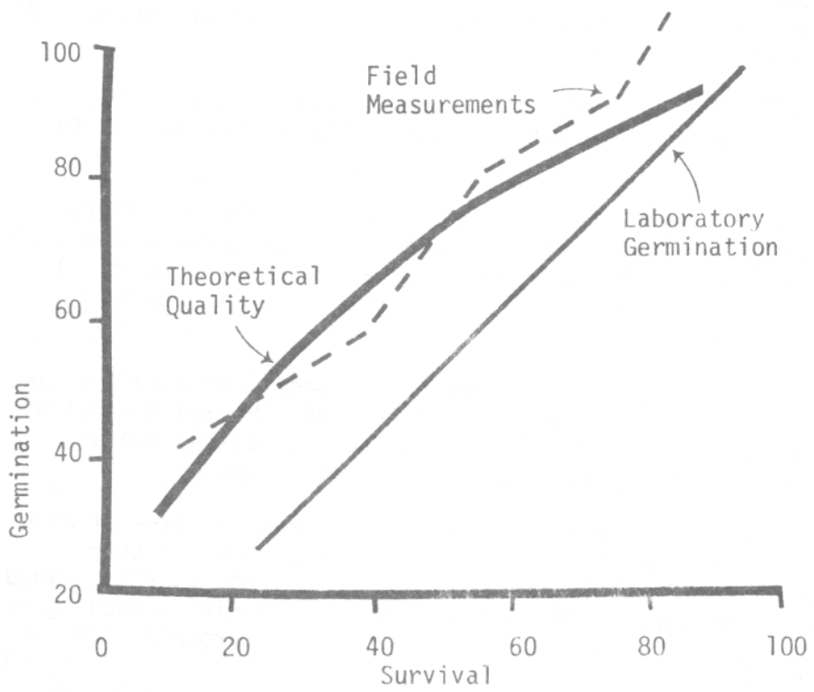


Figure 4. Seed quality as described by vigor classes.

Table 2. Categories of seed quality based on laboratory indicies.

| | GERMINATIVE | | |
|---|---|---|---|
| Category | Capacity | Energy | Approximate Germination Percent* |
| 1 | + (high) | + (high) | 85% |
| 2 | ± (medium) | + (high) | 70-84% |
| 3 | ± (medium) | - (low) | 50-69% |
| 4 | - (low) | - (low) | 30-49% |

*Approximate germination values have been inserted to associate the reader with values with which he is familiar. However, one must remember these only indicate capacity and do not necessarily reflect energy. The author also assumes that seed below 30% germination will have practically no energy and therefore would not be considered as a regenerative product.*

USE OF QUALITY SEED

The idea of high grading seed for containerization and sending the leavings to the bare root nursery suggests less than a financially sound operation. As pointed out by Eerden (1974), lower crop yields in bare root nurseries increase the cost of seedling production.

If we consider there are four uses of this seed: container planting, bare root nursery, direct seeding, or storage we may relate seed quality to these uses.

Container operations are very expensive and carrying empty containers or having to thin existing containers adds to the cost of seedling production. Therefore, only category 1 should be considered for a container program. If category #1 seed is not available then serious thought should be given to another method of regeneration.

The Bareroot Nursery has a more controlled environment and therefore can produce acceptable seedlings from category #1 and #2 seed. Having control of moisture and fertilization may strengthen otherwise weak seedlings and as long as the energy is high prompt germination is generally assured.

Direct seeding is a harsh environment with normal survival rates of about 20%. These are not due to weather or microclimatic pressures but rather predators such as rodents and insects. It is pointless to feed your best seed to the predators. Thus, category 2 and 3 are candidates for direct seeding or a combination of these. The high energy seed will germinate promptly leaving the poorer seed for predator food.

Storage should be reserved for the better seed of category 1 and 2. Why waste the space on seed which is on a fast course to death. If category #3 and #4 are to be stored they should be reclean and up graded first. If category #4 can not be improved it should be considered a liability. As a liability, the seed manager should consider whether the cost of handling and sowing of category #4 seed is substantially greater than the value of the seedlings to be produced. If so, a decision may be reached to discard the seed. Keep in mind that the planting value of seed is always less than the laboratory germination value and the difference increases as the quality decreases. Thus, a complete crop failure may result with category #4 seed. Such losses would include the cost of labor and supplies for planting as well as the cost of the seed and operating costs on the planting area.

Summary

Seed quality is estimated in the laboratory and then applied to environmental conditions through survival measurements. A broad range of qualities may be obtained but application is better discussed when grouped into four categories.

Seed quality is estimated in the laboratory through a combination of germination capacity and germinative energy. These measurements can be grouped into four categories as shown below, to provide practical guidelines for regenerative practices.

Literature Cited

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Heydecker, W. 1972. Vigour. In Viability of Seeds. E. H. Roberts (ed) pg.

| | Capacity | Energy | Use |
|---|---|---|---|
| #1 | high | high | container stock & bareroot nursery & storage |
| #2 | medium | high | bareroot nursery & direct seeding & storage |
| #3 | medium | low | direct seeding & recleaning |
| #4 | low | low | recleaning, upgrading or discarding |

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