GENOTYPIC VARIATION FOR MANGANESE EFFICIENCY IN CEREALS

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Abstract

The experiments described in this thesis consider the extent of genetic variation for Mn efficiency (ie. tolerance to Mn deficiency) in cereals, with particular reference to wheat, and explore some possible plant factors associated with Mn efficiency. Emphasis has been given to the growth of seedling plants under growth cabinet conditions in pots containing Mn-deficient soil. A long term objective was to develop a screening technique for Mn efficient genotypes in a screening program.

Barley proved to be more Mn efficient than wheat, triticale or rye, when grown for 4-5 weeks in small (250 g cap.) pots at 15°C, having the highest dry matter production, Mn uptake and utilisation efficiency. The higher rate of Mn uptake for barley was much more strongly associated with root growth and root morphology (greater lateral root development) rather than with enhanced chemical or biological modification of the rhizosphere. From a study with wheat-barley addition lines it appeared that the Mn efficiency of barley could be transferred to wheat, but that the mechanism of this efficiency was not obvious nor simply inherited.

Differences in growth between wheat cultivars (in particular) without added Mn were confounded by differences in the Mn content of sown seeds. Nevertheless significant wheat cultivar variation in the rate of growth, Mn uptake and Mn utilisation became apparent when a little Mn (10 mg kg^{-1} soil) was added. Cultivar differences for a functional requirement of Mn in photosynthesis, as determined by room temperature chlorophyll *a* fluorescence, were small.

Further growth cabinet and field studies demonstrated that seed Mn content (natural ocurring as well as artificially increased by soaking in $MnSO_4$) played a vital role in determining early plant productivity as well as influencing grain yield. Manganese-inefficient genotypes could be distinquished by their greater response to seed soaking in the field.

Results of field experiments conducted mainly at Wangary on the same soil as used in the pot experiments showed that agronomic Mn efficiency (based on relative grain yield) varied considerably between cereal cultivars. Rye and Weeah barley were the most Mn-efficient and oats the least Mn-efficient cereal. Considerable differences were evident between cultivars of wheat, barley and triticale for actual and relative grain yields. The best wheat (Aroona) yielded about the same as the worst barley (Galleon). Yields of triticale were intermediate between wheat and rye. The least Mn-efficient cultivars were characterised by severe plant mortality mid-season as well as low grain yields per plant.

Table of contents

CHAPTER 2

TOLERANCE OF WHEAT, TRITICALE, RYE AND BARLEY SEEDLINGS TO MANGANESE DEFICIENCY

CHAPTER 3

FACTORS ASSOCIATED WITH MANGANESE AQUISITION BY WHEAT AND BARLEY SEEDLINGS

CHAPTER 8

GENERAL CONCLUSIONS