

UNDERSTANDING SEED VIGOUR

Prepared by the ISTA Vigour Test Committee

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INTRODUCTION

High germinating seed lots may differ substantially in field emergence when sown at the same time in the same field, and/or may differ in performance after storage in the same environment or transport to the same destination. The questions that must be asked when looking at the germination data for these seed lots are: "Were the germination results wrong?" and "Why the difference in performance?" The answer to the first question is no, the germination results were correct. The answer to the second question is that it has become apparent that the germination test is not sensitive enough to indicate subtle but significant quality differences among high germinating seed lots. These differences are caused by another component of seed quality, seed vigour.

WHAT IS SEED VIGOUR

Seed vigour is defined as "the Sum total of those properties of the seed which determine the level of activity and performance of the seed or seed lot during germination and seedling emergence". In any seed lot, losses of seed vigour are related to a reduction in the ability of seeds to carry out all the physiological functions that allow them to perform. This process, called physiological ageing (or deterioration), starts before harvest and continues during harvest, processing and storage. It progressively reduces performance capabilities, due e.g. to changes in cell membrane integrity, enzyme activity and protein synthesis. These biochemical changes can occur very quickly (a few days) or more slowly (years), depending on genetic, production and environmental factors which are not yet fully understood. The end point of this deterioration is ultimately death of the seed (*i. e.* complete loss of germination). However, seeds lose vigour before they lose the ability to germinate. That is why seed lots that have similar high germination values can differ in their physiological age (the extent of deterioration) and so differ in seed vigour and therefore the ability to perform. These seed vigour differences exist in seed lots of agricultural, horticultural and silvicultural species.

THE NEED FOR MORE QUALITY INFORMATION

Germination testing remains the principle, and internationally accepted, criterion for seed viability. Germination test results less than an acceptable standard (for example 90% for temperate herbage grasses) usually reflect seed deterioration, and indicate that the seed lot performance may be poor. However for high germinating seed lots, the germination test result alone may not provide enough information as to potential seed lot performance. It is in these circumstances that the vigour status of the seed lot becomes important and vigour testing necessary.

SEED VIGOUR TESTS

Any seed vigour test must be able to provide a more sensitive index of seed quality than the germination test and provide a consistent ranking of seed lots in terms of their potential performance. It must also be objective, rapid, simple and economically practical, reproducible and interpretable. Internationally many vigour tests have been proposed. Some have gained wide acceptance (for example the cold test for *Zea mays* L. and the conductivity test for *Pisum sativum* L.), while others have been proved of value in a local context only (within country). Unfortunately some tests have inherent procedural or interpretation problems and fail to meet the requirements of a vigour test.

After many years of comparative vigour testing, the ISTA Vigour Test Committee has concluded that vigour tests which consistently rank seed lots in terms of their potential performance in the field and/or in storage can be standardised. Single tests based on some aspect of germination behaviour (e.g. the accelerated ageing and cold tests) along with the conductivity test show the most promise for this purpose. The primary objective of such tests is to indicate to the seed purchaser, or seed store manager, whether or not trouble may be expected from a high germinating seed lot if the lot is placed under environmental stress in the field, in storage or during transit. These tests do not produce a planting or storage index. Such indices are not possible because of the complexity and variability of factors involved in any planting/storage environment.

Vigour testing methods are published in the ISTA Handbook of Vigour Test Methods. These are recommendations only, and are not yet included in the ISTA Rules for Seed Testing. The ISTA Vigour Test Committee will introduce a Vigour Testing Chapter into the Rules once ISTA is satisfied that results are consistently reproducible among seed testing laboratories.

WHAT ARE THE CONSEQUENCES

FOR SOWING

When seed bed and environmental conditions are close to ideal, field emergence will correlate well with germination and seed lot vigour is not an important factor. However, optimum field conditions are not often encountered in practice, and environmental stresses (e.g. low or high soil temperature, excess or low soil moisture) may lead to varying field performance depending on the vigour status of the seed lot. This may cause differences in emergence level or rate, differences in uniformity of crop growth, and in some species differences in both vegetative and reproductive yield. High vigour seed lots will perform better under environmentally stressed seed bed conditions than low vigour seed lots, even though the laboratory germination of the lots may not differ.

FOR STORAGE

The storage potential of seed lots is related to their stage of deterioration (vigour status) on entering storage. If the storage environment exerts any form of stress (e.g. changes in temperature or relative humidity in uncontrolled storage), high vigour seed lots will be better able to withstand such environmental stresses and will decline in quality at a slower rate than lower vigour seed lots. Even under controlled storage conditions (i.e. low temperature and low seed moisture content), performance after storage is dependent on the vigour status of the seed lot.

USES OF SEED VIGOUR

The assessment of seed vigour has important implications for the seed industry and seed consumers. Vigour tests are commonly used by seed production companies to establish "in house" seed quality standards, to monitor seed quality during the various phases of seed production and processing. This allows them to identify where losses of seed vigour occur, and to identify practices which could subsequently lead to improved seed vigour. Seed store managers may use vigour test results to make better informed decisions about the suitability of seed lots for storage, the possible length of storage time and the storage conditions required. Seed exporters can use vigour information to decide which seed lots can withstand the rigours of transport and thus be expected to arrive in the importing country with quality unimpaired. For the ultimate consumer, the farmer, it would be advantageous to know the vigour status of each high germinating seed lot before making any decision as to which one to buy. Such information will not usually provide an expected field emergence value, but will indicate whether a seed lot is of high or low vigour, and therefore indicate which seed lots will be more likely to perform under sowing conditions which provide some form of stress.

CONCLUSION

Future research will provide more information about which seed production practices impair seed vigour, and the steps necessary to improve the vigour status of seed lots. However, there will always be a requirement for vigour testing, as an important component of seed quality. Seed testing laboratories only perform vigour tests at the request of the client. How a seed industry chooses to use vigour test results will differ from country to country and species to species. One fact that is common internationally however, is that the ultimate user must be properly educated on the subject of seed vigour, before vigour test results can be effectively interpreted and understood.

The ISTA Handbook of Vigour Test Methods can be purchased from the ISTA Secretariat, Zurich, Switzerland.