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Project Code	
Project Type	

FINAL REPORT 2022

PROJECT CODE	S419
PROJECT TITLE	
Improving the early management of dry sown cereal crops.	

PROJECT DURATION	
Project start date	1/07/2019
Project end date	30/06/2022

PROJECT SUPERVISOR CONTACT DETAILS		
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Executive Summary

With larger seeding programs and increased summer weed control to conserve soil moisture, more growers Australia-wide are considering dry sowing early. The research reported here assessed the impact of management which could be used with dry sown crops on wheat establishment on three different soil types of the upper Eyre Peninsula:

- fertiliser type (P and N) and fertiliser placement
- herbicides and seed dressings.

Soil type was important with a red loam soil having better establishment and lower impact of fertiliser placement than the grey calcareous soils. Sandy soils are more vulnerable to wind erosion and thus more prone to pre-emergence herbicides impacting on establishment.

Better plant establishment was achieved by placing fertiliser 3 cm below seeds, achieving a similar establishment to the nil fertiliser treatment. Placing urea with the seed lowered plant establishment on all soil types. If fertiliser separation cannot be achieved due to seeding system limitations, then using MAP (10:22) is a safer option than DAP (18:20), especially on highly calcareous soils under drier conditions.

Dry sowing increased early plant dry matter but did not necessarily result in better yields than seeding on the break.

Sowing seed in a position to utilise deeper moisture was important and new long coleoptile wheat varieties will be valuable for early and vigorous crop establishment where soil moisture is in or just below conventional seed beds. Spartacus CL barley is a good early dry sowing option as it had improved establishment and early dry matter production compared to wheat.

All trial reports are accessible via the SARDI website, Eyre Peninsula Farming Systems Summaries – PIRSA https://pir.sa.gov.au/research/research_specialties/livestock_sciences/farming_systems/farming_systems_eyre_peninsula_summaries or previous progress reports.

PROJECT REPORT:

Project objectives

With larger seeding programs, increased summer weed control to conserve soil moisture and more variable autumn rainfall patterns, more growers Australia-wide are considering dry sowing early.

On upper Eyre Peninsula in 2017 and 2018, seed was placed in the soil for many weeks with limited soil moisture, some seed still germinated but the delayed plant emergence often resulted in lower plant establishment. This raised questions by farmers about the soil factors which influence seed germination and reduce germination and establishment.

This research assessed the impact of management on wheat establishment on three different soil types in field trials and in pot experiments –

- NP fertiliser type and fertiliser placement
- herbicides
- seed dressings.

Further pot experiments assessed how much moisture was needed on the three soil types to germinate wheat and achieve emergence, and how long a germinated seed can survive in dry or barely moist soil and still establish.

Overall Performance

This project resulted in several key outcomes for growers. Soil type was found to be important to crop performance with a red loam having better establishment, lower impact of fertiliser placement and yielding better than grey calcareous sands.

Application of NP fertilisers are still important to current farming systems because without fertiliser, the lowest dry matters and yields were observed in the no fertiliser treatments. Regarding fertiliser placement, better plant establishment was achieved by separating the fertiliser to 3 cm below the seed in both pot and field trials and this resulted in similar establishment to the nil fertiliser treatment. Fertiliser treatments in which urea was applied with the seed had lower plant establishment on all soil types. It was found that if fertiliser was applied with the seed, then using MAP (10:22) was a safer option for successful seedling establishment than DAP (18:20).

Even with reasonable starts to the seasons, average plant establishment in the field trials was lower than the 180 plants/m^2 targeted. Growers in lower rainfall environments, and especially those on the grey calcareous soils may need to increase seeding rates to achieve the desired plant numbers of 180 plants/m^2. Dry sowing improved early plant dry matter but did not necessarily result in better yields than seeding on the break.

Calcareous sandy soils are more prone to wind erosion and therefore herbicide management could be more of an issue for crop establishment. Most herbicides and fungicides evaluated in the field trial did not impact on plant establishment unless the crop was dry sown and soil movement from wind erosion moved herbicides into the furrow.

Spartacus CL barley had improved establishment and early dry matter production compared to wheat so is a good early dry sowing option. In future the long coleoptile wheats may provide an option for earlier plant establishment and dry matter production where subsoil moisture is present lower in the seed bed, or just under it.

Due to COVID restrictions extension activities were limited during 2020 with cancellation of Minnipa Field Day in September preventing a major extension opportunity. All research was presented in the Eyre Peninsula Farming Systems Summaries and at the 2021 Minnipa Field Day. This research has been further extended to EP growers through the SA Drought Hub 'Best practice for early sowing opportunities' project in collaboration with AIR EP. This included demonstrations of the best options from this research sown at Penong and Cowell in 2022.

Personnel
There were staff changes during the project (see below), with Amanda Cook being appointed to the Minnipa Agricultural Centre Research Scientist role, changes in technical officer staff and Nicole Baty being appointed as Project Management Support Officer during the life of this project.

Research Officer PO2 0.2 FTE funded - the Research Officer role on the project was originally filled by Amanda Cook. This became a SARDI in-kind contribution when Amanda was appointed to the Minnipa Agricultural Centre Research Scientist role. This salary was then used to support Nicole Baty.
Agricultural Officer OPS3 0.2 FTE funded. The Agricultural Officer role was filled by Neil King in 2019 until February 2021. It was then filled by Ian Richter until Craig Standley was appointed to the project in July 2021.
Project Manager ASO5 0.05 FTE in-kind was initially N Scholz who left SARDI in 2020. The project was then managed by Amanda Cook (in-kind) until Nicole Baty was appointed as Project Support (funded) in October 2021.
Casual wages $1000 per year funded. Overall casual wages were higher at times due to gaps occurring between successive appointments of new Agricultural Officers.
Co-operators SARDI Minnipa Agricultural Centre (Minnipa), Myles and Kylie Tomney (Cungena), Luke Kelsh (Streaky Bay), Matthew Cook (Minnipa - 2020 during COVID)

KEY PERFORMANCE INDICATORS (KPI)		
KPI	**Achieved**	**If not achieved, please state reason.**
Finalise trial program to evaluate dry sowing with EPARF Research and Review Committee.	Yes ☒ No ☐	
Identify three trial sites (upper EP), implement and monitor trial program to evaluate dry sowing in current farming systems.	Yes ☒ No ☐	
Establish pot experiments to evaluate different soil moisture conditions, fertiliser placement and type on seedling emergence and vigour. To be undertaken in Year 2 if required.	Yes ☒ No ☐	
Trial results collated, analysed, published and presented to EP farmers annually and progress report compiled.	Yes ☒ No ☐	
Reassess and make any changes to trial program to evaluate dry sowing with EPARF Research and Review Committee.	Yes ☒ No ☐	
Implement and monitor trial program to evaluate dry sowing in current farming systems.	Yes ☒ No ☐	
Establish pot experiments to evaluate different soil moisture conditions, fertiliser placement and type on seedling emergence and vigour if required.	Yes ☒ No ☐	
Trial results collated, analysed, published and presented to EP farmers annually and progress report compiled.	Yes ☒ No ☐	
Reassess and make any changes to trial program to evaluate dry sowing with EPARF/Low Rainfall Research and Review Committee	Yes ☒ No ☐	
Implement and monitor trial program to evaluate dry sowing in current farming systems.	Yes ☒ No ☐	
Trial results collated, analysed, published and presented to EP farmers. Final report compiled and extended.	Yes ☒ No ☐	Final report results extended in March 2023 at SARDI Farmer Meetings.

TECHNICAL INFORMATION

In 2019 and 2021 field trials were undertaken at Minnipa on a red loam and on a sand in 2020, and at Streaky Bay and Cungena on grey calcareous soils. Each site had two trials sown each year with Razor CL Plus wheat @ 72 kg/ha, aiming for 180 plants/m^2. The trials were sown with a small plot seeder on 25.5 cm (10") row spacing with Harrington points and press wheels. The seeder had the ability to sow fertiliser either with the seed or deeper (3 cm), or the fertiliser could be split (50% with seed: 50% below the seed) or delivered as a fluid fertiliser.

Different fertiliser treatments were applied in field trials to assess the impact of NP fertiliser type and fertiliser placement on dry sown cereals (Figure 1). These treatments are listed in previous reports (see https://pir.sa.gov.au/research/research_specialties/livestock_sciences/farming_systems/farming_systems_eyre_peninsula_summaries).

The other trial at each site assessed the impact of herbicides and seed dressings on dry sown cereals. Trials were sown with Razor CL Plus wheat and 60 kg/ha DAP with the seed and with management options of Spartacus CL barley, Nil – Control (no fertiliser), herbicides (Trifuralin @ 2 L/ha, Boxer Gold @ 2.5 L/ha and Sakura @ 118 g/ha), fungicides (Baytan, EverGol, Uniform plus EverGol, Tebuconazole @ 50ml/100kg seed, and Flutriafol on fertiliser @ 166ml/100kg DAP), shallow sowing (2-3 cm), deep sowing (6-7 cm), and higher seeding rate (100 kg/ha).

In 2019 and 2020, seeding depth influenced plant establishment more than any of the fungicide or herbicide treatments. In 2021 the management trial tested if new long coleoptile wheat varieties, which can be sown deeper and hence into better soil moisture, could be used in current farming systems where sowing would be dry for "conventional" varieties and achieve earlier plant establishment. Seed was accessed from different sources and plant breeding companies.

Impact of NP fertiliser type and fertiliser placement on dry sown cereals.

Field Trials

In 2019 Minnipa dry sowing resulted in higher plant establishment with an average of 166 plants/m^2 compared to sowing on the break with 126 plants/m^2 (Figure 1). At Streaky Bay and Cungena there were no differences in plant establishment between dry sowing or sowing after the break.

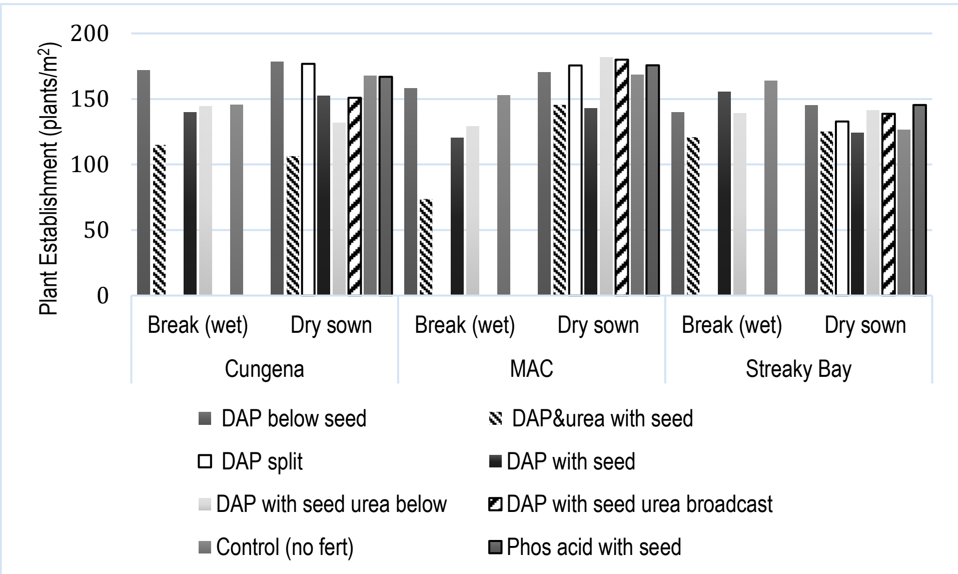

Figure 1. Plant establishment of CL Razor wheat at three trial site locations in 2019 **(LSD (P=0.05) Location*Break*Fertiliser = 29)**

On 1 July 2020, when the last emergence count was taken, overall establishment over the 3 sites was 101 plants/m^2 which was lower than the expected 180 plants/m^2. The Minnipa sand had the lowest overall emergence with 98 plants/m^2, Minnipa red soil 101 plants/m^2 and Streaky Bay grey calcareous soil 104 plants/m^2 (Table 1). Sowing at the break achieved 110 plants/m^2 and sowing dry achieved 92 plants/m^2 (Table 2) overall.

Table 1. Establishment of Razor CL Plus wheat at three trial site locations on 1 July, 2020.

Soil type	**Establishment (plants/m^2)**
Minnipa red loam	101ab
Minnipa sand	98 b
Streaky Bay grey calcareous soil	104 a
LSD (P=0.05)	*5*

Table 2. Plant establishment of Razor CL Plus wheat at different time of sowing on 1 July, 2020.

Timing	**Establishment (plants/m^2)**
Dry sown	92
Break	110
LSD (P=0.05)	*4*

In 2019 and 2020 urea and fertiliser placed with the seed often had lower crop establishment than those where the seed and fertiliser was separated (Figures 1 and 2). Treatments which separated the fertiliser from the seed had similar establishment to the nil fertiliser treatment (Figure 2). Treatments with urea placed with the seed had lower establishment (Figure 2). Similar to 2019, the red soil type showed less variability between treatments in establishment compared to the other soils (Figure 1).

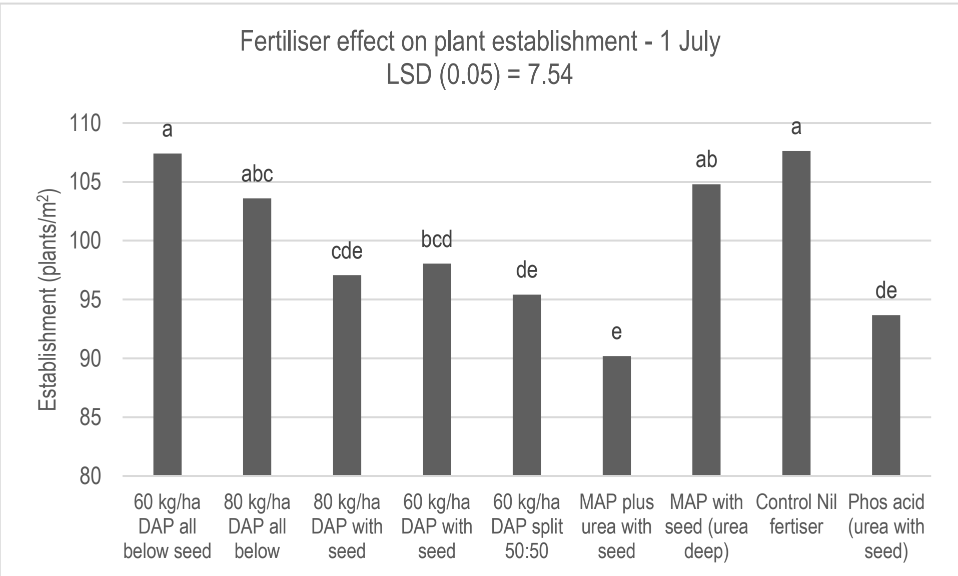

Figure 2. Establishment of Razor CL Plus wheat over three trial site locations with different fertiliser treatments on 1 July, 2020.

The 2021 season was a late break to the season and there was little rain between dry sowing and the break to the season. At the break, seeding conditions were ideal with good moisture levels and no drying of the topsoil before the next rainfall event. The Cungena trial experienced some wind erosion due to strong wind events on 31 May which resulted in dry sowing plants being wind damaged and 'cut off' and an increase in sowing depth by 1-2 cm in the dry sown treatments due to the furrows filling with blown sand. At all sites, dry sowing trial treatments began emerging on 1 June (Table 3), with the dry sown treatments having higher plant numbers than the 'break' treatment over all sites (Table 3).

In 2021, season break sowing had lower emergence at Cungena compared to the other sites (Table 4). On 24 June, dry sowing of CL Razor wheat had slightly higher establishment with 108 plants/m^2 and sowing at the break having 102 plants/m^2 (Table 3). On 24 June, overall emergence over the 3 sites was 105 plants/m^2 which was much lower than the targeted plant density of 180 plants/m^2 (Table 4).

Table 3. Plant establishment of CL Razor wheat at different times of sowing in 2021, averaged over 3 sites.

Date	Dry sowing	Break	*LSD (P=0.05)*
1 June	74 a	0 b	*7*
8 June	115 a	104 b	*7*
17 June	117 a	110 b	*6*
24 June	108 a	102 b	*4*
29 June	106 a	93 b	*9*

Table 4. Plant establishment of CL Razor wheat at different locations and sowing time on 24 June, 2021.

Location	Dry sowing	Break
Minnipa	117 a	113 a
Streaky Bay	105 b	104 b
Cungena	86 c	106 b
LSD (P=0.05)	*7*	

Table 5. Grain Yield of CL Razor wheat at different times of sowing in 2021.

Location	Dry sowing	Break
Minnipa	3.27 a	3.21 a
Streaky Bay	2.10 b	1.87 c
Cungena	1.63 d	1.53 e
LSD (P=0.05)	*0.07*	

In 2021, dry seeding did not make crop performance any more susceptible to fertiliser at seeding (Figure 3). Urea and DAP fertiliser placed with the seed resulted in lower crop establishment than those where the seed and fertiliser were separated. The treatments which separated the fertiliser from the seed had similar establishment to nil fertiliser.

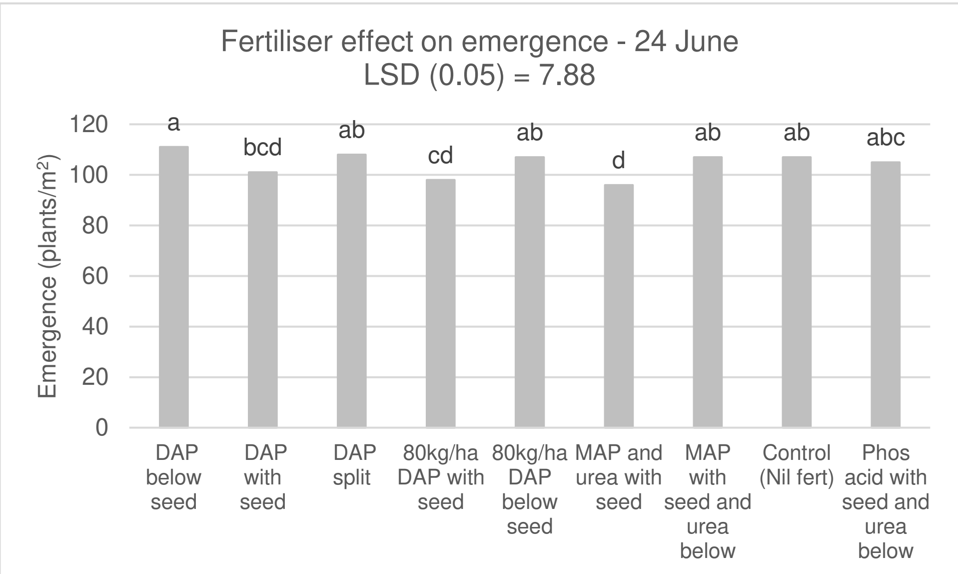

Figure 3. Plant establishment of CL Razor wheat over the three trial site locations with fertiliser treatments on 24 June 2021. (LSD (P=0.05) = 8).

Over the three years of the trials plant establishment averaged 108 plants/m^2 which was much lower than the targeted 180 plants/m^2.

Rhizoctonia root disease was scored in field trials at 10 weeks (GS Z20) by randomly sampling 20 plants per plot. Roots were scored using a (0-5) scale with 0 being a healthy non-infected root system. In 2020 Rhizoctonia root disease score averaged across the site was highest on the Streaky

Bay grey calcareous soil (3.0) and lowest on the Minnipa sand (2.3), with the Minnipa red loam being 2.7 *(LSD (P, 0.05) = 0.2).* In 2020 seeding at the break of the season had slightly higher infection levels of 2.8, than at the dry sowing timing with a 2.5 score for Rhizoctonia infection *(LSD (P, 0.05) = 0.2).*

Pot experiments

In 2019 and 2020 pot experiments were undertaken between June and August in the hot house using 0-10 cm topsoil from the field sites. The soils were dried after collection at 70°C for 48 hours. The soil was potted into plastic tubs before fertiliser and seed were placed into the tubs in two seed and fertiliser rows. The tubs were placed in a glasshouse in a replicated randomized design with 3 replications.

In 2019 soil was taken from a Minnipa red loam, and Streaky Bay and Cungena grey calcareous soils in non-sprayed and non-cropped areas. All paddocks were pastures in the 2018 season and cropped with wheat in the 2019 season. Four fertiliser placement treatments were imposed using Diammonium phosphate (DAP, 18:20:0:0). They were (i) Nil Control (no fertiliser), (ii) 60 kg/ha DAP with seed, (iii) 60 kg/ha DAP 3 cm below the seed or (iv) split application with 30 kg/ha DAP with seed and 30 kg/ha of DAP 3 cm below the seed. The equivalent of 60 kg/ha of CL Razor wheat seed was sown at 3 cm below the soil surface, on 22.5 cm (9") row spacing.

In 2019 nearly all plants had emerged from the Minnipa soil after 19 days and were vigorous (Table 6). Emergence in the Cungena soil was only lower when all the DAP had been placed with the seed. In the Streaky Bay soil, emergence was reduced by DAP all in the seed row and also when split. The lowest emergence occurred in Streaky Bay soil with DAP all in the seed row.

Table 6. Soil type and fertiliser placement effect on % emergence after 19 days.

	Soil		
Fertiliser Placement	Cungena	Streaky Bay	Minnipa
Nil	97	96	96
DAP below seed	93	97	100
DAP split	89	85	90
DAP with seed	68	58	93
LSD (P=0.05)	*10*		

Electrical conductivity (EC) is used to estimate salinity. With no fertiliser applied, the Minnipa soil had the lowest EC of 0.14, Cungena 0.16 and Streaky Bay 0.18. In the presence of DAP fertiliser Minnipa had an EC of 0.17, Cungena 0.21 and Streaky Bay 0.21 (Table 7). Salinity in soil from around the seeds was higher in the presence of DAP, regardless of whether it was split or all with the seed (Table 7).

Table 7. Fertiliser placement effect on salinity (EC, water) in soil averaged across the three soil types from the seed row after 19 days.

Fertiliser Placement	**EC (water)**
Nil	0.16
DAP split	0.20
DAP with seed	0.20
LSD (P=0.05)	*0.01*

The 2020 pot trial assessed the impact of fertiliser type and placement on wheat establishment on three different soil types; a Minnipa red loam, Streaky Bay grey calcareous soil and a white siliceous sand (Minnipa). The soil was potted on 15 June into plastic tubs at 5% (w:v) soil moisture before fertiliser and seed were placed into the tubs in two seed and fertiliser rows. Eight fertiliser treatments were imposed using DAP or MAP (Figure 4). Nitrogen was balanced with urea placed 3 cm below the seed. A splitter boot system was also simulated with a 3 cm wide band of DAP and seed.

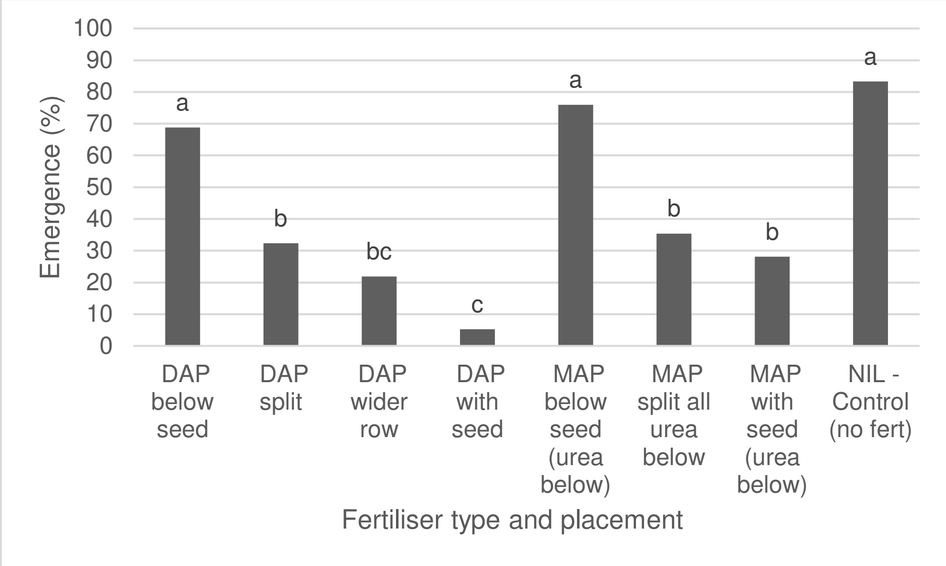

Figure 4. 2020 Pot Experiment. Emergence of wheat 8 days after seeding (% of seeds planted) in a white sand with different fertiliser types and placement (LSD (P, 0.05) = 23). Columns with the same letter are not statistically different at P=0.05.

Nil fertiliser and fertiliser placed below the seed resulted in higher emergence in the Minnipa white sand (Figure 4*)*. DAP with the seed caused lower emergence than MAP (Figure 4). In the red loam the fertiliser effect was reduced as seedling emergence was similar for all fertiliser treatments after 16 days from seeding (non-significant).

Emergence was later in the grey calcareous soil (Day 36) with poor plant growth after emergence, and by Day 49 emergence in the calcareous soil in the nil control was better compared to both fertilisers placed with the seed (Figure 5).

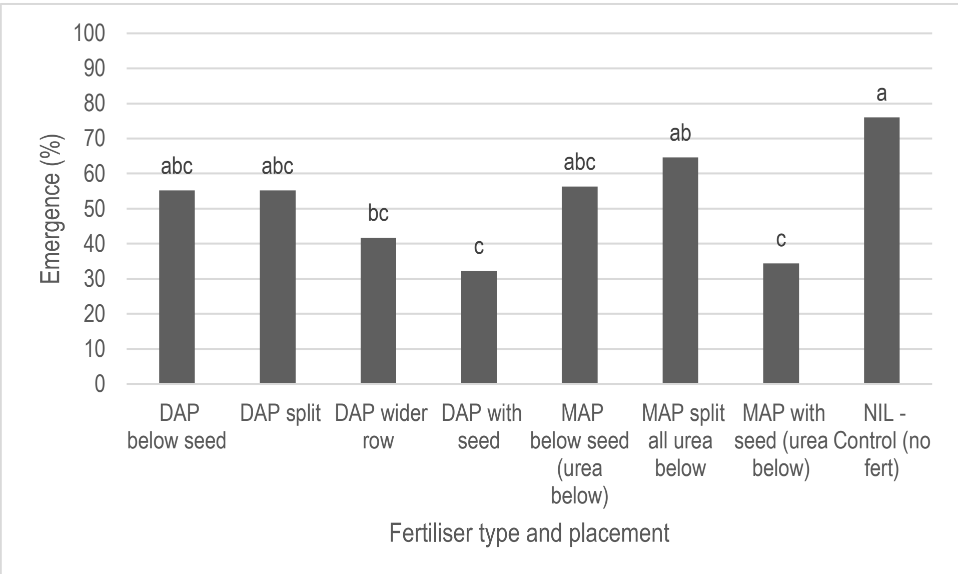

Figure 5. 2020 Pot experiment. Emergence of wheat 49 days after seeding in Streaky Bay grey calcareous soil (% of seeds planted) with different fertiliser types and placement. Columns with the same letter are not statistically different at P=0.05.

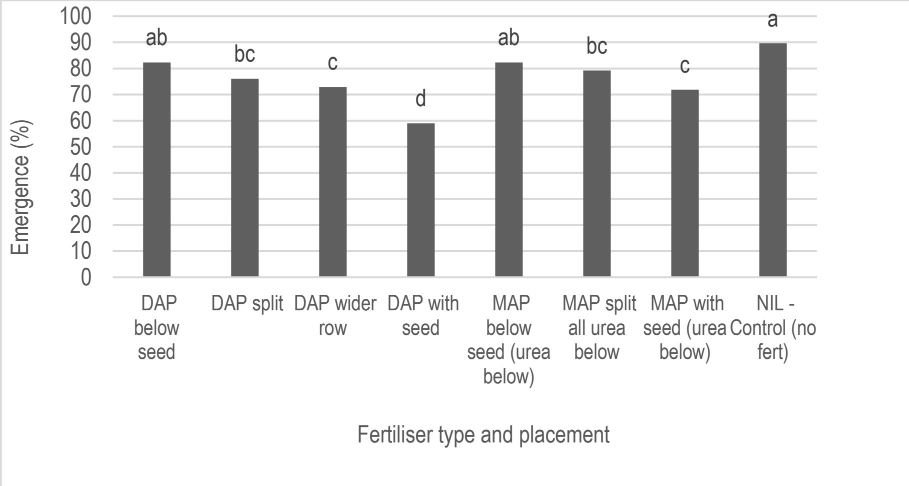

Figure 6. 2020 Pot experiment. Overall effect of fertiliser type and placement on wheat emergence (% of seeds planted) in pots for all three soil types after 56 days (LSD (P, 0.05) = 9.6). Columns with the same letter are not statistically different at P=0.05.

At seedling harvest on Day 56, eight weeks after sowing and with good soil moisture, the overall emergence percentages for Minnipa sand and Minnipa red loam were similar at 91% and 87%, respectively *(LSD (P, 0.05) = 6).* Emergence in the Streaky Bay grey calcareous soil was poor with only 53% overall *(LSD (P, 0.05) = 6).*

In the pot experiment simulation of a splitter boot with 3 cm spread (DAP wider row) improved emergence compared to a single row, and splitting DAP between the seed row and below (DAP split) resulted in emergence intermediate between all DAP with the seed and all below the seed (Figure 6).

Overall the results from the pot experiments indicate fertiliser placement with the seed is reducing establishment.

Management options to assess the impact of practices, herbicides and seed dressings on dry sown cereals in the field.
In 2019, Streaky Bay had lower establishment than the other sites (Table 7). Across all sites the highest plant establishment was achieved with the high seeding rate (207 plants/m^2) compared to the average of 150 plants/m^2 in the standard seeding rate (*LSD Treatment (P, 0.05) = 25*).

The high seeding rate was the only management treatment in 2019 which increased early dry matter production in wheat (*LSD Treatment (P, 0.05) = 0.04)*; 0.17 t/ha compared to 0.14 t/ha with the standard seeding rate, and Spartacus CL barley at 0.18 t/ha.

Table 7. Site averages for crop performance in dry sown management trials in 2019.

Trial location	Establishment (plants/m2)	Early dry matter (t/ha)	Yield (t/ha)
Minnipa	165 a	0.17 a	1.85 b
Streaky Bay	129 b	0.15 a	2.50 a
Cungena	156 a	0.09 b	1.06 c
LSD (P=0.05)	*10*	*0.02*	*0.11*

In 2019 the highest grain yield across the sites was achieved with Spartacus CL barley at 2.16 t/ha (Figure 5). Despite better plant establishment and greater early dry matter, higher seeding rate did not yield better for wheat, nor did deeper sowing (Figure 5). Evergol seed dressing and deeper sowing yielded lower than DAP with the seed (Figure 5).

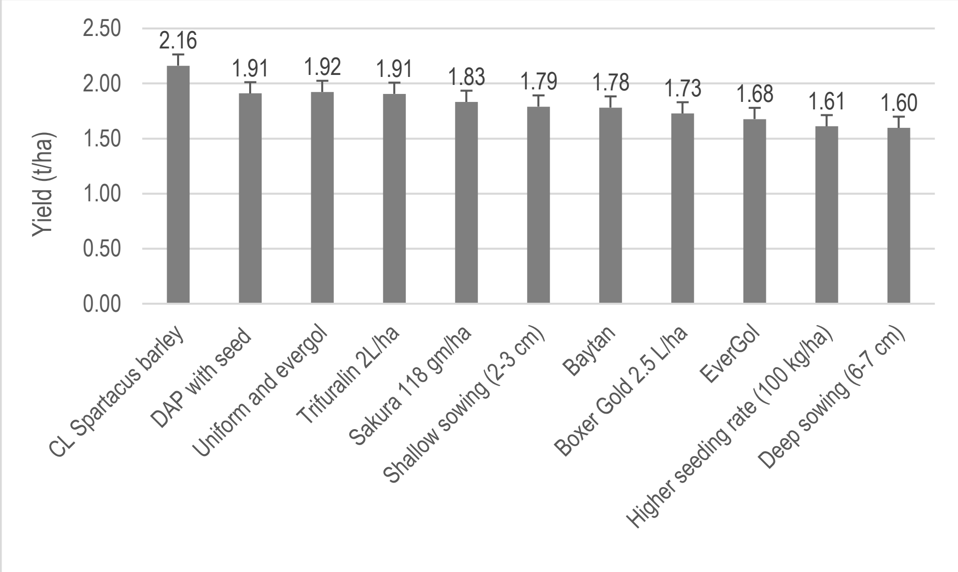

Figure 5. Average cereal yield (t/ha) of management treatments across three sites (Minnipa, Streaky Bay and Cungena) in 2019 (LSD (P, 0.05) = 0.10).

In 2020 the Minnipa sandy soil had lower establishment (74 plants/m^2) than the other sites, Minnipa red loam at 107 plants/m^2 and Streaky Bay at 100 plants/m^2 which was at least partly due to wind erosion increasing seeding depth because of in-filling of the dry sown furrows (*LSD (P, 0.05) = 13*). Some dry sown herbicide treatments had lower plant establishment at the sand site due to sand being blown into the furrow and moving the herbicide into the crop row. These were Trifuralin @ 2 L/ha with 49 plants/m^2 and Boxer Gold @ 2.5 L/ha with 52 plants/m^2 (Figure 6). Deeper sowing (6-7 cm) at the Minnipa red site resulted in better establishment due to utilisation of soil moisture from the January rainfall events. At the grey calcareous site shallow sowing (2-3 cm) established earlier and similar to the barley treatment. All other management options had similar establishment to the control (Figure 6). Sowing seed in a position to utilise moisture was also important as it was observed dry sown deep (6 cm) had earlier emergence at the Minnipa red site following good summer rainfall events but dry sowing shallow (2-3 cm) at Streaky Bay resulted in earlier emergence there.

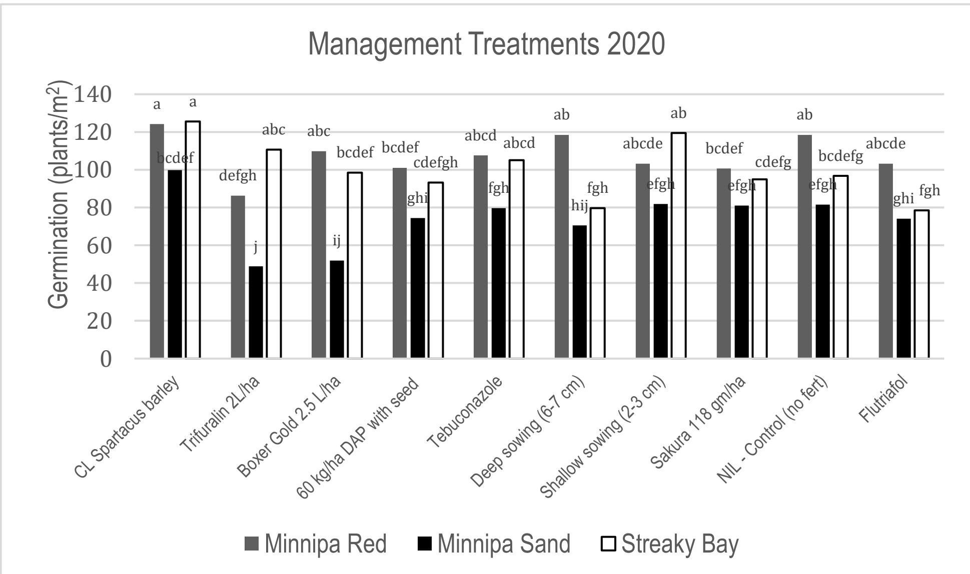

Figure 6. Establishment of CL Razor wheat over three trial site locations with differing management on 18 May, 2020. (LSD (P, 0.05) = 23).

Although not significant for grain yield, CL Spartacus barley performed well for a second time in the management dry sown sites compared to wheat (Figure 7). Sowing seed in a position to utilise moisture was also important as it was observed dry sown deep had earlier emergence at the Minnipa red site following good summer rainfall events, and dry sowing shallow at Streaky Bay resulted in earlier emergence (Figure 6).

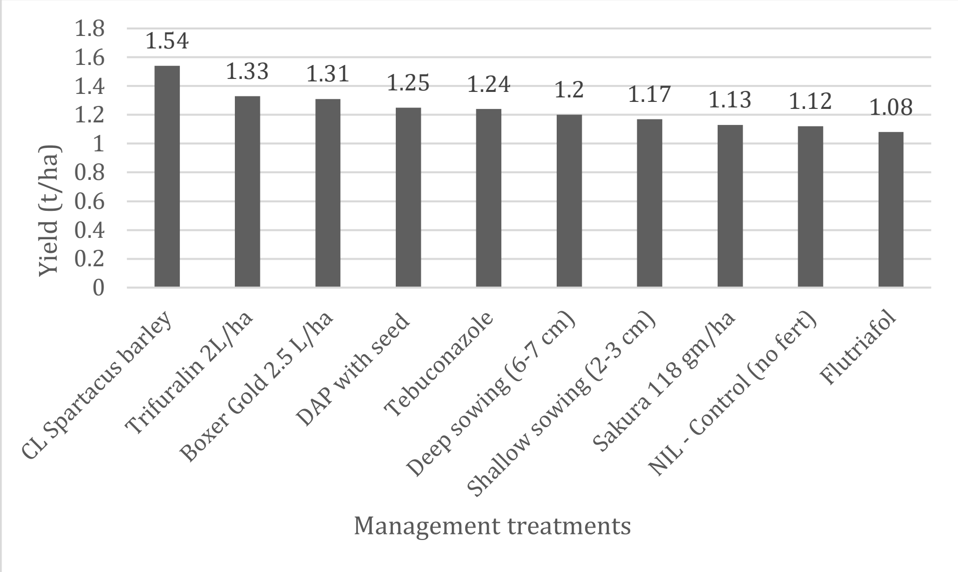

Figure 7. Yield (t/ha) of management treatments averaged across three sites in 2020. (LSD (P=0.05) NS).

In 2021 there were no herbicide or fungicide management treatments, but the opportunity to increase early plant establishment using seeding depth with the new long coleoptile varieties (AGT Calibre and LRPB Bale) was assessed. The cereal varieties were sown to the recommended sowing depth across the three trials depending on coleoptile length and aiming to sow into the moisture. Deeper sown treatments (Halberd (11-12 cm), LRPB Bale (10-11 cm), Magenta (7.5 cm) and AGT Calibre (11-12 cm)) germinated two weeks earlier at Cungena and Minnipa due to the seed being placed into subsoil moisture. At Minnipa the shallow sown Scepter (2-3 cm) and Spartacus barley (2-3 cm) treatments also germinated early. The only treatment which had germinated at Streaky Bay by 18 May was the deeper sown Spartacus CL barley (6 cm). On 29 June, Cungena site had the highest overall emergence with 108 plants/m^2, Minnipa red soil had 83 plants/m^2 and Streaky Bay had 93 plants/m^2 (*LSD (P, 0.05)* = 19). Lower establishment of the deep sown cereal varieties (Halberd and LRPB Bale) at Minnipa was due to the 'cloddy' nature of the heavier soil after the deeper sowing treatments compared to the sandier soils.

Again in 2021, the Minnipa red soil (3.2 t/ha) had higher yields than the other sites with Streaky Bay yielding 2.0 t/ha and Cungena 1.6 t/ha overall (*LSD (P, 0.05) = 0.5*). The average yield of the deeper sown Halberd was 1.94 t/ha, LRPB Bale averaged 2.0 t/ha and average yield of CL Razor was 2.2 t/ha (*LSD (P, 0.05) = 0.17*). The deeper sown LRPB Bale had lower plant establishment which may have influenced yield. Halberd is an older less adapted variety.

Sowing seed in a position to utilise current moisture was important as the dry sown deep treatments had earlier emergence at the Minnipa red site and Cungena but further assessment is needed as there was no advantages in yield. The long coleoptile wheats may provide an option for earlier plant establishment and dry matter production where subsoil moisture is present within the top 10 cm but below conventional seeding depths.

CONCLUSIONS REACHED &/OR DISCOVERIES MADE

Key outcomes

The key outcomes from field trials and pot experiments to assess the impact of management on wheat establishment on different soil types from the three seasons (2019-21) were:

- Lower plant establishment occurred with urea placed with the seed.
- MAP is a safer fertiliser to place with wheat seed than DAP.
- Greater plant establishment was achieved with fertiliser placed 3 cm below the seed.

- Despite targeting 180 plants/m^2 the average plant establishment in field trials was 108 plants/m^2 over the three seasons so further research may be needed into the mechanisms controlling plant density in low rainfall seeding systems.
- Dry sowing improved early plant dry matter but did not necessarily result in better yields than seeding on the break.
- Soil type was found to be important to crop performance with a red loam having better establishment, lower impact of fertiliser placement and yielding better than grey calcareous sands.
- In a red loam soil dry sowing early resulted in a 0.2 t/ha increase in yield compared to sowing at the break of the season at Minnipa in 2019, a 0.18 t/ha decrease in yield in 2020 with late seasonal rains, and an equivalent yield in 2021.
- In 2019 for the highly calcareous soils at Cungena and Streaky Bay, dry sowing decreased yield compared to sowing on the break of the season into a moist seed bed. At Streaky Bay dry sowing decreased yield by 0.7 t/ha, and at Cungena by 0.3 t/ha (*LSD (P, 0.05) = 0.2*).
- In 2020 the seasonal conditions with slow early plant growth in winter, good spring conditions and late rains for grain fill favoured the later sowing time. In 2020 dry sowing decreased yield by 0.2 t/ha at all sites (*LSD (P, 0.05) = 0.1*).
- In the 2021 season at Streaky Bay and Cungena dry sowing compared to waiting until the break of the season resulted in a 0.2 t/ha and 0.1 t/ha yield increase respectively (*LSD (P, 0.05) = 0.1*).
- Having no fertiliser resulted in lower yields compared to applying fertiliser in all seasons.
- Most herbicides and fungicides evaluated did not impact on plant establishment when dry sowing, with the exception of Trifluralin and Boxer Gold in a sandy soil in 2020.
- Dry sowing early with barley is a good management option for early plant establishment.
- Sowing seed at a depth to utilise soil moisture for germination is important.
- New long coleoptile wheats may provide an option where soil moisture is available up to 10 cm deep for early plant establishment and vigour.

Potential industry impact and recommended practice changes for growers

Better plant establishment was achieved by separating fertiliser to 3 cm below the seed with similar establishment to nil fertiliser. Applying urea with the seed caused lower plant establishment, so if it is going to be used at sowing it should be applied away from the seed or consider applying urea by spreading pre or post seeding.

If fertiliser separation cannot be achieved due to seeding system limitations, then using MAP is a safer option than placing DAP with the seed, especially in drier seasonal conditions. These effects were most severe in grey calcareous soils, less in red loams.

Small reductions in Rhizoctonia infection may be another benefit of early dry seeding.

Spartacus CL barley had improved establishment and early dry matter production compared to wheat so is a good early dry sowing option.

Most herbicides and fungicides evaluated in the trial did not impact on plant establishment when dry sowing except in sands more prone to wind erosion and with soil movement of herbicides into the furrow.

Sowing seed in a position to utilise current moisture was important as dry sown deep in moisture had earlier emergence at the Minnipa red site following good summer rainfall events, and dry sowing shallow at Streaky Bay resulted in earlier emergence.

The new long coleoptile wheats showed sowing seed in a position to utilise moisture present at the time was important as the dry sown deep management treatments had earlier emergence at the Minnipa red site and Cungena. In the future the long coleoptile wheats may provide an option for earlier plant establishment and dry matter production where subsoil moisture is present either lower in, or below, conventional seed beds.

SA Drought Hub project funding in 2022 is helping to extend key outcomes from this SAGIT 'Improving the early management of dry sown cereal crops' research to growers with demonstration trials located at Charra/Penong and Cowell.

INTELLECTUAL PROPERTY

All intellectual property generated by this project is presented publicly and accessible via the SARDI website, Eyre Peninsula Farming Systems Summaries – PIRSA. No potential for commercialisation.

APPLICATION / COMMUNICATION OF RESULTS

The individual research trial results are accessible via the SARDI website, Eyre Peninsula Farming Systems Summaries – PIRSA.

Extension activities undertaken through the project.

2022

- 2021 season trial results from the project were published in the EPFS 2021 Summary.
- Minnipa Annual Field Day, 7 September 2022– overall project outcomes were presented to attending growers and industry representatives.
- SA Drought Hub project funding to extend key outcomes from the SAGIT Improving the early management of dry sown cereal crops research to growers, with demonstration trials at Penong/Charra and Cowell.

2021

- 2020 season trial results from the project were published in the EPFS 2020 Summary.
- Results from the project were presented in March at the EPFS Farmer group meeting at Minnipa, Port Kenny, Wirrulla/Piednippie, Charra, Cowell, Rudall, Kimba and Warramboo to 131 growers and industry representatives.
- Minister of Agriculture David Basham and Sam Telfer, now Member of the South Australian House of Assembly, visited the Minnipa Agricultural Centre for a presentation and went on a Field Tour on 30 June, 2021.
- Stephen Loss (GRDC) visited MAC on 11 August 2021.
- SAGIT members Malcom Buckby, Jenny Davidson and Andy Barr visited MAC and the SAGIT Field trials on 19 August 2021.
- Minnipa Field Day – project results and the 2021 Minnipa trial were presented to 141 growers and industry representatives.
- Streaky Bay Farmer Sticky Beak Day – project aims, results presented and discussion with farmers and industry reps.

2020

- 2019 season trial and pot experiment results from the project were published in the EPFS 2019 Summary.
- Project background and 2019 season trial and pot experiment results presented to 127 growers and industry representatives at EPFS Farmer group meetings held at Minnipa, Elliston/Port Kenny, Wirrulla/Piednippie, Charra, Cowell, Rudall, Kimba and Warramboo.
- Unfortunately, the Annual Minnipa Field Day 2020 was cancelled due to COVID concerns.
- SAGIT tour (9 September) – Minnipa red loam site visit and discussion on issues related to crop establishment, and impact of barley grass resistance to Gp A herbicides in low rainfall farming systems. Poochera Soils CRC Calcareous soils site visit to discuss alkaline soils research issues on upper EP. Other MAC trials visited.
- Minnipa/Poochera and Port Kenny Farmer Sticky Beak Days (2 separate days) – project aims, results and discussion with farmers and industry reps presented.

2019

- Minnipa Field Day – project background and early 2019 season trial and pot experiment results presented to 113 growers and industry representatives.
- GRDC Regional Cropping tour – Cungena site visit and discussion on issues related to alkaline soils on upper EP.
- Streaky Bay and Wirrulla Farmer Sticky Beak Days (2 separate days) – project aims, results and discussion with 16 and 35 farmers and industry reps (respectively) presented at Streaky Bay and Cungena trial sites.

POSSIBLE FUTURE WORK

- Further research into the mechanisms controlling plant density in low rainfall seeding systems. Other research in the Calcareous soils project and growers' paddocks is also showing similar low plant establishment compared to the target plant density.
- Seeding systems, management practices and fertiliser rates have all changed since previous seeding rate research was undertaken on which current seeding rate decisions are based, so further research may be needed to evaluate currently recommended seeding rates.
- Investment into future seeding systems to potentially improve plant densities.
- Using long coleoptile wheat varieties for early establishment and improved herbicide safety in current farming systems.
- Seed priming of wheat including long coleoptile varieties to increase early plant establishment and reduce nutrient deficiencies.