Fluid delivery systems and fungicides in wheat

RESEARCH

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Searching for answers

Location:
Warramboo
Darren Sampson and family
Rainfall
Av. Annual: 313 mm
Av. GSR: 227 mm
2015 Total: 326 mm
2015 GSR: 237 mm
Yield:
Potential: 3.2 t/ha
Actual: 3.0 t/ha
Paddock History
2015: Mace wheat
2014: Mace wheat
2013: Medic pasture
Soil Type
Red sandy loam
Plot size
20 m x 2 m x 3 reps

Location:
Streaky Bay
Luke Kelsh and family
Rainfall
Av. Annual: 379 mm
Av. GSR: 304 mm
2015 Total: 249 mm
2015 GSR: 212 mm
Yield:
Potential: 2.0 t/ha (W)
Actual: 1.2 t/ha
Paddock History
2015: Mace wheat
2014: Medic pasture
2013: Mace wheat
Soil Type
Grey calcareous sandy loam
Plot size
20 m x 2 m x 3 reps

Key messages

- **Phosphoric acid showed a yield response at Streaky Bay in 2014 of 13% and 2015 of 8%.**
- **Fungicides did not reduce Rhizoctonia infection or significantly increase yield in 2015 at either site despite high levels of inoculum.**
- **Including fungicides will increase input cost and risk over a cropping program.**
- **The addition of trace element or manganese treatments did not improve yield at Streaky Bay or Warramboo in 2015.**

Why do the trial?

A SAGIT Fluid delivery project was funded to update the benefits of fluid delivery systems from previous research and assess the potential of fluid nutrients and disease control strategies in current farming systems. The fluid systems (fertilisers or nutrients) have the potential to increase production through delivery of micro and macro nutrients, reduce cost of trace element delivery and increase control of cereal root and leaf disease.

Historically, fungicidal control of Rhizoctonia, which infects the major crops grown in southern Australia, has generally been poor, but fluid delivery systems with fungicides are a new option of delivery which may increase production and improve disease control. This trial was undertaken to assess the benefits of delivery of nutrients and these products, and various application strategies, on wheat in two upper Eyre Peninsula environments.

How was it done?

Three replicated trials were established, one at Warramboo on a red sandy soil and two at Streaky Bay on a grey calcareous sand in 2015. At Streaky Bay the nutrition and fungicide treatments were split into two smaller trials located behind each other due to the site variations with hills and shallow soil. Both trials had nutrition delivery treatments and fungicide application strategies. The fluid fertiliser delivery system placed fluid fertiliser approximately 3 cm below the seed at an output rate of 100 L/ha. The fungicide fluid system could also be split to deliver fluids both below the seed at approximately 3 cm, and above in the seeder furrow behind the press wheel in a 1 cm band.

The control treatment was 60 kg/ha of Mace wheat with 50 kg/ha of 18:20:0:0 (DAP). All phosphorus treatments were applied to the same rate of 9 units of phosphorus (P) and balanced with urea or UAN to 10 units of nitrogen (N). Manganese (Mn) was selected as the main focus trace element, with zinc (Zn) and copper (Cu) also included in the trace element mix. A DAP fertiliser dry blend with Mn @ 1.5 kg/ha was sourced. Phosphoric acid and granular urea, and ammonium poly phosphate (APP) and urea ammonium nitrate (UAN) were used as fluid fertiliser products to compare with granular fertilisers. Manganese sulphate was dissolved with standard rate being 1.5 kg/ha and 3 kg/ha as a high rate. 1 kg/ha Zn, as zinc sulphate and 0.2 Cu of copper sulphate were dissolved in the standard rates of trace elements, which were also delivered as foliar applications at 4-5 leaf stage.

The fungicides Uniform, EverGol, Vibrance (seed dressing) were assessed for Rhizoctonia disease suppression at different rates and in split applications. Triadimenol was also applied on fertiliser as a treatment.

The Warramboo trial was sown on 19 May with pre-sowing weed control of 1.5 L/ha Roundup Attack, 1.5 L Boxer Gold and 80 ml/ha Nail. In crop weed control was on 31 July with 1.2 L/ha of Broadside, later than ideal due to the sampling required on the trial. Urea was spread over the whole trial on 31 July at 20 kg/ha.

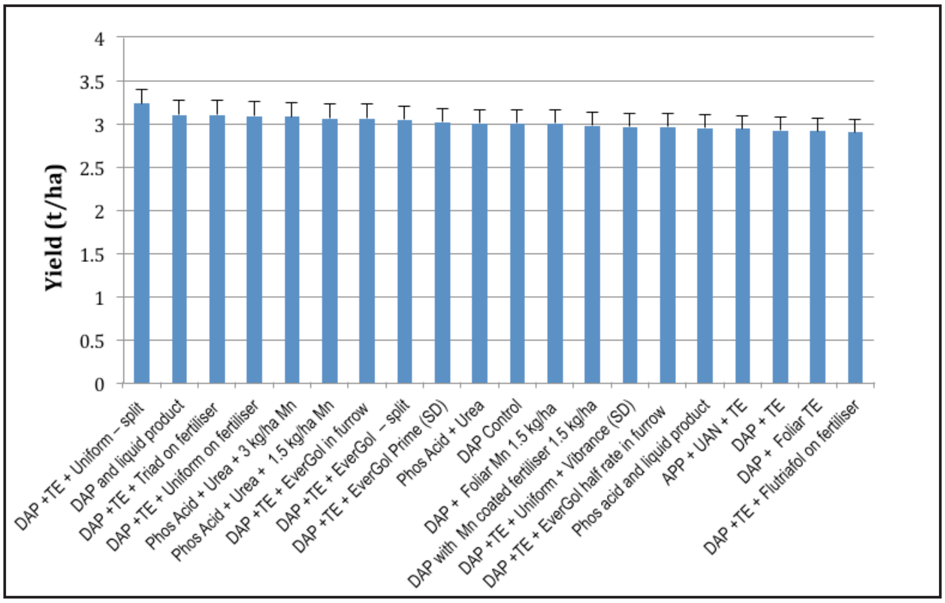

Figure 1 Yield for Mace wheat with fertiliser and fungicide treatments at Warramboo trial, 2015 (non-significant).

The Streaky Bay trial was sown in dry conditions on 28 May with pre-sowing weed control using 1.5 L/ha Roundup Attack, 1.5 L Boxer Gold and 100 ml/ha Nail. It was sprayed on 11 July with 240 ml/ha of Dominex Duo for insect control. The trace element foliar treatments were applied at Zadocks growth stage 22 on 14 August. In crop weed control was on 3 September with 1.5 L/ha of Amicide 700 to control Lincoln weed (*Diplotaxis tenuifolia*) and sheep weed (*Lithospernum avensis*).

PreDictaB disease inoculum levels (RDTS), plant establishment, Rhizoctonia seminal root score, Rhizoctonia crown root score, green leaf area index, grain yield and quality were measured during the season.

Rhizoctonia infection on seminal roots and crown roots was assessed using the root scoring method described by McDonald and Rovira (1983) approximately seven weeks from seeding, on 13 July at Warramboo and 20 August at Streaky Bay. Crown roots per plant were also counted on these samples with the number of roots infected with Rhizoctonia used to calculate % crown root infection.

Trials were harvested on 16 November at Warramboo and 17 November at Streaky Bay. Data were analysed using Analysis of Variance in GENSTAT version 16.

What happened?

At both sites, the initial Predicta B inoculum level predicted a high risk of Rhizoctonia disease (Warramboo 150 pg DNA/g soil, Streaky Bay 208 pg DNA/g soil), Take-all and *Pratylenchus neglectus* were low risk. Warramboo also had low levels of Cereal Cyst Nematode.

Both sites have alkaline pH, reasonable soil phosphorus levels and adequate nutrient levels (data not presented). Initial soil moisture levels were much lower at Streaky Bay than Warramboo. The main difference with these soil types from previous soil analyses are the calcium carbonate content of around 55-80% to 60 cm at Streaky Bay and Piednippie compared to 0-25% calcium carbonate content on the red sandy loams of Central Eyre Peninsula.

Plant establishment in ideal seeding conditions at Warramboo averaged 124 plants/m^2 but some fungicide treatments lowered plant establishment. In Streaky Bay the general plant establishment was poor due to the dry seeding conditions and not affected by treatments.

Rhizoctonia patches were present the Streaky Bay trial early in the season. The low soil moisture resulted in stressed plants and limited early plant growth. The trial at Warramboo had similar Rhizoctonia disease inoculum levels as Streaky Bay with some patches present in the trial area. The barley crop grown in the paddock showed significant Rhizoctonia disease symptoms.

There were no differences at Warramboo in dry matter or grain yield in fungicide and nutrition treatments, with treatments averaging 3.0 t/ha (Figure 1). Grain quality showed no differences with the trial averages being; test weight of 81.5 (kg/hL), protein 9.1%, screenings 1.3% (data not presented).

The fungicide treatments at Warramboo had Rhizoctonia infection on both seminal and crown roots however there were no significant differences between the fungicide treatments imposed on Rhizoctonia root assessment taken at eight weeks (data not presented). The application of fungicides in furrow did not perform better than fertiliser application or seed dressing at this site.

There were no significant differences in 2015 at Warramboo between the fungicide treatments (Figure 1), but there were small differences in fungicide treatments in 2014. The input costs (Table 1) of the treatments in the 2015 seasons at the Warramboo site shows the increased input cost over the control with higher risk over a whole cropping program. This soil type also showed no yield response to phosphorus or alternative phosphorus sources, highlighting the need for a responsive soil type before changing to a fluid fertiliser strategy for phosphorus.

Table 1 The input cost ($/ha) of the nutrition and fungicide treatments imposed at Warramboo in 2015.

Treatment	Variable costs* ($/ha)	P fertilser ($/ha)	Nitrogen +Trace Elements ($/ha)	Fungicide ($/ha)	Total Cost ($/ha)
DAP and Liquid Trace elements Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @ 0.2 kg/ha	99	38	15		152
Phosphoric acid and 3 kg/ha MnSO4 liquid and Gran Urea	99	43	26		168
Phosphoric acid and Gran urea (equivalent 50 kg/ha DAP)	99	43	23		165
Phosphoric acid and 1.5 kg/ha MnSO4 liquid and Gran Urea	99	43	24		166
DAP and Foliar Trace elements (4-5 leaf stage) Mn @ 1.5 kg/ha	99	38	13		150
DAP and Foliar Trace elements (4-5 leaf stage) Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @ 0.2 kg/ha	99	38	15		152
APP and UAN (equivalent 50 kg/ha DAP) and Foliar Trace elements (4-5 leaf stage) Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @ 0.2 kg/ha	99	53	15		167
DAP with Mn coated fertiliser 1.5 kg/ha	99	38	13		150
Control DAP	99	38	11		148
DAP+TE Uniform @ 300 ml/ha Split IF	99	38	15	19	171
DAP+TE EverGol 80 ml/ha Split IF	99	38	11	9	157
DAP+TE Uniform on fertiliser @ 300 ml/ha	99	38	15	19	171
DAP+TE Uniform@300 ml/ha + Vibrance (SD)	99	38	15	25	177
DAP and TE EverGol 80 ml/ha IF	99	38	15	9	161
DAP and TE EverGol 40 ml/ha IF	99	38	15	4	156
DAP and TE EverGol (SD) 80 ml/100 kg seed	99	38	15	9	161

Variable costs are seed, chemical, repairs and maintenance, fuel and crop insurance

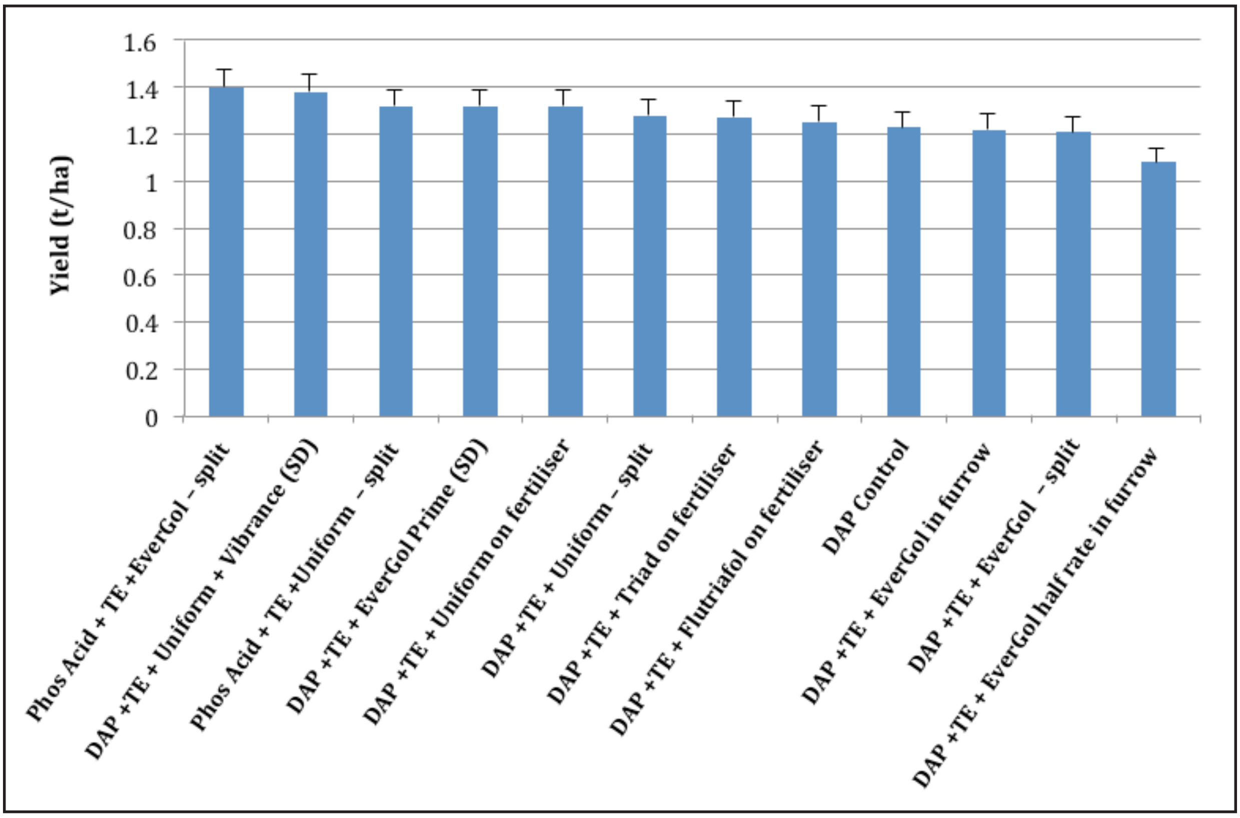

Figure 2 Yield for Mace wheat with fertiliser and fungicide treatments at Streaky Bay trial, 2015 (non-significant).

Table 2 Fluid delivery of nutrition trial growth measurements, yield and grain quality for Mace wheat at Streaky Bay, 2015.

Treatment	Plant establishment (plants/m^2)	Early dry matter (g/plant)	Late dry matter (t/ha)	Yield (t/ha)
Phosphoric acid and 1.5 kg/ha MnSO4 liquid and Gran Urea	79	0.34	3.4	1.30
Phosphoric acid and 3 kg/ha MnSO4 liquid and Gran Urea	81	0.30	3.3	1.28
Phosphoric acid and Gran urea (equivalent 50 kg/ha DAP)	75	0.39	3.3	1.24
Phosphoric acid and liquid product	92	0.32	3.2	1.24
APP and UAN (equivalent 50 kg/ha DAP) and Foliar Trace elements (4-5 leaf stage) Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @ 0.2 kg/ha	84	0.28	3.0	1.16
DAP and Liquid Trace elements Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @ 0.2 kg/ha	89	0.25	2.9	1.08
DAP and liquid product	88	0.25	2.9	1.08
DAP with Mn coated fertiliser 1.5 kg/ha	109	0.23	2.6	1.07
DAP and Foliar Trace elements (4-5 leaf stage) Mn @ 1.5 kg/ha	82	0.21	2.5	1.00
Control	96	0.23	2.3	0.95
DAP and Foliar Trace elements (4-5 leaf stage) Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @ 0.2 kg/ha	108	0.21	2.4	0.91
LSD (P=0.05)	*19*	*0.10*	*0.7*	*0.16*

The trial at Streaky Bay was very uneven and had patchy growth due to moisture stress early as well Rhizoctonia disease expression. The Streaky Bay nutrition trial had visual differences in early growth with the phosphoric acid treatments looking better than other treatments. The phosphoric acid treatments were the highest yielding (Figure 2). The grain quality at Streaky Bay was not affected by treatments and averaged test weights of 82.4 (kg/hL), protein of 10.8% and screenings of 5.3% for both trials.

The fungicide trial was generally more even in growth earlier in the season than the nutrition trial, but Rhizoctonia patches were still present. There were no treatments which were visually better in the fungicide trial during the season. There were no differences in early and late dry matter (data not presented) or yield in the fungicide treatments in 2015 (Table 2), despite reasonable levels of Rhizoctonia seminal and crown root infection.

In 2015 there was a 0.11 t/ha (8%) yield increase from 1.25 t/ha using granular DAP to 1.36 t/ha using phosphoric acid in this soil type in a dry season. A similar trial conducted at Streaky Bay, in 2014, showed a 0.13 t/ha yield increase (13%) over DAP using phosphoric acid as the phosphorus source.

The trace element treatments or manganese treatments did not improve yield at either site in 2015.

What does this mean?

Consistent improvements in grain yield have been observed through using a fluid form of phosphorous (phosphoric acid) over a granular product on the highly calcareous sandy loams soils of Streaky Bay in both 2014 and 2015. However yield improvements to the same products were not observed on the red sandy soil at Warramboo in either year. This highlights the specific soil type benefit in using fluid phosphorous fertilisers and their advantage on calcareous soil types.

In 2015 trails at both Streaky Bay and Warramboo were unable to demonstrate any yield advantage to using a range of fungicides aimed at controlling rhizoctonia. The current research on fungicides for rhizoctonia control shows yield variation between seasons which may depend on spring rainfall (McKay, A., *et. al*). Using break crop rotations and lowering rhizoctonia inoculum levels before a cereal crop may be the best option. All current information should be taken into account when formulating a management plan to control rhizoctonia in high risk situations.

These trials will be sown again in 2016 to have a better understanding of the best fertiliser mixes and fungicide applications and to increase confidence in fluid delivery systems.

Acknowledgements

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Registered products: see chemical trademark list.

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