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INTERPRETATION OF TETRAZOLIUM TESTS^{1/}James C. Delouche^{2/}

The technique of the tetrazolium test has generally been known to seed analysts in this country for over 10 years. The potential usefulness of the test is recognized. Yet, only a few workers have effectively applied the method for rapidly determining the viability of seed. It appears that difficulties in interpreting the results of tetrazolium tests are largely responsible for the rather limited use of the test.

The technique of the tetrazolium test is relatively simple. Intact or bisected seeds are soaked for a period of time in a 0.1 to 1 % solution of tetrazolium. The length of the soaking period and the concentration of the solution vary with the kind of seed, whether the seeds are intact or bisected, and to some extent with the temperature. If the proper method has been used, the living parts of the seed stain bright red, while dead areas remain unstained. Seeds uniformly stained or unstained present no particular interpretation problem. However, when both stained and unstained areas are present on the same seed, proper interpretation is essential.

In interpreting tetrazolium test results, it is very important that the person performing the test have a clear understanding of seed morphology and seedling development. Knowledge of the relative importance of the various seed organs in each species is essential.

The morphological basis for interpretation can perhaps best be illustrated by considering interpretation problems in the legumes and large-seeded grasses,

^{1/}A more comprehensive treatment of this subject is contained in a bulletin "Rapid Viability Tests", available upon request from the Mississippi Seed Technology Laboratory.

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two important groups of crops.

Legumes

A soybean seed with the seed coat removed is illustrated in Figure 1 A. The seed (excluding seed coat) consists of three organs: cotyledons, radicle, epicotyl. Each of these organs has a particular function. The cotyledons are food storage organs and supply the basic nutritional needs during germination and development of the young seedling until it becomes established. The radicle develops into the primary root. The epicotyl develops into the aerial portions of the plant. Thus, each organ is essential for normal seedling development. The cotyledons, however, can be dead in certain areas and still function to the extent that a normal seedling develops.

The critical area in legume seed is indicated in Figure 1 B. The area includes the radicle, and the area of attachment of the radicle and cotyledons. This vital area, which includes the epicotyl, must be alive for normal seedling development. As previously indicated, minor dead areas of the cotyledons do not prevent normal seedling development. However, if the dead areas are extensive, normal seedling development will generally be prevented.

Morphologically, the seeds of most legume species are similar, with the exception of size an alfalfa seed is similar to a soybean seed. Thus, interpretation problems in the legumes are also similar.

Large-seed grasses

A bisected corn seed is illustrated in Figure 2 A. It can be readily seen that the internal structure of corn is much more complex than that of soybeans. The seed consists of the pericarp or seed covering, endosperm or food storage organ, scutellum or modified cotyledon, and an embryonic axis consisting of the plumule and radicle. The endosperm is non-living tissue and does not stain upon treatment with tetrazolium. Like the cotyledons it supplies the nutritional needs during

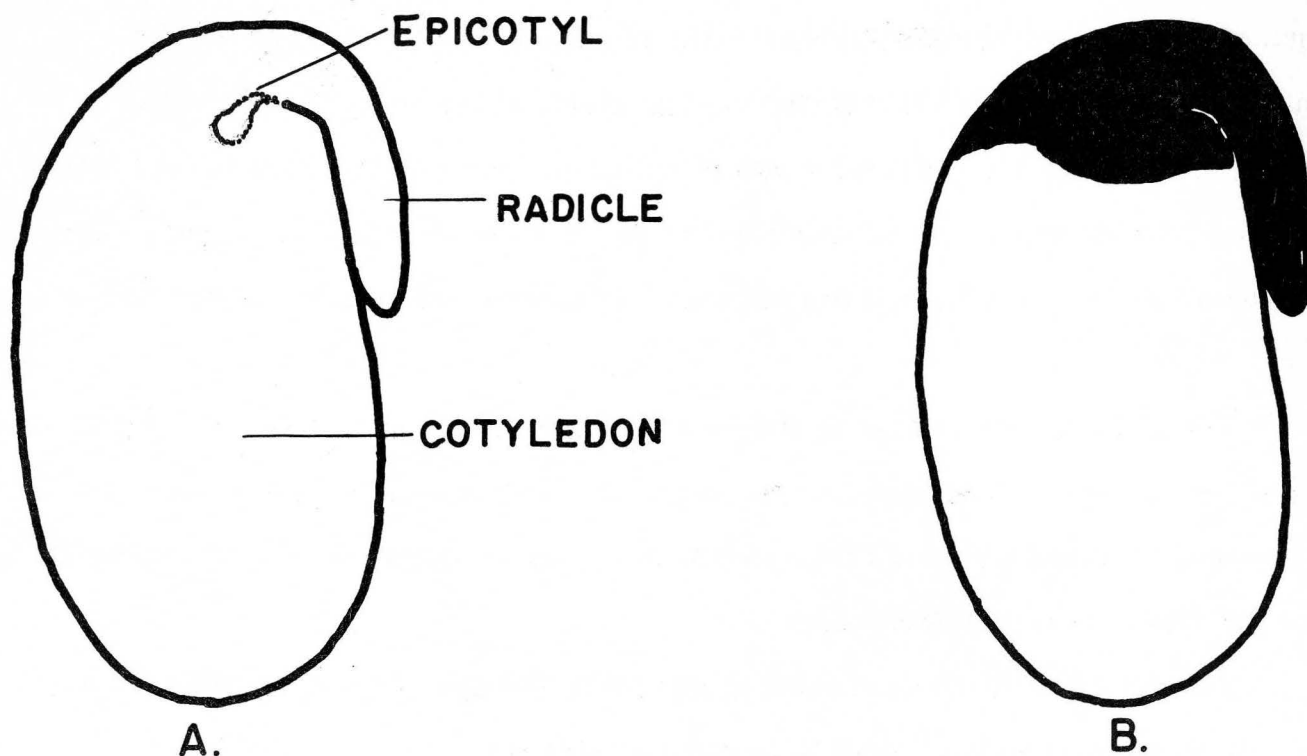


Figure 1. A. Structure of the soybean seed. B. Soybean seed with "vital" area indicated in black.

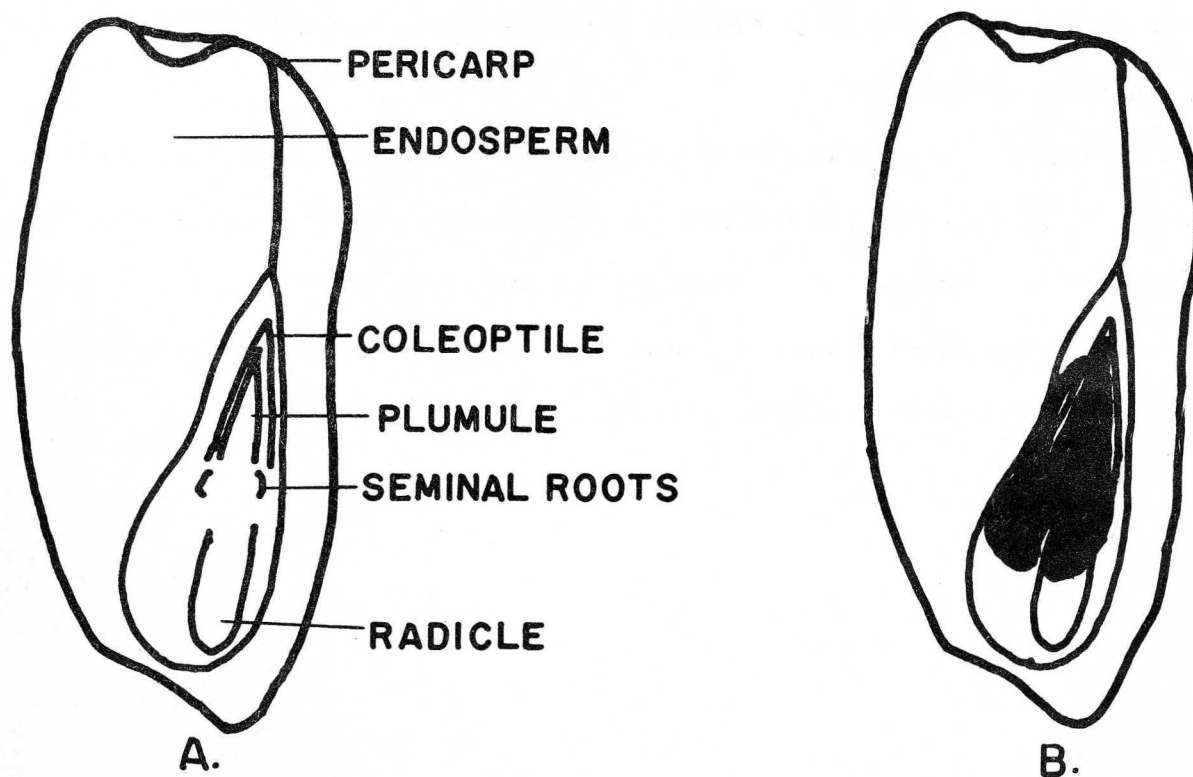


Figure 2. A. Structure of the corn seed (longitudinal section). B. Corn seed with "vital" area indicated in black.

germination and seedling development. The scutellum is living tissue and functions in food mobilization and transport. The plumule develops into the aerial parts of the plant and the radicle develops into the primary root. In grasses, however, the primary root is not so important as in the case of legumes. Other roots--the seminal roots--develop and are adequate for normal seedling and plant development.

The critical area in corn is indicated in Figure 2 B. It includes the plumule, central portion of the scutellum, upper part of the radicle and the region between plumule and radicle from which the seminal roots arise. These vital areas must be alive for normal seedling development.

The structure of the corn seed is typical of the grasses and the above statements apply equally well to other large-seeded grasses.

While minor dead areas might not prevent normal germination and seedling development of seed, they are indicators of deterioration and provide useful information regarding seed vigor.

The illustrations above indicate the importance of a knowledge of seed morphology in interpretation of tetrazolium test results. Much information, however, needs to be obtained before more precise and detailed interpretation criteria can be developed. Widespread use of the tetrazolium test will depend upon development of these criteria. Considerable work is currently underway to provide such information.