Eastern Eyre Peninsula soil management project

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Key messages

- **Soil amelioration through ripping with inclusion plates or clay delving has supported the development of plant cover on areas with a history of wind erosion.**
- **Mixed species pasture systems can present an opportunity to increase soil cover and feed levels.**
- **Summer cover crops can deliver higher levels of soil cover over summer, providing increased soil protection and can support soil amelioration practices, such as ripping with inclusion plates.**
- **Compared to stubble treatments, summer cover crops can lower soil water levels when growing, but soil water levels measured post germination showed mixed results. Even where soil water is lower, there may not be a negative impact on biomass or yield in the subsequent crop as shown in 2021.**

Why do the trial?

In 2021 the north-eastern area of Eyre Peninsula had been affected by four years of below average rainfall conditions. On water repellent sands and sodic, sandy clay loams, the lack of rain made it difficult to grow enough biomass to provide sufficient soil cover to prevent soil erosion. Amelioration of water repellent sands by clay application have been constrained due to the high costs involved. There were also concerns about increasing soil erosion risk when using more cost-effective options such as ripping with inclusion plates.

A few farmers have been experimenting with summer cover crops to increase soil protection but there are questions and concerns about the impact of reduced soil water on following winter crops. Mixed species winter pastures are also gaining farmer interest but with limited uptake to date.

This project aimed to provide support to landholders in the north-eastern area of the EP to address bare areas with repeated soil erosion events. This was done by providing funding to trial a range of practices to increase soil cover and providing technical support to deliver and evaluate these practices.

How was it done?

Funding was provided to Agricultural Innovation & Research Eyre Peninsula (AIR EP) by the Eyre Peninsula Landscape Board. A committee was established to steer the project and included representatives from the Buckleboo Farm Improvement Group, and the Roberts-Verran and Franklin Harbour Agricultural Bureaus. A target range of activities were identified and expressions of interest from farmers were sought for grant funding.

Funding constraints did not allow for detailed replicated trials however, monitoring to support extension activities was conducted with some soil data and a pictorial record of results collected. Farmers also collected their own data.

Activities and monitoring included:

1. Soil amelioration - data was collected on the impacts of ripping with inclusion plates on a sandy paddock between Arno Bay and Cleve. The landholder conducted ripping with inclusion plates on areas with and without erosion and double sowed eroded areas.

   Ripping was undertaken at a 15-degree offset to the sowing line. Anecdotal evidence from Western Australia suggests this improves uniformity of sowing depth. To reduce erosion risk there was no levelling post ripping which allowed for maximum surface cover and the maintenance of surface roughness that may have assisted in reducing wind speed at the soil surface. Plant numbers, plant biomass and yield data were collected on both the treated and untreated areas and these were compared to unripped sites that had not been subject to soil erosion.
2. Summer cover crops - to assess the impact on subsequent winter crops, soil water levels with and without summer cover crops were compared on three sites (Kimba, Arno Bay/Cleve and Wharminda). Soil sampling was conducted to 70 cm depths in January, March-April and at germination. Samples were weighed, dried for a minimum of 48 hours at 50 degrees Celsius and then reweighed. Soil gravimetric water (percent water) was converted to volumetric water (mm) using an estimated soil bulk density. Pre-seeding soil nitrogen data was also collected at each site and yield data was collected on the Wharminda site.

3. Mixed species pasture systems - three paddocks were sown to a range of mixed species pastures at Elbow Hill (Table 1). Stock exclusion cages were established following germination and prior to grazing at two locations under each species mix. A pictorial record was collected throughout the season with dry matter data collected from each cage in July and September 2021.

What happened?

1. Soil amelioration

- Where ripping was undertaken without additional levelling operations there was very limited wind erosion or drift observed. One site was sown in very strong wind conditions and even on previously eroded areas that had been ripped there was very little drift observed.
- Landholders considered that ripping at a slight angle to the seeding line appeared to improve management of sowing depth.
- On the Arno Bay site, plant numbers were highly variable in both ripped and unripped treatments with no significant differences between the treatments.
- Plant biomass and yield was generally higher on ameliorated treatments with one landholder reporting header yield data showed delved and ripped areas yielding between 2-2.5 t/ha compared to less than 0.5 t/ha on untreated areas.

2. Summer covers

Soil water measured in the January and March/April periods showed low levels of soil moisture on all sites (data not presented). At germination there was little difference in soil water between paired sites at the Kimba and Arno Bay sites. Soil water levels under the cover crop were lower than under the stubble cover at the Wharminda site (Figure 1).

Soil mineralised nitrogen at seeding was lower under summer cover crops on the Kimba and Arno Bay sites but higher on the Wharminda site (Table 2). There is no obvious reason for this as both of the Wharminda sites have been in a similar rotation for the previous two seasons.

Yield data was only collected on the Wharminda site and showed that despite lower soil water levels the cover site yielded as well as or better than the stubble site (Figure 2).

3. Winter mixed species pasture

On the Elbow Hill site mixed species biomass data showed great variability both within and between the paddocks (Table 3). Soil differences between sites may have had an impact with the landholder considering the Little Ducks paddock to be more productive than the other 2 paddocks. However, the dry September and early August visually appeared to impact on species such as plantain, kale and chicory more than other species. Despite this the landholder was very pleased with the results and reported higher levels of grazing than volunteer pastures. Also, the mixed species persisted longer and made use of later rains in spring when volunteer pasture had hayed off. There may also be beneficial soil impacts with the tillage radish forming larger tap roots that may improve the poorly structured soils in these paddocks.

Table 1. Elbow Hill species mixes sown for winter 2021.

Paddock name	Base species mix
Little Ducks	Smart radish, oats, vetch, plantain, field peas
Fox Hole	Tillage radish, barley (CL Spartacus), vetch, chicory, field peas
One Pole	Smart radish, barley (CL Spartacus), vetch, kale, field peas

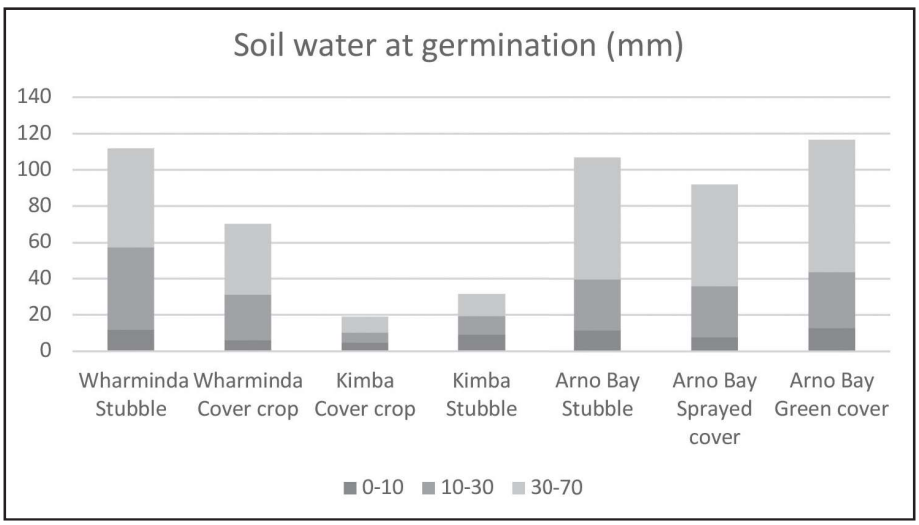

Figure 1. Soil water at germination in autumn 2021. Note that higher rainfall occurred in April at the Arno Bay, and Wharminda sites than at Kimba. This impacted on soil moisture levels and sowing dates.

Table 2. Soil mineralised nitrogen at germination, autumn 2021.

Site	Nitrate N (mg/kg)	Ammonium N (mg/kg)
Wharminda stubble	11	5
Wharminda cover crop	21	33
Kimba stubble	20	1
Kimba cover crop	6	1
Arno Bay stubble	48	2
Arno Bay sprayed cover crop	14	2
Arno Bay cover crop	13	1

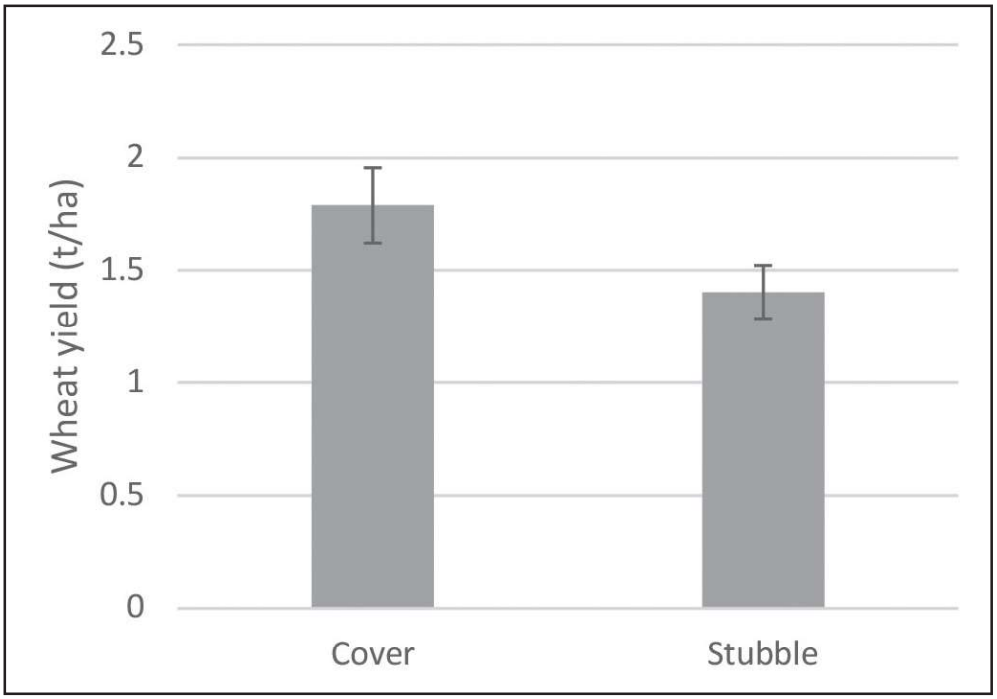

Figure 2. Wheat yield (t/ha) at the Wharminda site in 2021, error bars represent error of the mean.

Table 3. Winter mixed species biomass (t/ha) at Elbow Hill in 2021.

Site	Dry matter 9 July (t/ha)	Dry matter 11 September (t/ha)	Total dry matter (t/ha)
Little Ducks North	2.1	6.4	8.5
Little Ducks South	2.6	11.7	14.3
Fox Hole SW	0.7	4.7	5.4
Fox Hole SE	0.9	6.0	6.9
One Pole NE	0.8	4.6	5.4
One Pole W	1.7	3.4	5.1

What does this mean?

Although these studies require further validation there have been a number of conclusions and questions arising that include:

- Ripping with inclusion plates on light textured soils has been shown in other studies to increase yields that persist for a number of years. While concerns regarding the potential for wind erosion have been raised, this limited study has shown that ripping without levelling post ripping has resulted in no or limited erosion. Also, that the need to level to support control of sowing depth may not be as necessary if ripping is conducted at a slight offset to the sowing line.
- This study has suggested that the current view that a reduction in soil water following summer cover crops will have a negative impact on a subsequent winter crop is not always the case. Although all sites had lower levels of soil water under growing summer cover crops, differences in soil water were less obvious at germination. This could be due to covers providing a mulching effect, or improving water infiltration, or may be due to high rainfall in early winter. Even where there were clear measured differences in soil water, this did not seem to impact on biomass or yield. This study was only limited to measuring the total amount of soil water and not able to quantify differences in plant available water. However, it should be noted that this was a very limited study conducted over one season only. Also, this data should not be seen to support decisions on summer weed control as cover crops may have a different impact compared to summer weeds.
- Mixed species pastures appear to be an option to replace volunteer pasture phases in low rainfall environments. They appear to provide greater biomass, improved soil cover and grazing. Anecdotal reports suggest they also may support increased soil biological function and improve soil structure. Further research needs to be undertaken on the best mixes for different soils and climates and the most cost-effective pasture systems.

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Brian Dzoma and Steve Jeffs applying soil additives at the Minnipa calcareous soil trial, March 2021.