Department of Primary Industries and Regional Development
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GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Effect of deep ripping on weeds and root lesion nematodes

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Key messages

- Deep ripping to 500mm increased plant biomass, tiller numbers and crop yield, by 500kg/ha
- There was no significant difference in weed numbers between ripped and un-ripped treatments; however weeds in the deep ripping treatment were bigger and had more seeds, therefore potentially a greater seed bank.
- The root lesion nematode species *P. neglectus* population increased over the season with the multiplication rate observed in un-ripped plots double that seen in ripped soil.

Background to the activity

Soil renovation techniques, such as deeper deep ripping (>300mm), provide crop benefits by reducing compaction, allowing plant roots better access to water and nutrients. These benefits have proven to create opportunities for significant yield gains in the Western region. Unfortunately, in the short term, this type of soil amelioration can leave the soil surface uneven, potentially causing poor plant establishment. This poor establishment is the result of difficulty in managing seeding depth due to an uneven soil surface after ripping as well as the bar sinking into very soft loose soil (DPIRD 2017). The soil can take several seasons to settle. In the interim period, patchy crop germination reduces weed competition leaving the ameliorated paddocks open to an increased weed burden. This potential for increased weediness may be combatted by increasing the seeding rate for a denser crop to increase crop competition. Techniques to achieve good crop establishment and weed control post soil renovation require further research to capitalise on the benefits of deeper deep ripping.

Soil amelioration techniques may reduce soil borne disease and nematode pest impacts in paddocks where they are a constraint. This is because improved access to water and nutrients for crops in ameliorated soils may create greater resilience to soil borne disease and nematode pests. This follows the logic that a healthier plant will be better able to compete. The physical process of aggressive amelioration such as deeper deep ripping may also reduce pathogen levels by damage to the hyphal network of fungal diseases like *Rhizoctonia* and kill plant parasitic nematodes due to abrasion.

Activity objectives

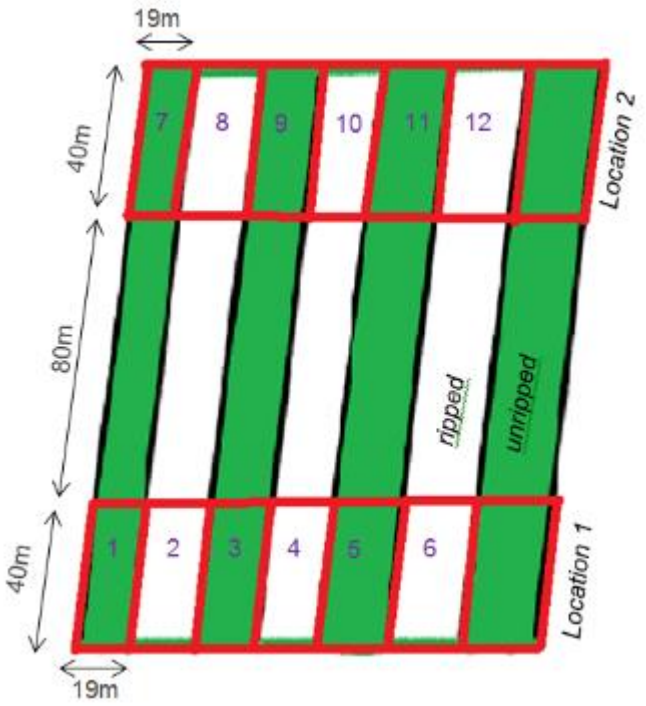
An observational trial was implemented to investigate the influence of deep ripping to 500mm on crop and weed establishment. The aims were to:

1. Gain a better understanding of the impact of crop competition on rigid ryegrass (*Lolium rigidum*) and brome grass (*Bromus spp*.) quantities and seed set after deep ripping to raise awareness and improve management.
2. Monitor for differences in *Pratylenchus neglectus* levels between ripped and un-ripped plots throughout the season.

Methods

The trial was conducted in 2018 at a property east of Geraldton. Prior to seeding, a *Pratylenchus neglectus* infested paddock was deep ripped to 500mm at a 15-degree angle to the direction of cropping/traffic/seeding lines.

Strips, approximately 40m by 19m, were left un-ripped to observe crop and weed establishment in the different treatments. *P. neglectus* multiplication over the season in ameliorated versus un-ameliorated strip plots was monitored using PreDicta B testing before seeding and again at harvest. The crop was sown to Ninja wheat in early May on a deep yellow sand. The seed rate treatment was not applied as planned, however the trial was still monitored to observe the effect of ripping on weed and nematode populations.



Symbol	Soil renovation	No. replicates
	Ripped	6
	Unripped	6

Results

The deep ripped area yielded 2.55 t/ha, which gave a significant ($p<0.05$) positive yield response of almost 500kg, compared to the un-ripped strips, and a yield gain of 23.4% (Table 1). The ripping area also produced a significantly higher ($p<0.05$) crop biomass and number of tillers.

Table 1. Comparing wheat (Ninja) yield components and weed numbers in ripped and un-ripped areas.

Treatment	Tillers (Wheat)	Dry weight (g) (Wheat)	Yield (t/ha) (Wheat)	Average number of weeds per m^2
Ripped	66	2286	2.55	0.3
Un-ripped	53	1722.6	2.06	0.8
LSD	8.26	345.7	0.356	0.926

The un-ripped strips appeared to have a higher weed burden than the ripped, however there was no statistical difference at 0.05. Similarly, there was no significant difference in crop establishment density between ripped and un-ripped treatments. The average crop establishment count was 70 plants per m^2 in both ripped and un-ripped plots.

There were no significant differences in grain quality data between the treatments; average protein was 10.58%, moisture 10.58% and hectolitre weight 84.53 g.

Penetrometer readings taken on 29 August 2018 demonstrated that the un-ripped areas were much harder than the ripped areas (Figures 1 and 2). The penetrometer was difficult to push into the ground below 10cm in the un-ripped area and it exceeded the load limit, hence the straight line on the screen (Figure 1). The ripped areas were a lot softer; however, a hard pan below 350mm in the rip line was discovered (Figure 2).

The grower intended to rip to 500mm across the whole paddock but the soil was very tight at the bottom of the hill where the readings were taken and the ripper could not achieve the same depth as it did at the top of the hill in the lighter sand.

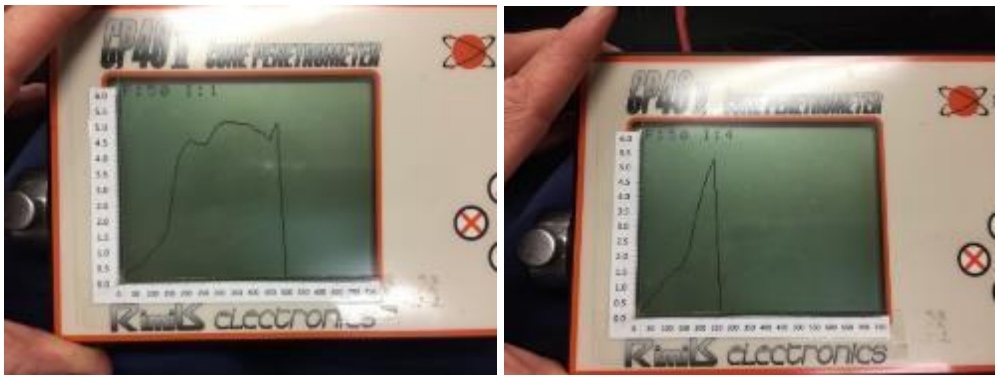


Figure 1. Penetrometer readings in the un-ripped area taken on 29 August 2018.

Observations of crop development throughout the season showed obvious differences between the two treatments. Plant development in the un-ripped areas was more advanced than the ripped areas during the season as shown in Table 1 and Figure 1.

Figure 2. Penetrometer readings in the ripped area taken on 29 August 2018. The image on the left is between the rip line and the image on the right is in the rip line (hard pan below 350 mm).

General weed observations were made throughout the season (Table 2 and Figure 3).

More brome grass was observed in the whole paddock than ryegrass and the weeds occurred in patches throughout the plot areas. Although the results in Table 1 indicate there was no significant difference in weed numbers between the treatments, there were more weeds recorded in the un-ripped areas.

The brome grass also produced more seeds per plant in the un-ripped areas, probably because these plants had more tillers (Table 3). In contrast, the ryegrass produced more seeds per plant in the ripped areas where plants had more tillers. These are general observations, but more weed sampling may be necessary to allow for confidence in the statistical analysis.

Prior to sowing, the population of root lesion nematode *P. neglectus* in the trial area was relatively consistent with no significant difference (P>0.05) between RLN levels in the ripped and un-ripped areas. The average *P. neglectus* per gram of soil across the whole trial area pre sowing was 1.25 *P. neglectus* / g soil, which indicated that the risk of yield loss from RLN infestation was low (refer to PredictaB manual) . RLN levels increased in the susceptible wheat crop (Ninja) sown across the trial but multiplication was significantly lower in the strip plots that had been ameliorated by deeper deep ripping (Table 4). So, while end of season RLN levels were elevated in both treatments to a high risk for yield loss due to *P. neglectus* infestation if a wheat crop is sown (refer to PredictaB manual), the population increase was significantly less after ripping

Table 2. Observations showing variation in crop development and biomass between ripped areas and un-ripped areas.

Date observed	Ripped	Un-ripped
6 July		
29 August		
29 August		

Table 3. Weed biology measurements for brome and rye grass, the main weed species present in the trial area

Weed species	Treatment	Height (cm)	Tillers	Head length (cm)	Florets per head	Seeds per floret	Total seeds per plant
Brome grass	ripped	121.5	5	12	16	7	432
Brome grass	un-ripped	82	6	12	16	6	603
Rye grass	ripped	84	15	26	18	9	2430
Rye grass	un-ripped	75	3	26	18	10	540

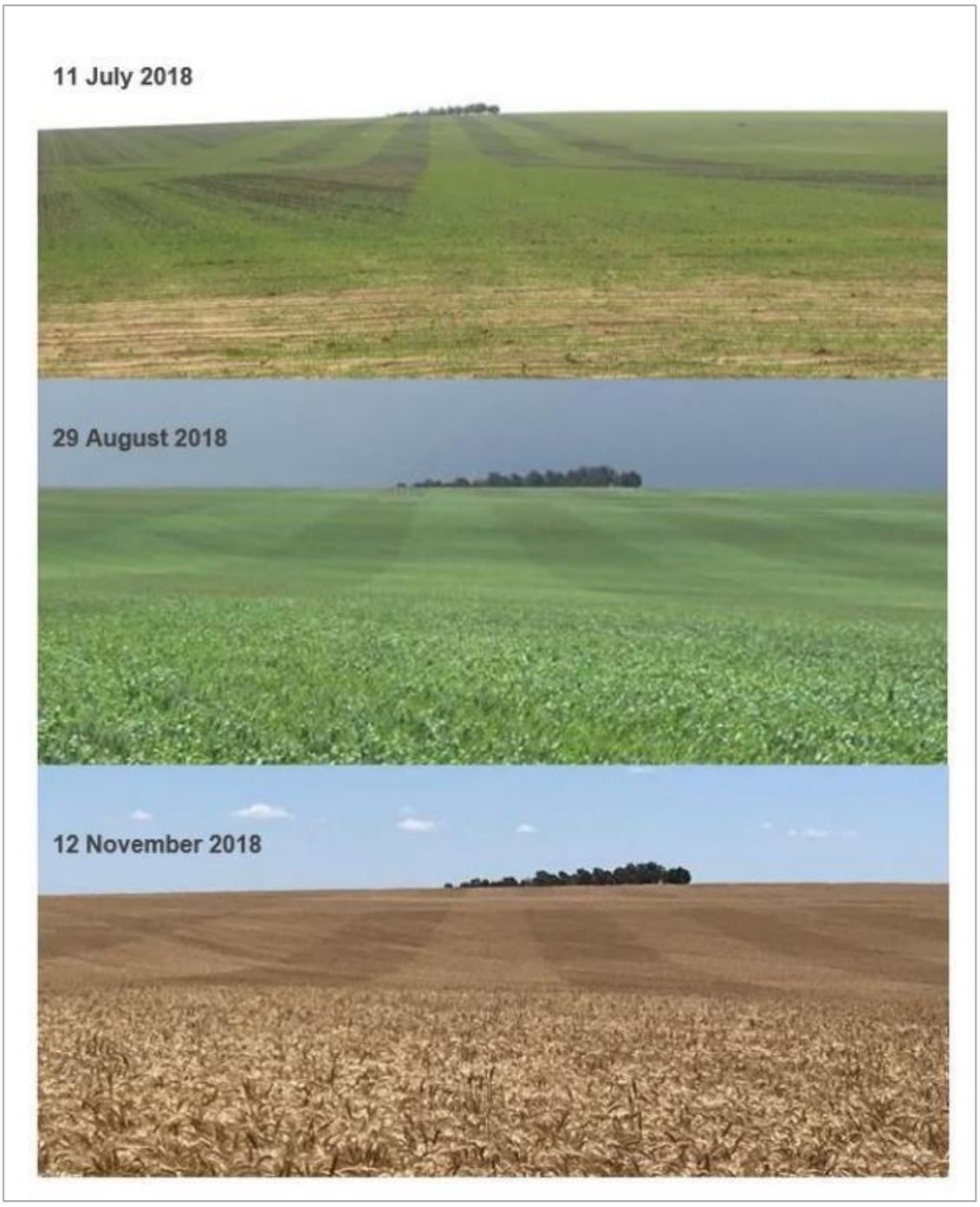


Figure 3. Strips of ripped (lighter) and un-ripped (darker) areas at different dates in the trial paddock.

Table 4 Average *P. neglectus* nematodes per gram soil at sowing and post-harvest on deeper deep ripped and un-ripped yellow sand near Geraldton (p 0.014)

	Average *P. neglectus* /g of soil in Ripped split plots	**Average *P. neglectus* /g of soil in Unripped split plots**	**Statistical significance**
Presowing	1.43	1.05	
Harvest	32.35	49.57	
P. neglectus Multiplication	21.1	46.1	P <0.02

Conclusions

Deep ripping to 500 mm provided the crop with more access to water and nutrients that increased crop competition due to a bigger biomass and yielded an extra 500kg/ha. Deep ripping an extra 100mm deeper may achieve further yield gains removing the hardpan that was still present below 300mm

While the numbers of weeds were lower post deep ripping compared to un-ripped, observations indicated, like the wheat, they responded to ripping with a bigger biomass and set more seeds therefore potentially have a higher weed seed bank. Further investigation would help determine if this is the reason more weeds have been observed in years after deep ripping rather than poor plant establishment post-ripping.

Deep ripping did not have an impact on crop establishment in this paddock and thus did not reduce crop competition with weeds during early crop development. In fact, the crop was more advanced in the un-ripped areas throughout the season and had less biomass and tillers than the ripped areas. This suggested the crop was more stressed in the un-ripped areas and reduced crop competition

No difference in plant establishment between the ripped and un-ripped areas may have been due to the paddock being cross-ripped. Observations of cross-ripping by Crop Production Officer, Adriano Rossi in 2018 found on a yellow sand at Three Springs cross ripping improved plant establishment by nine percent and there was less bar sinkage compared to ripping in the main traffic direction.

The deep ripping also reduced the multiplication of *P. neglectus*, which is not surprising as tillage is known to reduce the presence of soil borne diseases. The reduction of nematode numbers has also contributed to the yield increase from deep ripping.

The trial provided an opportunity for observations between ripped and un-ripped areas within the same area of a paddock to be made, therefore continued monitoring in this paddock may allow for patterns in weed quantities and seed set to be established over time.

References and useful links

Bakker D, Davies S and Isbister B (2017), Deep ripping for soil compaction. Department of Primary Industries and Regional Development. Accessed on 04/08/2021 at https://www.agric.wa.gov.au/soil-compaction/deep-ripping-soil-compaction

Important disclaimer