Manganese nutrition status and resistance in barley (*Hordeum vulgare L.*) to take-all (*Gaeumannomyces graminis* var. *tritici*)

by

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Thesis summary

Wilhelm *et al.,* (1990) had shown that wheat genotypes with increased Mn efficiency when grown under Mn-deficient soil conditions, showed less *Gaeumannomyces graminis* var. *tritici* (*Ggt*) infection compared to Mn-inefficient wheat genotypes. This result suggested the hypothesis that take-all resistance in wheat may be genetically linked to Mn efficiency. In this thesis I set out to test that hypothesis but chose to use barley, a simpler diploid crop species, in which traits such as Mn efficiency are likely to be more simply inherited than in hexaploid wheat. Using both physiological and genetic studies, no causal connection has been found between enhanced resistance to *Ggt* in barley and the presence of manganese efficiency alleles at two loci.

To begin to test if Mn efficiency is associated with resistance to *Ggt*, infection levels were compared between the Mn-efficient Amagi Nijo and the Mn-inefficient breeder's line, WI 2585, when grown in Mn-deficient soil. Amagi Nijo was found to have a higher shoot Mn concentration and low root infection measured as a short root average length of stelar lesion (Av.LSL) (mm/plant), compared to WI 2585.

Comparison of WI 2585 and Amagi Nijo grown over a range of Mn additions with no *Ggt* inoculum found them to have the same critical shoot Mn concentration. It was therefore reasonable to assume that there is equal Mn stress in WI 2585 and Amagi Nijo when they have the same shoot Mn concentrations. When WI 2585 and Amagi Nijo infected with *Ggt* were grown under soil conditions of equally high Mn stress (similar and low shoot Mn concentration), the Av.LSL in WI 2585 was significantly longer than in Amagi Nijo. But the susceptibility of WI 2585 to *Ggt* was not reduced by the elimination of Mn stress.

A major Mn efficiency locus, *Mel 1*, had been mapped using 4 RFLP markers to chromosome 4HS in an F_2 population of a cross between WI 2585 and Amagi Nijo (Pallotta *et al.*, 1999). Further, a WI 2585 x Amagi Nijo doubled haploid (DH) population had been generated by Dr. P. Davies (SARDI). A field trial was conducted using 62 entries from this DH population to search for more loci linked to Mn efficiency. A new locus controlling shoot Mn concentration showed significant linkage with RFLP marker, *Xwg645* on chromosome 2HL.

An investigation of the genetics of Mn efficiency in Amagi Nijo was used to determine if the take-all resistance was an Mn-independent varietal trait, unlinked to Mn-efficient alleles at both the *Mel 1* and *Xwg645* loci on chromosomes 4HS and 2HL respectively. Neither Mn-

efficient allele at *Mel 1* or *Xwg645* showed linkage with a short Av.LSL in a controlled-environment experiment on 29 DH lines grown in Mn-deficient soil.