Ripper Gauge – timing of ripping

Hosts: Williss Family

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Key messages

- Post-seeding ripping resulted in reduced yield performance across all treatments.
- All ripping treatments resulted in reduced soil strength.
- The pre-seeding ripping outperformed the untreated control.
- The use of inclusion plates in post-seeding ripping resulted in a significant burial effect.
- The trial site was subject to significant waterlogging throughout 2021.

Introduction

Stirlings to Coast Farmers has completed the first year of a trial aiming to assess the effectiveness of deep ripping post-seeding in the Albany Port Zone (APZ). The trial's objective was to build on the knowledge gained from previous ripping trials and assess whether the ripping window could be extended.

Deep ripping traditionally takes place during the summer fallow period, with the optimal time falling at the end of this period after the autumn break. However, this bumps up against the seeding window, resulting in a small optimal window for ripping to take place. Whilst deep ripping can be done earlier in the fallow period, this increases the risk of wind erosion and increases the costs by having to rip into hard baked soils.

Soil compaction poses a significant constraint to crop production in Western Australia (WA), with estimates that 18.8 million hectares of WA agricultural land are susceptible to compaction. The annual cost to the WA agricultural industry is estimated to be $330 million (DPRID, 2018). Soil compaction is caused by livestock and machinery traffic compressing the macropores in the soil. Seventy percent of compaction occurs in the first pass, often resulting in widespread compaction across paddocks where controlled traffic is not in place.

Soil compaction affects macroporosity in soils by pushing particles closer together, while the micropores remain largely unaffected. This results in a reduction in aeration of the soil, which causes a build-up of CO_2. The increased soil strength resulting from compaction also acts as a physical barrier to root growth, with a soil strength of 2500kPa becoming a limiting factor to root growth and 3000kPa stops root growth. Limited root growth and, as an extension, root surface area, limits water and nutrient uptake, causing a lower nutrient use efficiency (NUE), further exacerbating the stressors on crop growth.

Soil compaction is an ever-present issue in the APZ, particularly on the shallow sandy duplexes which are common to the area. These shallow duplexes are also prone to waterlogging and erosion, which can be further exacerbated by the effects of soil compaction as natural drainage is reduced, and the soil profile is compressed.

Trial design

The trial was a fully replicated and randomised paddock scale trial. There were four ripping treatments all to a depth of 60cm.

- Pre-seeding
- 1 week post seeding
- 3 week post seeding
- 6 week post seeding

The trial also included an untreated control (UTC) and a tramline buffer zone (Figure 1). Throughout the season a range of soil and plant measurements were taken to evaluate the effectiveness of the post seeding deep ripping. The paddock was seeded with RGT Planet barley and the plots were agronomically managed by the host farmer.

Methodology

Soil compaction was measured using a CP200 Cone Penetrometer, which digitally records the soil strength in kPa at 25mm intervals to a depth of 700mm. Readings were taken at random intervals within the plots and the results were averaged out to form a base line soil strength in each plot. These plot readings were analysed and

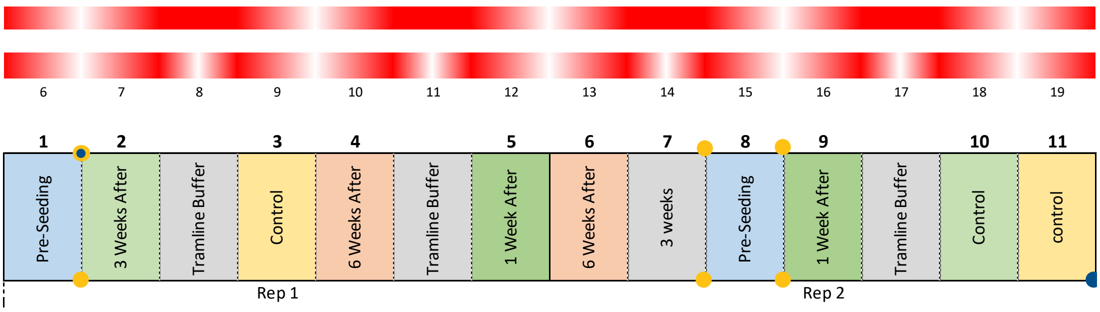

Figure 1: Ripping trial layout at the Williss property at Takalarup in 2021.

graphed using statistical software to determine the relationship between the timing of ripping and the soil strength.

Plant counts were taken after the 6-week rip was applied, and plant biomass cuts and tiller counts were taken two weeks later at growth stage 24-26. The data was analysed and converted to a per m^2 metric. Harvest yields were taken via the calibrated yield monitor of the host farmer's header. These results were analysed to determine the relationship between timing of deep-ripping and yield.

Results

Soil Strength

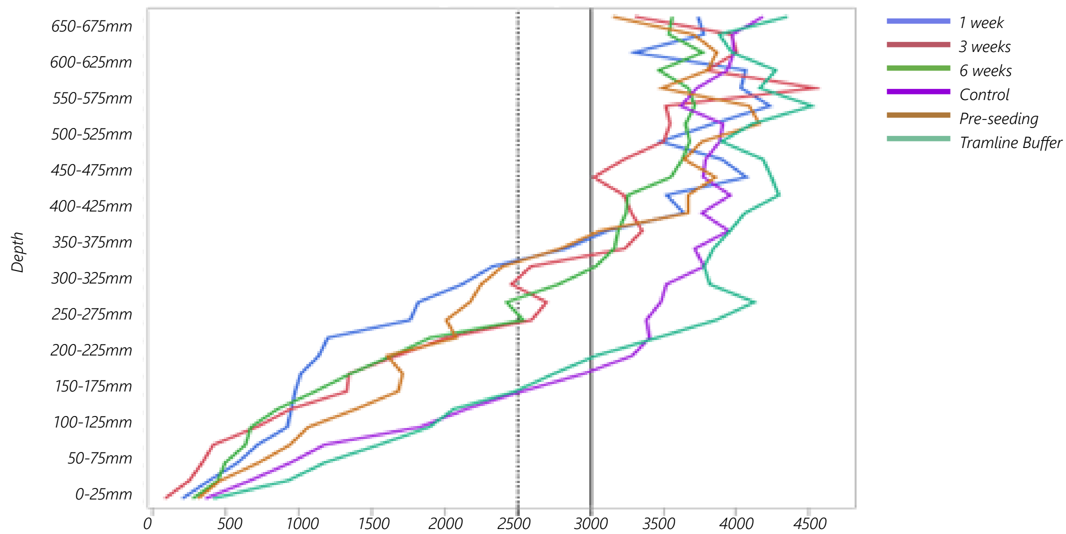

Figure 2: Mean soil strength measured using the CP200 Cone Penetrometer for all treatments from the soil surface to a depth of 700mm.

Each deep ripping treatment was effective in reducing soil strength, allowing the plants to access an average depth of 300mm, compared to 125mm of the soil profile before reaching a soil strength of 2500kPa. (Figure 2) A soil strength of 2500 kPa is deemed to limit root growth, whilst 3000kPa stops root growth stops in most broadacre crops. Notably, each ripping treatment regardless of timing was effective in significantly reducing the soil strength. This is interesting as the paddock became increasingly more waterlogged between pre-seeding and six weeks post-seeding, suggesting that waterlogging does not impact the effectiveness of deep ripping to alleviate soil compaction.

Plant establishment and biomass

All three post-seeding ripping treatments caused a burial effect that reduced plant numbers, tillers, and plant biomass when compared to the UTC and the pre-seeding ripping treatment. The one-week post-seeding treatment resulted in the lowest number of plants and tillers per m^2 (62 and 192 respectively) however the plants that survived appeared a lot less stressed than the 3- and 6-week plots. This is supported by the greater tiller to plant ratio of 3.1 tillers per plant, compared to 2.6 for the 3-week and 2.4 for the 6-week treatment. This is likely due to the 1-week post seeding treatment burying the seed/coleoptile, causing a high rate of mortality, however the plants that did successfully emerge were able to thrive. The pre-seeding rip produced more plants and tillers than the UTC, however this was not statistically significant.

Biomass

Deep ripping post-seeding had a negative effect on plant biomass. This was likely attributed to the loss of plant matter rather than a significant reduction in plant growth. However, the 3-week and 6-week post seeding plots looked particularly stressed at the time when biomass was taken.

The 3-week and 6-week post seeding treatments resulted in significantly less dry matter per m^2 (75 g/m^2 and 77.2 g/m^2 respectively) when compared to the UTC (166 g/m^2) and the pre-seeding (194 g/m^2) treatment. The 1-week post seeding ripping produced greater biomass than the further delayed treatments, however this was very dependent on the number of plants that were in the measured area, which can be seen in the higher standard deviation.

The pre-seeding rip resulted in the greatest level of biomass produced, however this was not statically significant when compared to the UTC. At the time these measurements were taken, the trial plots were subject to a prolonged period of severe waterlogging, which likely stunted plant growth. Under normal conditions, it is likely that there would be a greater difference between biomass produced in the post and pre-seeding rips.

Yield

All three post-seeding ripping treatments negatively impacted barley yields compared to the UTC, whilst the pre-seeding ripping treatments performed better than the UTC. The yield penalty resulting from the 3-weeks after and 6-weeks after seeding treatments was 0.73t/ha compared to the UTC and 1.5t/ha compared to pre-seeding deep ripping. The one-week after seeding treatment (4.05t/ha) yielded only slightly less than the UTC.

It should be noted that each plot was subject to yield limiting waterlogging, which likely reduced the yield potential of all the plots. Under less extreme conditions we would expect a greater differential between the pre-seeding ripping treatment and the control as well as the post-seeding ripping treatments.

The final yields mirror the growth stage 25 dry matter, results which suggest that it is the initial mechanical damage from post season ripping that was carried through the season and affected grain yields.

Conclusion

Whilst deep ripping post-seeding is effective in reducing soil strength and alleviating compaction, the resulting yield penalty is too costly to warrant adopting the technique when pre-seeding ripping is still an option. Over the lifespan of the ripping treatment the initial cost associated with the yield penalty, particularly in the one-week post seeding treatment would likely be recouped, however given this treatment falls in the seeding window, this strategy would face the same opportunity cost as pre-seeding ripping currently does.

This project will continue in 2022 where we will look at the following season's crop performance in response to the 2021 ripping treatments. By the end of the project, we should have a clear picture of the effectiveness of deep ripping post-seeding and the economics around timing of deep ripping.

Reference: Davis S, Bekker D, Lemon J, & Isbister B, soil compaction: overview, Agriculture and Food, The Department of Primary Industries and Regional Development, 2018

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