Seeds, as reproductive units, are expected to produce plants in the field. However, farmers and seed producers have long recognized that the labeled germination often overestimates the actual field emergence of seed lots. This occurs because by definition, germination is the “emergence and development from the seed embryo of those essential structures which, for the kind of seed in question, are indicative of the ability to produce a normal plant under favorable conditions (AOSA 2000).” As a result, the standard germination test may fail to provide accurate information concerning a seed lot’s field performance potential for at least four reasons. These include the following.

1. The definition of seed germination emphasizes that the seed analyst must focus on essential structures which lead to the production of a normal plant. But, this emphasis on seedling morphology may have little relationship with rapidity of growth; a prime element in the potential for successful stand establishment.

2. Methodology for the conduct of a germination test is standardized so that test results are reproducible within and among seed testing laboratories. This process means that favorable conditions are utilized as described in the definition to ensure greater uniformity in test results. Tests must be conducted on artificial, standardized, essentially sterile media in humidified, temperature controlled chambers; conditions that are so synthetic that they seldom relate to field conditions that seeds are likely to encounter. In essence, because the standard germination test is conducted under favorable conditions, it basically establishes the maximum plant-producing ability of the seed lot. When field conditions are optimum, the standard germination test may correctly predict field performance of the seed lot. For the most part, however, standard germination values overestimate actual field emergence. We know, for example, that when the standard germination test result is 80%, actual emergence under field conditions seldom reaches 80%. In most instances, the field emergence is considerably less.
3. The standard germination test is designed to provide for a first and final count. The first count has a purpose of basically removing most of the strong seedlings that have already germinated. The final count is designed to provide a sufficiently long period that even weak seeds are coaxed or provided every opportunity to be considered germinable. The germination percentage, therefore, is the sum of strong and weak seedlings. The difficulty with such a process is that weak seedlings seldom perform adequately when provided environmental stresses associated with field emergence.

4. By definition, germination is scaleless. A seed is considered either germinable or it is not. There are no distinctions provided for strong or weak seedlings. Those considered germinable may vary from weak to semi-lame to robust in field performance. This inability to document the quality of the seed fails to take into account the progressive nature of seed deterioration, which has a major impact on stand establishment.

These deficiencies have led to a continuously disquieting murmur for years that not all facets of seed quality were being properly identified by the standard germination test. As a result, it is useful to review the history and development of seed vigor testing.

**HISTORY OF SEED VIGOR TESTING**

In 1876, Fredrich Nobbe first distinguished the concept of seed vigor from that of germination. He introduced the term *triebkraft*, which means driving force or shooting strength to convey the idea that, in addition to germination, speed and uniformity of emergence were important parameters of seed quality. However, it was not until the 1950 International Seed Testing Congress that renewed interest was focused on seed vigor. At that time, European and American laboratories were expressing concern that germination test results were not standardized. In an attempt to explain these disparities, Franck (1950) pointed out the differing concepts of germination testing between European and American laboratories. He noted that in Europe, germination tests were made under optimum, reproducible conditions, to assure that seed lots could be sold across national boundaries, while special tests, such as the brick grit and soil tests were developed to evaluate "seedling vigor." The American concept of germination, which was based on soil test results, was to determine the plant-producing ability of a seed lot. Franck (1950) contended that both groups needed to come to grips with these differing philosophies. To start the debate, he proposed that germination testing should be conducted under favorable conditions in order that uniform test results be obtained. The plant-producing ability in the field of a seed lot was to be defined by a new term: vigor.

**Definition of Seed Vigor**

The development of a satisfactory definition of seed vigor has been a central theme in the development of vigor tests. Without a definition, the ability to measure or test this undefined entity becomes difficult, if not impossible. Fortunately, many definitions have been proposed and a study of their evolution portrays the initially confusing and changing status in the expectations for seed vigor. As an example, in 1957, Isely defined seed vigor as "the sum