

Best practice for early sowing opportunities

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Location

Penong

Rainfall

Av. Annual: 317 mm

Av. GSR: 240 mm

2023 Total: 219 mm

2023 GSR: 125 mm

Paddock history

2022: Wheat

2021: Legume pasture

2020: Wheat

Soil type

Sandy loam

Plot size

10 m x 1.76 m x 3 reps x 25.4 cm row spacing

Location

Cowell

Rainfall

Av. Annual: 260 mm

Av. GSR: 125 mm

2023 Total: 309 mm

2023 GSR: 167 mm

Paddock history

2022: Wheat

2021: Pasture (ploughed with offset disc in November)

2020: Barley

Soil type

Sandy loam

Plot size

10 m x 1.76 m x 3 reps x 25.4 cm row spacing

- **Seed priming increased early crop establishment in Calibre wheat at Penong, but this did not increase grain yield.**

Why do the trial?

More growers Australia-wide are considering dry sowing early due to larger seeding programs. On the upper Eyre Peninsula, in several seasons, dry sowing occurred with seeds placed in the soil for many weeks with limited soil moisture. Although some seeds still germinated, the delayed plant emergence often resulted in poor plant establishment. Therefore, questions were raised by farmers about which soil factors influence seed germination and establishment. A project “best practice for early sowing opportunities” was led by AIR EP and delivered by SARDI Minnipa Agricultural Centre, to build on the results from a past SAGIT investment “Improving the early management of dry sown cereal crops” (S419) by Amanda Cook. In 2021, the SAGIT trial at Minnipa evaluated seeding depth and the new long-coleoptile wheats had the best early and late dry matter. Sowing seed early in a position to utilise any moisture present at the time was important as the deeper sown management treatments had earlier emergence at two sites. The long coleoptile wheats may provide an opportunity for earlier plant establishment and dry matter production where moisture is present below the conventional seeding depth.

The SAGIT research project finished in June 2022 with the following findings:

- Better plant establishment was achieved by separating fertiliser (especially urea) to 3 cm below the seed, which achieved similar germination to using nil fertiliser at seeding.
- If fertiliser separation cannot be achieved in the seeding operation, then using MAP (10:22) with the seed is a safer option than DAP. Also consider applying urea pre or post seeding by broadcasting.

In 2023, SA Drought Hub funded demonstration sites were a tool for engaging farmers and increasing awareness of options to improve early plant establishment and to show the impacts of fertiliser toxicity on seed germination and emergence.

How was it done?

In 2023 two demonstration sites were conducted at Cowell and Penong. The treatments implemented were management options to potentially improve early plant establishment and to show the impacts of fertiliser placement on seed germination and emergence.

The sites were sown on 1 May (Cowell) or 2 May (Penong) with Scepter or Calibre wheat aiming for 180 plants/m². Both sites were sprayed with Weedmaster 2 L/ha, Li700 400 ml/100 ml, Estercide Xtra 680 400 ml/ha, Trifluralin 1.15 kg/ha and Sakura 118 g/ha prior to seeding.

Key messages

- **Poor crop establishment in an early sown crop did not reduce grain yield in the 2023 season.**
- **55 kg/ha MAP + 5 kg/ha urea applied with the seed resulted in the highest final yield at both Cowell and Penong site compared to other treatments.**

Fertiliser rates were district practice of 60 kg/ha DAP, or MAP sown at 55 kg/ha plus 5 kg N/ha as urea (sown 3 cm below the seed) to provide the same amount of nitrogen as with DAP. In addition, 25 kg/ha of urea was applied either with the seed or 3 cm below. Primed seeds were soaked in water or potassium sulphate solution (K_2SO_4) for 4 hours then air dried for 30 minutes in trays immediately before sowing (Table 1).

NVDI and early dry matter were sampled on 4 July at Penong and on 6 July at Cowell. Late dry matter was assessed on 30 August at Penong and 8 September at Cowell. The Cowell trial was harvested on 24 October and Penong on 1 November 2023.

What happened?

Crops were sown early into moist soils in the 2023 season due to April rainfall. The gravimetric soil moisture content measured at sowing (0-10 cm) at Cowell was 4%, with a Phosphorus Buffer Index (PBI) of 74. The key available nutrient levels for 0-10 cm were Colwell phosphorus (P) 7 mg/kg, nitrate nitrogen (N) 11 mg/kg and

Colwell potassium (K) 303 mg/kg. Penong had a gravimetric soil moisture content of 8% in 0-10 cm zone. The 0-10 cm soil test showed a PBI of 91, 13 mg/kg P and N 12 mg/kg and K was 490 mg/kg.

Crop establishment averaged 98 plants/m² at Cowell and Penong, both well below the target of 180 plants/m². The highest establishment rates at Cowell in good sowing conditions were Treatment 4 (60 kg/ha DAP plus 25 kg/ha urea) and Treatment 10 (55 kg/ha MAP + 5 kg/ha urea applied with seed primed in 1% K_2SO_4 for 4 hours) (Table 2). The lowest plant establishments were in Treatment 3 (DAP and urea placement below the seed) and Treatment 5 (DAP with the seed) (Table 2).

At Penong, crop establishment appeared to have two main response groups (Table 2). Most treatments (Treatments 1, 4, 5, 7, 8, 10 and 11) were not significantly different to the Nil control for plant emergence in 2023 (Table 2). The second response group had lower emergence, Treatment 3 (DAP and urea placement below the seed) was similar to Treatment 6

(MAP and urea below the seed), Treatment 2 (Calibre unprimed) and Treatment 12 (Scepter wheat primed 4 hours in water) (Table 2).

At Cowell, Treatment 8 (MAP with seed + 5kg/ha urea) (Table 3) had the highest early dry matter (DM), followed by Treatment 9 (Nil fertiliser). However, the differences in DM weight between Treatment 9 and most other treatments were not significant. Treatment 1 (Calibre, primed) and 2 (Calibre, unprimed) had the lowest early DM weights. There were no significant differences in late DM measured at Cowell.

At Penong, Treatment 8 (MAP with seed + 5kg/ha urea) (Table 3) had the highest early DM weight, but the difference is not very significant when compared with most other treatments that includes the combination of phosphate fertilisers and urea. Treatment 1 (Calibre primed) had the lowest early DM weight. In late DM measurements, Treatment 5 (DAP with seed) had the highest weight, but it was not significant when compared to other treatments. Treatment 1 (primed Calibre) again had the lowest DM.

Table 1. Early sowing treatments at Cowell and Penong in 2023. Scepter was used in all treatments except for first two (*Calibre was used).

Treatment No.	Treatment	Seeding strategy
1	*Calibre, primed with water (4 hours)	Sown at 6 cm with 55 kg/ha MAP + 5 kg/ha urea
2	*Calibre, unprimed	Sown at 6 cm with 55 kg/ha MAP + 5 kg/ha urea
3	DAP + urea below seed	60 kg/ha DAP + 25 kg/ha urea applied 3 cm below seed
4	DAP + urea with the seed	60 kg/ha DAP + 25 kg/ha urea applied with the seed
5	DAP with seed	60 kg/ha DAP applied with seed
6	MAP + urea below seed	55 kg/ha MAP + 30 kg/ha urea applied 3 cm below seed
7	MAP + urea with the seed	55 kg/ha MAP + 30 kg/ha urea applied with the seed
8	MAP with seed	55 kg/ha MAP + 5 kg/ha urea applied with the seed
9	Nil fertiliser	No fertiliser
10	Primed with 1% K_2SO_4 , normal depth (4 hours)	55 kg/ha MAP + 5 kg/ha urea applied with seed primed in K_2SO_4
11	Unprimed, 1 % K_2SO_4 fluid @ 80L/ha, normal depth (control)	55 kg/ha MAP + 5 kg/ha urea applied with the seed, K_2SO_4 solution with seed
12	Primed, normal depth (4 hours)	55 kg/ha MAP + 5 kg/ha urea applied with the seed primed in water

Table 2: Crop establishment (plants/m²) at Penong and Cowell with different seeding strategies in 2023. Scepter wheat was used in all treatments except for first two (where Calibre wheat was used). Significant differences between means at P=0.05 are shown by a different letter.

Treatment No.	Plant establishment	
	Cowell	Penong
1*	101 bcd	132 a
2*	75 ef	72 de
3	63 f	58 e
4	137 a	101 abcd
5	82 def	102 abcd
6	89 cde	75 de
7	109 bc	112 abc
8	89 cde	100 bcd
9 Nil Control	109 bc	115 abc
10	115 ab	110 abc
11	98 bcde	121 ab
12	105 bcd	85 cde
LSD (F prob=0.05)	26	31

Table 3. Early and late dry matter weight (t/ha) with different seeding strategies at Cowell and Penong, 2023. Significant differences between means at P=0.05 are shown by a different letter.

Treatment No.	Cowell		Penong	
	Early DM	Late DM	Early DM	Late DM
1*	1.31 d	5.76	0.29 e	1.17 d
2*	1.48 cd	6.84	0.46 bcd	1.55 bc
3	1.55 bc	7.08	0.39 de	1.33 cd
4	1.7 bc	6.49	0.45 cd	1.51 bc
5	1.62 bc	6.67	0.57 abc	1.98 a
6	1.53 cd	6.55	0.52 abcd	1.42 bcd
7	1.64 bc	6.54	0.47 bcd	1.53 bc
8	1.94 a	7.04	0.61 a	1.6 bc
9 Nil Control	1.78 ab	7.23	0.52 abcd	1.52 bc
10	1.69 bc	6.41	0.52 abcd	1.56 bc
11	1.58 bc	7.15	0.57 abc	1.68 ab
12	1.65 bc	6.81	0.58 ab	1.57 bc
LSD (F prob=0.05)	0.24	ns	0.13	0.29

At Cowell, Treatment 8 (MAP with seed + 5kg/ha urea), Treatment 11 (Unprimed, K₂SO₄ fluid, normal depth (Control)) and Treatment 9 (Nil fertiliser) (Table 4) had the highest yields at just over 3 t/ha. Treatment 1, 5, 6 and 12 had the lowest yields (Table 4).

At Penong, Treatment 8, 9, 10, 11, 12, 2, 4, 7, 6 and 5 had similar higher yield performance (Table 4), and Treatment 12 (Primed, normal depth (4 hours)), 5 (DAP with seed)

and 3 (DAP + urea below seed) had lower yields. Treatment 1 (Calibre primed) had the lowest grain yield (Table 4).

Grain protein at Cowell increased with increasing grain yields, with an average of 11.4% for the trial. At Penong the protein (%) was similar across treatments with the average being 13.6%.

What does this mean?

These demonstrations were implemented to show best management practice for early sowing and plant establishment. The sites had some soil moisture at sowing due to the good mid-April rainfall in 2023.

Table 4. Wheat grain yield (t/ha) and protein (%) with different seeding strategies at Cowell and Penong, 2023.

Treatment No.	Cowell		Penong	
	Grain yield	Protein	Grain yield	Protein
1*	2.38 e	11.5 abc	0.52 c	13.2
2*	2.77 b	11.3 bcd	0.64 ab	13.5
3	2.6 bcd	11.5 abc	0.59 bc	13.2
4	2.74 bc	11.4 abcd	0.62 ab	13.7
5	2.51 de	11.8 a	0.61 b	13.4
6	2.55 cde	11.6 ab	0.64 ab	13.5
7	2.74 bc	11.1 cde	0.62 ab	13.6
8	3.23 a	10.7 e	0.69 a	14.0
9 Nil Control	3.13 a	11.3 bcd	0.62 ab	13.9
10	2.75 bc	11.2 bcd	0.62 ab	13.6
11	3.19 a	11.0 de	0.64 ab	13.5
12	2.52 de	11.8 a	0.61 b	13.9
LSD (<i>F</i> prob=0.05)	0.21	0.45	0.07	ns

Even though urea placed with the seed along with DAP at sowing (Treatment 4) had the highest crop establishment at Cowell in ideal sowing conditions (opposite of the 2022 trial and previous research), and primed Calibre (Treatment 1) had the highest crop establishment at Penong, these early season advantages in plant establishment did not translate into an increase in either early and late dry matter (DM), final yield, nor protein content, meaning that in a season like 2023, higher crop establishment did not necessarily result in higher yields.

MAP with seed (Treatment 8) did not show a high crop establishment at either site, but did have the highest early and late DM's, along with the highest final yield and protein level, indicating low crop establishment in early season did not result in final yield reduction either. In addition, no other phosphate fertilisers and urea combination strategies showed significant improvement in final yield, as base rates of fertiliser applied were adequate for crop demand in a low decile season.

Primed Calibre seeds (Treatment 1) had relatively high crop establishment at Cowell and the

highest crop establishment at Penong but resulted in the lowest early and late DM weights and final yield. However, due to the long, dry period during winter in this growing season, the already established plant roots may have drained soil moisture before other treatments, therefore amplifying the impact of drought that hampered biomass production, resulting in lower final yields.

Even though K_2SO_4 solution did not improve crop establishment, it did improve final yields compared to the crop where seeds were not primed. This result was not shown in the 2022 trial.

These demonstration trials will be continued in 2024 in other regions allow grower extension, discussion and learning of the best management practices for early seeding.

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