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POST HARVESTSEED QUALITY ASSESSMENT

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The marketing of seed in New Zealand and the servicing of a large seed export market has traditionally been controlled by the New Zealand Seed Trade. The price which seed commands, however, is capable of wide variation depending on such factors as the overseas demand, the perceived value of the species and cultivar and perhaps by the reputation our seed has in many of the approximately 45 countries who buy seed from New Zealand. In setting the price of a seedlot in any particular selling situation emphasis is also placed on the analytical aspects of seed quality – particularly germination percentage, but also physical purity and freedom from certain weeds, e.g. wild oats *(Avena fatua)* and nodding thistle *(Carduus nutans).*

In recent years there has become more interest in the term 'quality' in seed. This has lead to a greater interest in the development of relatively quick and reliable seed quality testing methods which can be used to expose seed weaknesses which may not be detected in normal laboratory tests for purity and germination.

Various rapid methods for testing seed quality have been developed to allow distinction to be made between seedlots of high potential storability and vigour and seedlots which have already begun to deteriorate. Such tests can also be used to detect possible causes of deterioration and whether this has occurred as a result of mechanical injury during threshing, poor drying technology, damage during processing or seed treatment, or to deterioration due to respiration heating, fungal activity or poor storage conditions.

This paper examines the use of post-harvest seed quality assessment techniques such as tetrazolium testing, vigour testing, heat and storage fungal tests, accelerated ageing methods and x-ray analysis for determining seed quality in maize. The methods shown however, may be equally applicable to a much wider range of seed species.

A. Tetrazolium Testing

This biochemical test allows living tissues to be distinguished from dead tissues by their ability to reduce colourless 2.3.5-triphenyl tetrazolium chloride solution (0.5%) to red, stable, non-diffusible triphenyl formanzan. This makes it possible to distinguish the red stained living parts of a seed from the colourless dead areas. Treated seeds fall into three groups completely stained viable seeds; completely unstained non-viable seeds; and partially stained seeds. The overall staining pattern and the varying proportions of stained tissues occurring in different parts of partially stained seeds can be used to determine likely seed storage life and previous injury due to mechanical damage or poor drying. Since tetrazolium chloride is phytotoxic all treated seeds are subsequently non-viable.

B. Vigour Testing

The term 'seed vigour' is being used increasingly by agronomists, seed technologists and associated specialists investigating the relationship between laboratory seed germination and the field performance of crops. Essentially, vigour tests have been produced in an attempt to identify seedlots which are capable of rapid and uniform seedling emergence in the field and seedlots with high emergence ability in unfavourable conditions. Many factors induce variations in the level of seed vigour including genetic constitution, stage of maturity at harvest, seed size and weight, mechanical integrity, pathogens, ageing and deterioration. One example of a direct vigour test is the cold test, chiefly used for maize, which determines whether germinating seeds and emerging seedlings can survive sub-optimal temperatures and the accompanying attack by soil and seed-borne organisms. Speed of germination, and the ability of seedlings to emerge from depth in the soil have also been suggested as useful guides to 'vigour' in seed. The electrical conductivity test has now become more widely accepted as a 'vigour' test for pea seed moving in international trade. This test measures differences in the levels of sugar leached from seeds into a known volume of water. Poor quality seedlots record high levels of soluble sugars measured on a conductivity meter. High quality seedlots record low levels of leachate.

The development and use of vigour tests should be encouraged as a useful supplement to laboratory germination testing. This is particularly the case with precision-sown crops in which uneven seed performance prevents the full expression of the potentialities of the cultivation and sowing methods used.

C. Heat and Storage Damage Tests

Storage fungi are a major cause of spoilage in seeds. Their presence can therefore be used to determine whether seed has been deteriorated by exposure to environmental conditions which favour the development of storage fungi. Such conditions of high temperature and moisture are encouraged in seed by harvesting out of condition, respiration heating or by the storage of seed at unsafe moisture contents. The presence of species of *Aspergillus* or *Penicillium* is therefore useful as an indicator of seed deterioration and can be readily detected by plating seeds onto high salt media such as malt-salt-agar.

D. Accelerated Ageing Tests

The storage of seed at high moisture contents in a hot environment greatly speeds the process of deterioration. This 'accelerated ageing' system provides the basis for distinguishing between seedlots which deteriorate rapidly and therefore have potentially poor storability and better quality seedlots which resist deterioration under accelerated ageing conditions. The technique involves imbibition of water at 5°C for 24 hours and storage of seed in a sealed container at 40°C for 24-72 hours depending on the species. Germination tests are then used to detect differences in seed quality,

E. Radiography

Seed radiography is based on the principle that different parts of a seed absorb soft x-rays to different extents. Such an x-ray contrast method also reveals gross internal details allowing a distinction to be made between empty and full seeds which show internal disruption due to internal cracking, embryo disorientation or insect damage. This method has been used successfully on a range of species, including forest tree seeds, grasses including maize and in sugar beet. The maize seeds in Plate 1 were photographed using a Faxitron Cabinet x-ray system onto Polaroid 4 x 5 Land Film type 55 pos/neg. Four quality assessment characteristics are apparent.

1. Very dark seeds (D) are dead.

2. Seeds showing embryo disorientation (E) have been mechanically damaged during threshing and are likely to produce abnormal seedlings.
3. Seeds showing vertical (V) or transverse cracking (T) have been damaged during threshing or drying. Transverse cracking generally occurs as a result of mechanical damage whereas vertical cracking is more often associated with steep moisture gradients formed as a result of fast and high temperature drying.
4. Insect damage (1) is readily seen.

The X-ray contrast method is very rapid, very conclusive and has the advantage that X-rayed seeds can subsequently be sown to ratify results. This latter aspect is an obvious advantage over the tetrazolium test.

These quality assessment methods have value in providing additional information to that provided on an official Certificate of Analysis. As a result they provide extra information which can be used by seed purchasers, traders, quarantine authorities and producers to distinguish between seedlots which, although they may have identical or similar quality levels in laboratory purity and germination tests, may subsequently perform very differently in storage or in the field. They therefore allow a more expansive and comprehensive assessment to the term 'quality' in seed.

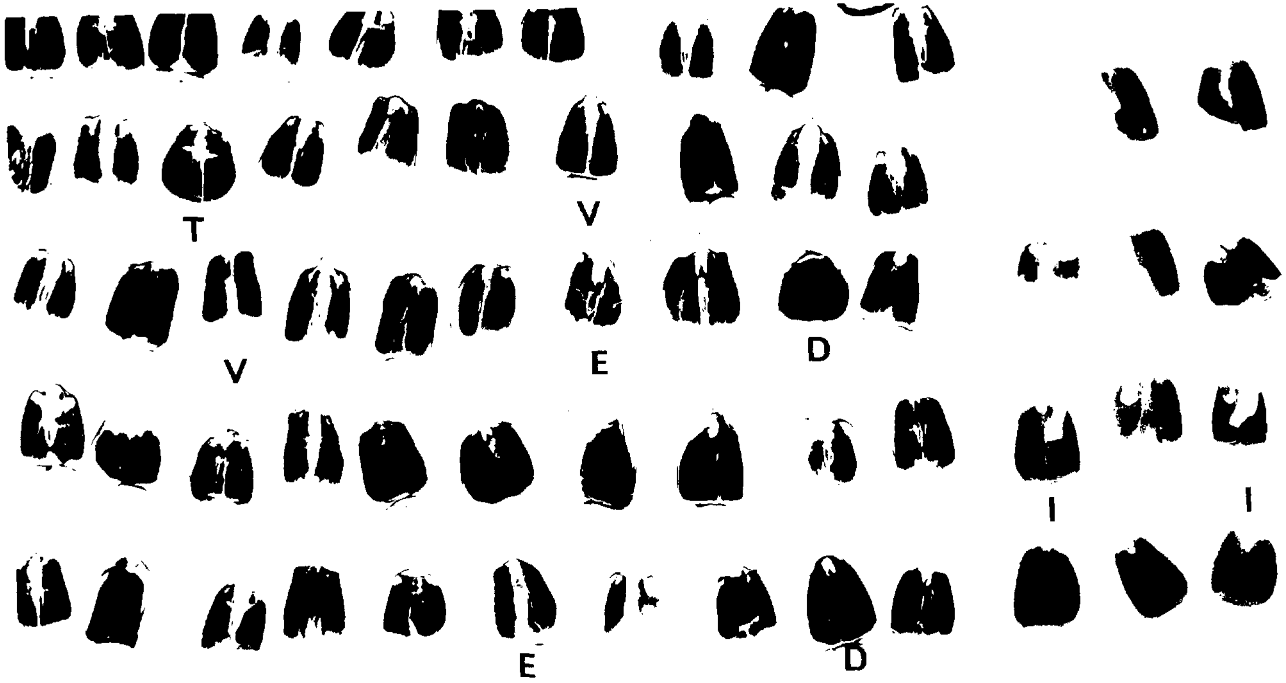

Plate 1: **X-ray photograph** *showing various types of internal damage in maize seeds.*