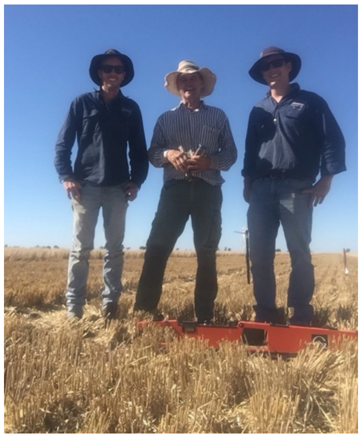
PROC-9176281: Impact of stripper header fronts and straw length on soil evaporation and fallow efficiency



Milestone 106: Year 2 Progress Report & Communication & Extension Report Year 1. June 2022

including updated research plan and annual operating plan

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Table of Contents

Overall project aim

The project proposes to evaluate the impact various forms of stubble architecture created by either stripper or draper header fronts on the capture, maintenance and storage of soil moisture (fallow efficiency dynamics) and provide growers with key crop establishment, development and yield metrics to make decisions regarding the incorporation of stripper fronts in the farming system in southern NSW.

The project will focus on measuring and analysing the effects of stubble length and architecture on:

- Water capture, storage and conversion to grain yield.
- Stubble breakdown rates.
- Impacts on soil surface conditions, notably wind speed.
- Canopy temperature.
- Weed emergence, pest incursions and impacts on control measures required.
- Harvest efficiency and impacts on investment return.

METHODS

i. Farmlink / CSIRO / Grassroots Agronomy

Three experimental sites were established by the 18th February 2022 that encompassed medium and low rainfall environments across two main soil types (red loam and vertosols) in the Riverina region of NSW. These sites were located at Yuluma (near Urana), Matong and a new site located at Temora.

In December 2021, barley was harvested at Yuluma and Matong and wheat was harvested at Temora in late January 2022. At each site two contrasting header fronts (stripper and draper fronts) were used to harvest large strips "plots" of contrasting stubble heights. Each header front treatment strip consisted of two header widths (2 x 12m = 24m), and three replications of each treatment strip (header front) was implemented at each trial site. An example of a trial design is illustrated in figure 1.

In each strip, two detailed measurement areas or locations (each approximately 30m long x width of the strip) were selected and monitored over the summer fallow (between harvest 2021 and sowing the following crop in 2022) that represented the main differences in soil type, topography within the strip and be reasonably uniform in structure (Figure 2).

The methods have been detailed in previous milestone reports. However, additionally, in year 2 (2021-22 fallow period) weed data was collected at the Yuluma. Weeds were counted in 4 quadrats (each 1.2m^2) per strip at the Yuluma site.

ii. Charles Sturt University

Two experimental sites were sown to barley in May 2021 following the wheat harvest in December 2020. At both sites the trial areas were harvested with a stripper front then after harvest was completed a draper front was attached to the harvester which then re-harvested two header widths at a height of 15cm. The trial area consists of two adjoining draper front treatments with the stripper front treatments external to these. Four replications were implemented along the direction of harvest, randomly assigned to the left or right pair of treatments. At the Collingullie site where the harvester is 9m wide the plots are 15m long while at Lockhart with a 12m harvest width plots are 20m long, to maintain equivalent width to length ratio between sites.

The climatic monitoring sensors were installed at the Collingullie site in January 2022 and at Lockhart in February 2022. At each site wind speed monitors have been placed at 15cm and 45cm above ground level. Temperature sensors have been installed at both sites at 50cm, 35cm, 10cm above ground and 2cm below ground while at Collingullie an additional sensor is placed on the soil surface below any residue present. A soil moisture, temperature and electrical conductivity sensor has been placed 10cm below the soil surface at both sites.

At Collingullie these sensors are recording every 10 minutes while at Lockhart they record at 15-minute intervals. Automatic rain gauges have been installed at both sites. Where any destructive measurements (residue samples etc) are taken they are taken outside the plots used for automatic logging.

High residue farming systems – why strip and disc?

An objective of the research is to quantify if there is additional value in using a stripper front compared to a draper fronts in high residue farming systems when sowing with a disc seeder. Many growers retaining stubble have moved to stripper fronts for a number of reasons including trying to maintain more groundcover over the summer fallow period through to sowing, increased harvest capacity and less hairpinning when disc seeding.

This stripper/disc system is very different to previous no-till stubble retention systems such as the draper/disc system where cereals can be cut high or low at harvest with the draper front or in the draper/tyne system where cereals are cut low at harvest and the seeder then inter-row sows through the standing stubble. Wider row spacings and accurate GPS guidance are critical for the success of these systems, especially in the tyne system in order to allow the seeder to operate between the stubble rows.

A stripper front works differently to a conventional draper front, whereby a rearwards spinning rotor with rows of fingers pluck grain from the head. Approximately 85% of the grain is threshed in the front with tall standing stubble left behind. With a lower volume of grain going through harvester, stripper fronts can achieve significant increases in capacity and efficiency especially in lodged crops whereby the fingers can remove heads without the need for processing large amounts of crop material.

Harvest efficiency is lifted through an increase in tonnes per hour and speed per hectar harvested as there is less residue to process and a reduction in threshing required. Growers have increased their harvest capacity with an improvement in timeliness especially during a wet harvest, where quality downgrades result in price discounts. An improvement in harvest efficiency equates to reduced depreciation, reduced repairs and maintenance, reduced fuel costs and reduced labour costs. A reduction in fuel costs and engine load is a major saving with growers stating they use half the volume of fuel per tonne harvested. Stripper front maintenance is generally low with a single gearbox and belt drive to spin the stripping rotor and grain-gathering auger, stripping fingers will also wear and break when coming in contact with sticks and rocks.

John Francis from Holmes Sackett quantified many of these metrics at the Wagga Wagga 2018 GRDC Farm Business Update (see paper attached). A key outcome of the study was the improved harvest efficiency that came with ownership of a Shelbourne front, and how this drives adequate cost reductions to generate good returns on investment.

The Shelbourne stripper front can only be used to harvest cereals and some minor crops such as safflower and linseed and is not suitable for harvesting pulses or direct heading canola. As many growers need to harvest canola and pulse crops, the purchase of a stripper front can add additional costs to the whole farm budget. Keeping grain away from a high capacity stripper front can be a challenge especially in high yielding seasons. Growers have addressed this by using additional chaser bin support whereby 2 chasers follow 1 harvester.

One negative associated with using a stripper front is the potential for increased grain losses compared to using a draper front, with this loss occurring at the header front or through the rotor. Kondinin Group analysis has indicated grain losses are increased when using a stripper compared to a draper front but much of this is related to growers seeking high capacity for example 80-100 tonne/hour. Growers have acknowledged this and continually make adjustments to settings and operating parameters to minimise losses. A more conservative harvest capacity of 50-60 tonne/hour has been found to minimise grain losses and allow harvest logistics to keep up. The GRDC funded stripper and draper, disc and tyne project currently being managed in Western Australia by the Liebe Group are currently examining harvest losses by both header fronts. Narrow row spacings, less than 200mm have been observed to improve grain feeding into the stripper with a constant wall of material pushing against the drum. This helps reduce grain loss from heads dropping under the front in wider row systems.

Other challenges experienced in the stripper/disc system are similar to any other stubble retention disc systems that include reduced pre-emergent herbicide choices. However, all stubble retention systems include mice risk, increased insect pressure in canola and seeding through a thick mulch of straw. All of these issues are real but have been addressed by growers largely through crop diversity and rotation which is important in all disc and tyne stubble retention systems. These changes include sowing sensitive crops such as canola into pulse stubbles (not cereal straw) with the tall straw improving crop establishment with a disc seeder given less hairpinning.

Disc seeding system are a first step when looking at adopting a high residue farming system in order to achieve a number of objectives in in dryland cropping enterprises. These include:

- Allowing dry or calendar sowing without clods
- Retention of very high stubble loads when sowing
- Potentially higher surface soil moisture at sowing, so greater sowing window opportunity

- Allows adoption of narrow row spacings while still retaining stubble

As with all systems there are compromises such as a higher cost of maintance, poor seed-soil contact due to hairpinning, poor penetration on hard soils and the seeding furrow left open. Growers have adapted their disc seeding configurations to overcome many of the issues outlined primarily by using aftermarket components that improve the precision and reliabity of single disc seeding units. This includes adding hydraulic downforce, using sharp discs, replacing worn bearings and bushes, using a flexible firming wheel, seed tabs and crumbler wheels for consistent seeding depth and furrow closure.

Weed management programs are adjusted using double break pulse-canola rotations, croptopping, narrow row spacings, early sowing for crop competition and the adoption of harvest weed seed control (HWSC). Research by John Broster, Charles Sturt University and Michael Walsh, Sydney University (see paper attached), concluded that stripper fronts can collect an equal quantity of ryegrass seed compared to conventional fronts. This makes HWSC a viable form of non-chemical weed control. The biggest difference is the reduction in straw going through the header with a stripper with Broster measuring 50% less chaff being processed.

Some key differences with strip and disc compared to draper and tyne:

- Tall stubble left following cereals
- Higher harvest capacity
- Reduced summer weed growth due to the thick mulch
- Sown with a disc seeder
- Narrow row spacing is critical for crop competition
- Agronomy changes are warranted with early sowing, early N
- Greater risk of grain loss at the front and through the rotor
- Ensure disc seeder is configured eg sharp discs, hydraulic downforce, firming wheels, crumbler wheels to achieve accurate seed plament and furrow closure
- Reduced pre-em herbicide options
- Frost risk can be greater with high residues and a diverse rotation will mitigate the risk
- Canola is highly sensitive to insect pressure in stripper stubble, therefore sow after pulses

Some key points using either strip and disc or draper and tyne:

- Harvest weed seed control is effective
- Soil amelioration eg lime or gypsum applications are still required and strategic cultivation following lime to the depth of the acid band is critical in first instance followed by keeping soil pH ($CaCl_2$) higher than 5.5 to keep alkali moving downwards
- Diverse rotations are essential for stubble breakdown, N, weed control, minimise disease in stripper/disc system but also very important in draper/tyne
- Double break pulse-canola rotations are critical for N, weeds & reduced insect pressure

Potential System benefits

The stripper system leaves tall standing stubble which shades the soil surface and has been found to reduce soil temperature which could potentially result in reduced evaporation in both summer and winter. This anecdotally has been observed to improve soil water capture and retention which in turn improves fallow efficiency and yield in some seasons.

Increased stubble has been found to buffer crop variability in dry seasons through two main functions, making marginal surface soil moisture available for crop establishment and secondly storing water longer for grain fill. GRDC and NSW DPI research consistently conclude that timely sowing is critical for optimising yield. It is widely accepted that yield will decline 4-7% with each week of delay in sowing after the optimum time for a specific variety. New GRDC research projects on early sown wheats and canola both recommend the timely sowing and establishment of varieties matched to their suitable phenological window, these varieties consistently yield more across a range of seasonal conditions.

To achieve crop establishment in marginal seasonal conditions, the retention of moisture from the summer fallow period is critical. Strict summer weed control is essential to increase soil moisture, soil nitrogen and higher yields with McMaster, Hunt and Kirkegaard finding that strict summer weed control can save between 40 to 89mm of additional soil water and about 0.6kgN/ha for every 1 mm of soil moisture retained by weed control. Groundcover is also important for maximising water infiltration, retaining moisture and keeping soil temperatures cooler with at least 70% groundcover required to maximise water infiltration and higher stubble loads will retain more moisture in autumn in some years, plus potentially ensure a more even germination and emergence of crops.

Growers incorporating the stripper front/disc seeder system have observed improvements in crop establishment across variable soil types over several years.

It has been highlighted in experiments over the past 30 years that sowing cereal with narrow rows has resulted in grain yields increasing by 4-5% (data from Glen Riethmuller from DPIRD WA - 1% higher yield for every inch narrower) along with more crop competition for weeds. The stripper front/disc system is trying to incorporate increased stubble cover and narrower rows to maximise crop yield. Calendar sowing has become a critical driver of yield for getting crops in on time and the accurate seed placement of the disc seeder is complemented by the presence of residual stubble.

There are no conclusive research projects that have compared stubble retained using a stripper front with conventional draper fronts, however the Northern Grower Alliance (NGA) setup comparisons looking at ways to maximise soil water capture and improve fallow efficiency GRDC Groundcover 2017). The work aimed to maintain 100% groundcover to boost fallow efficiency and improve planting opportunities in northern NSW and southern Queensland. The research found that extra groundcover can increase the depth of soil water accumulated by up to 50 to 60 cm compared with standing stubble, reduced evaporation losses was the most likely cause.

Results for year 2

1. Rainfall between June 2021 and July 2022
Farmlink / CSIRO / Grassroots Agronomy/ CSU

The 2021 cropping season continued to remain wet at all sites, with the Matong, Collingullie, Lockhart, Urana, Quandialla and Temora sites receiving above average rainfall until late November 2021. From late November 2021 until late June 2022, all sites received significantly above average rainfall with all sites remaining at decile 9 seasons and the wet 2021-22 summer period made harvest extremely challenging for all growers (Figures 3 to 8).

The 12 month annual rainfall between June 2021 and the end of June 2022 across the regions was Yuluma (860mm), Lockhart (883mm), Matong (765mm), Collingullie (893mm), Quandialla (917mm) and Temora (962mm), and all sites experienced trafficability issues that impacted harvest and sowing activities (Figures 3-8).

Traficability issues and extreme waterlogging were most evident at the Quandialla, Yuluma and Matong sites. The planned December 2021 harvest at Quandialla was delayed until late February 2022 and currently this site remains unsown for the 2022 season. The Yuluma and Matong sites were harvested in December 2021 but sowing for the 2022 season has not been possible. These two sites have not been trafficable since harvest and sowing is now unlikely to occur in 2022.

1. Pre-header harvest crop yields from hand harvested crops in December 2021 – January 2022

Prior to the growers harvesting their crops for a second season with either a stripper or draper header front between December and January 2021, large hand samples (two x 1.2m2 samples per location per strip) were removed from the two previous trial sites (Yuluma and Matong) in the project to determine the quantity of total dry matter (DM), grain yield and grain protein where barley was sown into previous wheat stubble harvested with either a draper or stripper front in 2020. Similarly, wheat maturity plant samples were also removed at the new Temora site, but these were only to be used to estimate crop yield, total DM and estimate how much new stubble from the 2021 year remained for the 2021-22 summer fallow period.

There were no significant difference in the quantity of barley dry matter, grain yield or protein content at the Yuluma trial sites (Table 1 – statistics not included in table). There was no significant difference in barley grain yield or protein content between header types at the Matong site but there was significantly more total dry matter at location 1 compared to location 2 (8.8t/ha vs 8.1t/ha) and there was a trend (P=0.078) for more stubble dry matter to be remaining following the stripper front 2020 treatment compared to the draper front (Table 2 – statistics not included in table).

Table 1: Total barley DM, barley grain yield, grain protein and new barley stubble remaining following grain removal at the Yuluma trial site in late December 2021.

Header front	Location	Total DM (t/ha)	Grain Yield @ 12.5% moisture (t/ha)	Protein (%)	New stubble remaining following harvest (t/ha)
Draper	1	11.7	6.8	10.5	5.6
Striper	1	10.1	6.0	10.7	4.8
Draper	2	9.7	5.9	10.3	4.5
Striper	2	11.0	6.4	9.6	5.3
Draper		**10.5**	**6.3**	**10.3**	**4.9**
Striper		**10.6**	**6.2**	**10.0**	**5.1**

At the Temora trial site, wheat maturity hand samples were removed prior to header harvest with either the draper or stripper front in January-February 2022. An excellent grain yield (average 7.1t/ha @ 12.8% protein) was measured from the hand samples with around 7.8t/ha of stubble remaining for the 2021-22 summer fallow period (Table 3).

Table 2: Total DM, barley grain yield, grain protein and new barley stubble remaining following grain removal at the Matong trial site in late December 2021.

Header Front	Location	Total DM (t/ha)	Total grain Yield @ 12.5% moisture (t/ha)	Protein (%)	Remaining new stubble residue (t/ha)
Draper	1	8.6	5.6	8.8	3.6
Stripper	1	9.0	5.5	9.7	4.2
Draper	2	8.1	5.5	9.1	3.2
Stripper	2	8.1	5.3	9.3	3.4
Draper		**8.3**	**5.5**	**9.0**	**3.4**
Stripper		**8.6**	**5.4**	**9.5**	**3.8**

Table 3: Total DM, wheat grain yield, grain protein and wheat stubble remaining following grain removal at the Temora trial site in January 2022.

Pre-Harvest Wheat Maturity samples					
Location		Total DM (t/ha)	Grain Yield @ 12.5% moisture (t/ha)	Remaining Stubble (t/ha)	NIR protein (%)
1	Draper	14.4	7.1	8.0	12.8
1	Stripper	14.5	7.0	8.2	12.9

2	Draper	13.4	6.8	7.4	12.7
2	Stripper	14.0	7.3	7.5	12.7
	Draper	13.9	7.0	7.7	12.7
	Stripper	14.2	7.1	7.9	12.8

3. Stubble architecture, stubble dry matter and decomposition

The objective of the stubble measurements was to examine the differences in stubble load/architecture and decomposition and how these differences influenced surface soil moisture (0-20cm) or soil temperature (0-5cm).

i. Pre sowing stubble load and type at the end of the 2021-22 summer fallow period

At the end of the 2021-22 fallow period, the stubble load was determined at two specific locations in each strip at the Temora site. The results showed more standing stubble in the stripper treatment, compared to the draper strips. The draper treatment did show more flat stubble (laying on soil surface), compared to the stripper treatment. Both these results are as expected.

The total stubble (standing and flat combined) indicates that there is decomposition differences between the two tretaments. The stripper treatment had 8.2t/ha total remaining stubble at the end of the fallow period, compared to 7.1t/ha total remaining stubble for the draper treatment.

These results have not yet been statistically analysed but do indicate some major differences in stubble architecture (flat or standing) and final stubble load/decomposition at the end of the fallow period.

Table 4: Stubble architecture and quantity post harvest at Temora in February 2022.

Header front	Location	Stubble height Dec 2021 (cm)	Standing stubble May 2022 (t/ha)	Flat stubble May 2022 (t/ha)	Total new stubble May 2022
Draper	1	40.1	4.5	2.5	7.1
Stripper	1	73.8	6.3	1.9	8.2

4. Soil moisture

Determining the total soil water content at harvest and pre-sowing and the change in soil water content is a sound method to provide evidence of differences between the two harvesting methods in one season. Similarly, the surface soil water content measurements (0-5cm and 5-10cm) can be used to provide evidence of differential conditions for seed germination.

The post-harvest starting soil moisture content were collected at all sites between December 2021 and February 2022. However, there have been major difficulties with accessing sites and taking measurements pre-sowing due to very high rainfall. As of 28th of June, only the Temora site has had the second round of fallow sampling completed (pre-sowing sampling). The Yuluma and Matong sites have been to wet, which has impacted our ability to access the sites and also on the quality of data. The farmers at these two sites have been unable to sow the 2022 crops.

i. Initial deep soil moisture post-harvest in December 2021

Initial results indicate that following the 2021 season, there was no significant difference in the total soil water content (0-130cm) pre-sowing (April-May) between the two header harvest methods at any of the four experimental sites. At two sites there was a significant effect in stored soil water by location, but no interaction with header front method.

Table 5: Post-harvest total volumetric soil moisture (mm) at 0-130cm in December 2021 at Yuluma.

Depth	Draper 1	Stripper 1	Draper 2	Stripper 2
0-10cm	20	18	20	17
10-20cm	31	27	22	18
20-30cm	37	32	37	32
30-50cm	68	64	69	67
50-70cm	70	54	67	58
70-100cm	103	89	106	81
100-130cm	69	93	104	86
Total soil water (mm)	396	376	424	359

ii. Initial soil moisture (mm) in the surface 0-5 cm, 5-10 cm and 10-20 cm post-harvest in December 2021-February 2022

At all sites, four surface soil samples were removed to a depth of 20cm from each plot in the same position (underneath) where the stubble biomass sample was removed. To reduce error relating to soil variability between December 2021 and June 2022, these three sets of soil and stubble samples were taken within 1m of each other, ensuring we had correct stubble architecture surrounding/buffering each sampling area. The initial surface soil moisture at Yuluma is illustrated in Table 5.

Table 6: Post-harvest average volumetric surface soil moisture content (mm) for three depths (0-5cm, 5-10cm, 10-20cm) following with a stripper or draper front in December 2021 at Yuluma.

Depth	Draper 1	Stripper 1	Draper 2	Stripper 2
0-5cm	0.20	0.19	0.21	0.24
5-10cm	0.17	0.18	0.18	0.19
10-20cm	0.28	0.30	0.20	0.21

iii. Soil moisture concentration at a depth of 6cm, 16cm and 26cm monitored using VIA's Chameleon sensors over the 2020-21 summer period

Following harvest at each of the experiment sites, a Via Chameleon sensor was inserted at three depths in all plots to monitor changes in the soil water potential between harvest methods over the summer fallow period. These gypsum based sensors (arrays) and electronic readers were selected as they were able to be installed in large paddock situations were treatments were several hundreds of meters apart without the need for extensive cables and were a low cost option that was required to keep within our project budget.

Although there are some 40,000 sensors worldwide, this is the first time they have been used in such a detailed way with the constraints that they have been subjected to. The change in soil water potential at the Temora site at three depths (4-8cm, 14-18cm, and 24-28cm) from four of the six harvest strips is illustrated in Figures 10 and 11.

The blue line is a where the water potential ranges between 0-20 kPA, green line at 20-50 kPa and the red line is where the soil is quite dry at greater than 50 kPa and not suitable for germinating seeds. When comparing the draper and stripper fronts, we need to compare strip 1 vs 2 (rep 1), 3 vs 4 (rep 2) and 5 vs 6 (rep 3), due to the blocking structure of the experiment. All of the soil water data is being processed by Kirsten Verburg and then modelled.

At Temora, there appears to be no difference in the soil water potential between the two header harvest types at any depth from the 10th April onwards, and little or no difference between the 18th February and mid April (Figures 9 and 10).

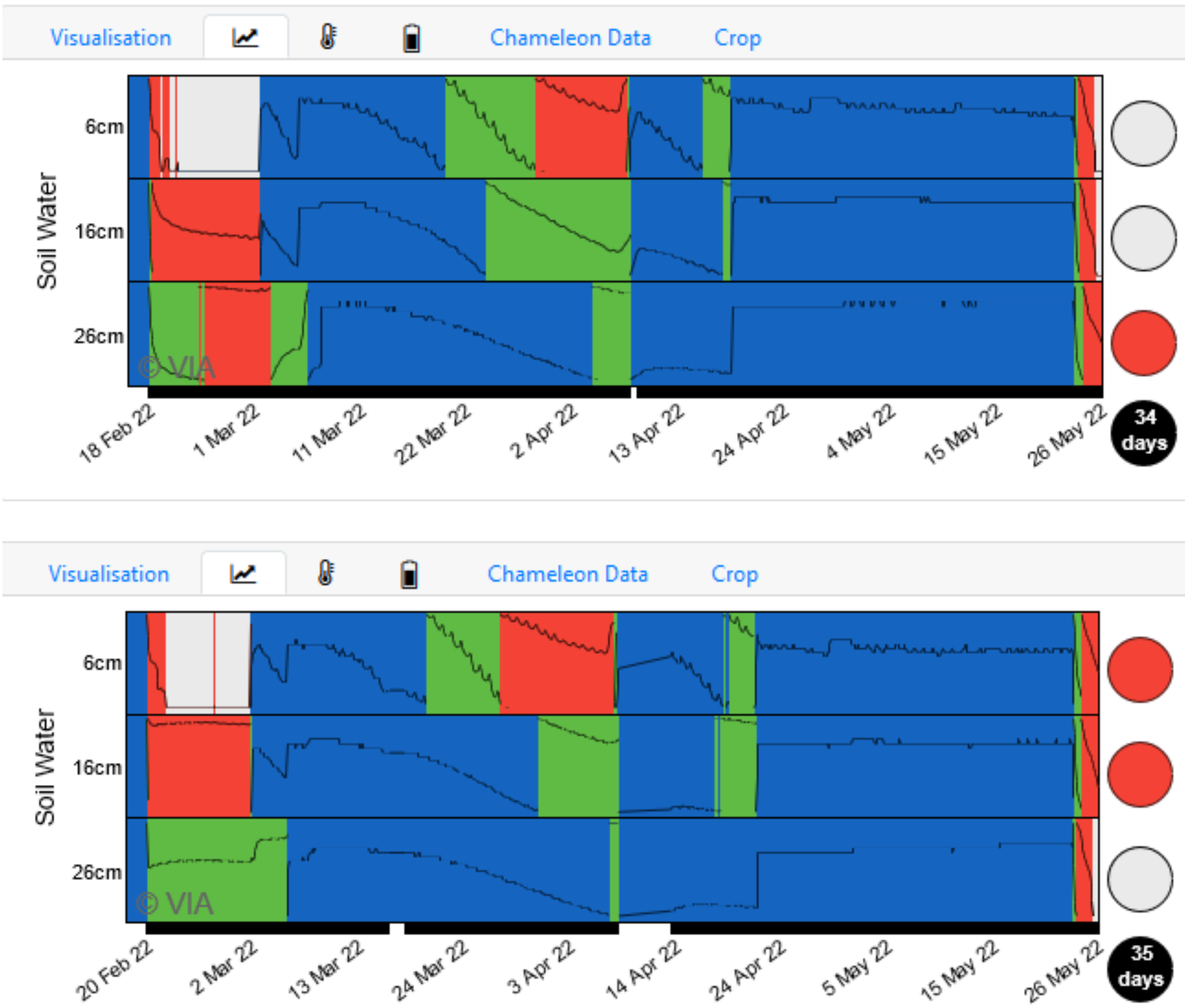

Figure 9 - Draper replicates 1 and 2: Soil water potential measured by Via's Chameleon sensor at the thre depths from 2 replicates between 18th February and 26th May 2022, at Temora.

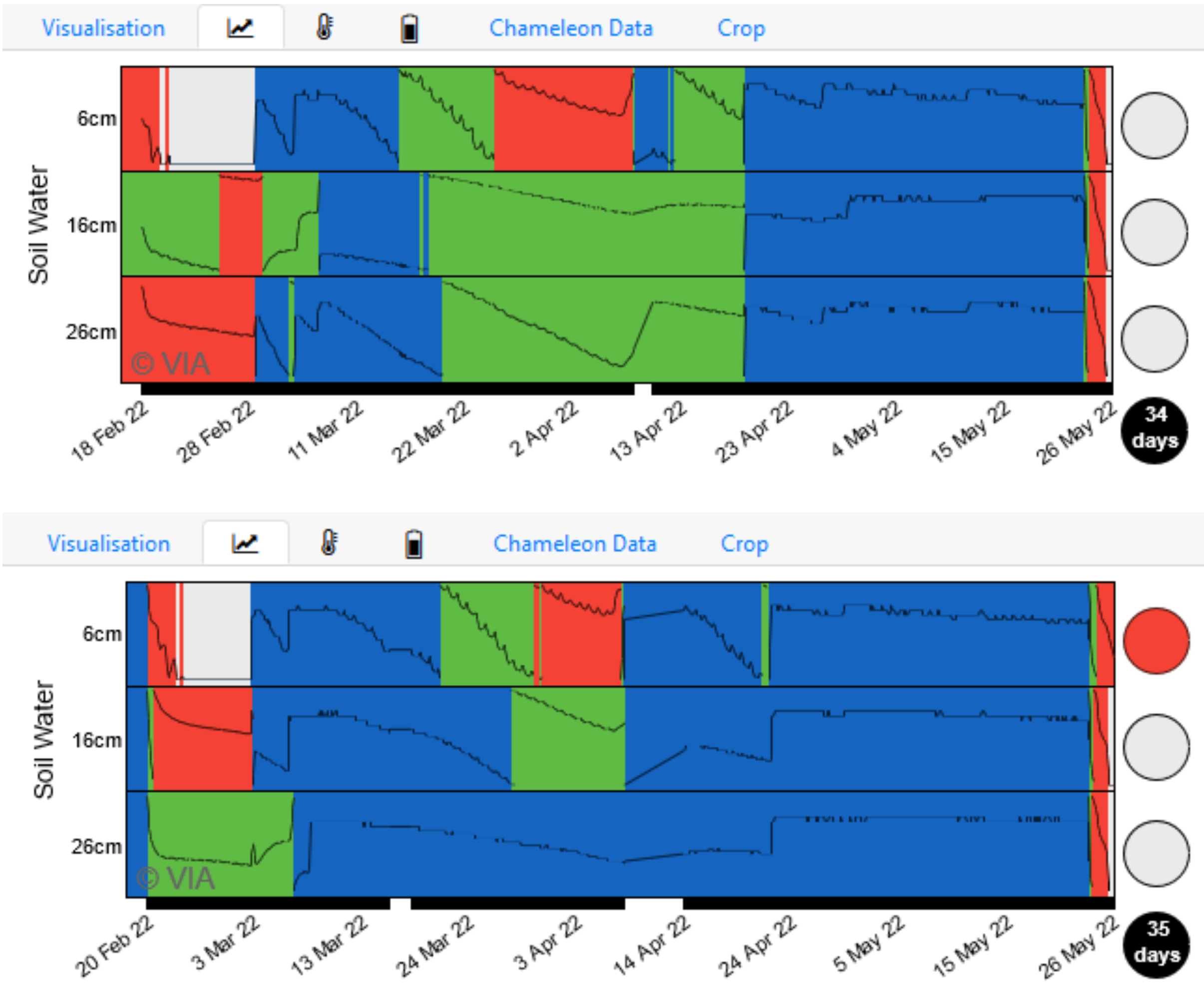

Figure 10 - Stripper replicates 1 and 2 Soil water potential measured by Via's Chameleon sensor at the thre depths from 2 replicates between 18th February and 26th May 2022, at Temora.

6. Canopy wind and soil water at Collingullie

6. Canopy air temperature

At both Collingullie and Lockhart air temperature sensors were installed at heights of 10, 35 and 50cm, at Collingullie the data were recorded every 10 minutes using Hobo loggers while at Lockhart the data were recorded using TinyTag radio loggers recording every 15 minutes.

These heights were selected such that the top sensor is above both canopies and the bottom sensor is below both canopies with the middle sensor midway between the two harvest heights.Unfortunately there is no temperature data included in this report.

7. Canopy wind speeds

At both Collingullie and Lockhart anemometers were installed at heights of 10 and 45cm, at Collingullie the data were recorded every 10 minutes while a Lockhart the data were recorded every 15 minutes, both sites used TinyTag loggers. The recording intervals for the data loggers measuring wind speed are set in the factory and cannot be adjusted, this is the reason for the different recording intervals between sites. Only the preliminary data for the Collingullie site has been included in this report.

The Collingullie site did show differences in wind run between the two header front treatments. Increased stubble residue height in the stripper front treatment resulted in decreased wind run, and vice versa, decreased stubble residue height in the draper front treatment resulted in increased wind run.

The average daily wind run at the 45cm height was 69.2km/day in the draper treatment compared to 10.7km/day in the stripper treatment (P<0.0001). The stripper treatment wind run remained less than 50% of the draper harvested treatment throughout the entire fallow period, reaching a peak of 44% of the draper wind run in early April (Figure).

At the 10cm height, the average daily wind run was 1.7km/day in the stripper treatment, compared to 28.4km/day in the draper treatment (P<0.0001).

Overall, the average wind run was reduced by 83% at 45cm and 96% at 10cm as a result of increased stubble residue height from stripper front harvesting. Over time the percentage wind run reductions of the stripper treatment was shown to reduce. This may indicate stripper stubble residue degradation.

It should also be noted that post sowing there was still significantly reduced wind run in the stripper compared to the draper treatment (P<0.0001).

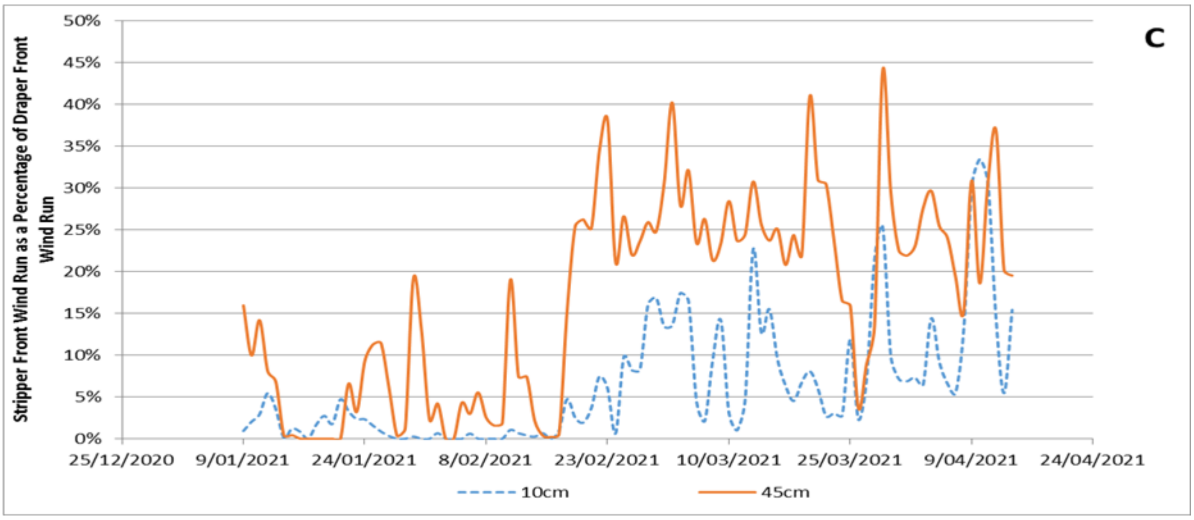

Figure 11. Stripper front daily wind run as a percentage of draper front daily wind run at both 45cm and 10cm.

Overall, the average wind run was reduced by 83% at 45cm and 96% at 10cm as a result of increased stubble residue height from stripper front harvesting. Over time the percentage wind run reductions of the stripper treatment was shown to reduce. This may indicate stripper stubble residue degradation.

8. Soil water

The Collingullie site showed differences in soil moisture between the stripper and draper treatments. The soil water content (SWC) at 10cm depth was higher within stripper harvested residue than it was in the draper residue, averaging 0.231cm3/cm3 and 0.198 cm3/cm3 respectively over the fallow period ($P<0.0001$).

On 23/3/2021 the SWC peaked at 0.35cm3/cm3 in the stripper treatment and 0.335cm3/cm3 in the draper treatment.

Interestingly, the soil water loss after rainfall had 3 distinct phases, A, B and C (Figure .) The first phase (A), occurs directly after the recharge event, where the loss of soil water occurs at the highest rate. This first phase lasts for 2-3 days. The second phase (B), typically showed water loss decreasing at a decreasing rate. With oin this second phase the differences in SWC between treatments begins to grow. This phase lasts for varying amounts of time. The final phase (C) shows the slowest rate of soil water loss and this rate of water loss is similar between treatments. This third and final phase lasts until the next recharge event.

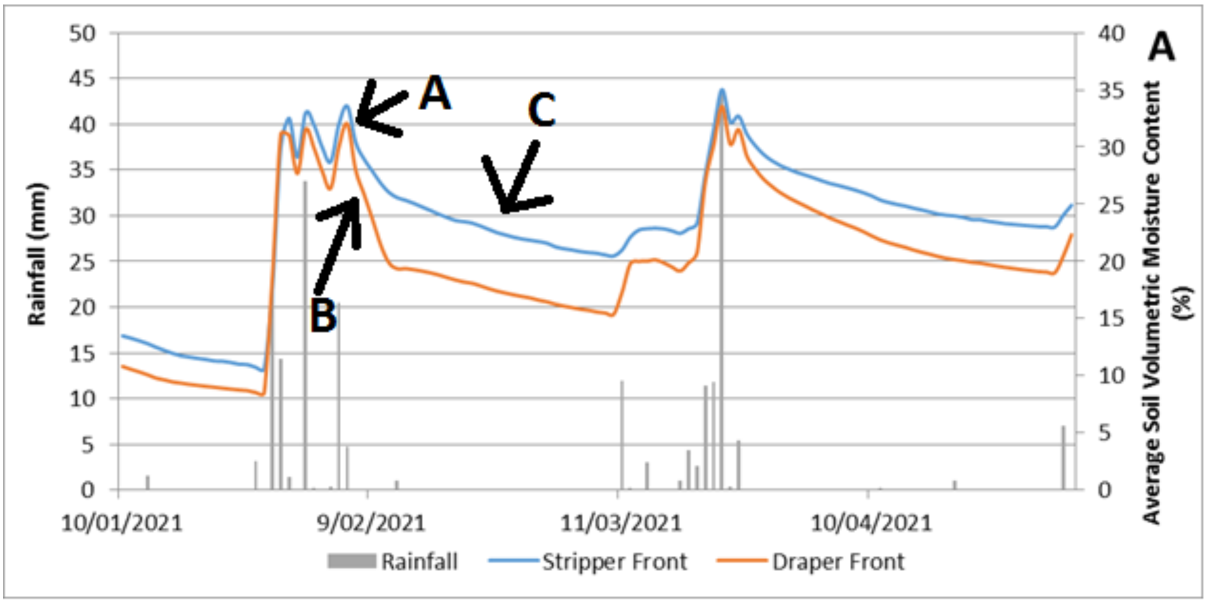

Figure 12. Differences in changes in soil water content at Collingullie during the fallow period.

8. Weeds

At the Yuluma site there was an observable difference in weed numbers between the stripper and draper treatments. The Stripper treatments at both sites had lower weed numbers compared to the draper treatments. The Yuluma results are shown below and the weeds observed were mostly sowthistle but also fleabane, crumbweed, cudweed and hairy panic.

Table 7. Yuluma weed results, stripper vs draper.

Treatment	Weeds per 1m^2
Stripper	7.9
Draper	11.3
Draper	14.0
Stripper	7.3
Draper	8.5
Stripper	5.0

Draper stubble on left showing more sowthistle than stripper stubble on right.

Discussion and Conclusion

In year 1 (2020-2021) we had favourable weather for this stubble management project. The lack of rain in April following good rain in February and March provided an excellent scenario to examine differences in surface and stored soil moisture pre-sowing in 2021. Hoevever, year 2 has been the complete opposite. All sites received very high rainfall that has made both farmer and trial activities very difficult. Trafficability has been a major issue. Harvest was delayed significantly at the Quandialla site and its has not been sown for the 2022 season. This led to the abandonment of this site and the establishment of a new site at Temora.

The Yuluma and Matong sites have also not been sown for the 2022 season due to poor trafficability. Trial work was also unable to be completed at these two sites. This meant that end of fallow measurements have not been taken. The value of this data would not be great anyway because the sites were and still are waterlogged and differences between treatments would be unlikely.

Water laying on the surface at the Yuluma site during harvest on 13 December 2021

Year 2 grain yield data was collected for the Matong and Yuluma sites. Unfortunately there was no significant difference in yield between the stripper and draper treatments. This is likely due to the above average rainfall throughout the 2021 growing season that reduced any soil moisture interactions between stripper and draper stubble.

The stripper and draper treatments did result in treatment differences at the Temora site (not yet statistically analysed). These differences in stubble load as as expected with more standing stubble dry matter found in the stripper treatments compared to the draper treatments. The opposite was true for "flat" stubble on the ground. The flat measurements showed more chopped up straw is spread on the ground following a draper harvest compared to a stripper front harvest.

The decomposition rate over summer was different at the Temora site. The draper treatment resulted in 7.1t/ha of stubble at the end of the fallow period, compared to 8.2t/ha for the stripper stubble treatment. This finding is consistent with industry observations that stripper fronts are key to maintaining higher stubble loads over the fallow period. It is likely that the greater percentage of flat stubble from the draper front results in faster decomposition at ground level, where conditions are cooler over the hot summer months and it is in contact with more soil biology.

Soil moisture results showed no significant difference across sites in year 2. The chameleon sensors at Temora show no major differences in soil moisture for the majority of the fallow period and this is consistent with the heavy rainfall received at this site. These sensors are designed to identify soil moisture changes at shallow depths near the surface. They would be useful in showing early sowing opportunities in a dry year. Unfortunately constant rainfall meant that both treatments were near or at field capacity for most of the fallow period.

Differences in soil moisture were shown in the 2020-2021 fallow period at the Collingullie site. At this site soil water content (SWC) data collected at 10cm depth was higher in the stripper treatment compared to the draper treatment. There were also differences in the rate of water losses post recharge events. The stripper treatment was slower to lose soil water and this supports the idea that higher stubble load systems will present more early sowing opportunities.

The Collingullie site also showed significant differences in wind speeds between treatments. At 10cm above ground in the stripper treatment the average wind run across the fallow period was 94% lower than in the draper treatment. The wind run differences between stripper and draper were reduced towards the end oif the fallow period. This is likely due to stripper stubble degradation late in the fallow period. However, there were still significant reductions late in the fallow period and interestingly these differences were present post sowing.

Overall, the year 2 data has been greatlky impacted by above average rainfall across all sites. This has reduced the value of the trial data collected at most sites. Ideally this project would be undertaken in a average to below average rainfall fallow period. This would allow different stubble loads to have a bigger influence on soil moisture.

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References:

John Broster et al, Charles Sturt University. GRDC Agronomy Updates 2019. The impact of stripper fronts and chafflining on harvest weed seed control.

https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2018/07/impact-of-stripper-fronts-and-chaff-lining

John Broster & Nathan Hatty, Charles Sturt University. GRDC Agronomy Updates 2020. Influence of header front on stubble micro-climate and winter crop growth.

https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2020/02/influence-of-header-front-on-stubble-micro-climate-and-winter-crop-growth

John Francis, Holmes Sackett. Wagga Wagga GRDC Farm Business Update 201The economics of changing from draper to stripper fronts.

https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2018/08/the-economics-of-changing-from-draper-to-stripper-fronts

James Hunt and John Kirkegaard, CSIRO. A guide to consistent and meaningful benchmarking of yield and reporting of water-use efficiency.
https://publications.csiro.au/rpr/download?pid=csiro:EP156113&dsid=DS2

GRDC Groundcover 2017. Northern Grower Alliance (NGA) trials help plains growers improve fallow efficiency.

https://grdc.com.au/resources-and-publications/groundcover/groundcover-issue-127-marchapril-2017/trials-help-plains-growers-improve-fallow-efficiency