MANAGING SUBSOIL ACIDITY (GRDC DAN00206)

# Quantifying the tolerance of canola cultivars to soil acidity

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A selection of current canola cultivars showed moderate to sensitive tolerance to soil acidity. The old Australian cultivars may not be a source for improving tolerance to soil acidity. We need to find either exotic germplasm or to transfer genes from other species to improve the tolerance of canola to soil acidity.

## Introduction

The utilisation of crops with tolerance to acidic soils, *i.e.* primarily to aluminium (Al) and manganese (Mn) toxicity, is an important complementary strategy to lime application for cropping on acidic soils. There is no current systematic evaluation for tolerance to acidic soils among canola (*Brassica napus*) cultivars and thus little is known of their tolerance levels. This is particularly difficult because canola cultivars are seldom commercially available for more than just a few years.

It is widely assumed that canola is sensitive to acidic soils, but in nutrient solution culture it has been shown that cultivars can exhibit a high level of tolerance to Al. Under controlled conditions, however, this level of tolerance is seldom expressed in acidic soil.

A pot screening experiment was conducted to evaluate the current level of tolerance to soil acidity among a selection of current and old Australian cultivars in an acidic soil, with and without addition of lime.

## Materials and methods

Soil was collected from the 10-20 cm layer at the long-term field site at Dirnaseer, west of Cootamundra, NSW (34°38'S, 147°49'E). The bulk soil had a pH 4.3 in $CaCl_2$ and Al comprised about 20% of the exchangeable cation capacity.

Soil samples (1.4 kg) were weighed in plastic bags and separated into two groups with one half of the bags being thoroughly mixed with lime to a target pH of 5.3. A full nutrient solution (5 ml) was added to each individual bag, fully mixed with soil and air-dried. The soil from each bag was then dispensed into individual PVC pots (18cm in height and 9cm in diameter) lined with a plastic bag to prevent drainage. The soil in pots was incubated for 8 weeks in a glasshouse with wet/dry cycles. All pots were watered to 100% field capacity (FC) by weight initially, dried to about 70% FC and then re-watered by weight to about 80% FC over the incubation period. The purpose of the 8-week incubation was to allow lime to react with soil and reach the target pH and to lessen the risk of Mn toxicity on plant growth.

A collection of 56 canola cultivars was evaluated, including most of the canola cultivars currently recommended for NSW. A number of old Australian cultivars were also included to represent the broader genetic pool. Two wheat cultivars known to be moderately tolerant (cv. Diamondbird) or sensitive (cv. Janz) to acidic soil were used in the assay for comparative purpose.

Six to eight seeds were sown per pot at about 1cm depth in pre-drilled holes and thinned to 4 plants per pot 5-7 days after sowing. Pots were placed in a control environment glasshouse and watered to 80% FC on a regular basis.

The experiment was set up as a split-plot design with cultivars as the main plot and the soil treatments as the sub-plot, replicated 4 times.

The plants were harvested 22 days after sowing on a replicate basis over 4 consecutive days. Shoots were cut at the soil surface, bagged and dried at 60°C for 3 days and then weighed.

The relative shoot weight (RSW) was calculated to evaluate differential response among cultivars. RSW (%) = shoot weight from the unlimed soil treatments divided by the shoot weight from the limed soil multiplied by 100%. The analysis of variance was performed using the REML procedure in Genstat Release 18.1.

## Results

A wide range of differential responses to the acidic soil was demonstrated among the 56 canola cultivars evaluated (Figure 1). Only 2 canola cultivars (Crusher TT and 45Y88CL) had greater RSW than that of Diamondbird wheat. However, the majority of canola cultivars were more tolerant than Janz wheat (Figure 1).

Manganese toxicity symptoms were observed in all the cultivars growing in the unlimed soil and were similar and consistent across the cultivars. The observed Mn toxicity symptoms included interveinal and marginal chlorosis of the leaf, necrotic leaf spots, necrotic leaf margins and reduced plant size. The partial necrosis on, or close to the margin of the leaves, appeared to restrict leaf expansion and thus resulted in the 'cupping' of the leaf (Figure 2). The 8-week incubation with wet/dry cycles in a warmer temperature environment did not lower the Mn toxicity level. Thus, the effect of soil acidity on the shoot biomass cannot be attributed to low pH and Al toxicity alone.

**Figure 2. Mn toxicity symptoms on canola plants with (left) and without lime (right).**

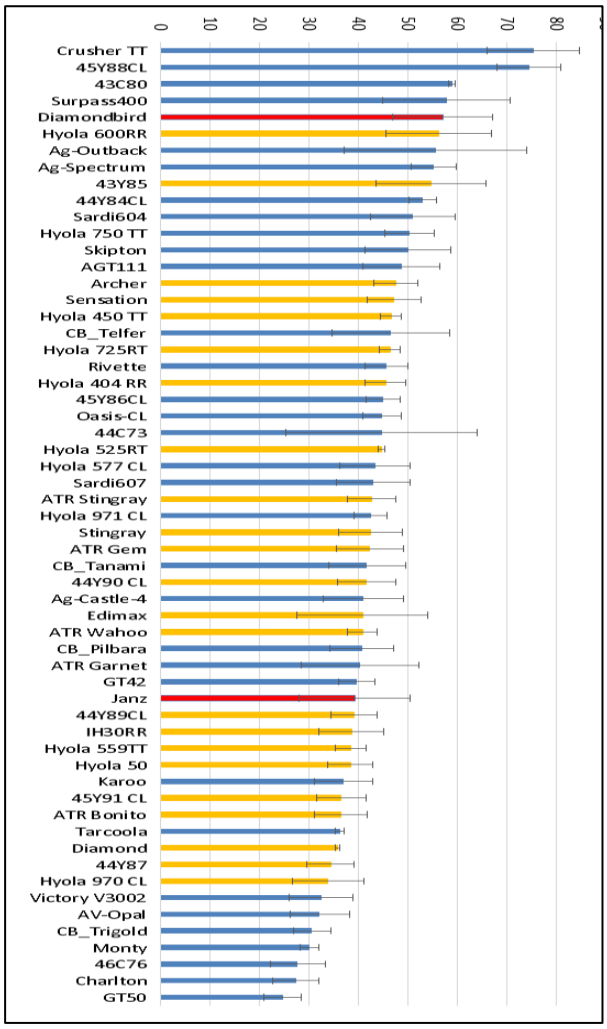


**Figure 1. The relative shoot weight (%) among a selection of canola cultivars (current cultivars in yellow, old cultivars in blue, wheat cultivars in red) in tolerance to an acid soil. Bars indicate ±SE.**

## Conclusions

The growth response to an acid soil among a selection current and old canola cultivars have shown the need to increase its level of tolerance. Based on this evaluation it appeared that old Australian cultivars would not be a source for improving tolerance to soil acidity. There is still a need to develop a screening protocol so that Mn toxicity can be removed as a confounding factor in the evaluation for acid soil tolerance among these canola cultivars.

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