Seed quality and crop establishment in wheat

by

Mohsen Moussavi-Nik

(B.Sc. Agronomy, Ferdosi, Iran)

(M.Sc.Applied Science in Agriculture)
(Western Sydney, Australia)

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Department of Plant Science

Waite Agricultural Research Institute

The University of Adelaide

Australia

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SUMMARY

Early seedling vigour of cereal crops is crucial to crop establishment and the achievement of high yields in dryland Mediterranean environments. Early vigour is achieved by sowing high quality seed and good management. Seed quality is a result of genotype and the growing environment of the mother plant from which it came.

A series of experiments were conducted to investigate aspects of seed quality. A range of bread wheat genotypes important in South Australia were used for laboratory, greenhouse and field experiments. A durum cultivar, Yallaroi, was also included.

A preliminary set of field trials involving seed from eight different sources of each of eleven genotypes were evaluated at eight wheat growing locations in South Australia for two years. Using two dimensional spatial analysis techniques seed source was shown to be an important determinant of grain yield. Thus in genotype evaluation experiments, such as regional trials, where seed of genotypes may be derived from different sources changes in rank due to seed source could occur. These seed source effects and interactions with genotype were more evident during early growth stages.

Farmers appreciate the importance of sowing plump seed free of weather damage and disease but they have little knowledge of the physiological quality of that seed. Experiments showed that within genotypes larger seed had larger embryos which, on germinating, produced longer coleoptiles, more vigorous seedlings resulting in higher grain yields. Rate of emergence from normal sowing depths was not affected. There were genotypic differences for both seed and embryo size but the two were not related. It should be possible for breeders to select for embryo size independent of seed size.

Large seed, of course, contains more nutrients than small seed with which to nourish the embryo, but, mineral nutrient analyses of different seed sizes indicated that there were differences in nutrient concentration between seed sizes. Again there were genotype differences and the patterns across genotypes varied for different minerals.

The quality of seed from different positions on the mother plant was examined for ten genotypes. Genotypes showed different potential for loading nutrients, but generally seeds of the main tiller were heavier and accumulated higher levels of nutrients than those from second tillers. Seeds from the outer florets of the middle spikelets of heads similarly had better quality than seeds from other positions. Wheat cultivar Machete accumulated more nutrients than other genotypes tested.

Two nutrients, zinc and manganese, were chosen for more detailed study because deficiencies of these nutrients are widespread in South Australia. High levels of Zn and Mn in seed greatly improved crop growth especially in Zn and Mn deficient soils, in fact, seed high in Mn was more effective than Mn fertiliser in improving early growth and grain yield. Genotypic variability occurred for Zn and Mn efficiency and also for Zn and Mn accumulation in the seed. Yallaroi, the durum, performed poorly in these experiments. These results suggest that farmers would do well to manage their seed crops differently than grain crops especially by attempting to increase the levels of trace elements in the seed.

The distribution of mineral nutrients within seed was examined in both high and low Zn content seeds of two genotypes and the remobilisation of nutrients was followed over the first twelve days after germination. Zn and Mn were disproportionately higher relative to other nutrients in the embryo, but this was only a small fraction of the total in the seed. Most

of the nutrient was in the seed coat and, under the aseptic conditions of the experiment, apart from potassium, most was never remobilised to the young seedling.

It is concluded that sound healthy seed does vary in quality and this affects seedling vigour, crop establishment and grain yield. Seed source can affect genotype performance in evaluation trials. There is genetic variability for embryo size, coleoptile length, nutrient efficiency and nutrient loading in to the seed which can be exploited by breeders. Agronomically, seed quality can be improved by managing seed crops to aid accumulation of mineral nutrients in the seed and then selecting, by grading, only large seed for sowing.