TRIAL LOCATIONS 2019: York, Western Australia

TRIAL 4: The contribution of nitrogen fertilizer timing and placement in reducing the growth and seed production of ryegrass (*Lolium rigidum* Gaudin) in competition with wheat (*Triticum aestivum* L.).

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ABSTRACT

This trial was located in York in the grainbelt of Western Australia and investigated combinations of UAN (Urea Ammonium Nitrate) Placement (streamed or broadcast), UAN rate (low and high input) and UAN timing (early or late in the crop growth). The average seedbank at the York site was 18,350 seeds/m^2. Whilst the streaming of UAN modestly reduced annual ryegrass (ARG) N percentage in the tissue, no difference in annual ryegrass seed production was evident. Due to the dry conditions in 2019, the application of supplementary UAN did not significantly increase wheat canopy closure or yield. Interestingly, UAN placement did affect the total nitrogen uptake in the ryegrass population, potentially increasing ARG competitiveness. Banding UAN to the crop row was found to increase ARG N uptake. As seeding systems provide herbicide free bands on otherwise herbicide treated soil for safe wheat establishment it was found that the majority of ARG emerged from these crop rows. Concentrating N applications to these regions may have inadvertently increased the N uptake in ARG. This study was conducted in York over the 2018 and 2019 seasons. A multi-environment trial analysis for the combined data to be completed.

INTRODUCTION

Managing fertilizer inputs in a dryland cropping system is an important yet underutilized component of integrated weed managements (Gill & Holmes, 1997; Liebman & Janke, 1990). Of all nutrients, the greatest competition between plants and weeds is for nitrogen (N) which is routinely applied by growers to optimize crop yield and grain quality (Patterson, 1995; Raun & Johnson, 1999). However, the application of additional N can greatly alter the competitive balance between crops and weeds. In many situations, this is because increased available N in the form of applied fertiliser can greatly increase the weeds growth rate relative to the surrounding crop species, resulting in an increased capacity for weeds to compete with the crop (Ampong-Nyarko & De Datta, 1993; Robert E. Blackshaw et al., 2003; Carlson & Hill, 1985; Dhima & Eleftherohorinos, 2001; Morales-Payan, Santos, Stall, & Bewick, 1998; Peterson & Nalewaja, 1992a, 1992b; Supasilapa, Steer, & Milroy, 1992). Past research has demonstrated that the placement of the N fertilizer influences the competitiveness of crops and weeds. Fertilizer placed in narrow bands below the soil surface, favoring crop growth compared to being surface broad-cast evenly across the site increasing weed growth and reducing the ability of crops to compete against wild oat (*Avena fatua* L.) (Kirkland & Beckie, 1998;

Reinertsen, Elliott, Cochran, & Campbell, 1984), foxtail barley (*Hordeum jubatum* L.) (R. E. Blackshaw, Semach, Li, O'Donovan, & Harker, 2000) and downy brome (*Bromus tectorum* L.) (Rasmussen, 1995). Therefore, this study determines the effect of N fertilizer placement, N fertiliser rate and N application timing on the competitive ability of wheat *(Triticum aestivum* L.*)* in dryland no-tillage cropping system in the Western Australian grainbelt.

TRIAL MANAGEMENT

Table 1 Trial management details.

Date sown	27 May 2019	
Crop type	Wheat	
Variety	Magenta (Intergrain Australia)	
Seeding rate (kg/ha)	75	
Tillage type	Minimum tillage	
Soil moisture, depth (cm)	Marginal	4-5
Seed bed	Burnt stubble	
Clod size	Small (<5cm)	
Stubble loading	Nil	
Sowing equipment	Knife points and press wheels	
Sowing speed (km/hr)	5	
Sowing depth	1.5 cm	
Row spacing (cm)	25.4	
Fertiliser applied	Pre-emergent	100 kg/ha Gusto Gold
	Post-emergent	As per treatment list
Herbicides applied	Pre-emergent	1.5 L/ha Roundup Ultra Max 2.5 L/ha Boxer Gold
	Post-emergent	1 L/ha Velocity
Fungicides applied	Seed treatment	N/A
Fertiliser treatment	300 mL/ha Uniform	
	Post-emergent	N/A
Insecticides applied	Seed treatment	N/A
	Pre-emergent	1 L/ha chlorpyrifos 200 mL/ha bifenthrin
Post-emergent	50 g/ha Transform 150 mL/ha Affirm	

TRIAL TREATMENTS

Table 2 Treatment list

Treatment Number	Topdressing N method description	Comments
1	Broadcast post N	Basal plus UAN broadcast across the site
2	Banded post N	Basal plus UAN banded only on the crop row
Treatment Number	**Fertiliser timing description**	**Comments**
1	Early top-dress timing	UAN application early tillering (see below)
2	Delayed top-dress timing	UAN application at stem elongation (see below)

Treatment Number	Fertiliser rate Description	Comments
1	Low N input	See Below
2	Yield optimising N input	See Below
Control	**Control**	**Comment**
1	No topdressing	No topdressing, basal only

Table 3 Factorial combinations of Urea and ammonium Nitrate (UAN) fertiliser placement (streaming over the crop row vs broadcast spray), UAN rate, and UAN application timing applied to wheat in 2019.

Treatment	Basal treatment	Treatment description	Total N applied
1	-10 kg N ha-1 with establishment fertilizer	Nil N applied post emergent	10 kg N ha-1
2	-10 kg N ha-1 with establishment fertilizer -10 kg N ha-1 UAN sprayed evenly post sowing	10 kg N ha-1 UAN sprayed evenly at GS21,	30 kg N ha-1
3	-10 kg N ha-1 with establishment fertilizer -10 kg N ha-1 UAN banded to the crop row post sowing	10 kg N ha-1 UAN banded to the crop row at GS21	30 kg N ha-1
4	-10 kg N ha-1 with establishment fertilizer -10 kg N ha-1 UAN sprayed evenly post sowing	10 kg N ha-1 UAN sprayed evenly at GS31	30 kg N ha-1
5	-10 kg N ha-1 with establishment fertilizer -10 kg N ha-1 UAN banded to the crop row post sowing	10 kg N ha-1 UAN banded to the crop row at GS31	30 kg N ha-1
6	-10 kg N ha-1 with establishment fertilizer -10 kg N ha-1 UAN sprayed evenly post sowing	40 kg N ha-1 UAN sprayed evenly at GS21,	60 kg N ha-1
7	-10 kg N ha-1 with establishment fertilizer -10 kg N ha-1 UAN banded to the crop row post sowing	40 kg N ha-1 UAN banded to the crop row at GS21	60 kg N ha-1
8	-10 kg N ha-1 with establishment fertilizer -10 kg N ha-1 UAN sprayed evenly post sowing	40 kg N ha-1 UAN sprayed evenly at GS31	60 kg N ha-1
9	-10 kg N ha-1 with establishment fertilizer -10 kg N ha-1 UAN banded to the crop row post sowing	40 kg N ha-1 UAN banded to the crop row at GS31	60 kg N ha-1

Locations

The York site was seeded on the 27th May. The soil in the top 10cm was sandy light brown with a pH 5.6 CaCl2 and a total organic carbon content of 1.33% (Table 4). It had an estimated annual ryegrass seed bank of 18,350 seeds/m^2 in the top 10cm of soil. The site was seeded into dry soil with limited rainfall of <15 mm in April and 6mm in May (2 weeks before seeding). Wheat germination and emergence did not occur until June when 132 mm fell in the month (Figure 1). Rainfall events occurred in July and August and they were close to the long term average; however, conditions were cold limiting growth. September and October were dry with 10mm and 16mm of rainfall recorded respectively (Figure 1). The dry conditions and lack of cloud cover in September resulted in multiple frost events; however, the effects of these were reduced by the site being located high in the landscape.

Table 4 Soil description at the York 2019 experimental site.

		York
	Depth (cm)	**0-10**
Colour		LTBR
Gravel	%	0
Texture		2.5
Conductivity	dS/m	0.063
pH Level (CaCl2)		5.6
pH Level (H2O)		6.5
Exc. Aluminium	meq/100g	0.094
Exc. Calcium	meq/100g	3.63
Exc. Magnesium	meq/100g	0.86
Exc. Potassium	meq/100g	0.25
Exc. Sodium	meq/100g	0.09
Total Carbon	%	2.05
ECEC	meq/100g	4.9
Organic Matter	%	2.87
Organic Moisture %	%	2.5
MIR% Clay	%	21.00
MIR% Sand	%	65.50
MIR% Silt	%	13.60

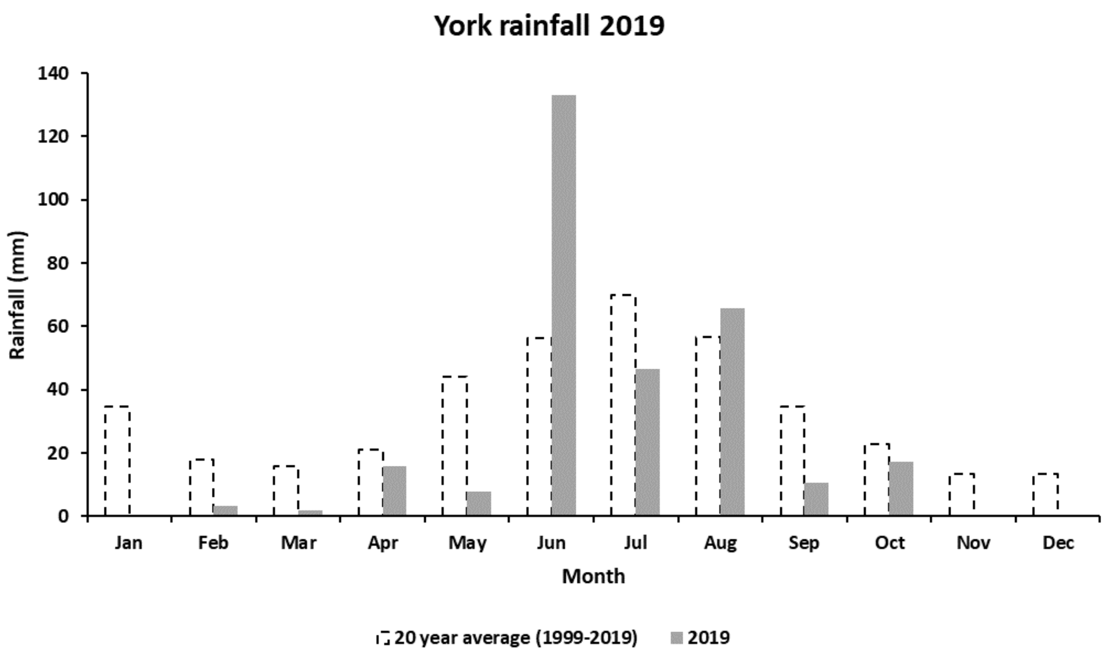

Figure 1 Monthly average rainfall for York in 2019.

Figure 2 Left, Farmer Kit Leake collecting NDVI data. Right, general site view in 2019.

RESULTS

ARG EMERGENCE

When assessing the ARG emergence in wheat crops with divergent nitrogen (UAN) placement, rate and timing treatments, it was found that no statistically significant interactions could be identified (P>0.05). However, the application of nitrogen (compared to the nil control) significantly increased ARG establishment (P<0.001).

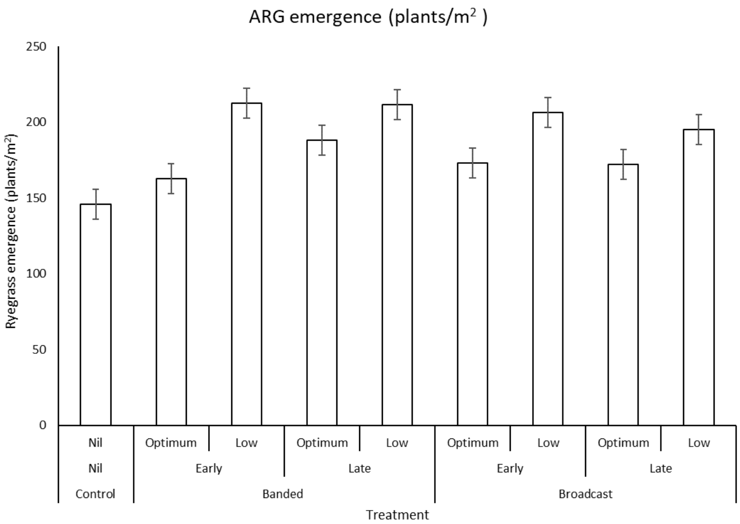

Figure 3 Annual ryegrass emergence at York in 2019.

ARG SEED PRODUCTION

No significant interactions of single factor differences in ARG seed production were found between the UAN placement, rate and timing treatments in 2019 (P>0.05)

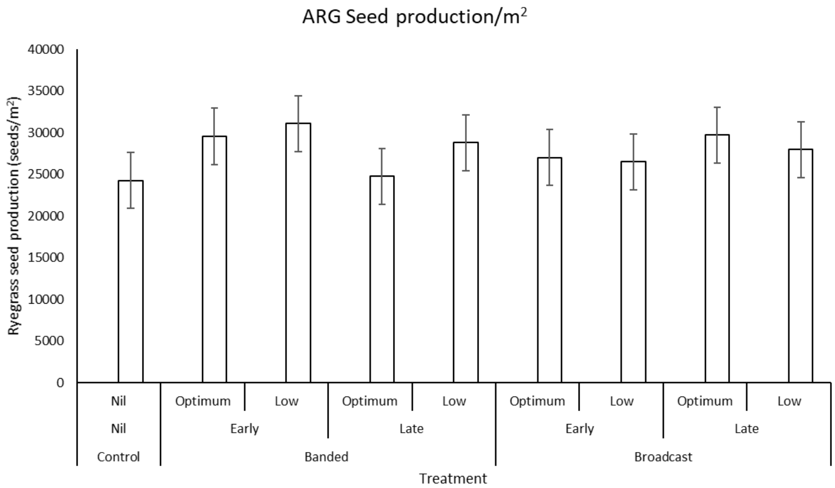

Figure 4 Annual ryegrass seed production at York in 2019.

RYEGRASS NITROGEN UPTAKE

When assessing the ARG total nitrogen uptake, which is a function of the tissue N concentration and the ARG biomass, it was found that no statistically significant interactions could be identified between the UAN application treatments (P>0.05). However, single factor significant differences within UAN Placement, UAN timing and UAN Rate treatments were identified. This study found that increased UAN rates consistently increased ARG total N uptake *(P<0.001),* and early application timings were found to also lead to increased N uptake *(P=0.003*). Interestingly, increased N uptake in ARG was also identified where UAN was banded only to the crop row *(P=0.004).* In this study, it was hypothesised that banding UAN to the crop row would reduce ARG N interception; therefore, giving the wheat crop a competitive advantage. As current no tillage tine based seeding systems remove herbicide treated soil from the crop row, it was found that the majority of ARG emerged from the rows. Concentrating N applications to these regions may have inadvertently increased the N uptake in the present ARG.

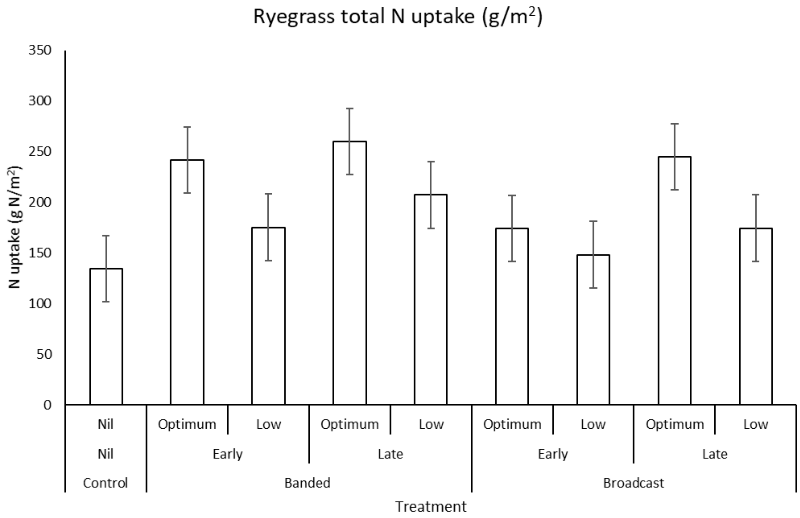

Figure 5 Annual ryegrass Nitrogen uptake.

Wheat yield

No significant interactions or single factor differences in wheat yield were found between the UAN placement, rate and timing treatments in 2019 (P>0.05)

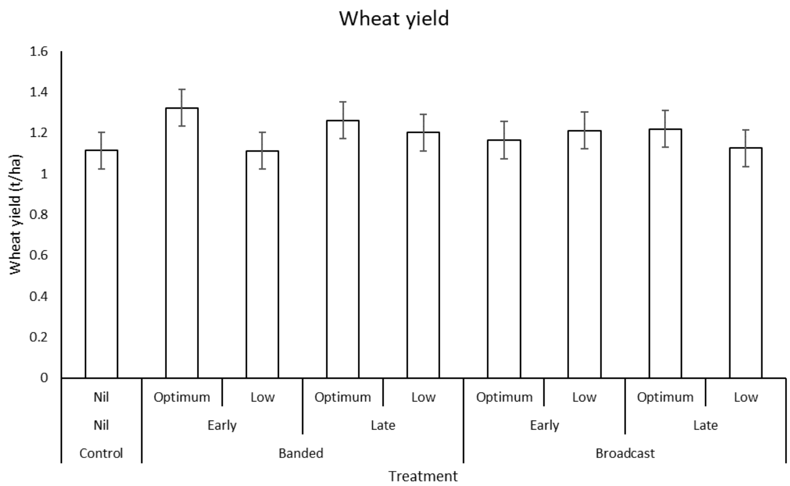

Figure 6 Wheat yield at York in 2019.

ACKNOWLEDGEMENTS

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