Final Technical Report - Optimising timing and rate of nitrogen

Final Technical Report

Optimising timing and rate of nitrogen applications in waterlogging conditions

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Abstract

Due to the prevalence of waterlogging in the high rainfall zones of Western Australia (HRZ) this project was undertaken to enable growers to make timely and efficient decisions in the Albany and Esperance port zones by having a rule of thumb around the cost/benefit of nitrogen (N) fertiliser decisions for crops on waterlogging soils.

The project was run over two growing seasons in the Albany Port Zone. In 2018, the results from the Frankland site showed no statistical difference between the N treatments, most probably due to the lack of significant waterlogging. In 2018, the results from the Muradup site (waterlogged) showed there was a significantly higher yield when the nitrogen applications were spilt (NApp3 and NApp4) compared with the single nitrogen applications (NApp1 and NApp2), by an average of 1t/ha. At this site, even lower split rates of N yielded better than higher rate single applications.

Due to lack of waterlogging, the trial was re-run in 2019 at the Frankland site. Significantly higher yields were achieved in all three N application treatments compared to the nil control. The two treatments with a third, late application of N applied achieved greater protein percentages, which achieved APW2 (lower N rate) and APW1 (higher N rate) grades, compared to ASW1 from both the ‘control’ and ‘farmer practice’ treatments which split the N applications in two only. Though this site did show that due to the cost of fertilizer the ‘Farmer Practice’ resulted in the most profitable returns.

With the varying results from this project, it is evident that response to N is both site and situation dependant. Further work needs to be undertaken to be able to create a broad rule of thumb around the cost/benefit of feeding N to crops on waterlogging soils.

Executive Summary

Recent research in Western Australia on nitrogen application has shown large yield responses when tactically splitting N applications at specific times over the growing season. Due to the prevalence of waterlogging in the high rainfall zones of Western Australia (HRZ) this project was undertaken to enable growers to make timely and efficient decisions in the Albany and Esperance port zones by having a rule of thumb around the nitrogen (N) fertiliser decisions for crops on waterlogging soils.

In 2018 the treatments for these trials were Nil nitrogen, grower timing and rate of N (NApp1), 100 kg after water logging events (NApp2), N to feed rainfall limited potential of crop according to phenology (100 units total split into 3) (NApp3) and N to feed rainfall limited potential of crop after each waterlogging event/s per grower timing (100 units total) (NApp4).

The results from 2019 have indicated:

- The 'farmer practice' strategy was the best nitrogen (N) strategy for the 2019 season. Yield response was greatest to N applied earlier (June-July) after good rainfall, achieving 5.43t/ha. Approximately half the mean rainfall (63mm) fell in September and October which favoured the early N strategy.
- The wheat likely achieved its water limiting yield potential despite the dry finish. This explains why our results showed more N did not improve yield in 2019.
- Despite the treatments that received additional N achieving a higher wheat grade, the cost of applying the N in a season with decile 8 pricing, reduced profits.

Contents

Background

Recent research in the high rainfall zone (HRZ) of Western Australia has shown a large yield response of approximately 60% when splitting nitrogen (N) applications tactically with some at seeding and the remainder after waterlogging events compared with all N at seeding or some at seeding and the remainder at Z31 with no regard for the waterlogging status of the soil. The number of tillers/m2 and, consequently, yield increased when tactical N was applied.

Higher seeding rates from field trials in the HRZ increased grain yields, whilst crops required less N to reach their potential. Tactical application of N and ensuring adequate tiller numbers, either through high seeding rates or appropriate N during the growing season, is a good strategy to maximise yields for HRZ growers. The technique enables savings to be made by reducing N requirement at higher seeding rates and to be flexible in response to seasonal conditions in the event of waterlogging.

Rainfall events are defined as waterlogging events if greater than 25mm is received within 24 to 48 hours. If waterlogging is moderate (7–30 days waterlogging to the soil surface), N application after waterlogging events to an actively growing crop is recommended. However, if waterlogging is severe (greater than 30 days waterlogging to the soil surface), then the benefits of N application post waterlogging are questionable.

This project was developed to determine if the returns on applying N to waterlogged crops are beneficial to HRZ growers in Western Australia. Ideally, HRZ growers would like to have a rule of thumb around the cost/benefit of feeding N to different crops on waterlogged soils (mainly wheat, barley, and canola).

Project objectives

To enable growers to make timely and efficient nitrogen decisions in the Albany and Esperance port zones by having a rule of thumb around the cost/benefit of nitrogen fertiliser for crops on waterlogged soils.

Methodology

2018 Sites

Two farm scale trials were established in 2018. One located in Muradup 15km west of Kojonup and the second located 10km east of Frankland in WA. Soil samples were collected in March 2018 to establish base line soil data, to ensure there were no limiting trace elements and to determine general fertiliser application rates. Predicta B samples were also collected and analysed, and the results came back negative. The trial margins were initially marked out before seeding and each replication was marked post seeding with fibre glass poles to assist the growers in the fertiliser applications.

Trial site 1 – Muradup (2018)

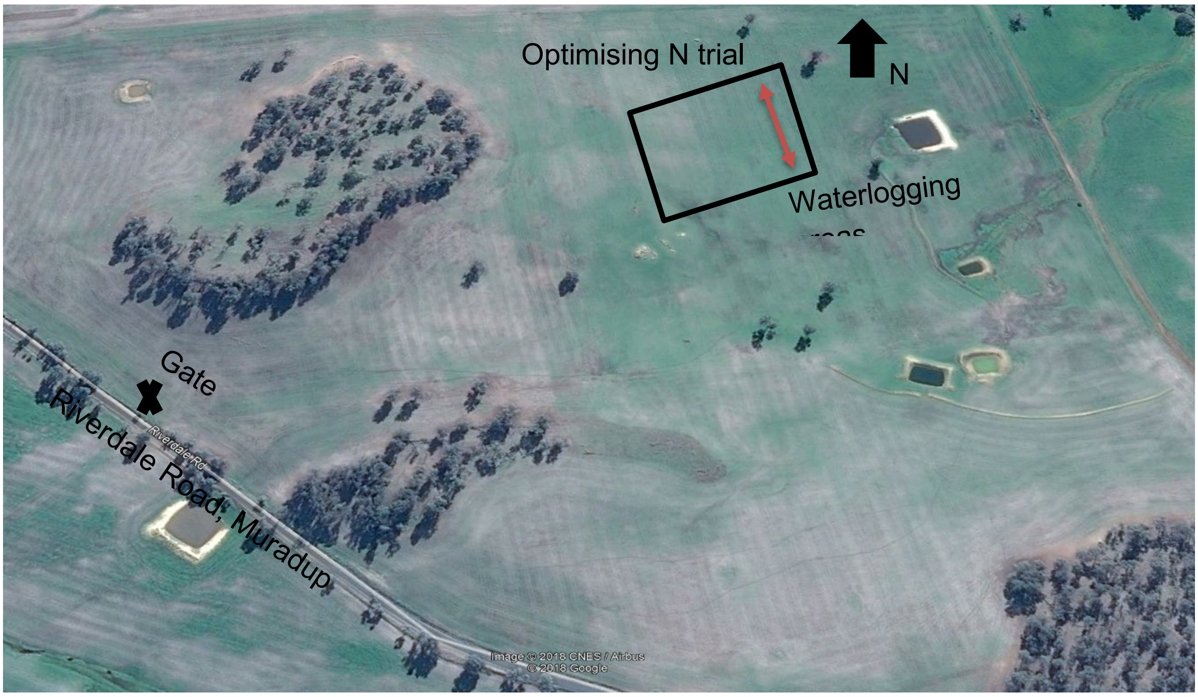
On the 19th of March 2018 soils samples were collected at each site from 0-10 and 10-30 cm depth at 15 random locations in each experimental area. Soil sent to CSBP and tested for pH (CaCl2), Organic Carbon, P, K, S, Exchangeable cations, reactive Fe and Al, available Ammonium and Nitrate N and electrical conductivity.

Two PreDicta B tests (including retained stubble from previous year) from each site analysed for presence of Rhizoctonia, Fusarium and Pratylenchus in waterlogged and non-waterlogged areas.

On the 21st of May 2018 the trial was sown to feed wheat variety Sunlamb at 90kg/ha with 100kg of Agstar Cu, Zn, Mn and 25kg MOP applied at seeding. This totalled 14.3 units of N, 14.0 of P and 9.0 of S. Post seeding nitrogen applications for each treatment are shown in the Table 1 and trial location, design and dipwell positioning in Figure 1.

Table 1: Post seeding Nitrogen Application (Muradup)

Treatment ID	N Treatment	N Rates	Date(s) Applied	Waterlogging event dates
Nil	nil	Nil		
NAppl1	N rate and timing as per grower application	200kg/ha	24/08/2018	
NAppl2	100 kg/ha N after each water logging event/s	100kg/ha	01/09/2018	28th – 31st August (20mm)
NAppl3	N to feed rainfall limited potential of crop according to crop phenology	165kg/ha 55kg/ha	24/07/2018 01/10/2018	
NAppl4	N to feed rainfall limited potential of crop after each water logging event/s	165kg/ha 55kg/ha	24/07/2018 01/09/2018	21st – 24th July (36mm) 28th – 31st August (14mm)



15m	15m	15m	15m	15m	15m	15m	15m	15m	15m	15m	15m	15m	15m	15m	
NAppl4	**NAppl4**	**NAppl4**	**Nil**	**NAppl3**	**NAppl3**	**NAppl3**	**Nil**	**NAppl2**	**NAppl2**	**NAppl2**	**Nil**	**NAppl1**	**NAppl1**	**NAppl1**	
Dipwell		Dipwell		Dipwell		Dipwell		Dipwell		Dipwell		Dipwell		Dipwell	
Dipwell		Dipwell		Dipwell		Dipwell		Dipwell		Dipwell		Dipwell		Dipwell	↕ 200m
Dipwell		Dipwell		Dipwell		Dipwell		Dipwell		Dipwell		Dipwell		Dipwell	

Figure 1: Trial Location, Design and Dipwell Positioning (Muradup)

Plant Establishment counts were collected on 24/07/2018 using a 0.1m quadrat and four replicates were collected from each plot.

NDVI Assessments, using a Green Seeker, were collected from the trial on 24/07/2018 and 02/08/2018.The Green seeker (NDVI) was held 1 metre above the crop and run from left to right across the plot rows. This was repeated 3 times in each plot.

Dipwell measurements were collected 3 times over the year on the 24/07/2018, 02/08/2018, and 05/09/2018.

Dry matter production was taken on the 3/10/2018 with measurements taken from 2 rows of 1 metre from each plot. The fresh samples were weighed and then dried at 70 degrees for three days and then dry matter weighed, and data recorded.

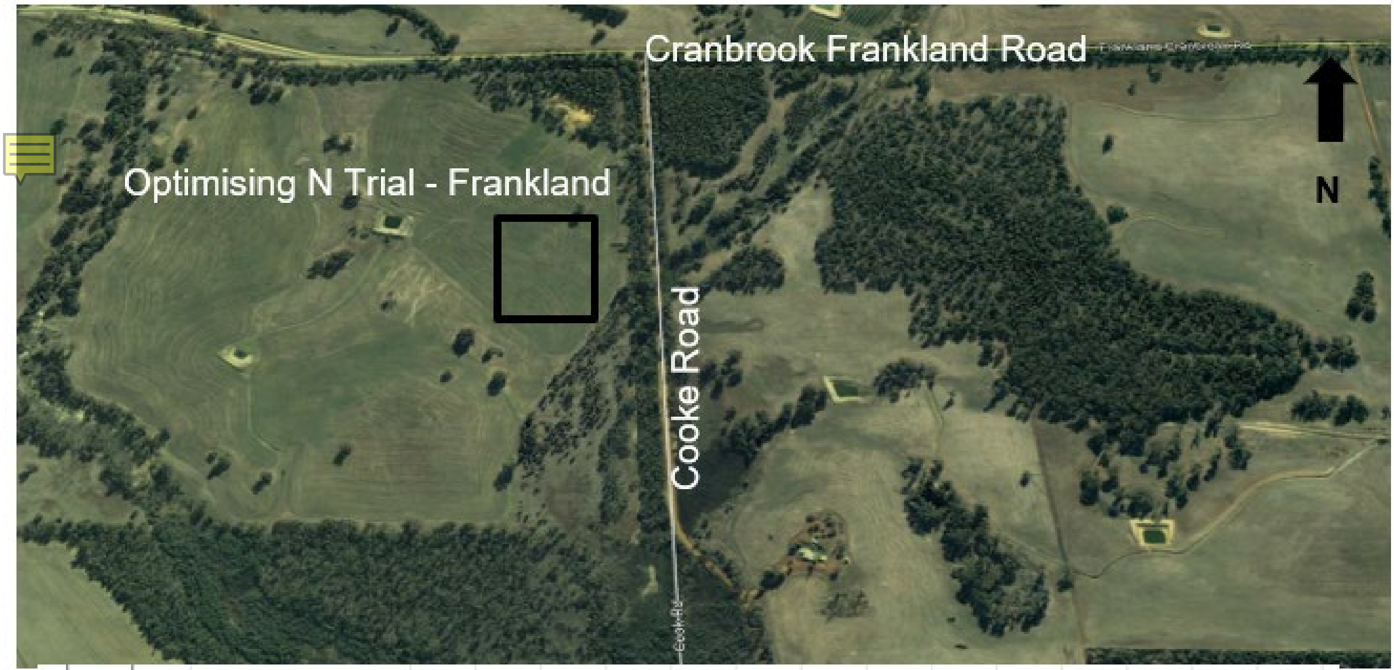
At harvest, the centre of each plot was harvested, and grain samples were collected for quality analysis. The trial was harvested 07/01/2019.

Trial site 2 – Frankland (2018)

On the 7th of June 2018 the trial was sown to Mace wheat at 100kg/ha with 105kg/ha Macrofertil and 20kg of MOP applied at seeding. This totalled 11.3 units of N, 23.4 of P, 29.0 of K, 0.3 of Copper and 0.5 of Zinc. Post seeding nitrogen applications for each treatment are shown in the Table 2 and trial location, design and dipwell positioning in Figure 2.

Table 2: Post Seeding Nitrogen Application (Frankland)

Treatment ID	N Treatment	N Rates	Date Applied	Waterlogging event dates
Nil	nil	Nil		
NAppl1	N rate and timing as per grower application	80kg/ha 70kg/ha	05/07/2018 17/08/2018	
NAppl2	100 kg/ha N after each water logging event/s	100kg/ha 100kg/ha	08/07/2018 15/08/2018	3rd – 8th July (64.5mm) 6th – 10th August (40.5mm)
NAppl3	N to feed rainfall limited potential of crop according to crop phenology	110kg/ha 130kg/ha	05/07/2018 17/08/2018	
NAppl4	N to feed rainfall limited potential of crop after each water logging event/s	110kg/ha 130kg/ha	08/07/2018 15/08/2018	3rd – 8th July (64.5mm) 6th – 10th August (40.5mm)



Frankland Cranbrook Road

	Gate	Cook Road		Gate	
Plot No	N Treatment				
1	100kg N after waterlogging	Dipwell	Dipwell	Dipwell	12m
2	Nil				12m
3	Yield potential crop phenology	Dipwell	Dipwell	Dipwell	12m
4	Yield potential after waterlogging				12m
5	Grower rate & Timing	Dipwell	Dipwell	Dipwell	12m
6	Yield potential crop phenology				12m
7	Grower rate & Timing	Dipwell	Dipwell	Dipwell	12m
8	Nil				12m
9	Yield potential after waterlogging	Dipwell	Dipwell	Dipwell	12m
10	100kg N after waterlogging				12m
11	100kg N after waterlogging	Dipwell	Dipwell	Dipwell	12m
12	Yield potential crop phenology				12m
13	Nil	Dipwell	Dipwell	Dipwell	12m
14	Grower rate & Timing				12m
15	Yield potential after waterlogging	Dipwell	Dipwell	Dipwell	12m

N

200m

Figure 2: Trial Location, Design and Dipwell Positioning (Frankland)

Plant Establishment counts were collected on the 24/07/2018 using a 0.1 m2 quadrat and we collected four replicates from each plot.

NDVI Assessments were collected from the trial on 24/07/2018 and 15/08/2018. The Green seeker was held 1 metre above the crop and run from left to right across the plot rows. This was repeated three times in each plot.

Dipwell measurements were collected three times over the year on the 24/07/2018, 15/08/2018, and 05/09/2018.

Dry matter production was taken on the 3/10/2018 with measurements taken from two crop rows of one metre in length from each plot. The fresh samples were weighed and then dried at 70 degrees for three days and then dry matter weighed, and data recorded.

At harvest, the centre of each plot was harvested, and a grain sample was collected for quality analysis. The trial was harvested on 4/01/2019.

Trial Site 2 – Frankland (2019)

One farm scale trial was established in Frankland in 2019 on Simon Hilder's property. The site was selected due to persistent waterlogging conditions over the past five years. The trial was located 8.5km east of Frankland townsite on the Frankland-Cranbrook road. The trial site sloped from north east down to south west over 4.8ha (fig 1). The trial was sown 24th May 2019 with 120kg/ha Scepter wheat with starter fertiliser at 110kg/ha of MAP and Mn and 20kg/ha of MOP.

The trial included four replicated N treatments at the Frankland site. Soil samples were collected before the trial was established to collect baseline soil data and to ensure other nutrients were not limiting.

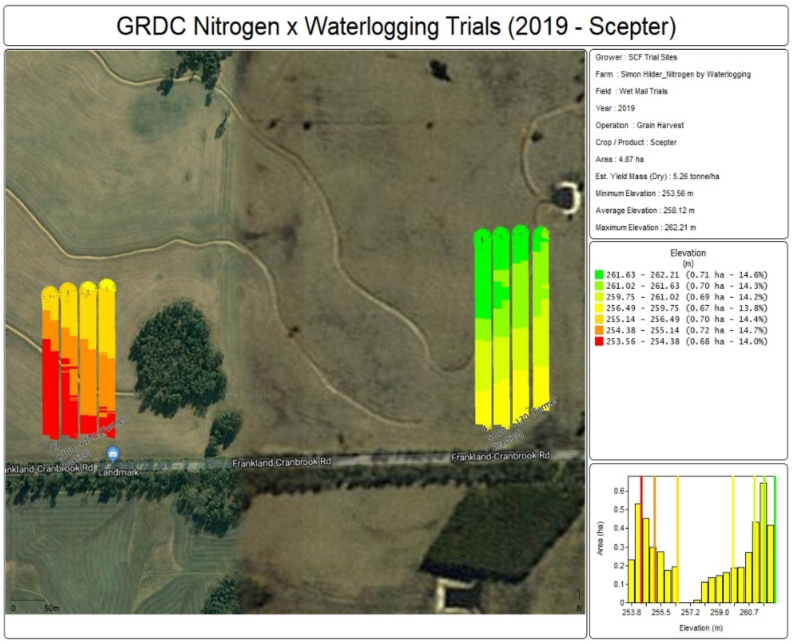


Figure 3: elevation map showing the Frankland nitrogen by waterlogging trial site in 2019

Assessments taken from the trial throughout the growing season included satellite NDVI readings, monitoring of rainfall data, waterlogging conditions, and grain yields. A basic economic analysis was assessed on the costs vs. returns of the additional applied N.

Four N strategies were developed by SCF, Simon and his agronomist for 2019. The trial consisted of four Urea applications, Control (100kg/ha), Farmer Practice (100kg and 130kg/ha), Split Application (100kg, 65kg & 65kg/ha), and High N (100kg, 130kg, 65kg and 65kg/ha) fig 2.

The N treatments were applied at three different intervals during the growing season. The fourth application of the 'High N' treatment was unable to be applied due to the dry spring conditions in 2019. The first application was on June 14, second on July 29, and the third and final applications were on August 19. All four treatments received 100kg/ha after a cumulative 27.4mm fell over five days form the 9th – 13th June fig 12.

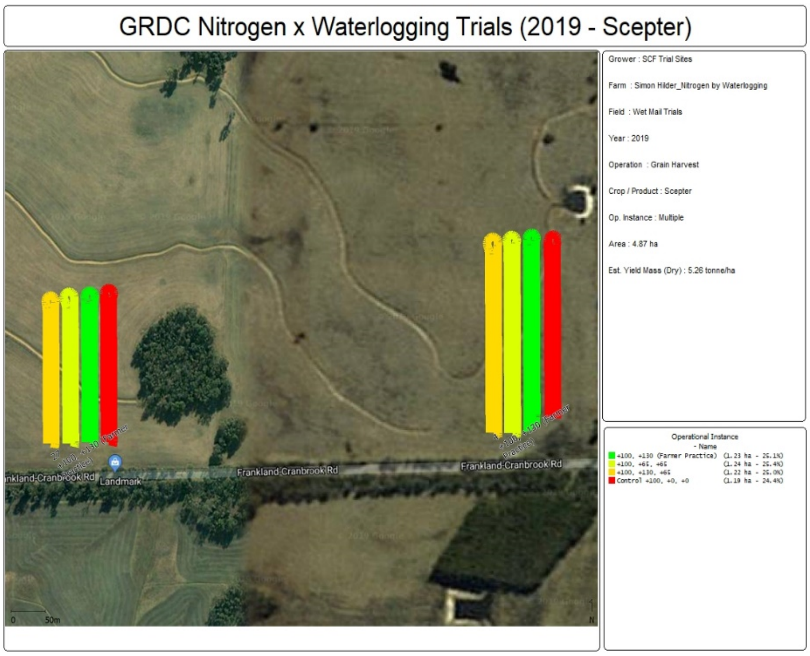


Figure 4: Trial map with nitrogen rate treatments at the Frankland nitrogen by waterlogging trial in 2019. The red strip indicates the control, green shows the control and yellow and orange shows the split and high n treatments respectively

Grain yield was measured using the header yield monitor that had been set up and calibrated correctly. The trial was harvested in one direction, taking cuts from the middle of each of the treatments. The yield maps were analysed, and the data was collated and sent to a contractor for statistical analysis.

Location

2018 Sites

	Latitude	Longitude
Trial Site #1	33°48'1.41"S	116°56'28.29"E
Nearest Town	Kojonup	
Trial Site #2	34°21'19.62"S	117° 8'58.81"E
Nearest Town	Frankland	

2019 Site

	Latitude	Longitude
Trial Site #1	-34.350905	117.172903
Nearest Town	Frankland	

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:

<table>
<tr><td>Research</td><td>Benefiting GRDC Region

(can select up to three regions)</td><td colspan="2">Benefiting GRDC Agro-Ecological Zone (see link: http://www.grdc.com.au/About-Us/GRDC-Agroecological-Zones) for guidance about AE-Zone locations</td></tr>
<tr><td>Experiment Title</td><td>Western Region

Choose an item.

Choose an item.</td><td>☐ Qld Central

☐ NSW NE/Qld SE

☐ NSW Vic Slopes

☐ Tas Grain

☐ SA Midnorth-Lower Yorke Eyre

☐ WA Northern

☐ WA Eastern

☒ WA Mallee</td><td>☐ NSW Central

☐ NSW NW/Qld SW

☐ Vic High Rainfall

☐ SA Vic Mallee

☐ SA Vic Bordertown-Wimmera

☐ WA Central

☒ WA Sandplain</td></tr>
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Results

2018 Dipwell results were unreliable hence have not be reported on in this report. Visual observations indicated the Muradup site was waterlogged only at the bottom of the hill (about one third of trial). The 2018 Frankland site was evenly waterlogged across the site, however, waterlogging at the Frankland site was mild.

2018 Sites

Trial Site 1- Muradup

The growing season rainfall total for Muradup in 2018 was 345.2mm and the annual rainfall was 454mm (Figure 5). This was average rainfall for the Muradup area. Cumulative waterlogging events occurred from 21st – 24th July (36mm) and a second rainfall event occurred 28th – 31st of August (14mm).

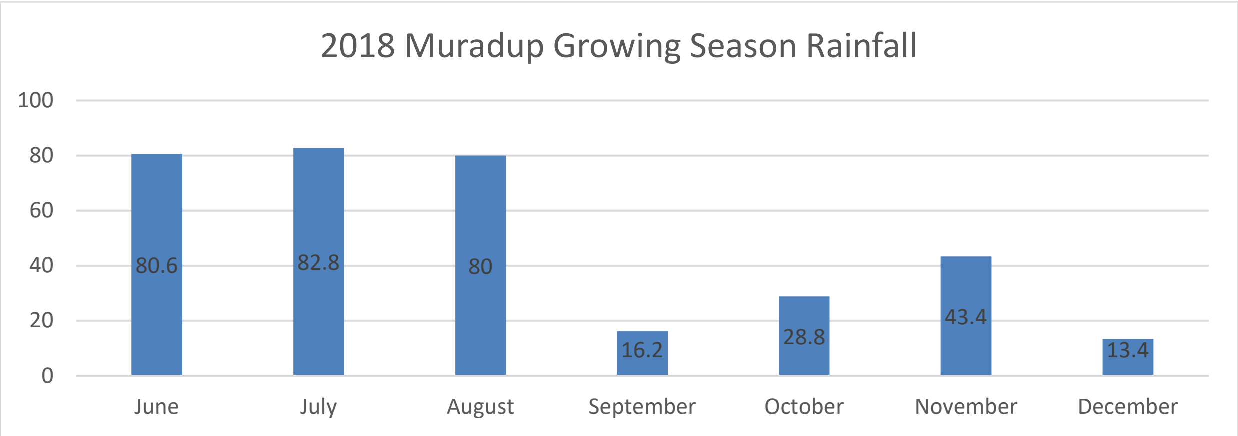


Figure 5:2018 growing season rainfall data, Muradup

PredictaB tests were negative for crown rot, and root lesion nematodes. Initial plant counts were between 137 and 180 plants/m2 which estimated the yield to be between 2 to 3.5 tonnes per hectare according to DPIRD'S wheat book yield potential estimator.

NDVI readings were undertaken on the 24th of July 2018 and on the 2nd of September 2018 (Table 3.). Results show there was no significant difference between treatments for the NDVI results.

Table 3:2018 Muradup NDVI Results

N Treatment	Average NDVI 24/07/2018	Average NDVI02/09/2018
Nil	20.33	57.11
NAppl1 -Farmer Practice (+200)	20.89	56.56
NAppl2-After Waterlogging event (+100)	20.11	57.44
NAppl3-Yield Potential (+165 +55)	20.22	57.00
NAppl4- Yield Potential after waterlogging event(+165 +55)	20.44	57.44

Table 4 displays the average dry matter weights per 1m^2 from the 3rd October 2018 at the Muradup site. NAppl4 had the heaviest dry matter per meter squared, though the differences are not significant.

Table 4: 2018 Muradup Dry Matter Weights

Treatment	Ave dry weight per 1m^2
Nil	1439.6
NAppl1 -Farmer Practice (+200)	1393.9
NAppl2-After Waterlogging event (+100)	1508.1
NAppl3-Yield Potential (+165 +55)	1689.1
NAppl4- Yield Potential after waterlogging event (+165 +55)	1612.0

Grain quality analysis showed the grain in treatments that had a later application of N had a higher protein % compared to the nil and farmer practice treatments (Table 5).

Table 5: 2018 Muradup Site Grain Quality Results

Treatment	Average Protein (%)
Nil	10.90
NAppl1 -Farmer Practice (+200)	10.77
NAppl2-After Waterlogging event (+100)	12.90
NAppl3-Yield Potential (+165 +55)	13.97
NAppl4- Yield Potential after waterlogging event (+165 +55)	13.77

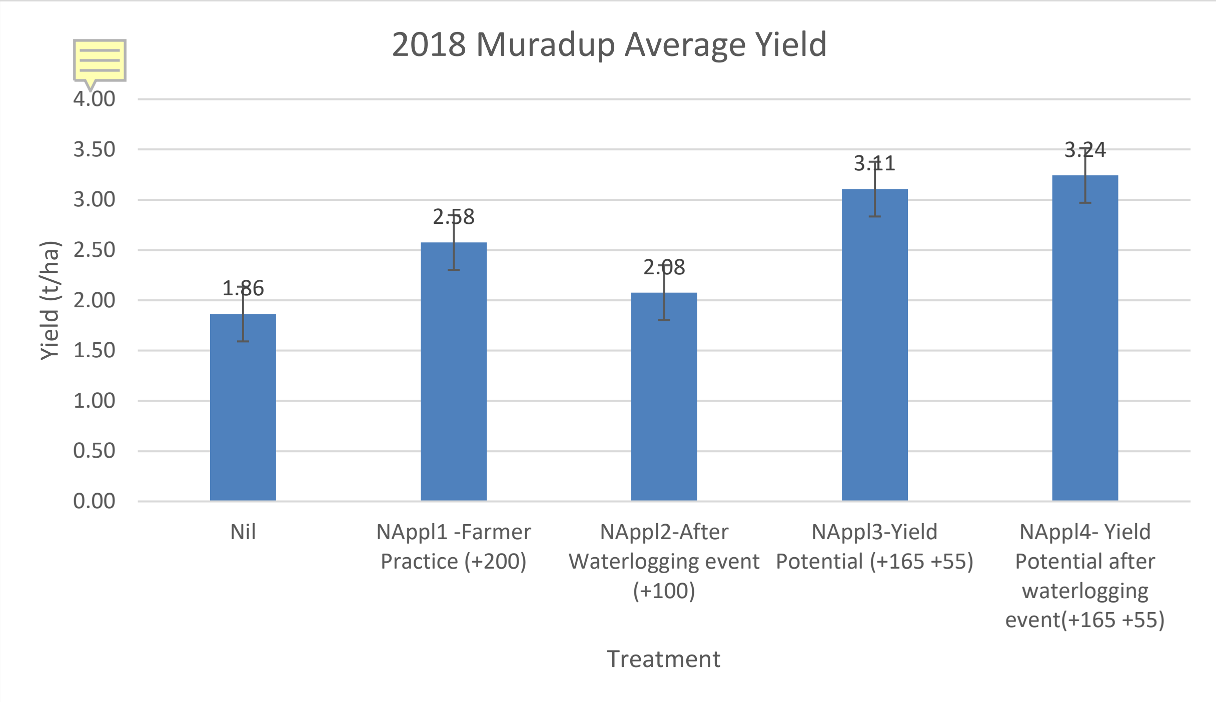


Figure 6: 2018 Muradup Yield Data

Figure 6 displays the yield data results for the 2018 Muradup site. Highest yields were seen in the split N application treatments, although these were not statistically different to the other treatments (single applications). On average spilt application treatments yielded 1t/ha higher compared to the nil and 100kg after waterlogging (single application) treatments. From the yield results it is evident that the yield advantage came first from a higher overall N rate (200-220 kg/ha N compared to nil or 100 kg/ha N) and secondly through splitting the higher rate applications. Soil analysis showed Nitrate N on average in 0 – 10cm soil layer to be 24 mg/kg.

Trial Site 2-Frankland

Growing season rainfall total was 440mm from June – December in 2018, with a total of 496.5mm for Frankland in 2018 (Figure 7). This was below the annual rainfall of 600mm. Cumulative waterlogging events occurred from 3rd – 8th July (64.5mm) and a second waterlogging event occurred 6th – 10th of August (40.5mm)

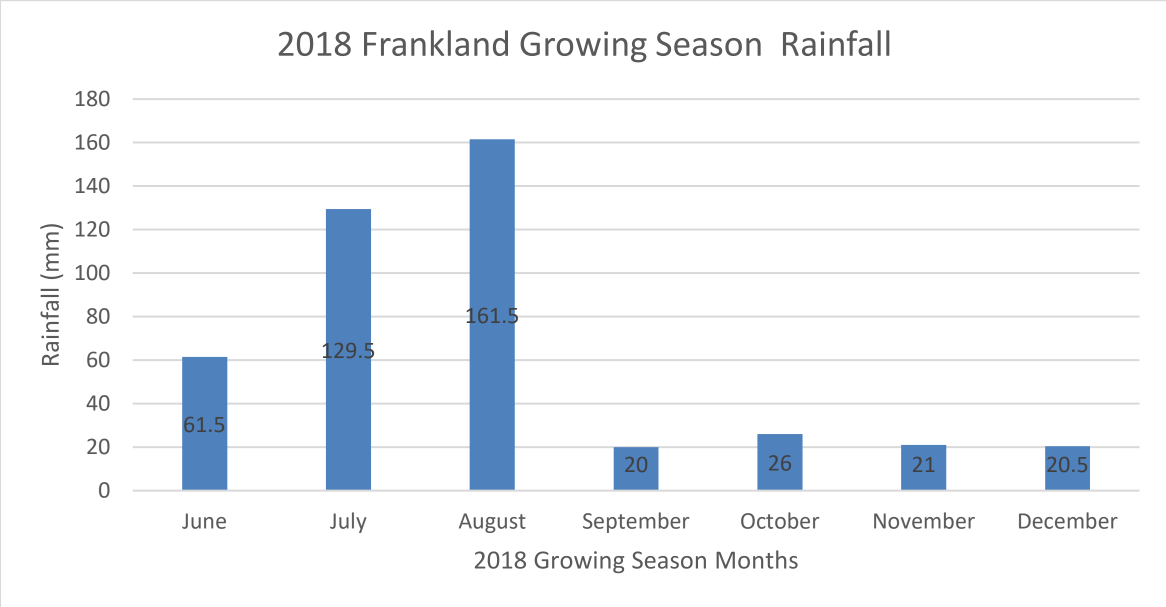


Figure 7: 2018 growing season rainfall data, Frankland

PredictaB tests were negative for crown rot, and root lesion nematodes. Initial plant counts were between 180 and 240 plants/m^2 which estimated the yield to be between 3 and 4 tonnes per hectare according to DPIRD'S wheat book yield potential estimator. Results from NDVI readings are displayed in Table 6, and. As per the 2018 Muradup site, there were no significant difference between the NDVI readings.

Table 6: 2018 Frankland NDVI Results

N Treatment	Average NDVI 24/06/2018	Average NDVI 15/08/2018
Nil	21.78	64.11
NAppl1 -Farmer Practice (+80 +70)	23.44	68.56
NAppl2-After Waterlogging event (+100)	24.44	65.00
NAppl3-Yield Potential (+100 +100)	23.78	66.89
NAppl4- Yield Potential after waterlogging event(+110 +130)	23.44	70.00

There were no statistically significant differences between yield results of the five different nitrogen treatments at the Frankland trial site (Figure 8). The highest yield however, was seen in the NAppl2 treatment (single application after waterlogging) and the lowest in the nil treatment. Higher protein percentages tended to occur in treatments where more nitrogen was applied (Table 7). Yield responses to specific N application timing may have been hampered due to the high pre-seeding soil Nitrogen levels which for 0 – 10cm of soil averaged 43mg/kg and the lower than average rainfall received in 2018 resulting in only minor waterlogging.

N Treatment	Ave protein (%)
Nil	21.73
NAppl1 -Farmer Practice (+80 +70)	22.13
NAppl2-After Waterlogging event (+100)	22.47
NAppl3-Yield Potential (+100 +100)	23.00
NAppl4- Yield Potential after waterlogging event(+110 +130)	23.17

Table 7: 2018 Frankland Grain Quality Results

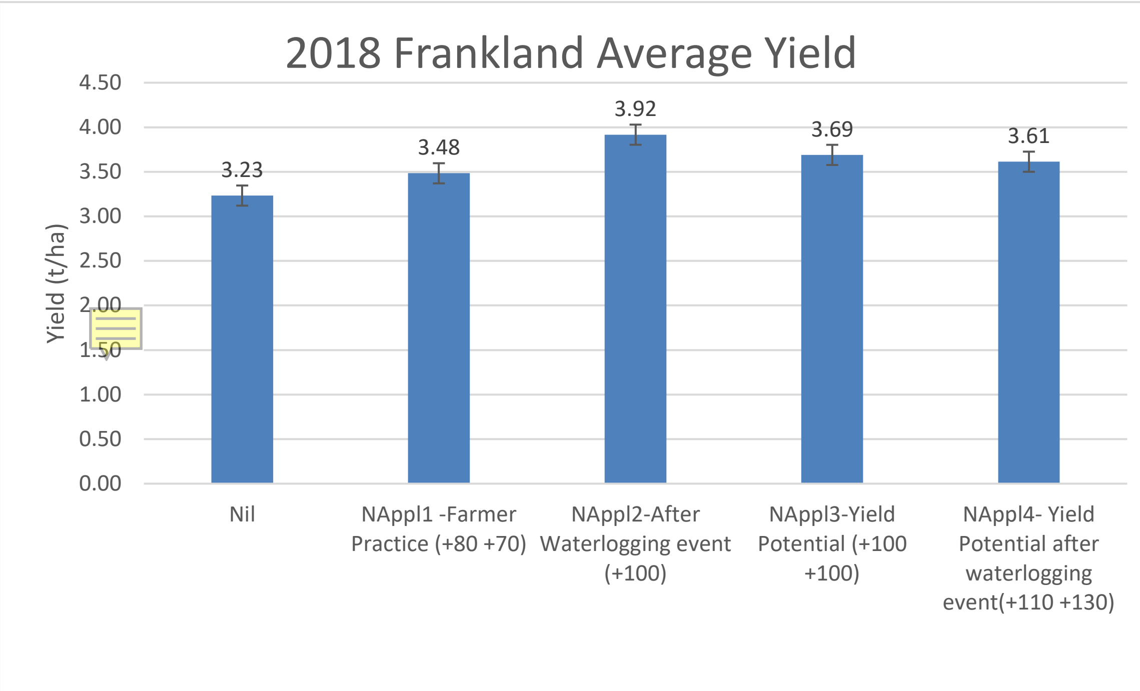


Figure 8: 2018 Frankland Yield Results

2019 Site

Trial Site 1- Frankland

The 2019 rainfall data was collected from the Department of Primary Industries and Regional Development (DPIRD) weather station located in Frankland River 15km North west of the 2019 trial site. The 2019 annual rainfall in Frankland was 433mm, with 340mm falling in the growing season (April – October) Figure 9. This was again lower than the average annual rainfall of 600mm.

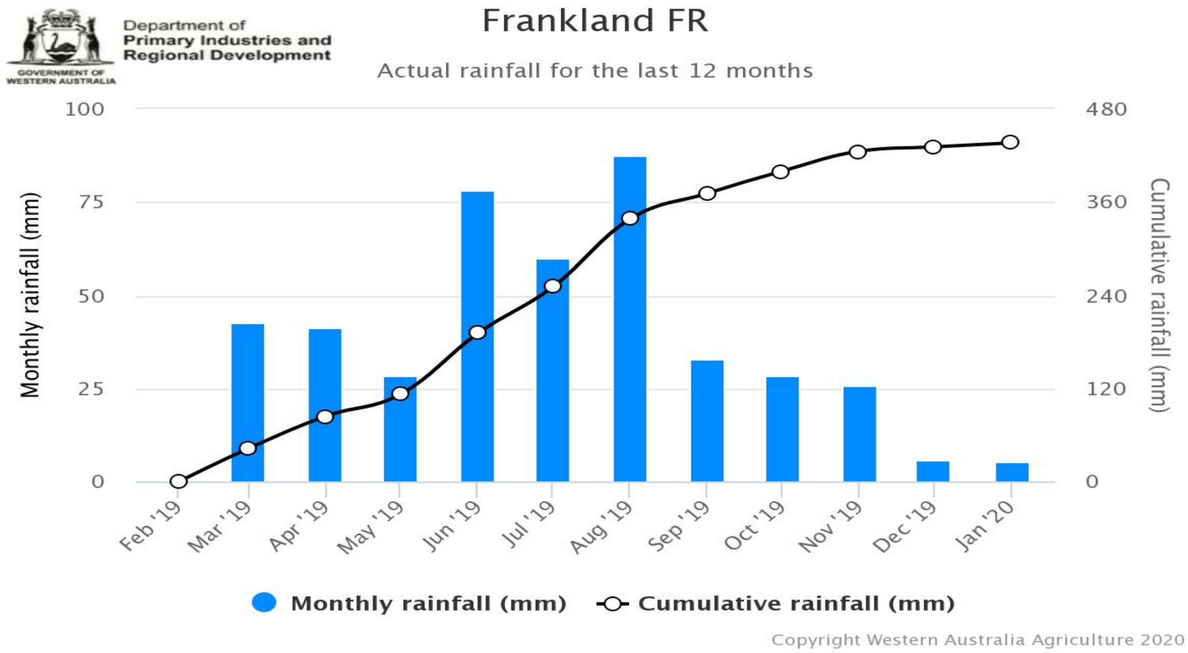


Figure 9 2019 annual rainfall from the DPIRD weather station located at Frankland River, WA, located 15km north west of the trial site

The first nitrogen (urea) was spread on June 14, 2019. All four treatments received 100kg/ha after a cumulative 27.4mm fell over five days form the 9th – 13th June (Figure 10).

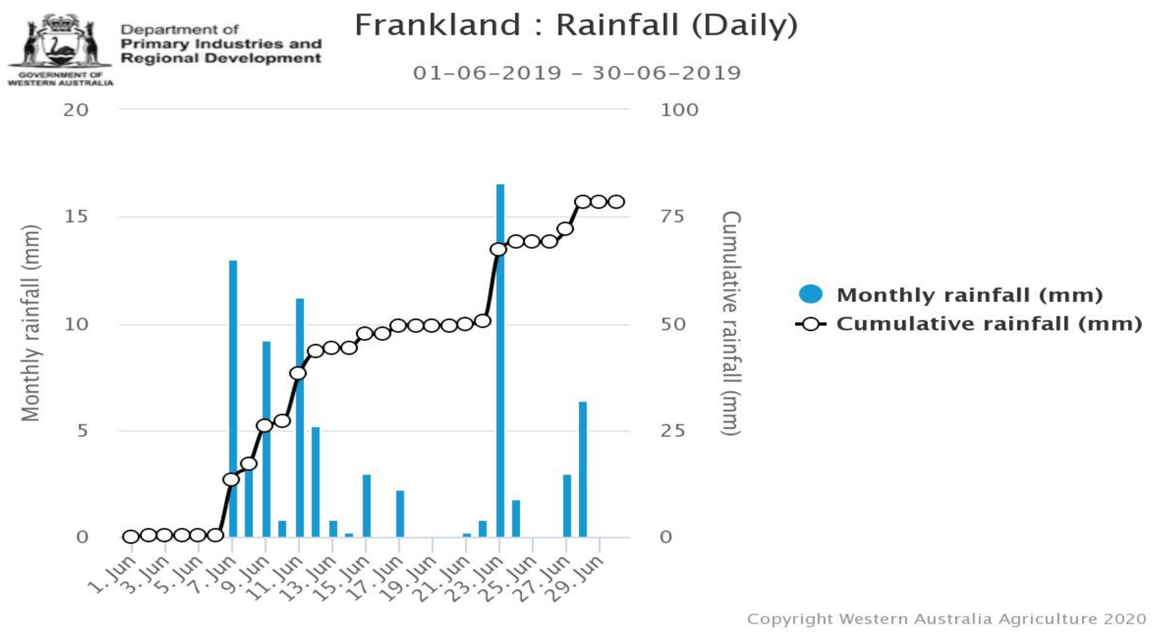


Figure 10 Amount in mm of rainfall for June 2019 data from the Frankland River weather station.

The second N application was spread on July 29. Both the farmer practice and high N treatments received 130kg/ha of urea. The split application received 65kg/ha while the control did not have an N treatment applied. 20mm of rain had fallen in the ten days before the N application being applied (Figure 11).

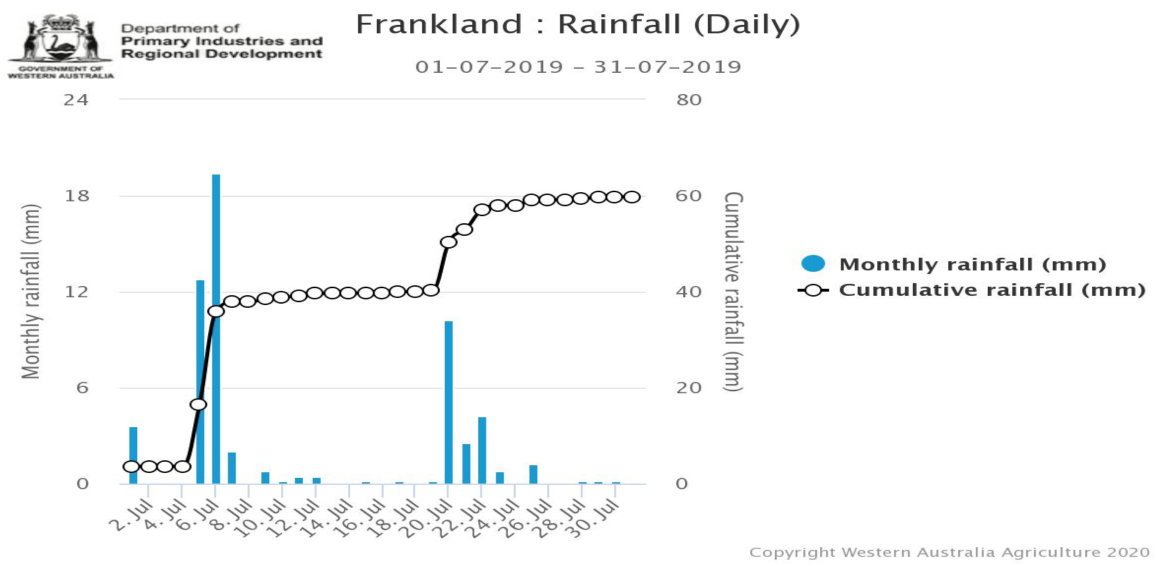


Figure 11 Amount of rainfall in mm for July 2019, data and graphs obtained from the DPIRD weather station at Frankland River, WA.

The third and final application was applied on August 19. Only two of the treatments received N. Both the split and High N applications received 65kg/ha post a 25.8mm cumulative rainfall event from the 15th – 18th July 2019 (Figure 13).

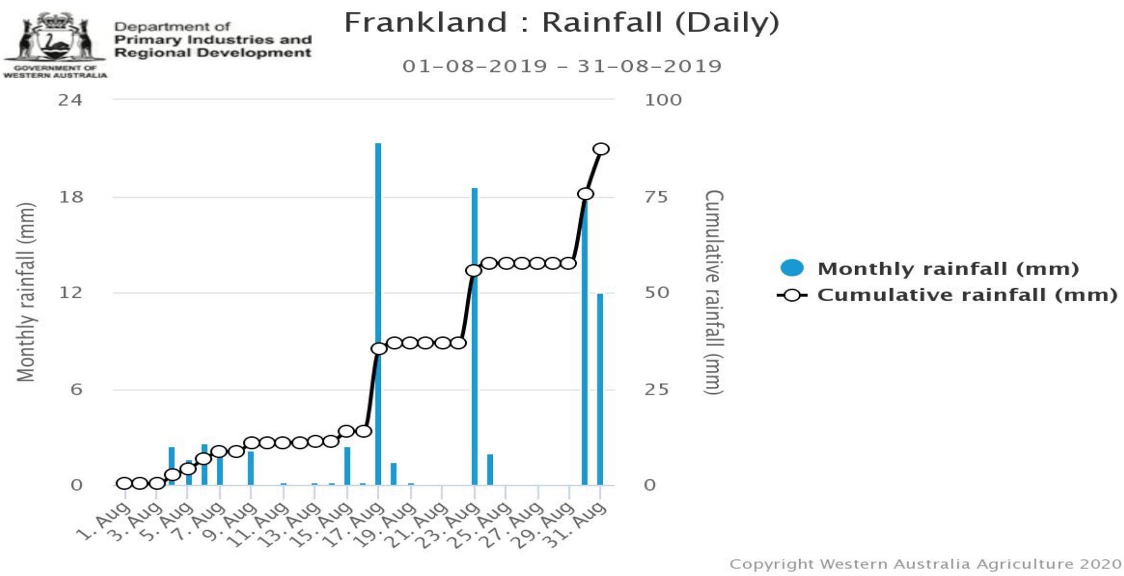
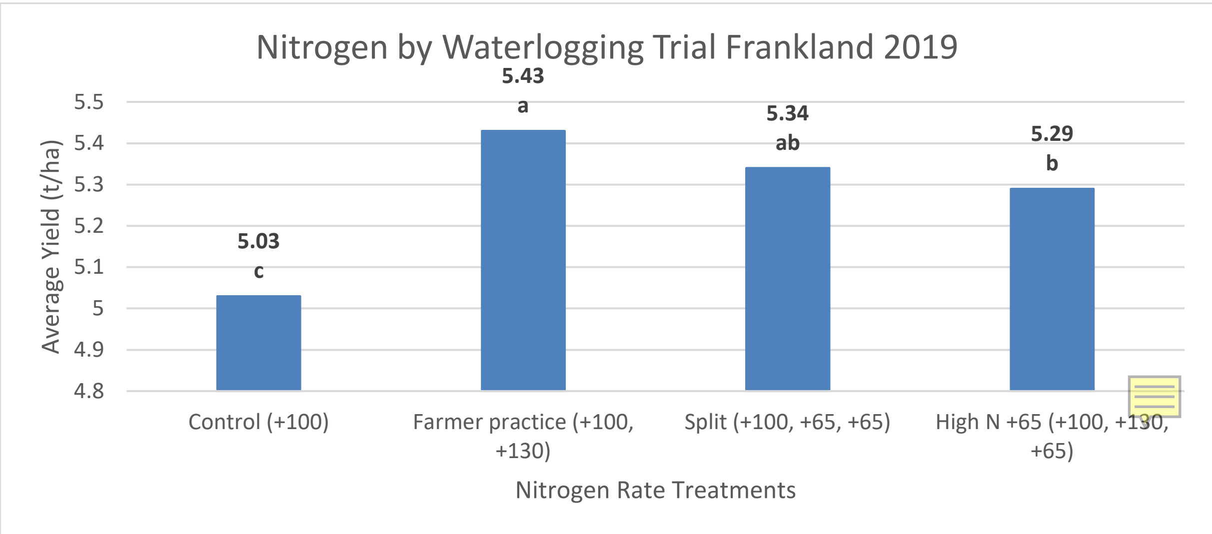


Figure 12 Amount in mm of rainfall received in August 2019, data obtained from the DPIRD Frankland River weather station.

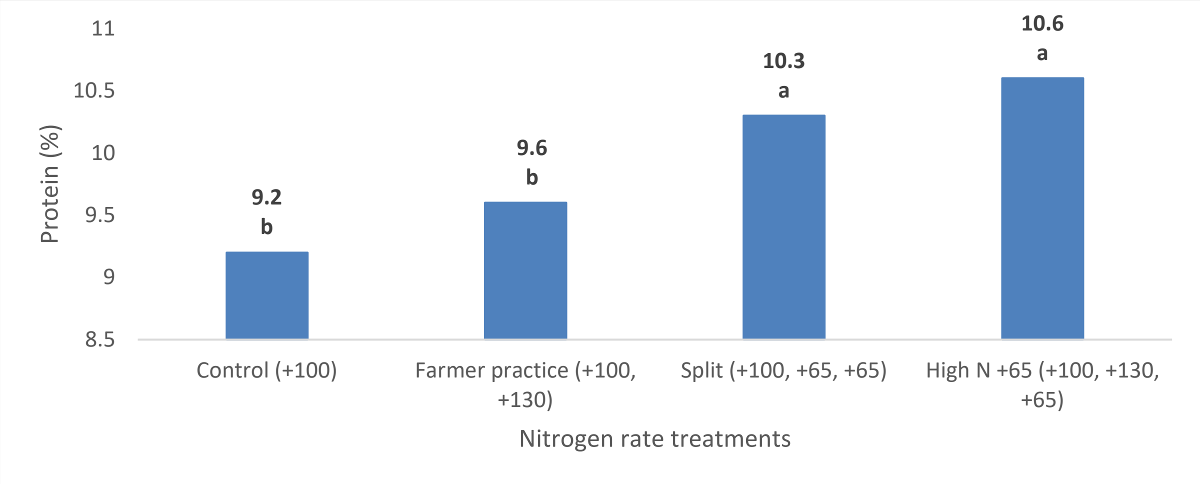
As displayed in Figure 13, there were significantly higher grain yields in the 'farmer practice,' 'split,' and 'high N' treatments compared to the 'control.' The farmer practice yielded significantly higher compared to the High N treatment, although the difference was only 140kg/ha. There were no significant differences in yield between the split and High N treatments.



Means followed by the same letter or symbol do not significantly differ (P=.05, LSD).

Figure 13 : 2019 Frankland Yield Results

Figure 16 shows that the Split and High N practices resulted in a significantly higher protein percentage compared to the control and Farmer Practice treatments.



Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)

Figure 14 : 2019 Frankland Grain Quality Results- Protein

There were not significant differences between the screening percentages, moisture percentages or hectolitre weights in any of the treatments (Table 8).

Table 8: 2019 Frankland Grain Quality Results

No.	Treatment	Screenings		Specific Wt.		Moisture	
		%		kg/hL		%	
1	Control (+100kg/ha)	0.95	a	82.4	a	9.7	a
2	Farmer practice (+100, +130kg/ha)	0.80	a	81.5	a	9.6	a
3	Split (+100, +65, +65kg/ha)	0.95	a	81.4	a	9.6	a
4	High N (+100, +130, +65, +65kg/ha)	1.06	a	81.2	a	9.6	a

Means followed by the same letter or symbol do not significantly differ (P=.05, LSD)

Table 9 displays the return on investment of applied nitrogen rates to the 2019 crop to improve wheat quality. The table shows the net returns from the four nitrogen strategies trialled. Although the treatment with a higher nitrogen rate made a higher wheat grade the additional cost of the nitrogen and with today's grain pricing (decile 8), the cost outweighed the benefit; the net returns equalled the same as the control. In this instance, the Farmer Practice was the most profitable.

Table 9: 2019 Cost Benefit Analysis

Treatment	Grade	Grain Price	Urea costs/ha	Yield (t/ha)	Revenue($/ha)	Net ($/ha)
Control (+100)	ASW	$340	$ 50.00	5.03	$1,710	$1,660
Farmer practice (+100, +130)	ASW	$340	$ 115.00	5.43	$1,845	$1,730
Split (+100, +65, +65)	APW2	$340	$ 115.00	5.34	$1,814	$1,699
High N (+100, +130, +65, +$65)	APW1	$342	$ 147.50	5.29	$1,807	$1,660

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Discussion and Conclusions

2018 Results

The Muradup trial N treatments yield potential crop phenology and yield potential after waterlogging treatment (both split treatments) yielded statistically higher than the nil and 100kg (single treatment) after rainfall treatments. The grower timing and rate treatment yielded the statistically the same. It is more likely that these treatments performed well due to the amount of N applied during the growing season rather than the timing of the N application. Waterlogging was not a problem in 80% of the trial in 2018. The bottom of the trial was located near a dam and the dipwells were full (30cm – 40cm) most of the growing season. All other measurements did not indicate any differences during the growing season.

The Frankland trial did not show any statistical differences in yield between the five treatments. This was likely due to the initially reasonably high amount of nitrogen in the soil at the start of the season. There was also a decent amount of rainfall over the growing season with even spread of waterlogged areas across the trial and treatments, although waterlogging was relatively mild due to less than average annual rainfall. All other measurements did not indicate any significant differences during the growing season.

2019 Results

All N treatments yielded significantly more than the control. The control treatment had 10 units of N applied during seeding and a further 46 units (100kg/ha urea) applied on June 14. Due to the late selection of the site, soil tests prior to seeding were unable to be obtained.

Rule of thumb calculations for wheat at 11% protein state that 40kg/ha of N is required per tonne of grain yield (*GRDC Project CSP00174*). Therefore, our control yield of 5.03t/ha required 201.2 units of N to be supplied from the soil and fertiliser applications. We only supplied 56 units, which meant the soil would have to supply 145.2 units to grow that yield.

By contrast, our highest yielding treatment, 'farmer practice,' was supplied 116 units of N from fertiliser but would have required a total of 217.2 units to grow the 5.43t/ha yield. The 100-unit (approximate) shortfall of N would need to have been supplied from the soil.

The wheat yields obtained from the growing season rainfall of 330mm indicate the crop achieved its water limited yield potential. Late applications of N, after mid stem elongation, are more likely to improve protein rather than grain yield (*GRDC Project CSP00174*), which we observed in this trial.

The 'high N' application achieved APW1, which made $342/t on December 6, 2019, whilst the 'split application' made APW2 ($340/t). Both the 'control' and 'farmer practice' treatments made ASW1, which was worth $340/t on December 6, 2019.

Assigning Urea, a value of $500/tonne in 2019, meant the additional 65kg/ha of Urea for the 'higher N' treatment cost $32.50/ha more than the 'farmer practice' treatment. 2019 saw exceptional grain prices, including the lower grades of wheat. Farmer investment on a higher

N strategy failed to improve profits in 2019. However, the ‘high N’ treatment net return was equal with the control, meaning money was not lost.

The ‘farmer practice’ strategy was the best N strategy for the 2019 season. The crop responded to the applied N up front after good rainfall and achieved a 5.43t/ha yield. The ‘split treatment’ strategy receiving the same units of N, as the ‘farmer practice’. The later applied N in the ‘split strategy’, helped boost the protein and was able to achieve a high wheat grade. Grain yield was slightly lower in the ‘split treatment’, although not statistically significant. In a wetter year, we would expect a greater return from the ‘split treatment’ in comparison to the ‘farmer strategy’ of applying all N by growth stage 31.

The past two growing seasons have had significant dry periods within the growing season. Without the rainfall, effects of waterlogging were minimal. SCF growers are still very interested in this research and would like to see the results from a wetter season. Simon is willing to repeat the trial in 2020, with support from Stirlings to Coast Farmers. We will collect the harvest yield results, analyse the statistics and complete a basic cost benefit analysis for our members.

Glossary and acronyms

Below is a sample Abbreviations and Acronyms list. Be sure to include on this page all abbreviations and acronyms that appear in the report

DAFWA	Department of Agriculture and Food, Western Australia
DAP	di ammonium phosphate
DArT	Diversity Arrays Technology
DAT	days after treatment
Db	bulk density
DAFWA	Department of Agriculture and Food, Western Australia

References

This section provides the information a reader would need to locate the articles, journals, and/or other publications referred to in the report.

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