Impact of fertiliser on wheat emergence under dry conditions

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Key messages

- **Eleven days after seeding, emergence in Minnipa and Cungena soils was higher with no fertiliser or with all the DAP banded below the seed row, compared to DAP placed with the seed or split.**
- **Emergence was most affected by the presence of DAP in the Streaky Bay soil, least in the Minnipa soil and Cungena soil was intermediate.**
- **Shoot weights decreased where DAP was placed in the seed row and this occurred in all soil types. The soil EC (salinity) was higher with DAP placed in the seed row.**
- **Fertiliser toxicity may be reducing wheat emergence on grey calcareous soils, even at quite low application rates of DAP at 30 kg/ha.**

Why do the research?

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

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 a lower plant establishment. This raised questions by growers about the soil factors which reduce germination and establishment.

This article summarises a pot trial which assessed the impact of DAP placement on wheat establishment on three different soil types; a red loam (Minnipa Agricultural Centre [MAC]) and two grey calcareous soils (Streaky Bay and Cungena).

How was it done?

Soil was taken from 0-10 cm depth from three paddock research trial sites in May/June 2019 in non-sprayed and non-cropped areas. All paddocks were pastures in the 2018 season and cropped with wheat in the 2019 season. The soils were dried after collection at 70°C for 48 hours. The soil was then potted on 14 June into plastic tubs at 7.5% (w:v) soil moisture 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.

Four 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, at the equivalent of 22.5 cm (9") row spacing.

Two water rates, low (a total of 19.5%) or high (25%) were implemented on 18 June, 5 days after seeding to simulate a light or heavy rainfall event. No further watering occurred during the experiment.

Seedlings started emerging from Day 9 to Day 11 and were counted every second day from then on. The experiment was harvested 19 days after seeding on 3 July. Shoot and root dry matter were weighed after oven drying. A soil sample from around the seed at harvest from the Nil Control, 60 kg/ha DAP with seed and the split application was analysed for pH, EC, nitrate-N and ammonium-N.

What happened?

Seedling emergence after 11 days in the Minnipa soil was the same for all three placements of fertiliser and vigorous (Table 2). Emergence in the Cungena soil was highest and vigorous with no fertiliser, but was severely reduced by the presence of DAP, most severely if the DAP was all with the seed, but also when all the DAP was below the seed. Almost no plants had emerged from any treatments in the Streaky Bay soil at 11 days.

Nearly all plants had emerged from the Minnipa soil after 19 days and were vigorous (Table 3). 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 1. Initial soil analysis results of 0-10 cm soil samples from three sites in 2019.

Soil	Cungena	Streaky Bay	Minnipa
Sampling date	**29 May**	**30 May**	**11 June**
DGT P (ug/L)	20	22	62
pH (water)	8.8	8.6	8.7
Texture	Clayey Sand	Sandy Clay Loam	Clayey Sand
Nitrate-N (mg/kg)	12	8	9
Ammonium-N (mg/kg)	11	33	8
*Wilting Point (vol %)	10	13	10**
*Field Capacity (%)	22	26	22**

** Based on paddock information (J Hancock, 2007). **Minnipa Ag Centre N7 paddock.*

Table 2. Soil type and fertiliser placement effect on % seedling emergence after 11 days.

Fertiliser Placement	Cungena	Streaky Bay	Minnipa
Nil	81	0	88
DAP below seed	63	5	94
DAP split	31	1	70
DAP with seed	10	1	71
LSD (P=0.05)	*17*		

Table 3. Soil type and fertiliser placement effect on % seedling germination after 19 days.

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*		

Table 4. Fertiliser placement effect on seedling dry shoot and root weight/plant after 19 days, averaged across all 3 soil types.

Fertiliser Placement	Shoot weight (mg)	Root weight (mg)
Nil	11	18
DAP below seed	10	17
DAP split	9	17
DAP with seed	9	17
LSD (P=0.05)	*1*	*ns*

Table 5. 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*

DAP placed all with the seed, or split, slightly reduced early shoot dry weights (Table 4), across all soil types. DAP placed below the seed row did not reduce shoot weight of emerged plants. Root weights were the same for all placements of DAP and similar to the nil treatment.

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. 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 5).

What does this mean?

Emergence in the Minnipa and Cungena soils was higher with no fertiliser or with all the DAP banded below the seed row, compared to DAP placed with the seed or split. DAP fertiliser resulted in lower emergence in the Cungena soil than in the Minnipa soil, and the greatest impact in the Streaky Bay soil.

The Streaky Bay soil has a higher wilting point at 13% compared to the other soils at 10%, which means a greater amount of water will be tied to the soil particles in this soil type before water will become available to plant roots. The higher wilting point in the Streaky Bay soil may have affected seed swelling, germination and emergence on this soil type, however adequate water was applied in the high water treatment.

In the red loam after nineteen days nearly all seeds had emerged regardless of the placement of fertiliser. In the grey calcareous soils emergence was lower with DAP placed with the seed, and in the Streaky Bay soil type emergence was also affected with the DAP split fertiliser application, with only 30 kg/ha of DAP placed with the seed. In all soil types shoot weights decreased where DAP was placed in the seed row, but there was no effect on plant root growth with fertiliser placement. Soil testing showed the soil EC or salt level was higher with DAP placed in the seed row.

The results from this pot experiment suggest fertiliser toxicity is an issue which is reducing wheat emergence on grey calcareous soils, even at quite low application rates of 30 kg/ha DAP with the seed on some soil types. Current fertiliser guidelines would consider 30 kg/ha DAP with the seed a safe rate. On the highly calcareous soils with a high pH (8-9), adding an alkaline fertiliser product (DAP) is resulting in issues with seedling germination potentially due to salinity near the seed, especially in lower moisture conditions.

Field trials undertaken in 2019 as part of this SAGIT research on the same soil types showed plant establishment was similar at Streaky Bay and Cungena with dry sowing or sowing at the break with ideal seeding soil moisture in 2019, and at Minnipa establishment was better with dry sowing. Dry sowing increased grain yield at Minnipa by 0.2 t/ha compared to waiting for the break in the season, and there was a yield penalty if no fertiliser was applied at Minnipa.

Dry sowing at Streaky Bay and Cungena reduced grain yield, by 0.7 and 0.3 t/ha respectively, compared to waiting for the break and sowing into a moist soil bed, and all three sites showed a decrease in early plant dry matter with dry sowing. The 2019 results indicate dry sowing on the grey calcareous soils using 60 kg/ha of DAP fertiliser placed with the seed is not beneficial to early dry matter production or final grain yield.

The result from this research indicate that in the grey calcareous soil types growers may want to consider the fertiliser product they are using and potentially use an acidic fertiliser product like MAP (10:22:0:0). Fertiliser placement should also be considered, as it may be beneficial to move DAP fertiliser away from the seed if this is an option. Further research on fertiliser placement and rates will be undertaken in 2020. The fertiliser placement and dry sowing effects on wheat on the red loam soils appear not to have the same negative impacts.

Further pot experiments will be conducted in 2020 to compare fertiliser types and impact on wheat emergence in calcareous soils.

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