5.2 RAISED BED MAINTENANCE

5.2.1 GNARWARRE

Researchers:
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Background:
Raised-bed technology has had a rapid rate of adoption in the high rainfall south eastern Australia since its introduction in 1996. While farmers practice both cropping and grazing on beds, some damage is likely on the beds with time, as a result of machinery, compaction by livestock and general wear. Some farmers prefer to carry out some bed maintenance/renovation work every two to three years or more frequently depending on the severity of damage.

(Note: *On a GRDC funded farming systems trial at Gnarwarre, raised beds, tactically grazed by sheep for two and three years respectively were sown to canola without any bed renovation and resulted in yields of 1.8 and 1.7 t/ha respectively on heavy clay basaltic subsoils in 2002.)*

Aim:
The aim of this preliminary trial was to examine the effects of some of the common bed renovation treatments adopted by the farmers, particularly on soil structure, soil water dynamics and subsequent crop performance on beds.

Collaborators:
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Methodology:
Four renovation treatments were tested on raised beds that had been cropped for three years. Stubble had also been grazed by sheep occasionally on these beds but only during the summer. The treatments were as follows.

- Control (zero renovation/maintenance)
- Simple reshape using a bedding machine
- Shallow cultivation to 100mm followed by reshape
- Deep rip to 50cm (Two rip lines per bed 50cm apart) followed by reshape,

The treatments were imposed in mid-April. Raised beds, 1.7m wide, were 60m in length and were arranged in a RCB design with three replicates. Each treatment was three beds wide and most measurements were confined to the centre beds.

Canola, var. Grace was sown @6 kg/ha on 28 May 2002 along with a basal application of MAP @ 130 kg/ha. A top dressing of 100 kg/ha of Urea was applied in early September. General management of the crop was similar to other canola crops on site.

Table 64: Yield Attributes of Canola in Response to Different Bed Renovation Treatments

Treatment	Yield attributes		
	Grain Yield t/ha	Harvest Index (%)	Oil Cont. (%)
Control	2.6	28.8	44.9
Reshape only	2.6	29.5	46.4
Cultivate (100mm) and reshape	3.0	30.2	43.6
Deep Rip (50cm) and reshape	3.3	30.7	44.5
Std.Dev.	0.51	2.2	

Two cores per plot were taken across all treatments; roots were washed and scanned using an electronic root scanner at La-Trobe University. The results of rooting depth and root dry weight are shown in Figures 1 and 2 respectively.

Figure 13: Effect of Different Treatments on Depth of Rooting

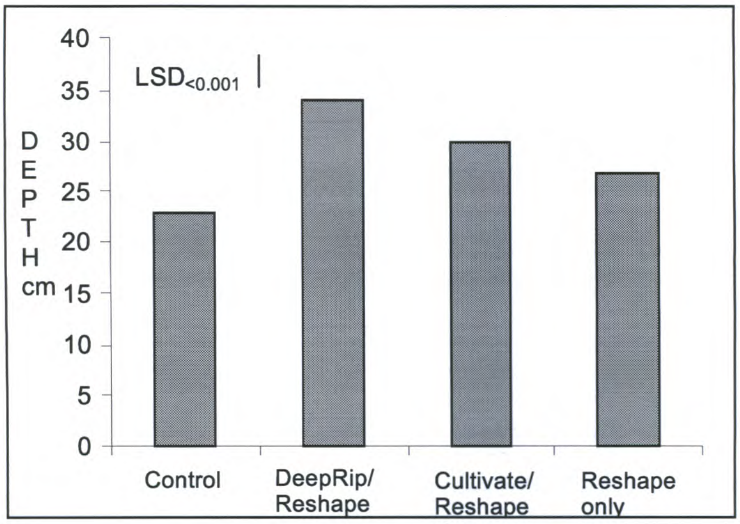


Figure 14: Effect of Different Treatments on Mean Dry Root Weight

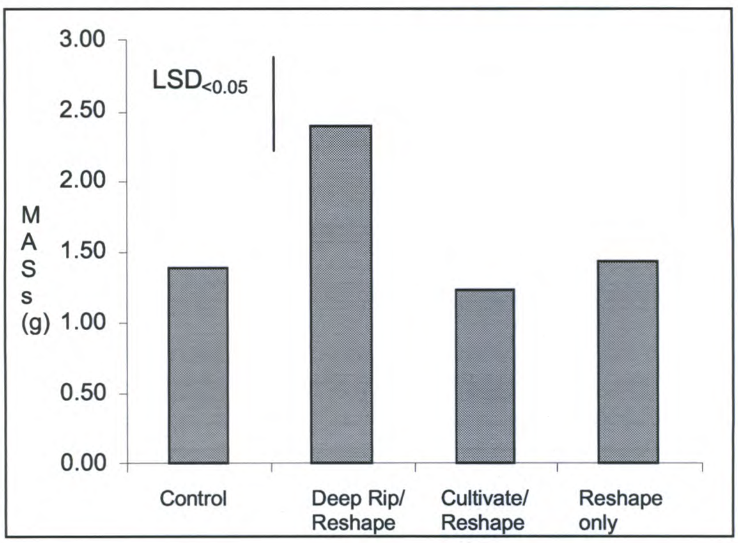
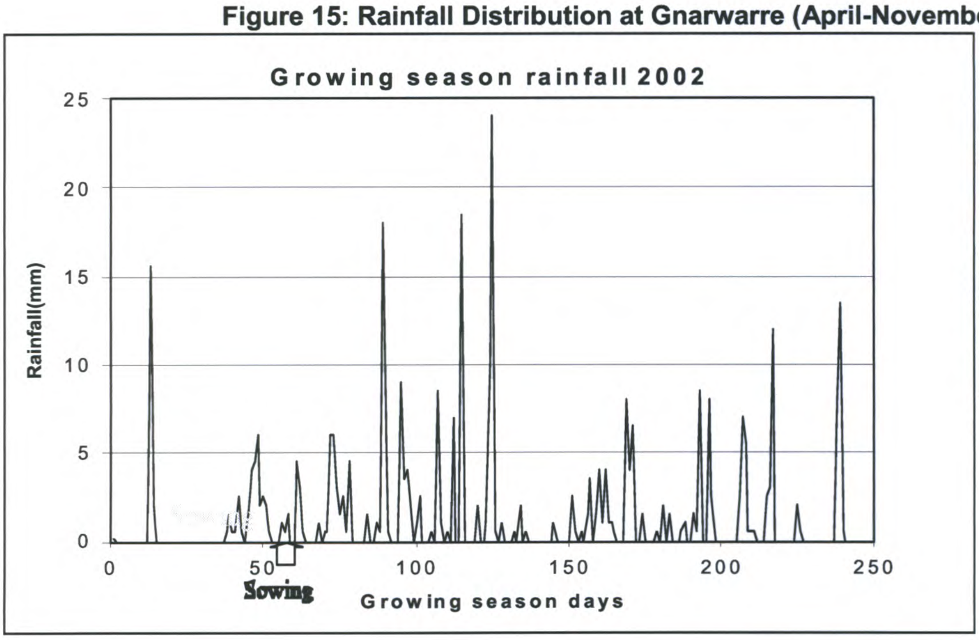


Figure 15: Rainfall Distribution at Gnarwarre (April-November 2002)



Rainfall to 42 days after sowing (29 May to 10 July)	
Rainfall	**Days**
10mm<	1
4-10mm	5
2-4mm	5
0<2	11
Rain-free	18

Discussion:

All bed maintenance/renovation treatments produced deeper roots compared to the control but the effect was most pronounced in the deep ripped treatment. This treatment also produced a significantly larger mass of roots suggesting more thorough exploitation of the profile during critical periods of yield development and is worthy of further investigation.

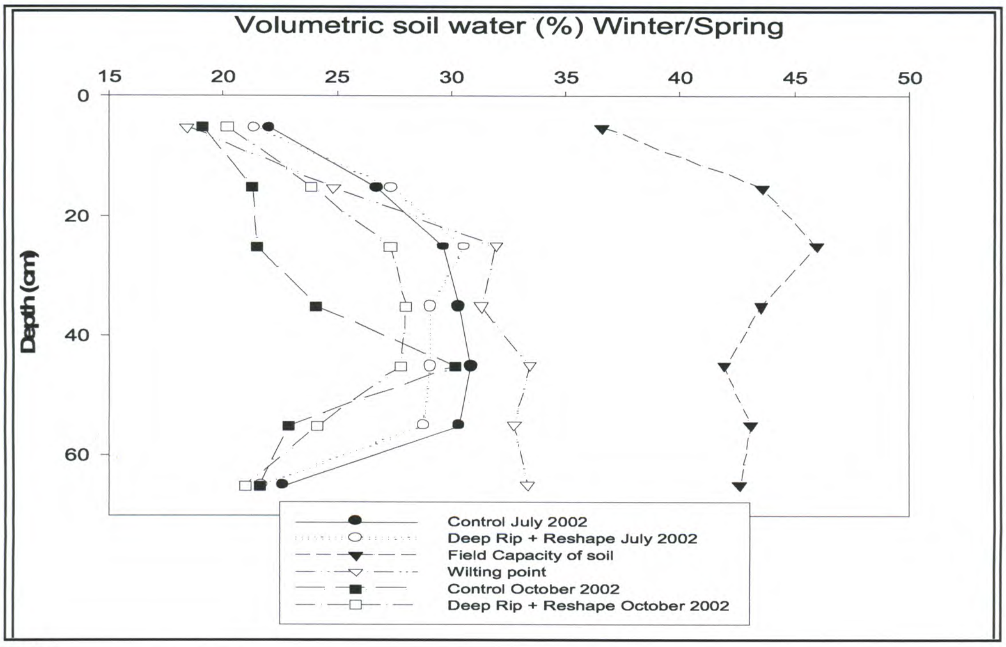
The rainfall distribution during Autumn and the winter growing season is shown in Figure 15. The growing season rainfall (May to Nov.) was around 330mm and was near average for the region. However, less than average autumn rainfall resulted in very low amounts of stored water in the profile at the start of the season. At the upper limit, this profile is capable of storing around 80mm of plant available water (PAW) to a depth of 70cm. It would appear that as a result of the low intensity of rainfall events during the season, the depth of profile was never fully replenished (see Figure 16).

The rainfall distribution during early growth suggests that plants would have experienced some water deficit during establishment.

From intact root cores taken later during the season it was observed that most tap roots of canola had either tapered or branched shortly after germination probably because of their inability to penetrate a dryer layer of soil. (The soil bulk density at commencement of trial was 1.2 and 1.3 gcm^{-3} respectively for depths 0-10 and 10-20cm)

Gravimetric soil sampling was carried out twice across all treatments in mid-winter (23 July) and Spring (16 Oct.) to assess the profile soil water extraction pattern. At the first sampling some PAW was detected in the 0-20cm depth in the profile (Figure 16). The figure compares the control with the deep rip treatment that produced a significant amount of roots to a depth of about 35cm. The figure suggests that most plant water use to be in the upper layers of the profile that would have been replenished by the infrequent and small rainfall events, a hypothesis supported by the depth of rooting data. Under the circumstances, the deep rip treatment may also have had an advantage in water use during spring grain filling period as observed by the marginal superiority in harvest index. However, the data sets were inadequate to detect the fate of water immediately after the few, heavy rainfall events.

Figure 16: Water Status of Soil for Control and Deep-Rip Treatments at Two Times During the Growing Season. (Values of plant available water (PAW) capacity and temporal changes suggesting the very low soil water status at depth in the profile.)



Conclusions:

The trend to higher grain yield and deeper root growth in the deep rip treatment suggests that in heavier soils deep ripping may be beneficial to encourage deep rooting and deeper infiltration of water following rainfall events. While the observations relate to responses in the year in which the treatments were imposed, it will take further cropping cycles to determine the stability and sustainability of these responses. The pattern of rainfall distribution and the overall soil water dynamics may have also had an impact on the yield responses. While the initial response is promising, further testing would be required before recommendations could be made.