Office Use Only	
Project Code	
Project Type	

FINAL REPORT 2022

Applicants must read the *SAGIT Project Funding Guidelines* prior to completing this form. These guidelines can be downloaded from www.sagit.com.au

Final reports must be submitted by email to admin@sagit.com.au as a Microsoft Word document in the format shown **within two months** after the completion of the Project Term.

PROJECT CODE	ELD 121
PROJECT TITLE (10 words maximum)	
Acid soils, ripping and lentil production improvement	

PROJECT DURATION *These dates **must** be the same as those stated in the Funding Agreement.*	
Project start date	**1/03/2021**
Project end date	**1/03/2022**

PROJECT SUPERVISOR CONTACT DETAILS *(responsible for the overall project)*		
Title:	**First Name:**	**Surname:**
Mr	Michael	Brougham
Organisation:	**Elders Rural Services**	

PROJECT REPORT: *Please provide a clear description for each of the following:*

Executive Summary (200 words maximum)

A few paragraphs covering what was discovered, written in a manner that is easily understood and relevant to SA growers. A number of key dot points should be included which can be used in SAGIT communication programs.

Various ripping machines and depths were investigated for their impact on alleviating water logging and surface acidity of lentils on an acid soil at Stockyard Creek and Mallala in 2021 whilst monitoring a ripping site from 2020 at Lower Light.

- Heavy clays at 10cm depth cause poor infiltration
- A wet June and July filled the profile and masked any improvement in infiltration
- Extremely deep ripping introduced salt into the rootzone which impacted on lentil growth
- Deep ripping reduced grain yield of lentils in year one
- small assessment plots of nitrogen and molybdenum showed no response

Project objectives

A concise statement of the aims of the project in outcome terms should be provided.

The key aim was to investigate the impact of ripping depths and techniques on a soil where lentils are not suited.

The key aim is to improve lentils growth in a soil marginally suited for lentils. The soil is acid at the surface, alkaline at depth and has poor infiltration. By ripping it was thought it would neutralise the surface acidity and improve infiltration and therefore improve growth. The different machines mix differently could/might/thought could improve effective neutralising. The increase in depth was to discover the best depth for lentil improvement.

Overall Performance

A concise statement indicating the extent to which the project objectives were achieved, a list of personnel who participated in the Research Project including co-operators, and any difficulties encountered and the reasons for these difficulties.

Excellent sites where selected for the project that proved to produce poor yields and surface acidity.
All works were installed early, and plot preparation was excellent. The plots were sown on time with excellent plants established.
Unfortunately, the ripping treatments did not increase yield at Mallala and stockyard creek.
A biomass response was observed at Lower Light.
Jonathan Forrest collected excellent soil strength and NDVI data whilst overseeing the management plot management, the plot preparation and harvest

KEY PERFORMANCE INDICATORS (KPI)

*Please indicate whether KPIs were achieved. The KPIs **must** be the same as those stated in the Application for Funding and a brief explanation provided as to how they were achieved or why they were not achieved.*

KPI	Achieved	If not achieved, please state reason.
Site selection	Yes ☒ No ☐	
Site soil testing	Yes ☒ No ☐	
Ripper activity at new sites	Yes ☒ No ☐	
Sowing grower equipment	Yes ☒ No ☐	
Plant number assessment	Yes ☒ No ☐	
Biomass assessment X3	Yes ☒ No ☐	
Post harvest soil test	Yes ☒ No ☐	
	Yes ☐ No ☐	

TECHNICAL INFORMATION (Not to exceed **three** pages)

Provide sufficient data and short clear statements of outcomes.

Key data

- Ripping reduced yield at both sites
- The extremely deep treatment was the lowest yielding
- Plant establishment at both sites was excellent
- Soil tests post-harvest show changes in soil properties
- pH did not correlate with yield at Mallala
- deep ripping increased soil pH of some plots
- deep ripping increased Ec and Chloride levels
- Site yield was poor compared to the rest of the paddock indicating good site selection
- At The lower light site ripping increased the NDVI measurement of lentils
- In 2021 the cause of poor lentil yeild is related to water logging and not a soil chemical property. To address this the ripping treatments were applied and reduced yield in year one. The season had a late break followed by a decile 8 June and a decile 9 July and all plots suffered water logging.

Mallala site

Plant establishment was excellent as represented in Figure 1.

The site was cut back to the single mix or pass treatments as the multiple pass treatments moved into better soil.

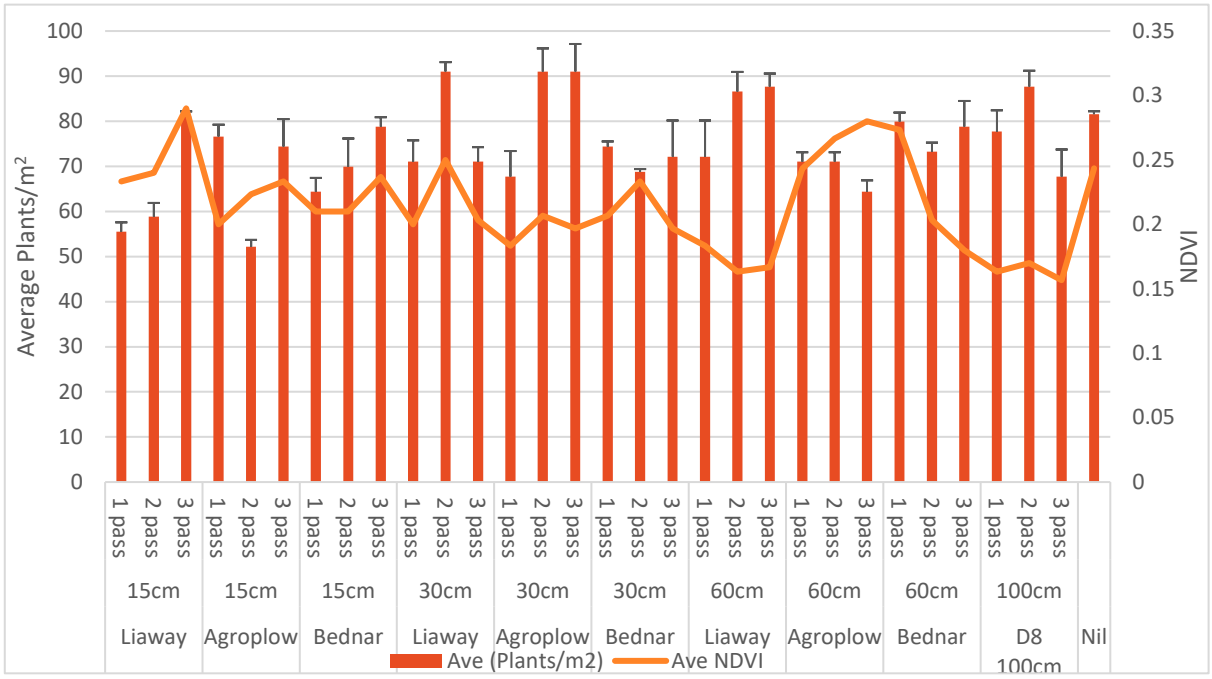

Figure 1: Plant establishment data and Ave NDVI measurements

The 1m deep treatment had the lowest yield. The soil test results show that this treatment did not change the soil pH. It did increase chloride and Ec levels, which did cause salt symptoms in the lentils. This treatment also shed water off as the soil was heaved up by ripping. This reduced the amount of water logging symptoms but also the plots stored less water which negatively impacted on growth during the dry months of September and October as shown in the rainfall table 1.

Visually the whole site was yellow with water logging in July. The D8 treatment had less water logging symptoms as can be seen in Figure 2

Figure 2: early season photo showing the D9 treatment on the left. On the right is the treatment again in the spring showing very poor growth

This soil and crop type performs best in no till and retained stubble cropping systems. The action of ripping has removed the stubble and reduced soil structure. To what extent the stubble removal and cultivation decreased yield is unknown as the nills has no preparation prior to sowing.

The liaway and agroplow machine at 30cm had higher yielding than the shallower and deeper treatments.
At 60cm the agroplow machine resulted in a large increase in soil pH (figure 4). At this depth the machines inclusions plates function, causing top soil to fall behind the tyne. This removes acid soil from the top soil and increased the pH of the surface soil.
Although this plot had a large change in pH it has not improved lentil yield.
By burying the top soil we have also removed nutrition and residue from the topsoil reducing the quality of the topsoil.

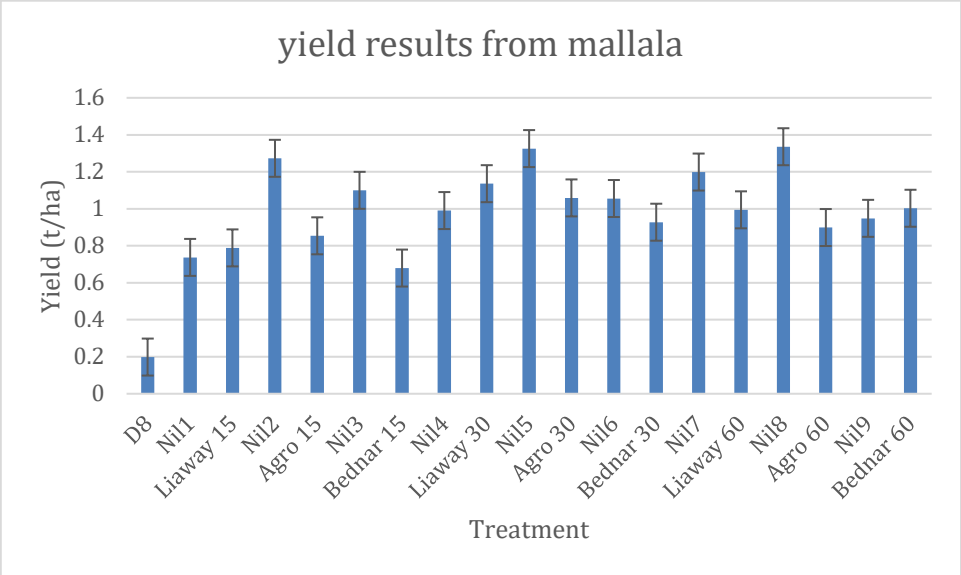

Figure 3: Yield for each treatment at Mallala Site.

The Bednar machine is designed to pull soil (delve) but did not increase soil pH. This machine struggled to achieve the targeted ripping depths during plot installation but did bring large clods to the surface. The Ec readings of plots treated with this machine increased. This suggests salts where included from the subsoil. Salts might be/are more soluble indicating the soil is still in the process of equalising.

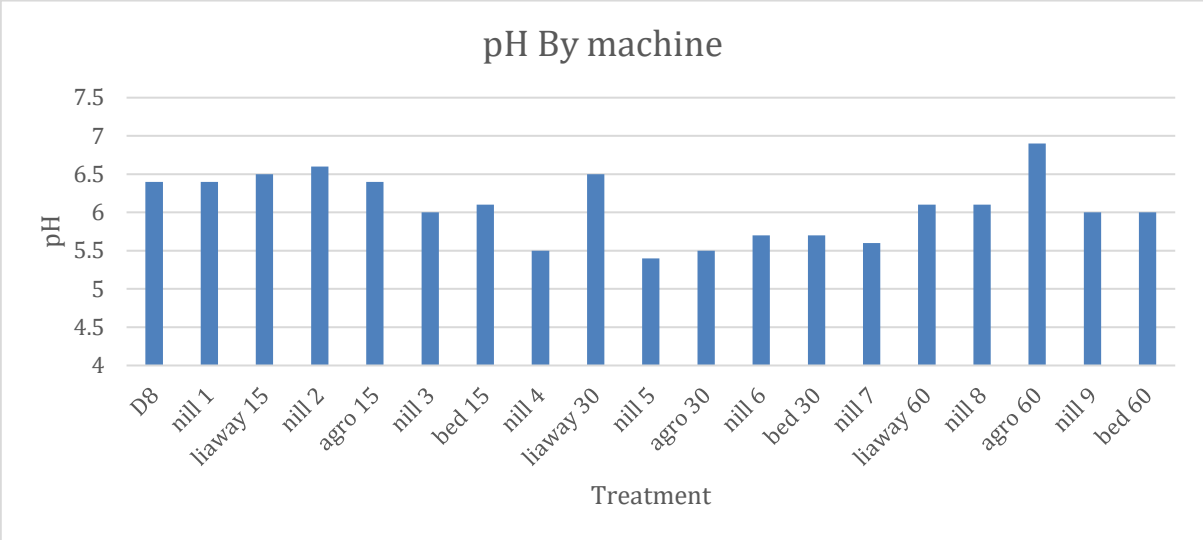

Figure 4: pH reading by machine and depth measured post-harvest at mallala

The soil test results for the nill treatments vary by one pH unit across the site (See figure 4). All treatments were sampled in pairs to capture the variability and compare to adjacent treated plots. The 30cm deep liaway machine and the 60cm agroplow treatment increased pH by one unit above the nearest nill plot. The Extremely deep treatment (D8) did not increase pH.
The soil at these sites after one year is not homogenous and so still contains visible aggregates of clay. Over time the ripped treatments it is expected the pH will increase.

Regression analysis

Using regression analysis to assess the relationship between pH and yield. pH showed no influence even though the pH ranged 5.4-7units across the site (see figure 5).

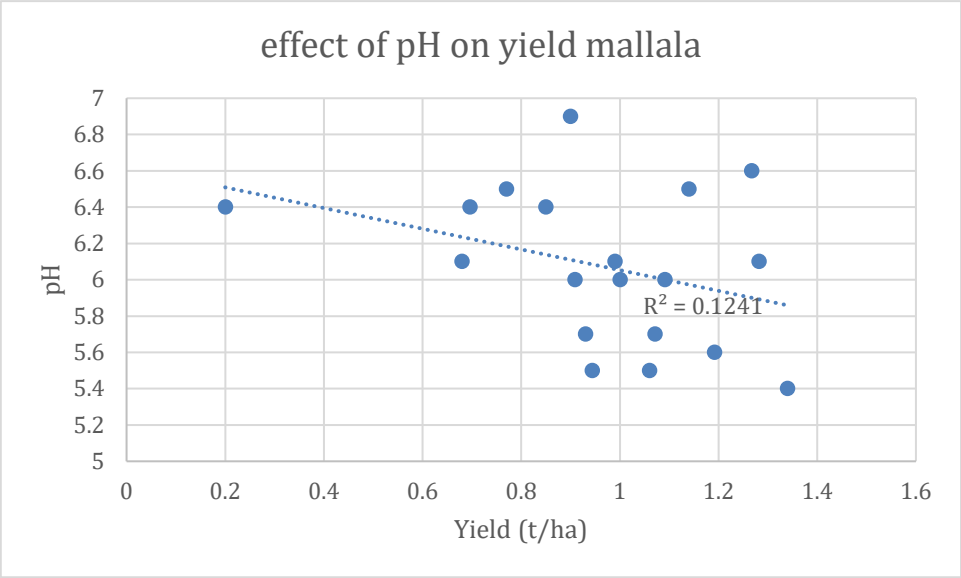

Figure 5: relationship between pH and lentil yield at mallala

Excluding the ripping treatments showed a R squared value of 0.042. Although the pH at the site is low the pH does not influence yield.

The relationship of Chloride on lentil yield was the strongest with and R value of 0.32
As shown in figure 6

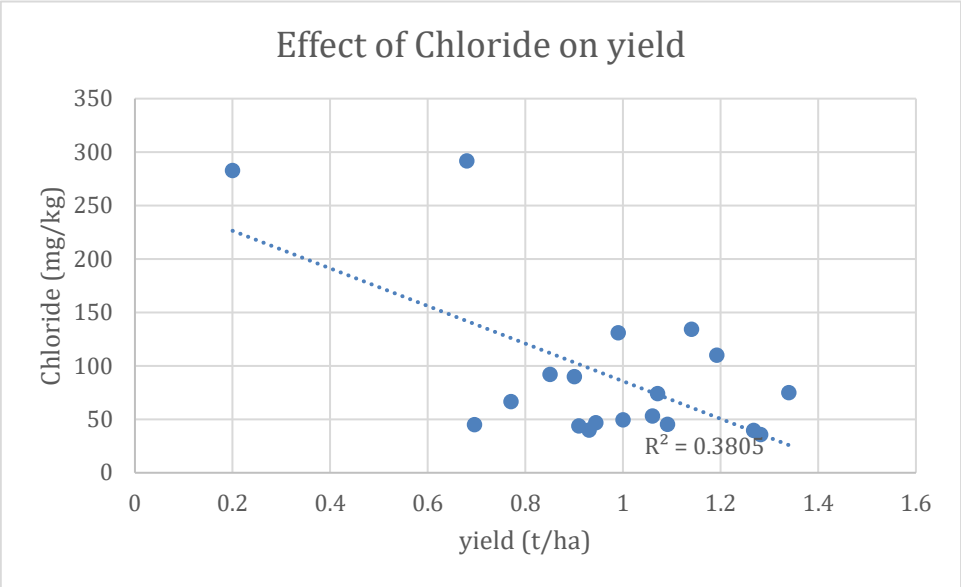

Figure 6: relationship of Chloride on yield at the mallala site

Excluding Ripping treatments
The mallala site had 9 nill treatment comparison plots. These were all samples post harvest. A regression analysis across the nill treatment plots was assessed at identify which soil analyte was contributing to yield. Soil pH and Ec showed no relationship. The strongest is a negative relationship for phosphorus, where the lower the P the higher the yield. The low P is caused by removing more p over many seasons, rather than an excess of nutrient reducing yields.

To further investigate the cause of poor lentil yield on this soil type replicated strips of sodium molybdate was applied in August. The rates investigated ranged from 50-800g/ha. No biomass response was detected.

High rates of lime (10t/ha) and nitrogen (200kg/ha) where applied at seeding in small un-ripped plots at both sites. The lime was to assess its impact in the same year. The nitrogen application was to rule out a nitrogen response associated with poor nodulation of legumes in acids soils and the potential effect of mineralised nitrogen in ripped treatments. No biomass responce was as detected.

Lower Light Site

The lower light site was ripped in 2020 with the Liaway machine at 35cm deep. This site has settled and retained residue from the 2020 crop. Ripping improved lentils biomass and increased the pH at this site as displayed in figure 7.
This site did not display any water logging symptoms or salt symptoms during the season.

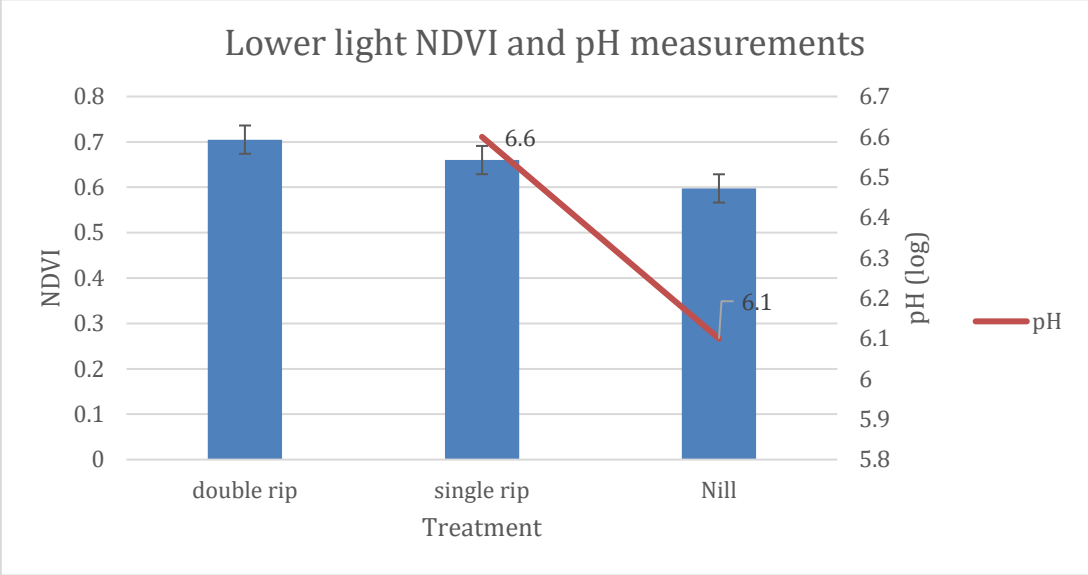

Figure 7: NDVI and post-harvest soil pH measurements at Lower light

	jan	feb	mar	Apr	may	june	july	august	sept	oct	nov	dec
lower light	18	17	13	12	24	52	80	30	18	48	53	2
mallala	16	17	13	11	24	65	84	32	23	47	57	1
stockyard creek	3.6	14.8	16	16	29	75	88	27.6	25	36	63	1

Table 1: Rainfall for the three sites lower light, mallala and stockyard creek

Plot preparation
Plots preparation was important for seed bed preparation given the clods on the surface following ripping. However, excessing prep whilst it reduced clods to improve crop establishment reduced soil structure and residue which are both important for successful lentil production, which may have contributed to yield penalties.
Monitoring the site in the next lentil crop will be important to assess the long term effects of ripping on these soil types

Stock yard creek site

The Stock yard creek site was reduced to the first mixing treatment as the site became highly variable further into the site. The plots where then harvested in three reps. The yield is displayed in figure 8. Figure 9 displays variability in lentil growth.

Figure 9: D8 treatment on left and nill. The nill treatment is yellow with water logging symptoms

The ripping reduced yield at this site and the regression analysis shows a trend that the deeper the ripping the lower the yield. The reason for the yield decline at depth looks to be caused by a change in Ec which explains 51% of the variation.

Post harvest soil tests show that soil pH was increased by the agroplow at 30 and 60cm and the Bednar at 60cm (see figure 10).

To significantly change the pH a depth of greater than 30cm was needed but this also increased Ec and decreased yield in year one.

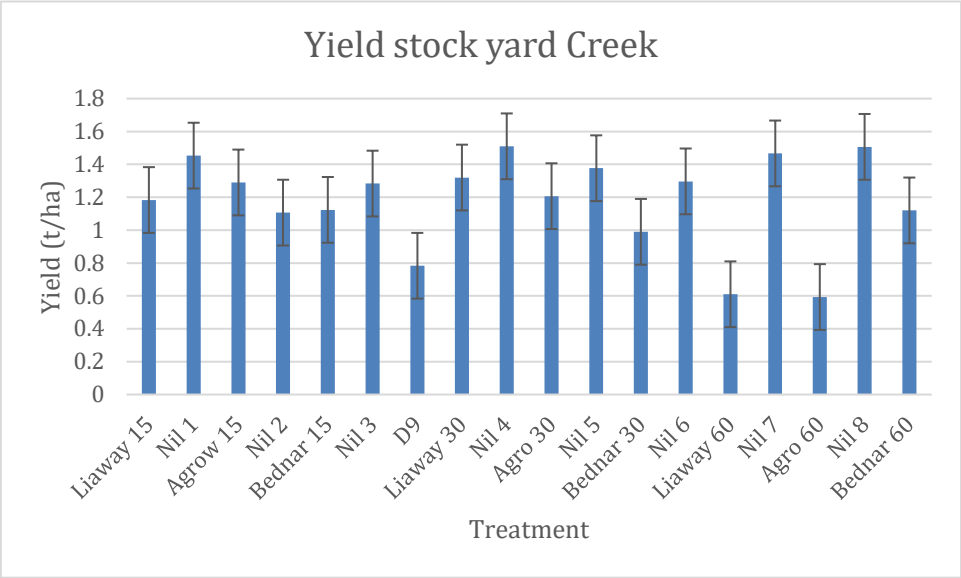

Figure 8: yield for each treatment at the stockyard creek site.

Regression analysis

Regression analysis looking at the relationship of pH on yield shows no correlation. Indicating that at these sites pH is not the contributing factor to yield variation.

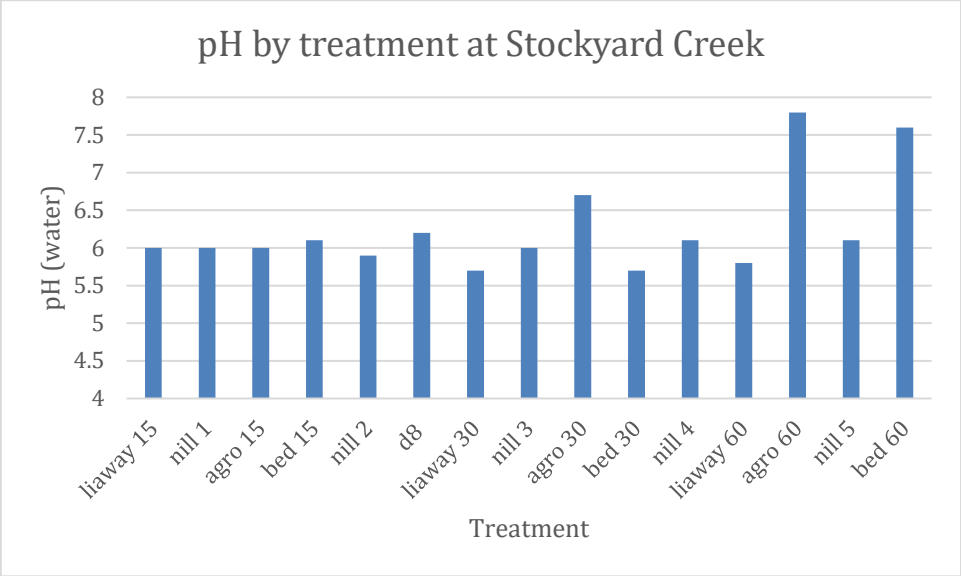

Figure 10: The post harvest pH measurements by treatment at stock yard creek

CONCLUSIONS REACHED &/OR DISCOVERIES MADE (Not to exceed one page)

Please provide concise statement of any conclusions reached &/or discoveries made.

The project indicates that ripping before lentils on this soil type will reduce yield in the first year.

Whilst ripping deep ripping can alter pH, ph is not driving yield on these soil types

This soil type suffers from waterlogging

INTELLECTUAL PROPERTY

Please provide concise statement of any intellectual property generated and potential for commercialisation.

Information is intended to be shared in the elders networks and Owen and mallala ag bureaus.

APPLICATION / COMMUNICATION OF RESULTS

A concise statement describing activities undertaken to communicate the results of the project to the grains industry. This should include:

- *Main findings of the project in a dot point form suitable for use in communications to farmers;*
- *A statement of potential industry impact*
- *Publications and extension articles delivered as part of the project; and,*
- *Suggested path to market for the results including barriers to adoption.*

Note that SAGIT may directly extend information from Final reports to growers. If applicable, attach a list of published material.

The mallala trial site was visited twice throughout the season with a total of 70 farmers experiencing the site.

The tock yard creek site, had the Owen ag bureau visits in September and the elders agronomy group. Totaling 50 people

The Upper north farming systems group visited the site at the start of 2021 will 35 people attending.

There is high interest locally for solutions to this soil type and a null result has been communicated at both Owen and mallala meetings held in march 22.

POSSIBLE FUTURE WORK

Provide possible future directions for the research arising from the project including potential for further work and partnerships.

As the sites have been installed and mapped with GPS the sites will be monitored for performance in 2023 when the sites return to lentil production.

An adjacent site to the west of the mallala site is pegged out to measure the residual effects 3 years following deep tillage.

Further treatments are being evaluated at that site to alleviate water logging