Quantifying the impact of high manganese (Mn) on canola under field conditions

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ABSTRACT

Quantifying the impact of high soil manganese (Mn) on canola (*Brassica napus*) is a pre-requisite for validating breeding for manganese tolerance. High Mn is prevalent in acid soils and varies widely during the season making it difficult to predict when or where it will occur and how high the soil Mn concentration will be. A foliar spray method is under development to empirically evaluate the impact of Mn toxicity on canola yield. This preliminary results hinted at the possibility of canola yield being reduced by a decline in leaf area index (LAI) induced by Mn toxicity.

Keywords: Manganese, tolerance, acid soils, *Brassica napus*, screening

INTRODUCTION

High soil manganese (Mn) is toxic to canola plants and there is anecdotal evidence of frequently being observed in south east Australia. High Mn is prevalent in acid soil and varies widely during the season (Conyers et al, 1997). Manganese toxicity of canola (*Brassica napus*) crops has been, without any empirical evaluation, unjustifiably dismissed as an inconsequential soil toxin. However, this conclusion is not supported by the physiological processes known to occur during Mn stress. Manganese toxicity disrupts the plant's photosynthetic system which will inevitably reduce the yield potential of the plant by either reducing biomass (both shoot and roots) or by disrupting the growth rate of the crop. To date, there has not been an empirical evaluation of the impact of high soil Mn on canola yield under field conditions. This evaluation is critical for establishing the importance of using Mn tolerant canola to combat subsoil acidity. Moreover, a field screening technique is necessary to evaluating already identified Mn tolerant *B. napus* germplasm (Moroni et al 1999).

MATERIALS AND METHODS

High soil Mn is a transitional occurrence in soils and it is difficult to predict when or where it will occur and how high the soil Mn concentration will be. Induction of Mn toxicity was attempted by adding Mn to the soil and/or by spraying Mn on the crop canopy both in glasshouse conditions and field plots. Physiological measurements were undertaken both prior and after the Mn treatments to quantify the effects of added Mn.

RESULTS and DISCUSSION

Normal levels of Mn content of canola with and without Mn toxicity symptoms are about 400 mg kg^{-1} and greater than 1500 mg kg^{-1}, respectively (Fig 1). Incremental levels of Mn solution sprayed on the canopy of potted plants in the glasshouse showed increased absorbance of Mn by the plants (Fig. 2). This was concomitant with severe Mn toxicity symptoms that developed at the highest applied Mn solution. These results were also observed in field conditions (Fig. 3) with incremental absorbance of Mn at higher Mn solution levels associated with Mn toxicity symptoms similar to 'natural' induced symptoms.

Terminal drought in 2006 and 2007 prevented the proper evaluation of the effects of Mn toxicity on canola yield. In 2006 the crop was severely affected and yields were minimal while in 2007 the crop died before pod stage. Preliminary data for the 2006 season however, hinted at the possibility of canola yield being reduced by a decline in leaf area index (LAI) induced by Mn toxicity (Fig. 4).

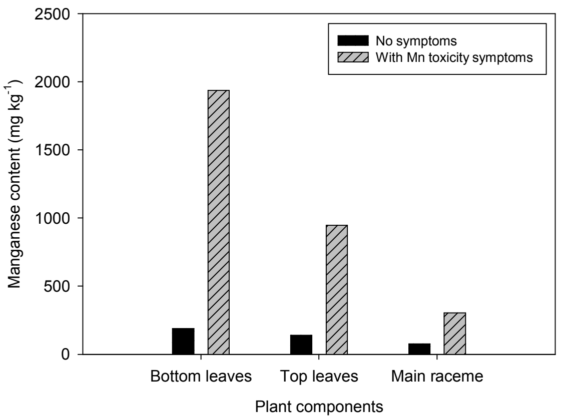

Figure 1. Example of manganese content of field grown canola plant components at the WWAI canola breeding nursery with and without Mn toxicity symptoms

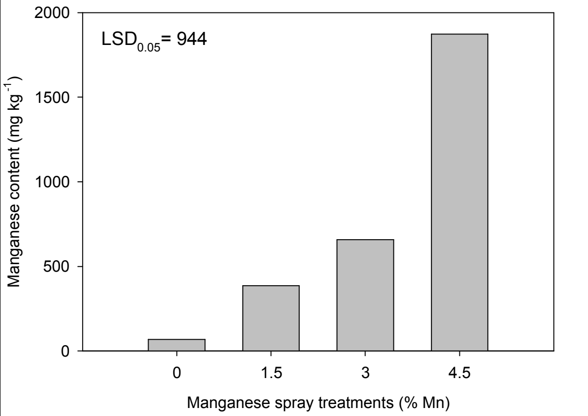

Figure 2. Manganese content of canola leaf sprayed with different concentrations of Mn solutions.

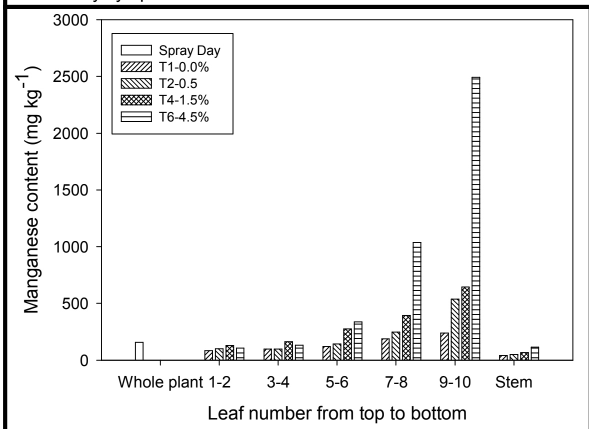

Figure 3. Manganese content of leaves and stem harvested 22 days after spraying with a Mn solution in field conditions.

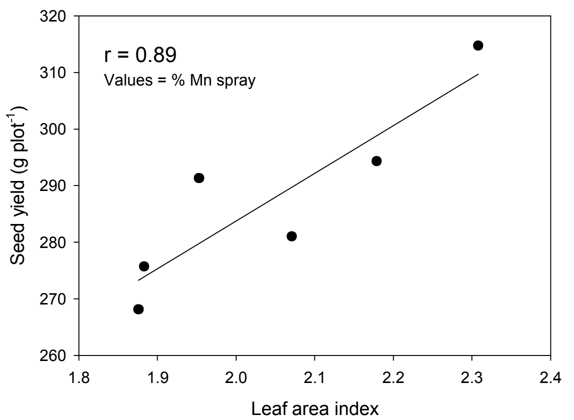

Figure 4. Relationship between means of leaf area index and seed yield.

ACKNOWLEDGEMENTS

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