Fluid delivery systems and fungicides in wheat

Amanda Cook, Ian Richter, Nigel Wilhelm and Sue Budarick
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location:
Warramboo
Darren Sampson and family
Rainfall
Av. Annual: 313 mm
Av. GSR: 227 mm
2016 Total: 333 mm
2016 GSR: 251 mm
Yield
Potential: 2.8 t/ha (W)
Actual: 2.1 t/ha
Paddock History
2016: Mace wheat
2015: 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
2016 Total: 485 mm
2016 GSR: 323 mm
Yield
Potential: 5.0 t/ha (W)
Actual: 2.3 t/ha
Paddock History
2016: Mace wheat
2015: Medic pasture
Soil Type
Grey calcareous sandy loam
Plot Size
20 m x 2 m x 3 reps

Key messages

- **Phosphoric acid as a fertiliser and granular P performed similarly at Streaky Bay in the wetter 2016 season. In the previous two years, phosphoric acid resulted in 13 and 8% higher yields in 2014 and 2015, respectively.**
- **In 2016 there was a small yield response to phosphoric acid over granular P at Warramboo.**
- **Fungicides and the addition of extra 40 kg/ha urea at seeding separately reduced Rhizoctonia seminal root infection compared to the control at both sites.**
- **Including fungicides will increase input cost and risk over a cropping program.**
- **The addition of a trace element mix or manganese did not improve yields at Streaky Bay or Warramboo.**

Why do the trial?

The aim of this SAGIT-funded project was to build on previous research by updating knowledge of the benefits, including disease control and nutrition, of fluid delivery systems. Fluid systems have the potential to increase production through efficient delivery of micro and macro nutrients, reduced cost of trace element delivery and increased control of cereal, root and leaf diseases.

Historically, fungicidal control of Rhizoctonia, which can infect all of the major crops grown in southern Australia, has generally been poor, but fluid systems are a new option for delivery of fungicides, which may improve disease control and increase production. Trials were undertaken to assess the benefits of fluid delivery of nutrients and fungicides, under various application strategies, to wheat grown in two upper Eyre Peninsula environments.

The previous two years of trials in this project are reported in Eyre Peninsula Farming Systems Summary 2015, *Fluid delivery systems and fungicides in wheat* p114 and Eyre Peninsula Farming Systems Summary 2014, *Fluid delivery systems and fungicides in wheat at Warramboo and Streaky Bay* p98.

How was it done?

In 2016, three replicated trials were established, one at Warramboo on a red sandy soil and two at Streaky Bay on a grey calcareous sand. Both sites 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 split fluids both below the seed at approximately 3 cm, and in the seeder furrow behind the press wheel in a 1 cm band width.

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 used. 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 the standard rate being 1.5 kg Mn/ha and 3 kg/ha as a high rate. 1 kg/ha Zn, as zinc sulphate and 0.2 kg/ha Cu as copper sulphate were dissolved in the standard rates of trace elements, which were also delivered as foliar applications at 4-5 leaf stage on 14 July in Streaky Bay and 21 July at Warramboo. The extra nitrogen at seeding treatment was applied as 40 kg/ha of granular urea.

The fungicides azoxystrobin + metalaxyl-M (Uniform), penflufen (new formulation of EverGol Prime) and sedaxane (Vibrance seed dressing) were assessed for Rhizoctonia disease suppression at different rates and in split applications. Triadimenol and flutriafol were also applied on fertiliser as treatments.

The Streaky Bay trial was sown on 19 May. Herbicides were applied and included 1.5 L/ha of trifluralin, 2 L/ha of glyphosphate and 80 ml/ha of carfentrazone-ethyl and a wetter. All treatments were sprayed on 28 June with tralkoxydim at 500 g/ha, clopyralid at 75 ml/ha, sulphate of ammonia at 800 g/100 L and paraffin oil, to control weeds in-crop. Snail bait was also applied. The Warramboo trial was sown on 26 May and received the same pre-emergent herbicide mix as at Streaky Bay. In-crop pest control on 1 July included 1 L/ha of flumetsulam, 750 ml/ha of chlorpyrofos insecticide and snail bait.

Trace element treatments were delivered as foliar applications at 4-5 leaf stage on 14 July in Streaky Bay and 21 July at Warramboo.

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 eight weeks after seeding, on 19 July at Streaky Bay and 3 August at Warramboo. Crown roots per plant were also counted on these samples with the number of roots infected with Rhizoctonia used to calculate % crown root infection.

Due to the good seasonal conditions all treatments received an extra 70 kg/ha of urea broadcast in-crop after root sampling on the 22 July at Streaky Bay and 9 August at Warramboo. Trials were harvested on 15 November at Streaky Bay and 23 November at Warramboo. Data were analysed using Analysis of Variance in GENSTAT version 16.

What happened?

Initial Predicta B inoculum was high risk of Rhizoctonia at Streaky Bay (201 pg DNA/g soil), and a low Rhizoctonia risk at Warramboo. All other tested diseases were low at both sites.

Both sites have alkaline pH, reasonable soil phosphorus levels and adequate nutrient levels (Cu and Zn marginal at Streaky Bay) (Table 1). Mineral nitrogen level was much higher at Streaky Bay than Warramboo and the PBI is also higher, especially in the 0-10 cm zone.

Plant establishment in ideal seeding conditions at Streaky Bay averaged 142 wheat plants/m^2. Rhizoctonia patches were visible in the Streaky Bay trial early in the season, however disease symptoms were much lower than in previous years, as soil moisture stress was low and early plant growth was not as limited. The trial at Warramboo was sown later due to low soil moisture, but had good plant establishment, with an average of 147 plants/m^2. There were no differences in plant establishment due to treatments applied at either site. The trial at Warramboo had lower risk of rhizoctonia infection, which may be due to the inclusion of a pasture phase in 2015, which may have reduced inoculum levels compared with a wheat phase (Cook, *et al* 2010), but some Rhizoctonia patches were present in the trial area early in the season.

The Streaky Bay nutrition trial had no visual differences in early growth this season, unlike previous seasons when the phosphoric acid treatments looked better than other treatments. There were no differences in late dry matter or yield attributable to the nutrition treatments in 2016 at Streaky Bay (Table 2). Grain quality at Streaky Bay was not affected by treatments and averaged test weights of 80 kg/hL, protein of 9.8% and screenings of 1% for both trials (data not presented).

The fungicide trial was slightly more even in growth earlier in the season than the nutrition trial, but Rhizoctonia patches were still present. The additional nitrogen treatments were visually better in the fungicide trial early in the season. There were no differences in late season dry matter or Rhizoctonia crown root infection (76%) in the fungicide treatments in 2016 (Table 3). There were slight differences in yield but only the phosphoric acid + trace element + fungicide (Uniform) split + extra nitrogen treatment was significantly different to the control. This treatment and the similar treatment without the extra nitrogen, and the EverGol Prime (new formulation) with extra nitrogen also had lower Rhizoctonia seminal root infection scores than the control treatment in 2016.

Table 1 Soil analysis of Streaky Bay and Warramboo sites in 2016

Location	Depth (cm)	pH (CaCl)	Cowell P (mg/kg)	PBI	Total soil N (kg/ha)	DTPA Cu (mg/kg)	DTPA Mn (mg/kg)	DTPA Zn (mg/kg)	Bicarb Sulphur (mg/kg)
Streaky Bay	0-10	8.5	24.7	206	28.9	0.14	1.60	0.24	15.6
	10-30	8.8	12.1	275	46.8	<0.1	0.87	<0.1	10.7
	Total reserves (0-100)				208.0				
Warramboo	0-10	8.7	18.1	84	16.6	0.20	2.61	0.83	4.7
	10-30	8.7	5.4	150	9.6	0.21	1.15	0.22	4.9
	Total reserves (0-100)				49.5				

Table 2 Fluid delivery nutrition trial growth measurements (dry matter), yield and grain quality for Mace wheat at Streaky Bay, 2016

Treatment	Plant establishment (plants/m^2)	Early dry matter (g/plant)	Late dry matter (t/ha)	Yield (t/ha)	2016 gross margin ($/ha)*
Phosphoric acid + gran urea + 1.5 kg/ha MnSO4 liquid	133	0.29	5.66	2.42	283
Phosphoric acid + Gran Urea + 3 kg/ha MnSO4 liquid	134	0.30	5.71	2.34	266
Phosphoric acid + Gran Urea (equivalent 50 kg/ha DAP)	133	0.30	6.34	2.38	277
Phosphoric acid + Gran Urea + Liquid TE	145	0.30	5.45	2.36	270
APP + UAN (equivalent 50 kg/ha DAP) + Foliar Trace elements (4-5 leaf stage) Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @ 0.2 kg/ha	159	0.30	6.38	2.39	284
DAP + Liquid Trace elements Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @ 0.2 kg/ha	156	0.28	6.17	2.33	278
DAP with Mn coated fertiliser 1.5 kg/ha	154	0.26	6.18	2.34	282
DAP + Foliar Mn @ 1.5 kg/ha (4-5 leaf stage)	119	0.29	5.73	2.45	303
Control	149	0.26	5.66	2.32	280
DAP + Foliar Trace elements (4-5 leaf stage) Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @ 0.2 kg/ha	154	0.30	4.98	2.31	274
LSD (P=0.05)	*ns*	*ns*	*ns*	*ns*	

**ASW wheat Port Lincoln 1 December 2016 $193, Urea $445 Port Lincoln February 2016*

Table 3 Fluid delivery fungicide trial growth measurements (dry matter), yield and grain quality for Mace wheat at Streaky Bay, 2016

Treatment	Seminal root score (0-5)	Crown root infection (%)	Late DM (t/ha)	Yield (t/ha)	2016 gross margin ($/ha)*
Phosphoric acid + granular urea (equivalent to 50 kg/ha DAP) + Liquid Trace elements (TE) of Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @0.2 kg/ha +Uniform @ 300 ml/ha SPLIT APPLICATION +extra 40 kg/ha granular urea at seeding	2.72 [c]	68.6	7.46 [a]	2.62 [a]	279
Phosphoric acid + urea + Liquid TE +new formulation of penflufen @ 80 ml/ha SPLIT APPLICATION + extra 40 kg/ha granular urea at seeding	2.73 [c]	78.7	6.53 [abc]	2.37 [abcd]	**
Phosphoric acid + urea + Liquid TE + Uniform @ 300 ml/ha SPLIT APPLICATION	2.77 [c]	82.0	6.82 [ab]	2.37 [abcd]	251
DAP +Liquid TE + new formulation of penflufen @ 80 ml/ha	3.03 [abc]	76.5	5.65 [bcd]	2.16 [bcdef]	**
DAP +Liquid TE +Uniform @ 300 ml/ha SPLIT APPLICATION	3.20 [ab]	75.8	5.55 [bcd]	2.41 [abc]	277
DAP + Liquid TE + triadimenol @ 250 g/ha APPLIED ON FERTILISER	3.34 [a]	83.3	5.75 [bcd]	2.00 [f]	215
DAP + Liquid TE + Uniform @ 300 ml/ha + Vibrance seed dressing @ 300 ml/100 kg seed	3.14 [ab]	82.7	4.87 [d]	2.12 [cdef]	211
DAP + Liquid TE + Uniform @ 300 ml/ha APPLIED ON FERTILISER	3.22 [ab]	78.7	5.49 [bcd]	2.09 [def]	215
DAP + Liquid TE + new formulation of penflufen @ 80 ml/ha SPLIT APPLICATION	3.20 [ab]	76.3	5.37 [bcd]	2.18 [bcdef]	**
DAP + Liquid TE + Flutrifol @800 ml/100 kg DAP APPLIED ON FERTILISER	3.13 [ab]	66.8	5.35 [bcd]	2.35 [abcde]	284
Phosphoric acid + urea + Liquid TE + new formulation of penflufen @ 80 ml/ha SPLIT APPLICATION	2.93 [bc]	66.3	5.70 [bcd]	2.46 [ab]	**
Control - 50 kg/ha DAP	3.13 [ab]	78.2	6.39 [abcd]	2.21 [bcdef]	258
DAP+ Liquid TE + EverGol Prime applied as seed dressing @ 80 ml/100 kg/seed	2.95 [bc]	76.8	5.19 [cd]	2.05 [ef]	207
LSD (P=0.05)	*0.31*	*ns*	*1.57*	*0.31*	

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***new formulation of penflufen, cost unknown*

At Warramboo, in drier conditions, phosphoric acid + trace element +fungicide (Uniform and EverGol Prime new formulation of penflufen) split + extra nitrogen treatments had lower Rhizoctonia seminal root infection than the control. There were no differences in crown root infection (average 56%) (Table 4). Only the phosphoric acid +with trace element +, fungicide (Uniform) split +and extra nitrogen treatment had higher late dry matter than the control (Table 3). The first five treatments in Table 4 had higher grain yields than the control in this trial in 2016 and all of these had phosphoric acid as the base fertiliser. Grain quality showed no differences with the trial averages being; test weight of 80.0 kg/hL, protein 9.7%, screenings 2.5% (data not presented).

In previous seasons there has been a 0.11 t/ha (8% from 1.25 t/ha using granular DAP to 1.36 t/ha in 2015) yield increase and 0.13 t/ha yield increase (13% in 2014) using phosphoric acid in Streaky Bay in drier seasons (Cook *et al*, 2015). In 2016 there was no benefit to using phosphoric acid at Streaky Bay. In previous seasons there has been no fertiliser response at Warramboo, however there was a response to phosphorus source this season.

The 2016 gross margins show the difference compared to the control but the increase in the input costs will result in higher risk over a whole cropping program. The results in the 2016 season have confirmed that soil type and also soil moisture conditions influence the response to phosphorus source.

Table 4 Fluid delivery trial growth measurements (dry matter), yield and grain quality for Mace wheat at Warramboo, 2016

Treatment	Seminal root score (0-5)	Crown root infection (%)	Late DM (t/ha)	Yield (t/ha)	2016 gross margin ($/ha)*
Phosphoric acid + granular urea (equivalent to 50kg/ha DAP) + Liquid Trace elements (TE) of Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @0.2 kg/ha + Uniform @ 300 ml/ha SPLIT APPLICATION + extra 40 kg/ha granular urea at seeding	2.85 d	55	6.77 a	2.41 a	288
Phosphoric acid + urea (equivalent to 50kg/ha DAP) +Liquid TE + new formulation penflufen @ 80 ml/ha SPLIT APPLICATION + extra 40 kg/ha granular urea at seeding	2.90 cd	54	6.39 ab	2.36 ab	**
Phosphoric acid + urea (equivalent to 50 kg/ha DAP) + Liquid TE	-	-	5.82 bcde	2.28 abc	299
Phosphoric acid + urea + 3 kg/ha MnSO4 liquid	-	-	6.15 abc	2.27 abcd	298
Phosphoric acid + Liquid TE + Uniform @ 300 ml/ha SPLIT APPLICATION	3.10 abcd	51	5.44 cdef	2.27 abcd	278
DAP +Liquid TE + new formulation of penflufen @ 80 ml/ha	3.17 abc	58	5.36 def	2.23 bcde	**
DAP + Liquid TE + Uniform @ 300 ml/ha SPLIT APPLICATION	3.10 abcd	51	5.17 ef	2.16 cdef	272
Phosphoric acid + urea + 1.5 kg/ha MnSO4 liquid	-	-	6.37 ab	2.16 cdef	278
DAP + Liquid TE +triadimenol @ 250 g/ha APPLIED ON FERTILISER	3.20 ab	58	5.40 cdef	2.15 cdef	289
DAP and Liquid TE and Uniform @ 300 ml/ha and Vibrance seed dressing @ 300 ml/100 kg seed	3.08 abcd	49	5.36 def	2.15 cdef	264
DAP + Liquid TE + Uniform @ 300 ml/ha APPLIED ON FERTILISER	3.32 ab	60	5.15 ef	2.15 cdef	270
DAP and Liquid TE and new formulation penflufen @ 80 ml/ha SPLIT APPLICATION	3.30 ab	56	5.24 ef	2.13 cdef	**
DAP + Liquid + flutriafol @800 ml/100 kg DAP APPLIED ON FERTILISER	3.25 ab	66	5.39 cdef	2.13 cdef	285
DAP + Foliar Trace elements Mn @ 1.5 kg/ha, Zn @ 1 kg/ha, Cu @0.2 kg/ha (4-5 leaf stage)	-	-	6.04 abcd	2.13 cdef	285
Phosphoric acid + urea + Liquid TE + new formulation of penflufen @ 80 ml/ha SPLIT APPLICATION	3.03 bcd	54	5.58 cde	2.13 cdef	**
DAP + Liquid TE			4.79 f	2.12 def	283
Control 50 kg/ha DAP	3.34 a	63	5.63 bcde	2.08 ef	278
DAP + Liquid TE + EverGol Prime applied as seed dressing @ 80 ml/100 kg/seed	3.07 abcd	51	5.16 ef	2.08 ef	266
Phosphoric acid + urea	-	-	5.92 bcde	2.08 ef	264
APP + UAN (equivalent 50 kg/ha DAP) + Liquid TE	-	-	5.55 cdef	2.06 f	265
DAP + granular Mn fertiliser @ 1.5 kg/ha	-	-	5.44 cdef	2.03 f	267
DAP + Foliar Mn @ 1.5 kg/ha (4-5 leaf stage)	-	-	5.44 cdef	2.02 f	265
LSD (P=0.05)	*0.29*	*ns*	*0.77*	*0.15*	

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***new formulation of penflufen, cost unknown*

What does this mean?

The trial results in 2014 and 2015 showed improvements in grain yield through using a fluid form of phosphorous (phosphoric acid) over a granular product on the highly calcareous sandy loam soils of Streaky Bay. However in 2016 at Streaky Bay the phosphorus source did not show a yield response. Yield improvements to the fluid form of phosphorous (phosphoric acid) were not observed on the red sandy soil at Warramboo in either 2014 or 2015.

Previous research has shown in drier soil conditions the movement of phosphorus to the plant roots in the soil water is restricted. Fluid fertilisers are able to diffuse away from the point of application in lower soil moisture conditions and are less likely to be fixed by calcium in soils with high levels of calcium carbonate (Holloway *et al*, 2001, Lombi *et al*, 2004). Having a responsive soil type is important before changing to a fluid fertiliser system for phosphorus and soil moisture conditions may play a role in the responsiveness of the fluid phosphorous fertilisers.

In 2016 at both Streaky Bay and Warramboo there were seminal root infection differences for Rhizoctonia with the split application of fungicides and extra nitrogen and a yield advantage over the control. The most reliable method to reduce Rhizoctonia inoculum and disease levels has been to include a break crop rotation before a cereal crop (Gupta, *et al*, 2013). All current information, including the increased input costs, should be taken into account when formulating a management plan to control rhizoctonia in high risk situations.

References

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