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Glutamic Acid Decarboxylase Activity (GADA) and Seedling Growth Measurments as Tests for Seed Quality

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GLUTAMIC ACID DECARBOXYLASE ACTIVITY (GADA)[1] AND SEEDLING GROWTH MEASUREMENTS AS TESTS FOR SEED QUALITY

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GADA

Glutamic acid decarboxylase activity (GADA) is a test that measures the activity of one specific enzyme rather than a system of enzymes as does tetrazolium. The level of enzyme activity is determined by the amount of carbon dioxide (CO_2) given off and is positively correlated to seed quality, i.e. the more CO_2 given off the better the quality of the seed.

GADA appears to be better related to seed quality of grain rather than to quality of dicotyledonous species such as soybeans, cotton, etc.

GADA is closely related to the storability, root growth and yield of corn (2,3). Grabe (3) and Gill (1) have shown yield decreases of 8% and 14% respectively between high and low GADA in corn. Relationships exist between GADA and seed quality in oats, wheat and rice (4).

The equipment needed for this test is relatively inexpensive. It consists of a water bath for controlling temperature, simple, easy to make manometers, a scale for measuring manometer fluid movement, small containers (1/2 pint jars) and a small grinder.

Some of the advantages of GADA test are:

1. It is simple and easy to conduct.
2. It does not require a large investment in equipment.
3. It can be completed in a short period of time.

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[1] Complete procedures for GADA are available on request from the Seed Technology Laboratory, P. O. Box 5267, State College, Mississippi 39762.

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Crop varieties differ in GADA; therefore, comparisons for quality must be made within varieties and not between varieties. Also, GADA is too sensitive to be used as an indicator for stand establishment.

GROWTH RATE TEST

Growth rate tests will probably be well adapted and easily incorporated into a regular germination testing program.

Some advantages of grwoth test are:

1. They are simple and easy to conduct. Any technician can conduct growth tests.
2. They can be incorporated into a germination testing program at little or no expense.
3. Most growth rate tests can be easily standardized.

First Count:

This test can be incorporated into the standard germination test. The number of normal seedlings removed when the preliminary count of the germination test is made is an indication of the quality of the seed lot. The higher percentage of normal seedlings removed at the perliminary count the better quality the seed lot.

If the first count is to be used to compare different lots of seed over a period of several months, all first counts must be made at the same time interval after planting.

Speed of Germination:

If a more detailed test is desired, speed of germination may be used. This test can be incorporated into the standard germination test, but will require more time to evaluate than a regular, standard germination test. After the seed have begun to germinate they must be checked daily at approximately the same time each day. Normal seedlings are removed from the test when they reach a predetermined size. This procedure is continued until all seed that are capable of producing a normal seedling have germinated.

An index is computed for each seed lot by dividing the number of normal seedlings removed each day by the day on which they were removed after planting. Thus quality indexes of 15 (lot A) and 23 (lot B) are obtained in the following manner:

Lot A:	no. seedlings removed daily = day after plant.	$\frac{(0)+(0)+(0)+(2)+(2)+(4)+(4)+(3)}{1\ 2\ 3\ 4\ 5\ 6\ 7\ 8} = \frac{0+0+0+8+10+24+28+24}{1\ 2\ 3\ 4\ 5\ 6\ 7\ 8} = 15$
Lot B:	no. seedlings removed daily day after plant.	$\frac{(0)+(3)+(4)+(6)+(9)+(1)}{1\ 2\ 3\ 4\ 5\ 6} = \frac{0+6+12+24+45+7}{1\ 2\ 3\ 4\ 5\ 6} = 23$

Lot B would be considered the better quality of the two lots since the higher index indicates seed quality.

Root and/or Shoot Growth:

Another growth rate test that may be easily employed is root length or shoot length or both.

This test involves the measuring of the length of root (or root and hypocotyl) or shoot at a specified number of days after planting in the germinator. When using this system of comparison, the lot making the most growth is considered to have the highest quality. Only normal seedlings should be measured.

Root and/or shoot growth can be employed with grasses and grains. However, dicots will probably have to be limited to root or root and hypocotyl growth because of the slowness of epicotyl elongation in many dicot species.

The tests we have discussed thus far can be conducted in the laboratory with no additional equipment other than that required for standard germination tests.

In order to make valid comparisons of these tests both the conditions of the test and the conditions of germination must be very carefully controlled. If some replications become dry, for example, growth will be slower and the results of the test will be biased. If alternating temperatures are used the time of day when the tests are placed in the germinator will affect the result. For example, corn is germinated at an alternating temperature of

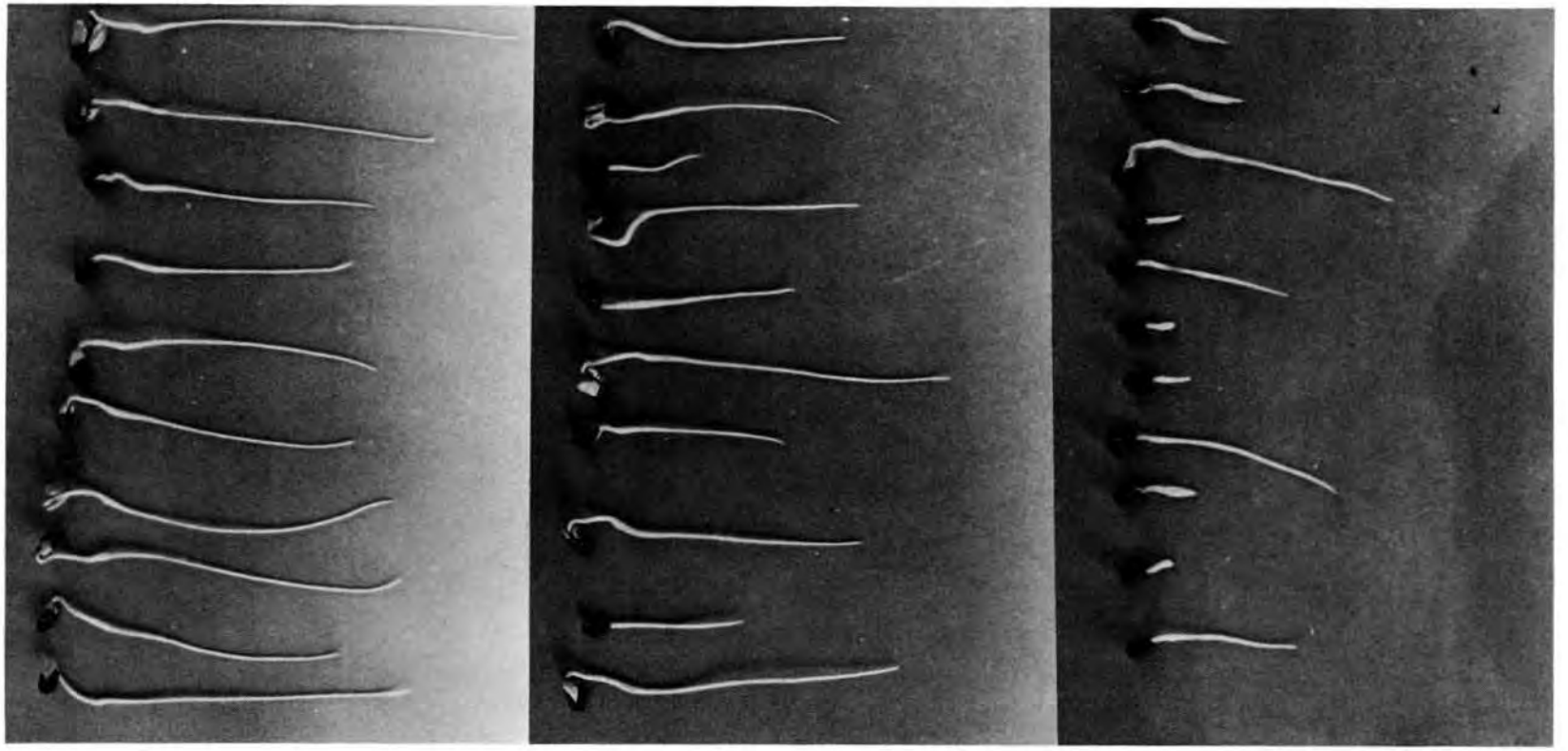

Figure 1. Differences in root growth indicating differences in seed quality. Top, high quality seed minimum deterioration, middle, seed lot beginning to deteriorate. Note, increased variation reduced growth of some seedlings. Bottom, seed lot too highly deteriorated germination about 60%.

20° - 30°C. If tests are placed in the germinator at the beginning of the 30°C. cycle and are compared with tests placed in the germinator at the beginning of the 20°C. cycle, we would expect the test which was begun at 30°C. to make more total growth than the test which was begun at 20°C., when measurements are made the same number of hours after the beginning of the test. If laboratory growth tests are to be used it would be well to consider using a constant temperature to avoid this problem.

Speed of Seedling Growth and Seedling Weights:

Several variations of laboratory growth rate tests may be used.

Total seedling growth in the greenhouse or field may be measured at a specified number of days after planting. The lot of seed producing the most growth per normal seedling is considered to be the best quality. Seedlings may be cut and weighed, fresh or dry, for additional information. Seedlings producing the most weight are considered to come from the better quality seed.

Emergence test will require additional facilities, mostly field plots and greenhouses and other investments outside the laboratory. Conditions in the greenhouse or field are much more difficult to control than those in the laboratory; therefore, results can be expected to be more variable.

Literature Cited

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