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Annual Results Report Template

2019
Annual Results Report

Optimising timing and rate of nitrogen application in waterlogging conditions in the Esperance Port Zone

Project code:	9176054
Prepared by:	Michelle Handley michelle@sepwa.org.au SEPWA Michelle Handley michelle@sepwa.org.au
Date submitted to GRDC:	18/06/2019

REPORT SENSITIVITY

Does the report have any of the following sensitivities?

Intended for journal publication	YES/NO	
Results are incomplete	NO (this report contains the results from year 1 of a project that will run 3 years)	
Commercial/IP concerns	YES/NO	
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KEY MESSAGES

- At Speddingup, yield of late sown Scepter wheat was highest (3.6 tonnes/ha) in treatment strips that received a 100L top-up of Flexi-N at early stem elongation in early September following a period of waterlogging in August. Yield was lowest (3.4 tonnes/ha) in the treatment to which all nitrogen was applied up front at seeding.
- At Condingup, mid-May sown Scepter wheat yield and grain protein increased as nitrogen application increased, with the Playing the Season treatment seeing the highest (8.4 tonnes/ha) and the Farmer Practice treatment seeing the lowest (6.9 tonnes/ha).
- Moderation of nitrogen applied up front provided the host grower at the Speddingup demonstration site with an opportunity to tailor nitrogen applications to the potential of the season and to address waterlogging issues faced during the season.
- The addition of extra nitrogen following waterlogging at the Condingup demonstration site resulted in improved yield and financial return (after nitrogen input costs had been deducted).
- Applications at stem elongation at Speddingup and as late as full flag leaf to head emergence at Condingup were able to provide yield with an associated positive effect on grain protein.

SUMMARY

As cropping systems have intensified there has been an increased reliance on nitrogen (N) fertiliser, now constituting the single largest variable cost for most grain growers. The challenge for growers is supplying the right amount of N at the right time and place to meet crop demand and optimise yield and quality, without over supplying N and reducing profit. The complexity of this decision is added to in waterlogging prone areas by the interaction between waterlogging and N uptake by the crop.

While growers in the Esperance Port Zone are achieving high yields in the higher rainfall parts of the port zone, production is impacted by waterlogging, especially in high decile years. Some growers are using tactics like raised beds, controlled traffic and deep ripping to minimise compaction to ensure better drainage in the paddock, summer cropping and deep drainage to reduce the impact of waterlogging on crop yields. In addition, growers are looking to agronomic options to counter the negative effects of waterlogging on crops.

What often eventuates is a guessing game of how much N to apply, given the associated risks of increasing financial losses with additional input costs. This project aims to enable growers to make timely and efficient nitrogen decisions in the Esperance port zones by having a rule of thumb around the cost/benefit of feeding N to crops on waterlogged soils.

While 2018 seasonal conditions at the Jedacuttup demonstration site were dryer than average, and waterlogging did not occur, the sites at Speddingup and Condingup did undergo a period of waterlogging due to 88mm and 150mm rainfall in August respectively.

At Speddingup, yield of the late sown (27th June) Scepter wheat crop was highest in the treatment strips that received a 100L top-up of Flexi-N 9.5 weeks after seeding when the crop was at Zadock 31 (early stem elongation). Yield was lowest in the treatment to which all nitrogen was applied up front at seeding.

Grain protein at the Speddingup site did not vary greatly between treatments but it was highest in both treatment strips to which 100L of Flexi-N had been applied at seeding along with 100kg of K-Till Extra rather than those that received 50L of Flexi-N. The difference in grain protein achieved was not enough to alter the grain receival standard nor price.

At Condingup, mid-May sown (10th May) Scepter wheat yield and grain protein increased as nitrogen application increased, with the Playing the Season treatment seeing the highest and the Farmer Practice treatment seeing the lowest.

In summary, moderation of nitrogen applied up front provided the host grower at the Speddingup demonstration site with an opportunity to tailor nitrogen applications to the potential of the season and to address waterlogging issues faced during the season. The addition of extra nitrogen following waterlogging at the Condingup demonstration site resulted in improved yield and grain financial return (after nitrogen input costs had been deducted). Applications at stem elongation at Speddingup and as late as full flag leaf to head emergence at Condingup were able to provide yield with an associated positive effect on grain protein.

The results collected from the Speddingup demonstration site in 2018 are consistent with the outcomes reported previously from the DPIRD-GRDC projects DAW00249 (wheat) and DAW00224 (barley) which found consistent increases in grain protein when the bulk of the target nitrogen was delayed up to Z31 (early stem elongation) with little deviation on grain yield.

1.0 BACKGROUND

Almost two-thirds of the agricultural land in the south-west region has a duplex soil profile with sandy loam surface soils over sandy clay subsoils. These soils are susceptible to waterlogging when the amount of rainfall exceeds the ability of the soil to drain away soil moisture. This susceptibility is increased by the strong texture contrast between sandy topsoils and clay subsoils; infiltration is higher through the topsoil than in the subsoil.

Waterlogging is excess water in the root zone which creates anaerobic conditions. The excess water inhibits gaseous exchange with the atmosphere and biological activity uses up available oxygen in the soil air and water. These conditions affect agricultural plants in several ways including nutrient deficiencies or toxicities, root death, reduced growth or death of the plant.

While growers in the Esperance Port Zone are achieving high yields in the higher rainfall parts of the port zone, production is impacted by waterlogging, especially in high decile years. Some growers are using tactics like raised beds, controlled traffic and deep ripping to minimise compaction to ensure better drainage in the paddock, summer cropping and deep drainage to reduce the impact of waterlogging on crop yields. In addition, growers are looking to agronomic options to counter the negative effects of waterlogging on crops.

When oxygen supply diminishes under waterlogging, N can be lost to the atmosphere largely in the form of either nitrous oxide (N_2O) or nitrogen gas (N_2). The form of N gas is influenced by soil water content; N_2 tends to be lost from highly waterlogged soils, while N_2O from less saturated soil. The rate of gaseous N loss is also driven by soil carbon (C) and soil nitrate (NO_3^-) levels, as well as soil temperature.

In high rainfall areas within the Esperance Port Zone growers say the decile 7+ rainfall years can hurt their profitability more than anything, particularly those with large areas susceptible to waterlogging. Alternatively, in good conditions like those seen in 2017 many growers in the Esperance Port Zone regretted not putting more N on their crops as their high yielding wheat and barley crops experienced low protein levels. In these parts of the port zone what eventuates often is a guessing game of how much N to apply, given the associated risks of increasing financial losses with additional input costs.

2.0 OBJECTIVES

This project aims to enable growers to make timely and efficient nitrogen decisions in the Esperance port zone by having a rule of thumb around the cost/benefit of feeding N to crops on waterlogged soils.

3.0 METHODS

Three demonstration sites were established in the Esperance Port Zone, one at Jerdacuttup, Speddingup and Condingup. The season's rainfall during 2018 determined the extent of waterlogging experienced at each of these sites but at all 3 locations areas were selected that were prone to waterlogging a range of decile years.

Three Nitrogen application treatments were applied to paddock length strips at each of the trial sites, with either 1,2 or 3 replicates per treatment. While its preferable that 2 to 3 replicates be implemented the number of replicates achieved was dependent on the size of the demonstration site paddock, the size of the site host's equipment and the size of the waterlogging prone area within the paddock. The width of the treatment strips was determined by the width of the site host's equipment.

The first treatment represented usual host "Farmer Practice," the second treatment, called "All Up Front" at the Jerdacuttup and Speddingtup sites consisted of total nitrogen application within the first 4-6 weeks from seeding, with total application being the same or similar to that applied to the "Farmer Practice" treatment. The second treatment applied at the Condingup site consisted of more nitrogen applied up front and was hence called "More up Front". It was intended that this treatment would to be "All up Front" but an aerially applied nitrogen top-up was required later in the growing season in the paddock in which the trial was located, following a period of waterlogging, and the trial site could not be differentiated from the rest of the paddock form the air. The third treatment applied to all three demonstration sites consisted of "Playing the Season" with the view of maximising yield and grain quality.

Soil cores were taken at each site prior to seeding in 2018 to establish pre-seeding nitrogen levels and during the growing season to measure movement of available nitrogen in the soil profile. One composite soil core per site was taken to 1m depth with a 'basic' analysis test conducted at 0-10cm and subsequent depth increments determined by soil horizon changes in the profile.

During the growing season crop establishment counts and Zadok scores were recorded and tissue tests were taken and analysed by CSBP's laboratory.

It was intended that Summit Fertilisers would provide (as an in-kind contribution to the project) an N rich strip across all treatments at each demonstration site, use a handheld Greenseeker® to measure NDVI in each of the treatments, and then input this data to Summit's N-Calc app. Unfortunately, Summit was unable to contribute this to the project during 2018. As a result, yields predicted by Summit's N-Calc during the season for each treatment were not compared by Summit Fertilisers to those measured at harvest. NDVI close to peak crop biomass was measured in each treatment at each location.

Crop agronomic management was implemented and paid for by the site host, in accordance with their usual farm practice under the advice of their agronomist.

At harvest, grain yield and quality measurements were recorded per treatment. Harvest yield was measured using header yield maps or a weigh trailer and grain quality was analysed using CBH's Infratec grain analyser.

Financial analysis of the respective nitrogen treatments for each location was conducted. Full gross margins were not presented because all treatments received the same inputs except for nitrogen application. As such the only variable input cost calculated was that of nitrogen application, not other variable costs such as fuel, machinery costs and labour.

4.0 LOCATION

NOTE: Where field trials have been conducted please include location details: Latitude and Longitude, or nearest town, using the table below (please add additional rows as required):

	Latitude (decimal degrees)	Longitude (decimal degrees)
Trial Site #1	-33.803996	120.358996
Nearest Town	Hopetoun	
Trial Site #2	-33.505026	121.820137
Nearest Town	Gibson	
Trial Site #3	-33.755401	123.019965
Nearest Town	Condingup	

If the research results are applicable to a specific GRDC region/s (e.g. North/South/West) or GRDC Agro-Ecological Zone/s please indicate which in the table below:

Research	Benefiting GRDC Region (can select up to three regions)	Benefiting GRDC Agro-Ecological Zone (see link: http://www.grdc.com.au/About-Us/GRDC-Agroecological-Zones) for guidance about AE-Zone locations	
Experiment Title	Western Region Choose an item. Choose an item.	☐ Qld Central ☐ NSW NE/Qld SE ☐ NSW Vic Slopes ☐ Tas Grain ☐ SA Midnorth-Lower Yorke Eyre ☐ WA Northern ☐ WA Eastern ☐ WA Mallee	☐ NSW Central ☐ NSW NW/Qld SW ☐ Vic High Rainfall ☐ SA Vic Mallee ☐ SA Vic Bordertown-Wimmera ☐ WA Central ☒ WA Sandplain

5.0 RESULTS

5.1 Jerdacuttup Demonstration Site

Rainfall was below average in 2018 in the Ravensthorpe area (see Figure 1). Growing season rainfall received in Ravensthorpe for the April to September period in 2018 was 120.6mm compared to 180mm in 2017. In addition to receiving less rain during the growing season, 2018 also saw less summer rain received than in 2017, resulting in limited subsurface moisture available prior to seeding. Rainfall for the January to September period in 2018 was 197.2mm compared to 471.8mm in 2017.

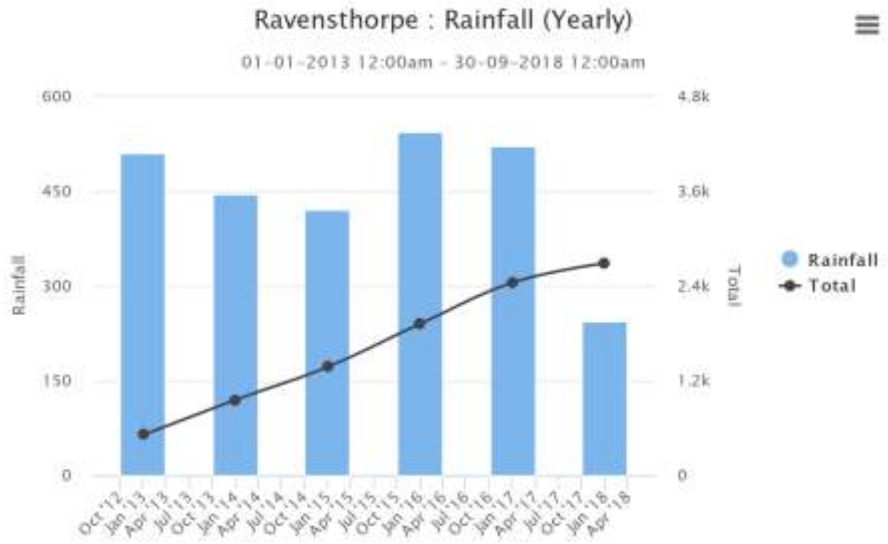

Figure 1: Annual rainfall for Ravensthorpe from January 2013 until September 2018.

As a result, the Jerdacuttup demonstration site was not exposed to waterlogging conditions during the growing season and it was agreed that data collection would cease at this location and resume in the 2019 growing season.

5.2 Speddingup Demonstration Site

5.2.1 Soil Type

Table 1: Pre-crop soil analysis at the Speddingup demonstration site.

		P11 A	P11 B	P11	P11	P11	P11
		0-10	0-10	10-20	20-40	40-60	60-80
Colour		LTGR	LTGR	GRWH	GRYW	GRYW	YWGR
Gravel	%	0	0	0	0	0	0
Texture		1.5	1.5	1.5	3.5	3.5	3.5
Ammonium Nitrogen	mg/kg	2	< 1	< 1	< 1	< 1	< 1
Nitrate Nitrogen	mg/kg	21	6	< 1	3	1	3
Phosphorus Colwell	mg/kg	31	38	25	5	< 2	< 2
Potassium Colwell	mg/kg	76	56	51	833	821	862
Sulfur	mg/kg	4.0	3.1	1.5	16.9	28.2	49.8
Organic Carbon	%	0.90	0.78	0.35	0.31	0.11	0.10
Conductivity	dS/m	0.084	0.068	0.047	0.348	0.584	0.644
pH Level (CaCl2)		5.1	4.8	5.8	7.6	8.4	8.5
pH Level (H2O)		6.0	6.1	7.1	9.0	9.6	9.6

Soils at the Speddingup demonstration site were a sand over clay duplex consisting of 20cm of acidic sand over alkaline clay (Table 1). Potassium and sulphur levels were marginal in the sand but high in the clay. Mild salinity persisted from 40cm depth.

5.2.2 Rainfall

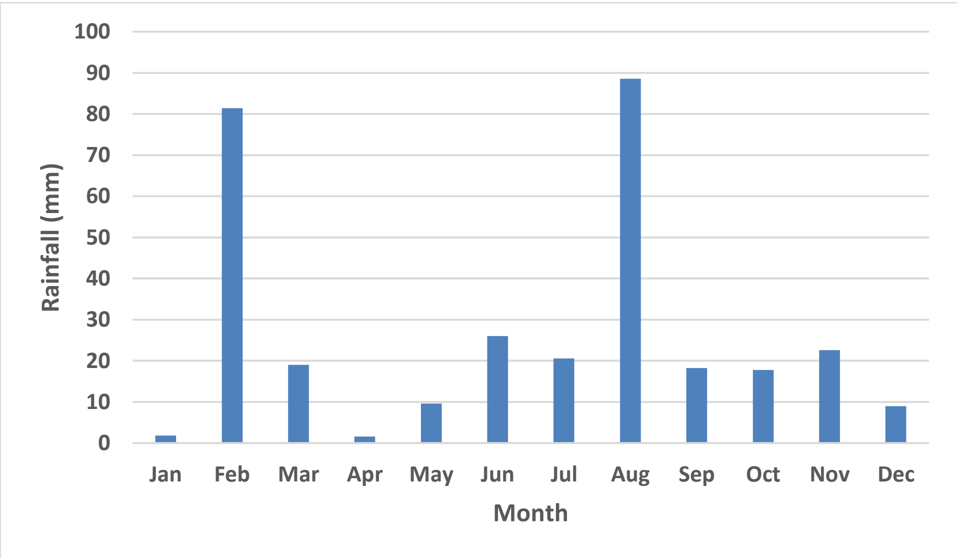

Figure 2: Monthly rainfall totals received at the Speddingup demonstration site. Total rainfall in 2018 was 316.2mm, growing season rainfall (April to October) was 182.4mm.

Rainfall was below average for both the year and the growing season at Speddingup. Despite 81.4mm falling in February the start to the growing season was dry with only 57.8mm falling between April and July (Figure 2). In August, 88.6mm was recorded which resulted in waterlogging throughout the demonstration site. The growing season concluded with a moderate finish with 36mm falling in September and October before harvest.

5.2.3 Treatments Applied to the Demonstration Site

All treatment strips at the demonstration site received 100kg/ha of K-Till Extra at seeding, on the 27th June 2018, coupled with the following Flexi N application regime:

- 50L on 27th June + 50L on 7th September (from here on in called 50 + 50). This treatment constituted 'Usual Farmer Practice.'
- 100L on 27th June + 0 for rest of growing season (from here on in called 100 + 0). This treatment constituted 'All Up Front.'
- 50L on 27th June + 100L on 7th September (from here on in called 50 + 100). This treatment constituted 'Playing the Season.'
- 100L on 27th June + 100L on 7th September (from here on in called 100 + 100). This treatment constituted 'Playing the Season.'

5.2.4 Growing Season Data

5.2.4.1 Establishment

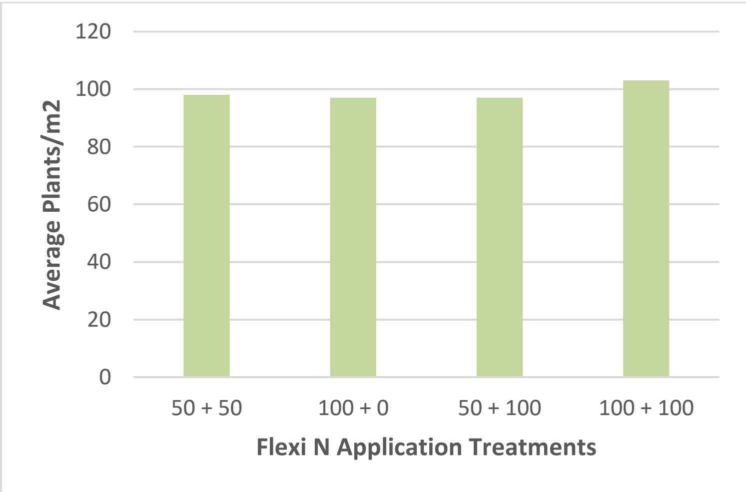

Figure 3: Scepter wheat establishment at the Speddingup demonstration site 3.5 weeks after seeding, 21/7/18.

Germination was fairly even with no variation in Zadock scores and little variation in plants/m^2 recorded between treatments on 21st July 2018 (Figure 3). The average Zadock score 3.5 weeks after seeding was Zadock 12.5. This evenness was again reflected in Zadock scores recorded on 31st August 2018 all of which were at Zadock 31.

5.2.4.2 In Crop Soil Nitrogen

Table 2: Soil Ammonium and Nitrate levels in each treatment strip, 31st August 2018 (9 weeks after seeding) and just prior to Flexi – N top up.

	Depth					Treatment
	0-10cm	10-20cm	20-40cm	40-60cm	60-80cm	
Ammonium Nitrogen (mg/kg)	1	<1	<1	<1	<1	50+50
Nitrate Nitrogen (mg/kg)	18	8	6	2	1	
Ammonium Nitrogen	<1	<1	<1	<1	<1	100+0
Nitrate Nitrogen	13	5	3	3	3	
Ammonium Nitrogen	1	<1	<1	<1	<1	50+100
Nitrate Nitrogen	24	3	3	1	2	
Ammonium Nitrogen	<1	1	<1	<1	<1	100+100
Nitrate Nitrogen	15	4	1	3	4	

Ammonium nitrate levels were low in all treatments 9 weeks after seeding, just prior to Flexi-N top-up time. Nitrate Nitrogen was highest in the top 10cm of soil in both treatments to which 50L of Flexi-N had been applied at seeding when compared to both of the treatments to which 100L of Flexi had been applied at the same time (Table 2). Nitrate nitrogen levels were marginal to satisfactory at 0-10cm depth and low below 10cm depth.

5.2.4.3 Tissue Test Results

Table 3: Scepter wheat tissue test results from nitrogen application treatment strips, 31st August 2018 prior to Felxi-N top up on 7th September 2018.

Treatment	50+50A	50+50B	100+0A	100+0B	50+100A	50+100B	100+100A	100+100B
Total N (%N)	3.13	3.11	3.81	3.74	4.28	3.02	3.95	4.14
Nitrate-nitrogen (mg N/kg)	116.29	89.08	477.97	246.35	1010.2	71.28	349.64	763.84
P (%P)	0.53	0.49	0.54	0.41	0.53	0.59	0.5	0.67
K (%K)	3.92	4.44	4.56	3.77	5.37	4.07	4.22	5.44
S (%S)	0.28	0.29	0.33	0.29	0.34	0.26	0.34	0.35
Cu (mg Cu/kg)	3.46	4.18	3.78	3.4	6.36	5.03	4.16	6.88
Zn (mg Zn/kg)	21.1	20.36	22.57	18.11	32	29.21	23.68	31.01
Mn (mg Mn/kg)	45.18	45.82	35.83	23.45	58.58	41.58	46.09	43.31
Ca (%Ca)	0.23	0.24	0.24	0.22	0.31	0.2	0.24	0.24
Mg (%Mg)	0.15	0.15	0.18	0.15	0.17	0.13	0.17	0.18
Na (%Na)	0.14	0.14	0.2	0.17	0.17	0.21	0.21	0.15
Cl (%Cl)	1.28	1.43	1.4	1.45	1.91	1.45	1.34	1.91
Fe (mg Fe/kg)	111.3	123.1	180.46	128.04	167.92	140.63	176.56	236.57
B (mg B/kg)	5.16	5.63	6.26	4.82	6.15	5.73	6.3	8.2
	Low							
	Marginal							

Analysis of the tissue test samples collected on 31st August 2018 reveal a general trend suggesting the crop required top-up nitrogen to be applied, particularly in those treatments that received 100kg/ha of K-Till Extra and 50L of Flexi-N at seeding compared to those that received 100kg/ha of K-Till Extra and 100L of Flexi-N at seeding (Table 3). These samples were taken just prior to application of top-up Flexi N in the 2 'Playing the Season' treatments and the 'Usual Farmer Practice' treatment and after a period of waterlogging following 88mm of rainfall in August (Figure 2).

5.2.4.4 Biomass

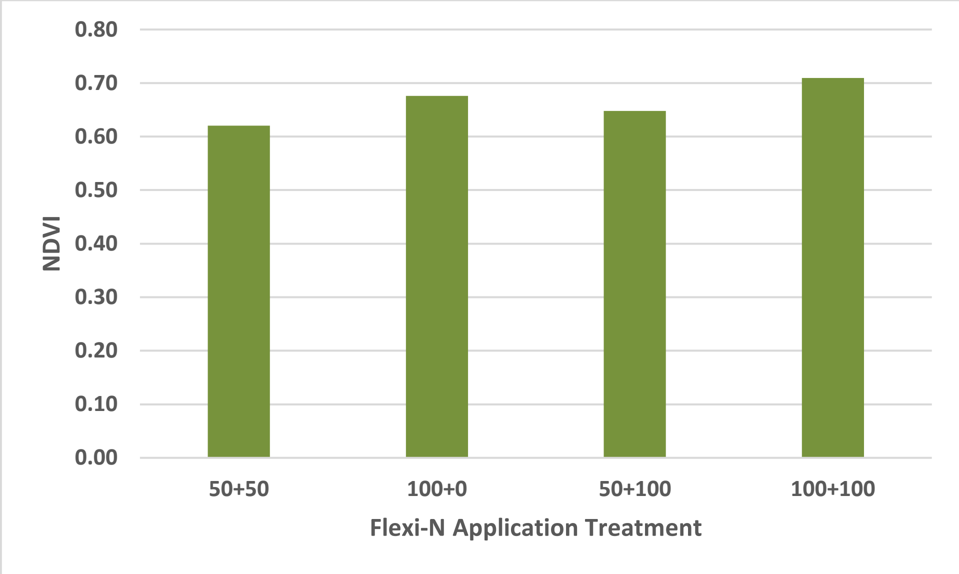

Figure 4: Scepter wheat peak biomass, Speddingup Demonstration Site, 20th September 2018.

Peak biomass was higher in both the of the treatments that received 100L of Flexi-N as well as 100kg of K-Till Extra at seeding on the 27th June 2018 compared to those that received 50L of Flexi-N as well as K-Till Extra (Figure 4). The treatment that received the highest nitrogen treatment had the highest NDVI measurement. That said, the NDVI difference recorded between all treatments was only 0.08.

5.2.5 Harvest Yield and Protein

Scepter wheat yield was highest in the treatment strips that received a 100L top-up of Flexi-N 9.5 weeks after seeding when the crop was at Zadock 31 (early stem elongation) (Figure 5). Yield was lowest in the treatment to which all nitrogen was applied up front at seeding.

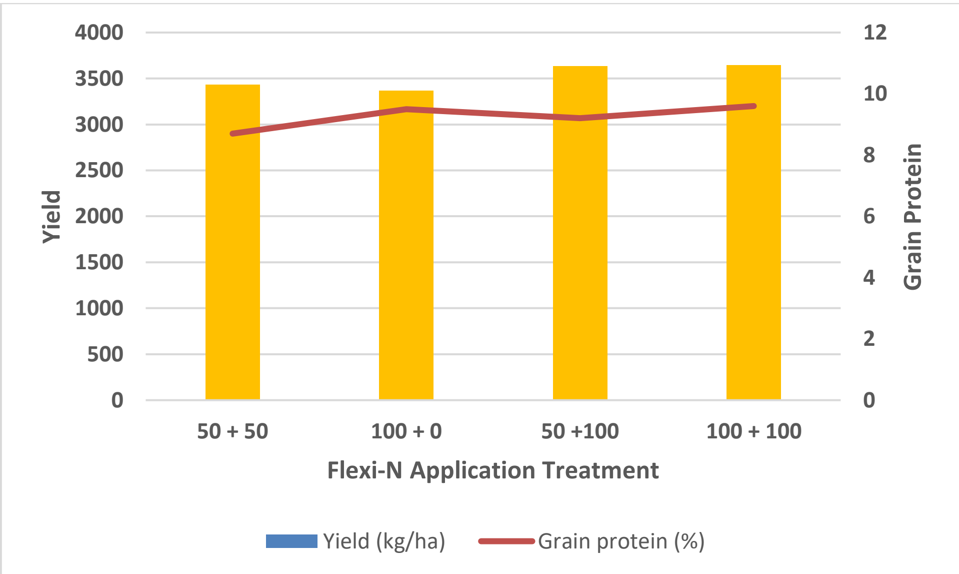

Figure 5: Late sown Scepter wheat yield and grain protein for Flexi-N treatment regimes applied, Speddingup, Harvest 2018.

Grain protein did not vary greatly between treatments but it was highest in both treatment strips to which 100L of Flexi-N had been applied at seeding along with 100kg of K-Till Extra rather than those that received 50L of Flexi-N (Figure 5). The difference in grain protein achieved was not enough to alter the grain receival standard and hence price.

5.2.6 Financial Analysis of Nitrogen Treatments

Table 4: Late sown Scepter wheat gross return for Flexi-N treatment regimes applied at the Speddingup demonstration site, 2018.

Flexi-N Treatment	Nitrogen Applied (kg/ha)		TOTAL N Applied (kg/ha)	Yield (kg/ha)	Grain Protein (%)	Free in to Store (FIS) ($/tonne)	Gross Return ($/ha)
	Seeding	Top Up					
	27/06/2018	7/09/2018					
50 + 50 (Farmer Practice)	31	21	52	3432	8.7	$325	$1115.4
100 + 0 (All Up Front)	52	0	52	3368	9.5	$325	$1094.6
50 +100 (Playing the Season)	31	42	73	3636	9.2	$325	$1181.7
100 + 100 (Playing the Season)	52	42	94	3648	9.6	$325	$1185.6

Scepter wheat gross return was highest in the treatment strips that received a 100L top-up of Flexi-N 9.5 weeks after seeding when the crop was at early stem elongation and lowest in the treatment to which all nitrogen was applied up front at seeding (Table 4).

Table 5: Late sown Scepter wheat grain return after deduction of nitrogen input costs, Speddingup, 2018.

Flexi- N Treatment	Cost of Nitrogen Input ($/ha)	Grain Gross Return ($/ha)	Grain Return – N input Cost ($/ha)
50 + 50 (Farmer Practice)	$78	$1115.4	$1037.4
100 + 0 (All Up Front)	$78	$1094.6	$1016.6
50 +100 (Playing the Season)	$107.50	$1181.7	$1074.2
100 + 100 (Playing the Season)	$143	$1185.6	$1042.6

Note: Direct N inputs are the only variable cost included in this analysis, items such as machinery, fuel and labour have not been included.

The results presented in Table 5 indicate that the cost of an additional 19 units of Nitrogen between the 50+100 treatment compared to the 100+100 treatment did not improve yield nor grain protein markedly. What is clear is the benefit to Scepter wheat yield and protein of applying nitrogen at early stem elongation over providing all nitrogen up front early in the growing season.

5.3 Condingup Demonstration Site

5.3.1 Soil Type

Soil at the Condingup demonstration site was a shallow sand over clay duplex (Figure 6).

Figure 6: A soil core taken from the Condingup demonstration site, 18th April 2018.

Phosphorus levels were marginal while potassium and sulphur levels were good (Table 6). In terms of pH the soil was acidic from 0-10cm depth and then close to neutral from 10-80cm depth.

Table 6: Pre-crop soil analysis at the Condingup demonstration site, 18th April 2018.

Depth	**0-10**	**10-30**	**30-80**
Colour	GR	GRBR	BRWH
Gravel (%)	0	0	0
Texture	1	3	3
Ammonium Nitrogen (mg/kg)	15	<1	<1
Nitrate Nitrogen (mg/kg)	18	7	6
Phosphorus Colwell (mg/kg)	17	4	<2
Potassium Colwell (mg/kg)	151	379	210
Sulfur (mg/kg)	6.5	12	17.6
Organic Carbon (%)	1.51	0.71	0.34
Conductivity (dS/m)	0.089	0.158	0.18
pH Level (CaCl2)	4.7	6.8	7.6
pH Level (H2O)	5.8	7.4	8.5
DTPA Copper (mg/kg)	0.36	0.22	0.06
DTPA Iron (mg/kg)	240	64.62	15.73
DTPA Manganese (mg/kg)	0.86	0.18	0.28
DTPA Zinc (mg/kg)	0.34	0.33	0.07
Exc. Aluminium (meq/100g)	0.213	0.066	0.065
Exc. Calcium (meq/100g)	3.47	21.52	18.26
Exc. Magnesium (meq/100g)	0.58	5.81	3.83
Exc. Potassium (meq/100g)	0.35	1.17	0.64
Exc. Sodium (meq/100g)	0.12	0.58	0.58
Boron Hot CaCl2 (mg/kg)	0.52	1.77	1.77
Aluminium CaCl2 (mg/kg)	2.8		

5.3.2 Rainfall

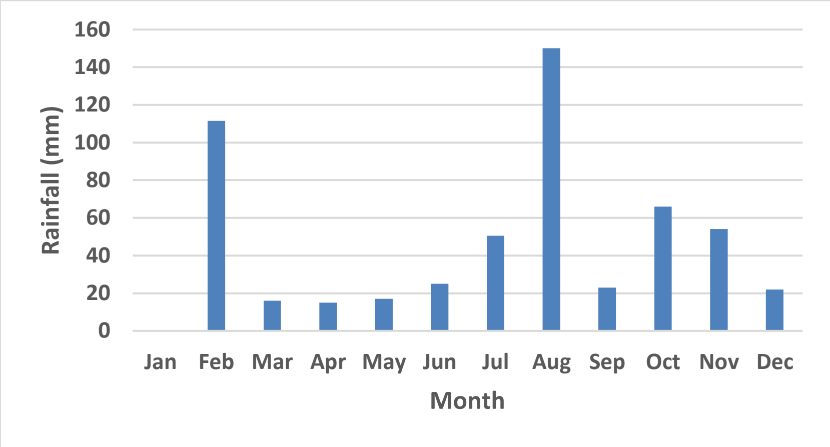

Figure 7: Monthly rainfall totals received at the Condingup demonstration site. Total rainfall in 2018 was 550mm, growing season rainfall (April to October) was 346.5mm.

Rainfall at Condingup in 2018 was average (Figure 7). Despite 111.5mm falling in February the start to the growing season was dryer than average with 92.5mm falling between April and July. In August, 150mm was recorded which resulted in waterlogging throughout the demonstration site. The growing season concluded with 89mm falling in September and October before harvest.

5.3.3 Treatments Applied to the Demonstration Site

- **"Farmer Practice"**

UAN - 50L/ha applied at seeding, 10th May 2018

Urea/Plus – 150kg/ha applied 20th June 2018

Urea – 100kg/ha applied 28th July 2018

Urea – 50kg/ha applied by plane 13th August 2018

- **"More Up Front"**

UAN - 80L/ha applied at seeding, 10th May 2018

Urea/Plus – 150kg/ha applied 20th June 2018

Urea – 100kg/ha applied 21st June 2018

Urea – 50kg/ha applied by plane 13th August 2018

- **"Playing the Season"**

UAN - 50L/ha applied at seeding, 10th May 2018

Urea/Plus – 150kg/ha applied 20th June 2018

Urea – 100kg/ha applied 28th July 2018

Urea – 50kg/ha applied by plane 13th August 2018

Urea – 100kg/ha applied 10th September 2018

5.3.4 Growing Season Data

5.3.4.1 Establishment

Establishment counts were not recorded at this demonstration site as germination was staggered and patchy (see Figure 8 below).

Figure 8: Uneven and patchy germination in nutrition treatment strips at the Condingup demonstration site, 8th June 2018.

5.3.4.2 In Crop Soil Nitrogen

Table 7: Soil Ammonium and Nitrate levels in each treatment strip on 30th August 2018 after a period of waterlogging.

	Depth			Treatment
	0-10cm	10-30cm	30-80cm	
Ammonium Nitrogen (mg/kg)	4	<1	<1	Playing the Season
Nitrate Nitrogen (mg/kg)	9	4	3	
Ammonium Nitrogen	<1	<1	3	Farmer Practice
Nitrate Nitrogen	3	3	1	
Ammonium Nitrogen	1	5	<1	More Up Front
Nitrate Nitrogen	2	<1	2	

Ammonium and nitrate levels were low in all treatments on 30th August 2018 during a period of waterlogging (Table 7). Nitrate Nitrogen was highest in the Playing the Season treatment. Nitrate nitrogen levels were marginal at 0-10cm depth and low below 10cm depth in this treatment and low at all depths in the other two treatments despite significant nitrogen inputs being applied during June, July and August.

Due to the logistical challenges faced with coordinating sample collection with host applied nitrogen treatments, and so many treatments being applied at this site, tissue testing was undertaken but sample collection was unable to be timed prior to the application of nitrogen top-up treatments so the data has not been presented in this report. The crop was not nutrient limited in any of the nitrogen treatment strips at the time of testing.

5.3.4.3 Biomass

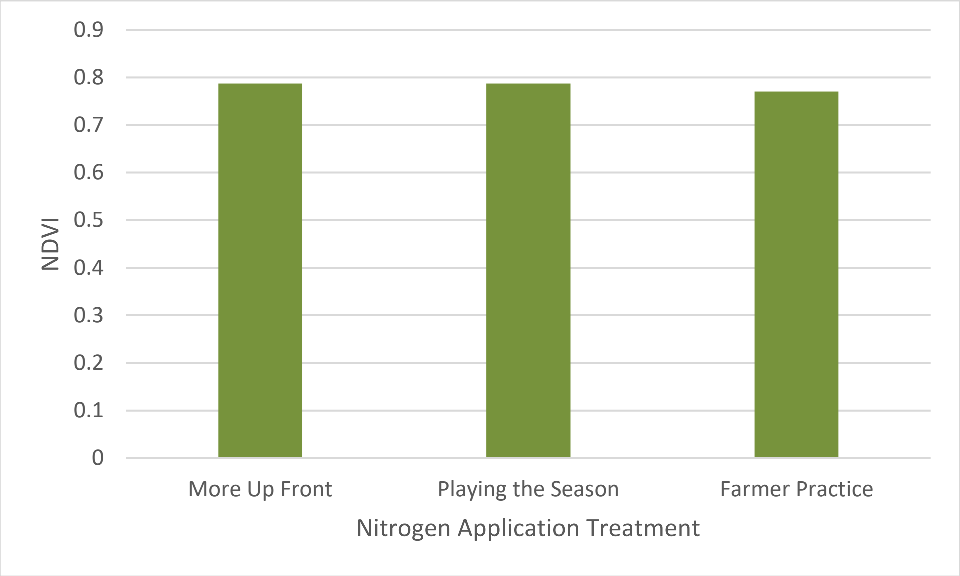

Figure 9: Scepter wheat biomass, Condingup Demonstration Site, 26th August 2018.

NDVI levels recorded on 26th August, 16 weeks after sowing, showed little variation between nitrogen treatment strips (Figure 9).

5.3.4 Harvest Yield and Protein

Table 8: Scepter wheat yield and grain quality for Nitrogen treatment regimes applied at the Condingup demonstration site, 2018.

N Treatment	Yield (t/ha)	Protein	Moisture	Hectolitre Weight (kg/hl)	Screenings	Classification	Free In to Store (FIS) ($/tonne)	Gross Return ($/ha)
Playing the Season	8.4	11.6	15.5	76.4	1.55	H2	$360	$3024
More Up Front	7.8	11.4	14.6	76.2	1.28	APW1	$350	$2730
Farmer practice	6.9	10.2	14.6	77.5	1.54	APW2	$340	$2346

Mid-May sown Scepter wheat yield and grain protein increased as nitrogen application increased, with the Playing the Season treatment seeing the highest and the Farmer Practice treatment seeing the lowest (Table 8 & 9).

5.3.5 Financial Analysis of Nitrogen Treatments

Table 9: Nitrogen input costs at the Condingup Demonstration Site, 2018.

N Treatment	Nitrogen Applied (kg/ha)						TOTAL N Applied (kg/ha)	Total Cost of N ($/ha)
	UAN @ Seeding (L/ha)	Urea/ Plus (kg/ha)	Urea (kg/ha)	Urea (kg/ha)	Urea (kg/ha)	Urea (kg/ha)		
	10/5/18	20/6/18	21/6/18	28/7/18	13/8/18	10/9/18		
Playing the Season	50	150	-	100	50	100	191.5	$243.5
More Up Front	80	150	100	-	50	-	158.1	$208
Farmer Practice	50	150	-	100	50	-	145.5	$188.5

Note: Water logging occurred during August, 150mm rain received for the month

While full gross margin data is not presented in this report the results presented in Table 10 indicate that in the 2018 season, in which a period of waterlogging occurred following 150mm rainfall in August, the cost of additional units of Nitrogen applied as late as full flag leaf to head emergence improved yield and grain protein.

Table 10: May sown Scepter wheat grain return after deduction of nitrogen input costs, Condingup 2018.

N Treatment	Cost of Nitrogen Input ($/ha)	Grain Gross Return ($/ha)	Grain Return – N input Cost ($/ha)
Playing the Season	$243.50	$3024	$2780.5
More Up Front	$208	$2730	$2522
Farmer Practice	$188.50	$2346	$2157.5

Note: Direct N inputs are the only variable cost included in this analysis, items such as machinery, plane hire, fuel and labour have not been included.

6.0 CONCLUSIONS

The conclusions of the demonstration sites implemented at Speddingup and Condingup in 2018 can be summarised as follows:

Speddingup – Late-June sown Scepter Wheat, waterlogging present in August

- Scepter wheat yield and gross return was highest in the treatment strips that received a 100L top-up of Flexi-N 9.5 weeks after seeding when the crop was at early stem elongation and lowest in the treatment to which all nitrogen was applied up front at seeding.

- The cost of an additional 19 units of Nitrogen between the 50+100 treatment compared to the 100+100 treatment did not improve yield nor grain protein markedly. What is clear is the benefit to Scepter wheat yield and protein of applying nitrogen at early stem elongation over providing all nitrogen up front early in the growing season.

Condingup – Mid-May sown Scepter Wheat, waterlogging present in August and early September

- Mid-May sown Scepter wheat yield and grain protein increased as nitrogen application increased, with the Playing the Season treatment seeing the highest and the Farmer Practice treatment seeing the lowest.

- In the 2018 season, in which a period of waterlogging occurred following 150mm rainfall in August, the cost of additional units of Nitrogen applied as late as full flag leaf to head emergence improved yield and grain protein.

In summary, moderation of nitrogen applied up front provided the host grower at the Speddingup demonstration site with an opportunity to tailor nitrogen applications to the potential of the season and to address waterlogging issues faced during the season. The addition of extra nitrogen following waterlogging at the Condingup demonstration site resulted in improved yield and grain financial return (after nitrogen input costs had been deducted). Applications at stem elongation at Speddingup and as late as full flag leaf to head emergence at Condingup were able to provide yield with an associated positive effect on grain protein.

The results of the Speddingup demonstration site supports the key findings of DPIRD-GRDC projects DAW00249 (wheat) and DAW00224 (barley) that followed over 20 trials conducted between 2012 and 2016 that found consistent increases in grain protein when the bulk of the target nitrogen was delayed up to Zadock 31 (appearance of the first node/early stem elongation), with little deviation in grain yield.

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   a. *May – August ie after seeding and before crop maturation when nitrogen timing decisions are being made.*

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