

Canola in

Depth

An update from the GRDC funded project
'The contribution of subsoil constraints to canola yield decline'.

Welcome to the 2nd edition of *Canola in Depth*. The focus of this issue is on subsurface acidity... what we do know and what we don't know (◊) about its effect on canola performance. (Following issues will focus on other subsoil constraints). With all the trials having now been sown, we've also outlined treatment details so you can follow their progress, and 'profiled' the site at Culcairn with subsurface acidity and compaction.

Soil acidity and canola

- Although canola is widely considered to be sensitive to acid soils and responsive to liming, **'reasonable' yields have been reported on low pH soils.**
- Results from paddock trials at 3 sites (Dubbo, Henty & Rutherglen) showed that although canola yields declined significantly at pH_{Ca} less than 5.0, the extent of yield loss varied greatly between the sites (ranging from 37 to 75%). This was due to differences in soil concentrations of aluminium and manganese, as well as differences in varietal sensitivity to those toxins and soil crusting. ◊ *The extent of canola yield loss at low pH is therefore not yet predictable.*
- Canola's performance is affected by acidity through both physical (eg. crusting) and chemical factors:
 - ▶ **Toxic levels of aluminium** (occurring when pH_{Ca} falls below 5.0) **in the subsoil causes canola to develop a stunted root system, or 'J-root'** (Figure 1). This affects its ability to take-up water and nutrients and can significantly reduce yields, particularly in a dry season. ◊ *Yet when canola is grown in nutrient solution in laboratory trials, canola roots tolerate high concentrations of aluminium.*



Figure 1:
Stunted canola roots resulting from high levels of aluminium in the subsurface.

- ▶ **High manganese levels** resulting from low pH and extreme environmental conditions

can also affect canola growth through reduced photosynthesis (Figure 2). Manganese toxicity is commonly seen at the seedling stage and/or flowering time, often in waterlogged soils at the end of winter as soils warm up. Although plants appear to overcome the toxic effects of manganese as the season progresses, ◊ *the effect of reduced photosynthesis on final yields is still unknown.*



Figure 2:
Canola showing symptoms of manganese toxicity.

- Liming is a proven method for managing topsoil acidity by raising pH and removing aluminium toxicity. (Manganese toxicity is more difficult to ameliorate and may not be removed even when lime is applied.) **However the current practice of surface liming does little to reduce subsurface acidity, if at all.** It can take more than a decade and continued re-liming before the lime will move down the soil profile and ameliorate the subsurface layer (10-20cm).
- **A combined approach of liming and the use of aluminium and manganese tolerant varieties is likely to be the most economic approach to growing canola on soils with subsurface acidity.** Plants with aluminium tolerance would grow roots through the acid layer, accessing moisture and nutrients, while plants with manganese tolerance would function normally under high manganese levels and be protected against sudden changes in soil manganese.

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Project Partners:



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Project Update

a) Acidic subsurface sites:

Treatments:

1. nil
2. deep rip (~30cm)
3. deep rip + injected lime^{1,2,3}
4. deep rip + injected lime @ double rate
5. deep rip + surface lime @ 3.75t/ha
6. knife points + surface lime @ 2t/ha*

Site	Treatments	Treatment date	Sowing date	Varieties
Culcairn*	1 to 3, 6 7.5t/ha lime ¹	6th March	24th May	Tornado & Beacon
Greenethorpe	1 to 3 4t/ha lime ²	21st March	11th May	46C76
Stockinbingal	1 to 5 3.75t/ha lime ³	14th March	15th May	Tornado

*all plots at Culcairn also received additional surface applied lime (1t/ha) in early May. 'nil' treatment included +/- fungicide.

Figure 3 - Location of 2007 trial sites:



b) Sodic, compacted and/or saline subsoil sites:

Treatments:

1. nil
2. deep rip (~30cm)
3. deep rip + injected gypsum
4. deep rip + surface gypsum

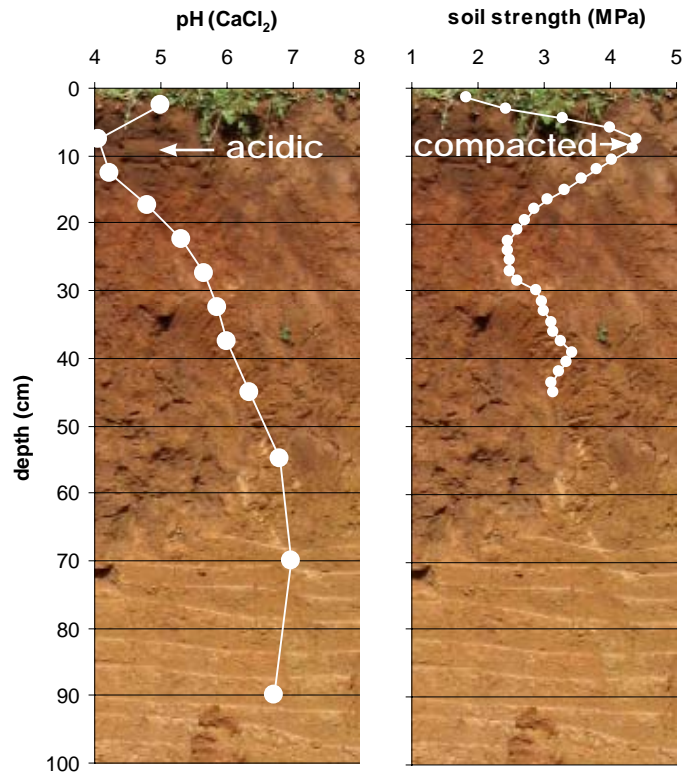
Site	Treatments	Treatment date	Sowing date	Varieties
Lockhart	1 to 4 4t/ha gyp	13th March	2nd May	Bravo
Rand	1 to 3 3.5t/ha gyp	1st March	27th April	Tornado
Corowa	1 to 4 2.2t/ha gyp	28th February	4th May	Tornado
Yuluma	nil*	NA	4th May	Sapphire

*monitoring crop on highly saline paddock

Culcairn in Profile...

- ▶ acid 'choke' from approximately 5-20cm depth (pH_{Ca} less than 5.0)
- ▶ compacted layer from approximately 5-15cm depth* (soil strength greater than 3MPa)
- ▶ treatments therefore focused on lime and deep ripping

*measured 4 days after being wet to field capacity



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