SUMMIT

FIELD RESEARCH

TRIAL REPORTS 2024

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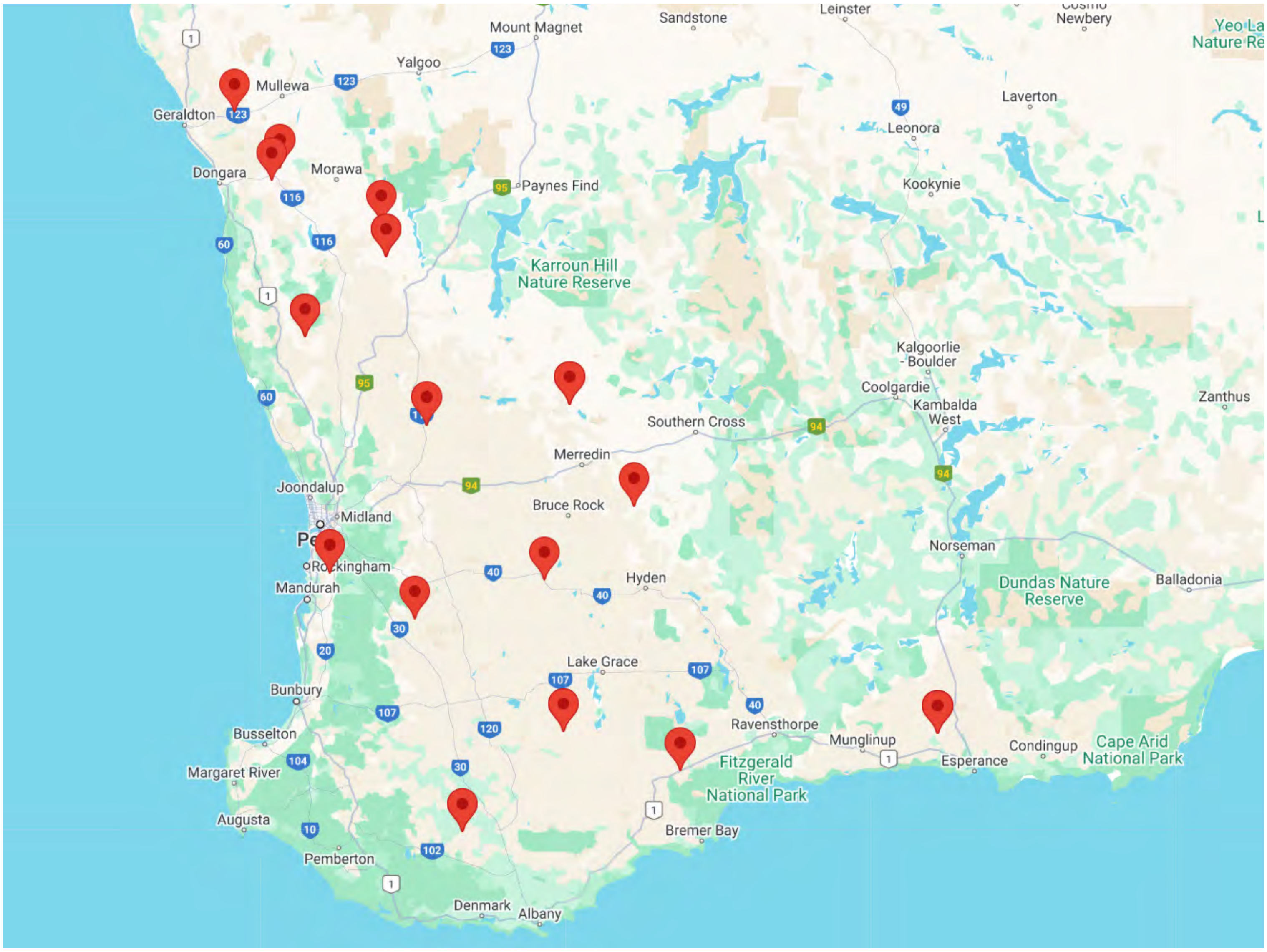


N-Shield EEF evaluation, 3 products, 13 trial sites, 2024

Key points

- **Given the right seasonal conditions, the N-Shield products tested provided significant yield benefits and worked as intended i.e. as added insurance against nitrogen losses.**
- **There were no significant yield decreases when either granular EEF product was used. This validates these inhibitors do not negatively impact crop growth, even if seasonal conditions do not result in volatilisation or leaching events.**
- **UAN Guard at Wandering, Nyabing and Jacup, did however result in some yield decreases over UAN. This will be further investigated in the Summit 2025 EEF trial program.**
- **When using EEF products, it should be understood yield increases are subject to seasonal conditions and should not be expected in every paddock, or in every season. We recommend growers discuss their potential benefits with Summit and be strategic with their use.**

Background and aim

Under increasing market, production and environmental pressures, maximising the efficiency of applied nitrogen fertilizers is of increasing importance to growers. Enhanced Efficiency Fertilizers (EEFs) have come into the Western Australian industry spotlight recently, as they aim to provide greater availability and retention of applied nitrogen, reducing losses to waterways and into the atmosphere.

With this emerging choice of EEF products, Summit Fertilizers trialled several N-Shield EEF products in 2024.

These products were tested as an insurance, taking into account there would not always be conditions conducive to significant N losses.

Summit conducted a state-wide project investigating the application, use cases and benefits of the N-Shield urease and nitrification inhibitor products. As explained (right), they can be applied to granular urea or with diluted UAN.

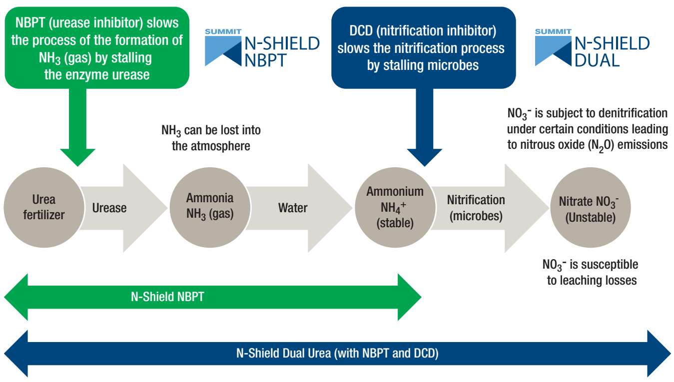


Figure 1 illustrates the process of nitrogen breakdown, with the NBPT and DCD modes of action shown in green and blue respectively.

Product Overview

N-Shield NBPT

N-Shield NBPT is a Summit Fertilizers product coated on urea. It contains N-(n-Butyl) thiophosphoric triamide (NBPT), a compound that directly interrupts hydrolysis, the process in which urease enzymes in the soil act on urea to convert nitrogen from the amine form (NH_2) to volatile ammonia gas (NH_3). NBPT decreases the activity of urease enzymes for a period of time to prevent nitrogen losses to the atmosphere through volatilisation of ammonia gas (NH_3).

N-Shield Dual

N-Shield Dual is also coated on urea. It contains both NBPT and Dicyandiamide (DCD). DCD is a compound that inhibits the nitrification process, in which ammonium (NH_4) is converted to nitrate (NO_3), a compound that is highly plant-available but also highly prone to leaching. This also indirectly prevents losses from denitrification in waterlogged soils. N-Shield Dual is designed to slow this conversion process long enough to reduce losses through both leaching and volatilisation events.

N-Shield UAN Guard

In 2024, Summit also trialled a liquid EEF product, N-Shield UAN Guard. This product is designed to be diluted in UAN and contains DCD. It is intended to function the same way as the DCD component of N-Shield Dual, in that it reduces losses via nitrate leaching. N-Shield UAN Guard is unique in that it is stable and designed for use with UAN.

SUMMIT FERTILIZERS

Trial design

Summit Field Research conducted 13 EEF trials in 2024. The trials were all designed in a way that included urea and UAN as control treatments, with the various EEF products compared to these untreated nitrogen sources, at the same nitrogen rate across all treatments.

N-Shield NBPT and N-Shield Guard were only applied as post-emergent products. N-Shield Dual was applied as a seeding product as well as a post-emergent product. This was to determine if the DCD would benefit the crop from preventing early nitrogen losses through leaching after germination rainfall events.

Sites were selected across the Western Australian growing region and were primarily in sandy or loamy soil types. Crops included wheat, barley and canola. Nitrogen rates remained the same across all treatments at each site, with the exception of the Wandering canola site, which had four nitrogen rates. 2024 trial site information is listed in Table 1 (below). Note, some areas received low-decile rainfall (primarily southern regions), while some northern growing regions received decile 10 rainfall.

Results

Rainfall patterns and timing of nitrogen application were key as to how effective these EEF products performed. This is because volatilisation and nitrification events are heavily driven by rainfall and weather conditions.

Data from Summit trials revealed several positive yield improvements from applying each N-Shield EEF product at ten different sites across the state. Depending on local weather and rainfall patterns, these ranged from 2% to 47% yield benefit over straight urea or UAN.

N-Shield Dual had the highest average positive yield bonuses of 5%, followed by NBPT (3%) and finally Guard (0%) across all ten sites. A standout was the Mingenew trial which experienced ideal conditions for both volatilisation and nitrification The end result was 46%, 47% and 5% yield bonuses for NBPT, Dual and Guard respectively.

These high yield increases bring the averages up across all products/sites. If they are excluded, there is a 1% average yield increase across all ten sites for both NBPT and Dual, with 0% observed for the UAN Guard treatment.

Average yield benefits, however, are not the most effective way to analyse the efficacy of these EEF products, as they are designed as an insurance against nitrogen losses under conditions conducive to leaching or volatilisation. As such, it cannot be expected to see any yield benefits at sites which did not experience such conditions. The northern growing regions experienced high, but patchy rainfall with the growing season condensed between June and September. This patchy rainfall provided ideal conditions for volatilisation events, as there were periods of warm windy conditions along with moist soil. With above average rainfall resulting in a reasonably full profile, conditions were also conducive to leaching losses, particularly at the sandier sites.

Mingenew experienced the most volatilisation and leaching in 2024. Product was applied to warm, moist soil which allowed the NBPT to reduce volatilisation losses, followed by heavy rainfall 3 and 10 days later at this sandy site. It all provided the perfect opportunity for the DCD product to minimise nitrification losses. Interestingly, also at the Mingenew site, it can be clearly observed that Guard performed significantly worse than Dual, which also contains DCD. The reasons for this are unclear, however the trend was replicated over several sites, with Guard frequently performing worse than Dual.

While not all 2024 sites showed significant yield increases, it demonstrates the fact that these EEF products are extremely weather dependent as to how effective they are. This also reaffirms they are designed as an insurance policy against potential nitrogen loss.

Figures 2-4 show % increase in yield (t/ha) over straight urea for NBPT and Dual, and over UAN for N-Shield Guard.

Table 1. 2024 EEF trial site information.

Site	Crop	Soil type	Growing season rainfall (mm)	Decile	Total N (kg)
Badgingarra	Wheat	Sand	331	4	120
Corrigin	Barley	Sand	267	5	100
Dalyup	Wheat	Sand	242	1	120
Eradu	Wheat	Sand	568	10	120
Frankland	Canola	Sandy Loam	377	5	180
Goomalling	Wheat	Loamy Sand	219	7	120
Jacup	Wheat	Sand	250	5	105
Maya	Wheat	Sandy Loam	285	9	90
Mingenew	Wheat	Sand	481	10	120
Mukinbudin	Wheat	Loamy Sand	145	4	75
Nyabing	Barley	Sand	278	4	110
Wandering	Canola	Loamy Sand	432	4	150

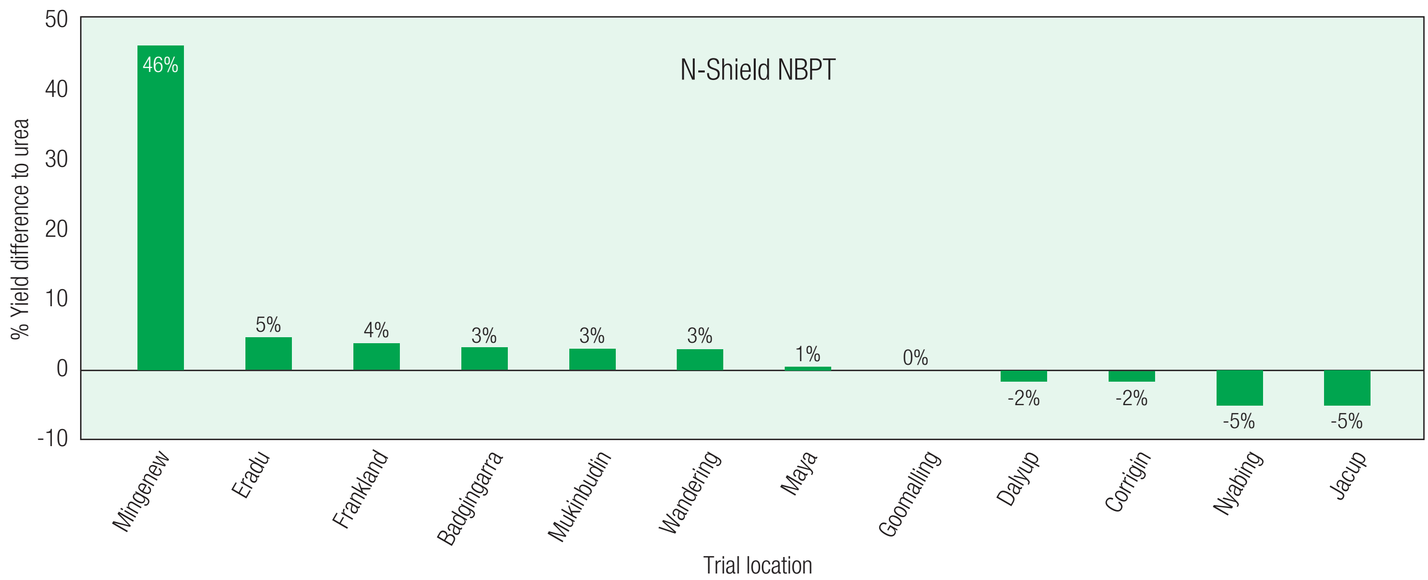


Figure 2. Percentage increase over urea for N-Shield NBPT at all sites.

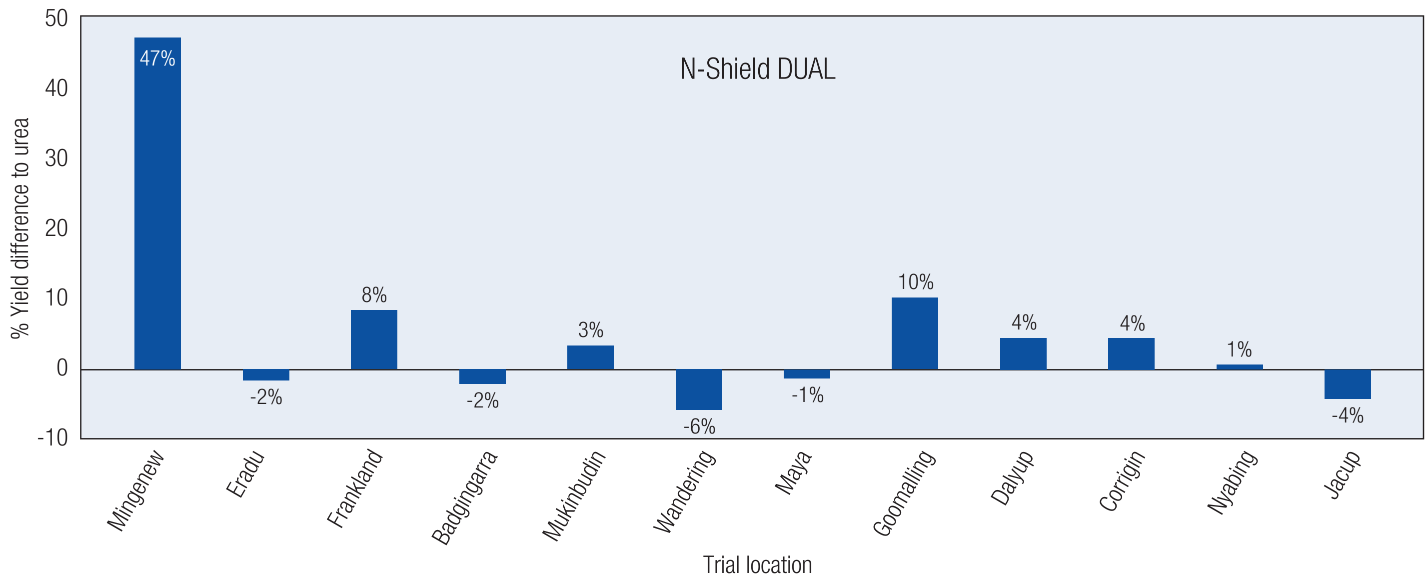


Figure 3. Percentage increase over urea for N-Shield DUAL at all sites.

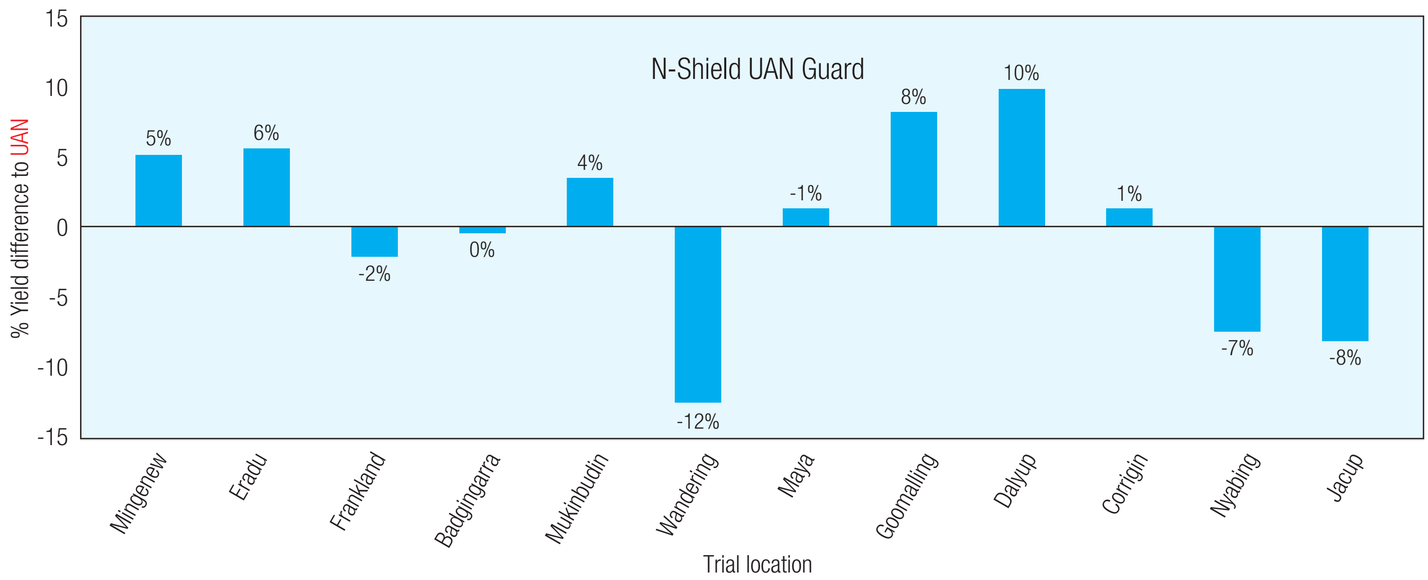


Figure 4. Percentage increase over UAN for N-Shield UAN Guard at all sites.

BiOWiSH biological EEF trial summary, 12 trial sites, 2024

Key points

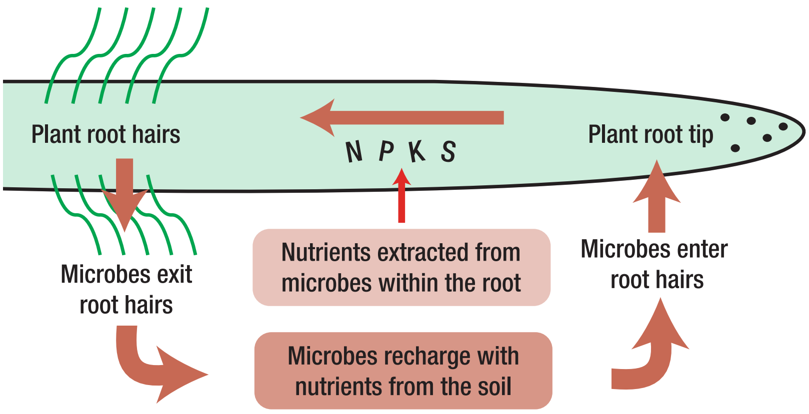
- 2024 trials demonstrated potential for yield and profitability increases when applying BiOWiSH to fertilizer in wheat and canola.
- Yield increases up to 18% in wheat and 14% in canola were achieved.
- Not all sites had improved yield, although in wheat and canola, no site had any significant decrease in yield compared to urea. This observation indicates BiOWiSH did not negatively impact on crop growth, even when conditions were not ideal for the bacillus to colonise the soil around crop roots.
- It was observed that all sites with rainfall greater than decile 5 had positive yield increases when BiOWiSH was applied. Many sites with decile 5 rainfall or below had minimal improvement compared with straight urea.
- At two barley sites there was a negative yield response. The reason for this is currently not understood and will be investigated further in 2025, along with more trials in wheat and canola.

Background

BiOWiSH is an enhanced efficiency fertilizer (EEF) which makes use of a proprietary bacterial blend (*bacillus sp.*) formulated to increase crop yields and profitability. The bacteria make use of the rhizophagy cycle found in all plants, including broadacre crops such as wheat, barley, canola and oats, as well as horticultural and tree crops. The bacillus form a symbiotic relationship with plant roots, increasing root biomass and stimulate other bacteria in the root zone to accelerate nutrient uptake.

Using BiOWiSH requires no practice change to implement in broadacre farming systems as it is applied to soil via coated fertilizer, or diluted in UAN.

Figure 1. Simplified diagram illustrating the pathway of nutrient uptake by plant roots using the rhizophagy cycle.



Aim

Summit Field Research incorporated BiOWiSH into 12 trial sites across all areas of the Western Australian growing region in 2024. The objective was preliminary testing of BiOWiSH under WA growing conditions and our broadacre farming systems.

While there is already extensive international research on this product, Summit wanted to determine its efficacy in our unique farming conditions.

Trial design

BiOWiSH was applied at all Summit trial sites where urea was used as the nitrogen source.

Coated on urea, BiOWiSH was applied at seeding and at subsequent in-season applications, typically at three leaf and mid-tillering growth stages for wheat and barley, and at 4-6 leaf and bulking stages for canola.

Application rates were matched to the control urea treatment, which reflected district practice for the location of the trial.

BiOWiSH was directly compared to urea as the control treatment, and was applied to wheat, barley and canola crops.

Site information for all 2024 BiOWiSH trial locations is given in Table 1 on the next page.

Emergence

In-season emergence counts identified several sites in which the BiOWiSH treatment showed greater emergence than the urea control. While none were statistically significant, visually the differences were clear to the eye. Figure 2 shows the percentage change in emergence counts relative to the urea control treatment.

NDVI

Biomass measurements recorded at most sites in general did not identify any visual or measured differences in NDVI between urea and BiOWiSH. Exceptions were Dalyup and Goomalling. NDVI was significantly higher at Dalyup ($p<0.05$) (Figure 3), and visually greater at Goomalling (Figure 4).

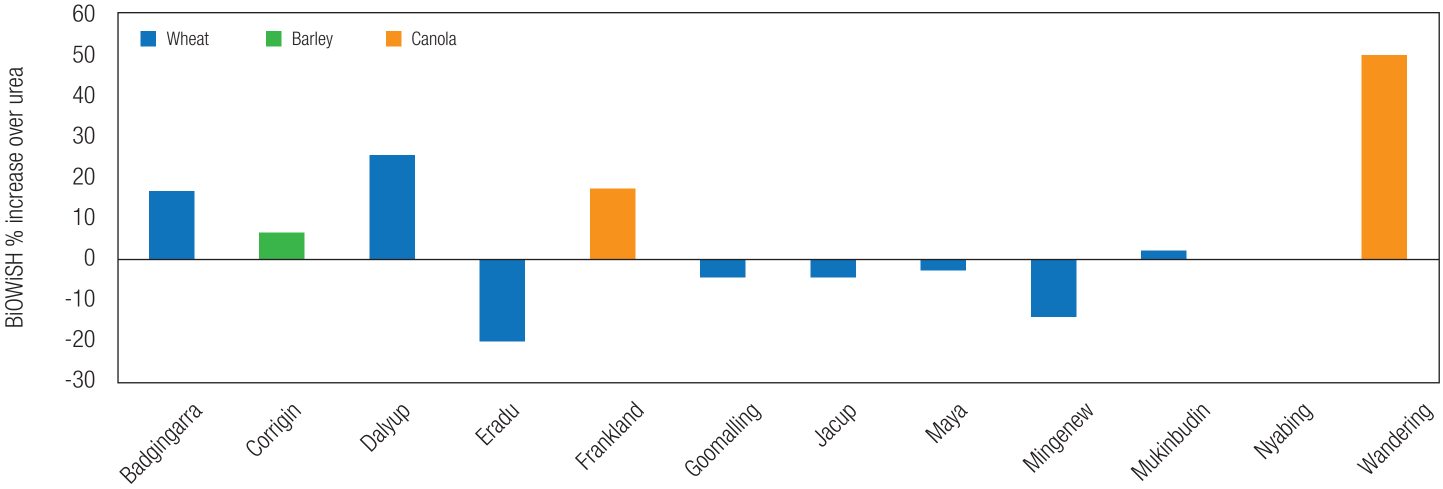


Figure 2. Percentage change (%) in crop emergence (plants/m^2) of BiOWiSH relative to the urea control treatment.

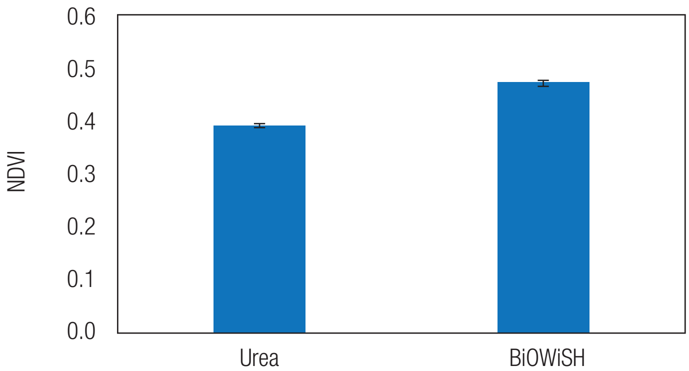


Figure 3-NDVI Measurements at Dalyup

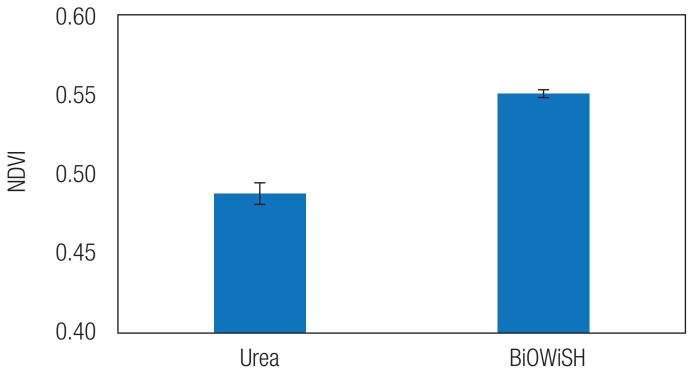


Figure 4-NDVI Measurements at Goomalling

Table 1. Basic site information for all 2024 BiOWiSH trial locations*.

Site	Crop	Soil type	Growing season rainfall (mm)	Decile	Total N (kg/ha)
Badgingarra	Wheat	Sand	331	4	120
Corrigin	Barley	Sand	267	5	100
Dalyup	Wheat	Sand	242	1	120
Eradu	Wheat	Sand	568	10	120
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Mingenew	Wheat	Sand	481	10	120
Mukinbudin	Wheat	Loamy sand	145	4	75
Nyabing	Barley	Sand	278	4	110
Wandering	Canola	Loamy sand	432	4	150

** Individual soil test results are available for each site*

Yield

Harvest data from all sites revealed an overall average yield increase of 3.1% in wheat and 11.4% in canola. Barley, however, did not perform as well, and showed a 5.5% decrease in overall yield at two sites, when compared to urea. No sites showed statistically significant yield increases, however some individual sites did have large yield increases, such as 18% at Mingenew (wheat) and 14% at Frankland (canola) . Figure 5 shows the wheat yield difference over urea control treatment at all sites in 2024.

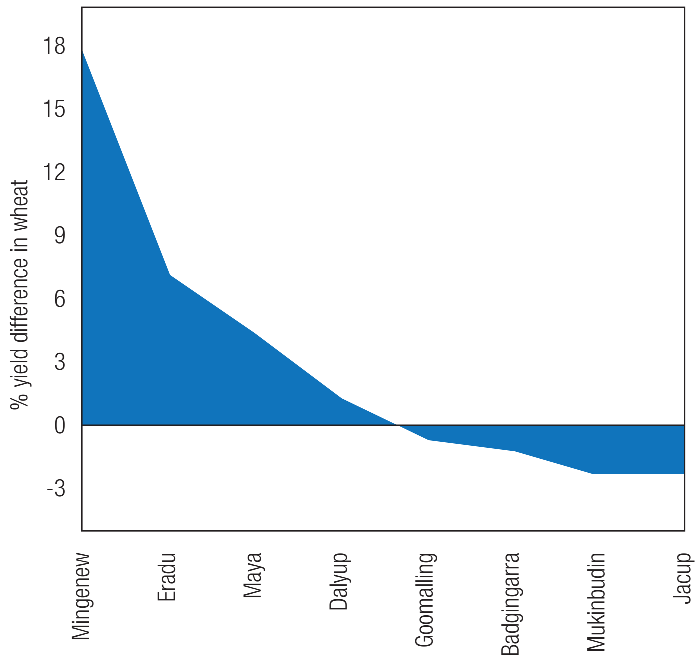

Figure 5. Average yield increase in wheat (t/ha, %) over urea at all sites.

Yield differences were observed between urea and BiOWiSH at both canola sites (Figure 6). Canola at Frankland had a 14% yield increase and wandering had a 9% increase over urea. Barley results showed a -4% yield response to BiOWiSH at Corrigin and -7% at Nyabing.

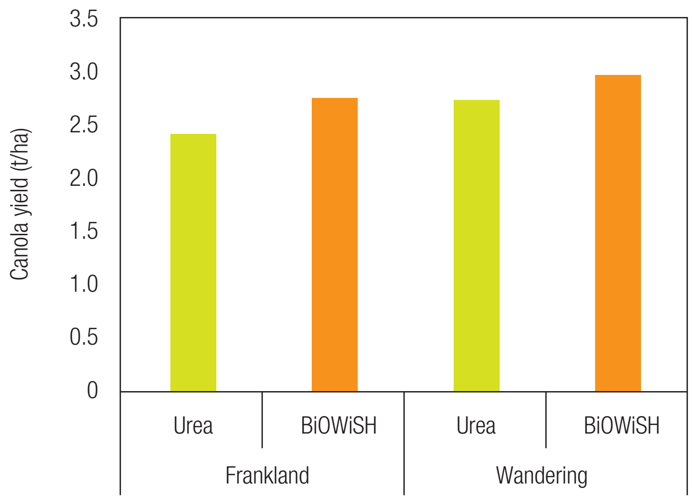

Figure 6. Canola yield (t/ha) at Frankland and Wandering in 2024.

Trial economics

Indicative gross margin calculations ($/ha) showed an overall profitability increase of 3.5% across all wheat sites when BiOWiSH was applied. Furthermore, canola crops showed a 13.1% increase in gross margins, while barley, unsurprisingly, showed a -15.6% profitability when treated with BiOWiSH.

Figure 7 displays the % difference in gross margin over urea for all BiOWiSH treatments at each site, excluding barley.

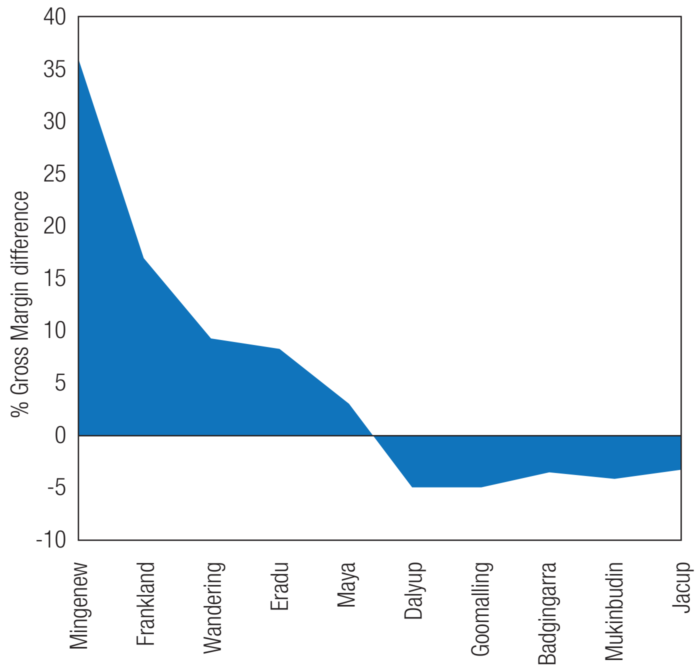

Figure 7. Indicative gross margins ($/ha) at all sites.

Interestingly, wheat protein was higher under the BiOWiSH treatment at all sites. This could be due to in-season applications of BiOWiSH increasing nitrogen uptake from post-emergent N applications. The result was a lift in grain receival quality at many sites, which increased profitability for BiOWiSH treatments at these sites.

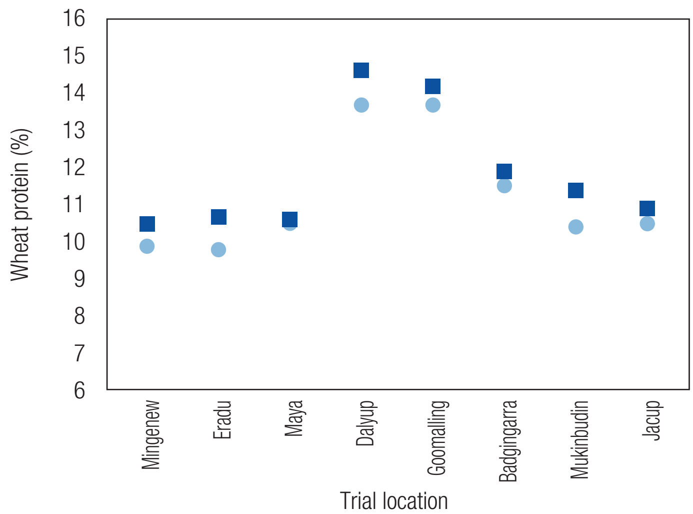

Figure 8. Wheat protein for BiOWiSH (dark blue squares) was increased across all sites, between 0.5 - 1%, compared with nil BiOWiSH treatments (light blue dots).

H_2Optimise tested at York, Bolgart and Narrogin, 2024

Key points

- 2024 trial results from York, Bolgart and Narrogin showed new wetter-humectant 'H_2Optimise' performance based on emergence, biomass and yield was at least equal to the current market leader.
- The trials showed H_2Optimise is fully compatible with Summit UAN and can be applied at sowing via liquid injection without extra mixing procedures.
- The Summit Field Research team plan to have more trials in 2025 to further examine optimal use rates and application methods across WA.

Trial aim

To test H_2Optimise, a new specially formulated wetter-humectant formulation against a current market leader, straight UAN and no wetting agent.

Background and agronomy details

The issue of non-wetting soils confronts many growers across Western Australian and significant yield penalties are likely when the season break and/or in-season rainfall happen to be light or patchy.

There are many soil wetting agents out there and many claims. Nevertheless, there is always room for a new product if it can be proven to offer premium performance and features like extra convenience or reliability.

Results

Growers will recall the challenging start to the 2024 growing season. After a slow start, trials at York, Bolgart and Narrogin showed H_2Optimise achieved emergence (Figure 1), biomass and yield efficacy that were at least equal to the current market leading wetter product.

Performance and convenience

Benefits of H_2Optimise include:

- easy to use;
- fully compatible with Summit UAN. It can be added directly to UAN and applied at sowing via liquid injection without extra mixing procedures;
- and can be stored in a diluted UAN suspension safely without risk of sedimentation or separation for up to two years. Hence, mixed solution could be carried over from one season to the next if required.

More trials are planned for 2025 to further examine optimal use rates and application methods across WA.

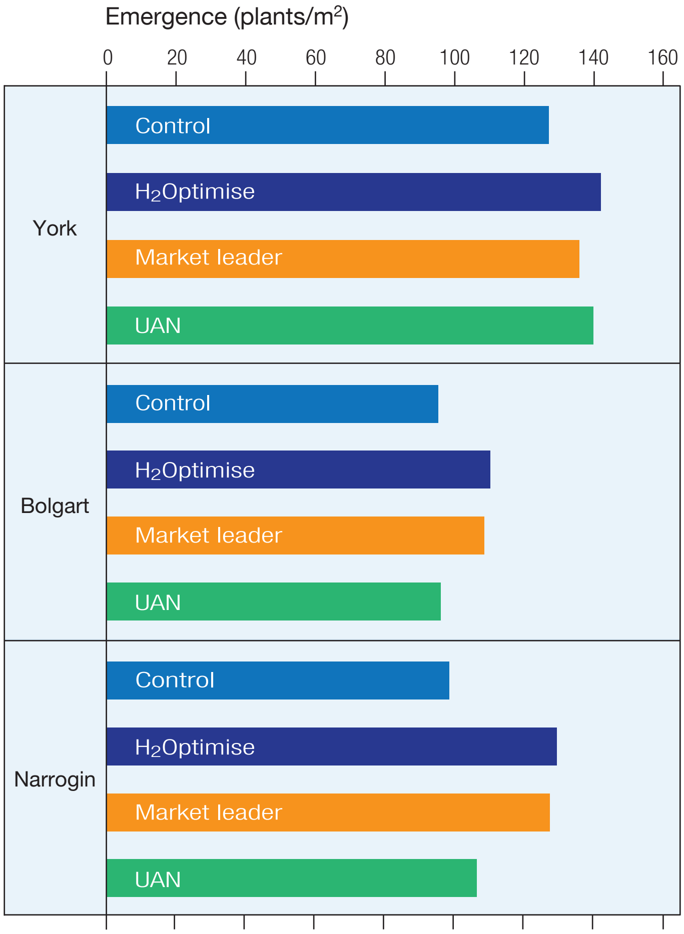

Figure 1. In three trials in WA in 2024, H_2Optimise had at least equal performance to the current market leader. These independent trials were conducted by SLR and Summit would like to thank N-Shield for making the results available.

Enhanced Efficiency Fertilizer products, Mingenew, 2024

Key points

- **Decile 10 GSR (210mm above average) provided ideal conditions to demonstrate N-Shield EEF product performance.**
- **N-Shield NBPT yielded significantly higher than Urea; N-Shield DUAL had a notable yield increase.**
- **N-Shield NBPT had the highest indicative gross margin at $1050/ha, compared to $730/ha for urea.**
- **Both N-Shield granular products had the greatest economic margins.**
- **Summit's new biological EEF, BiOWiSH, had an 18% yield benefit, with good protein levels and a 36% margin increase over urea.**

Trial aim

Summit Field Research conducted fourteen independent trials across the WA growing region in 2024 to test several enhanced efficiency fertilizers (EEF). This Mingenew trial aimed to identify the efficacy of three N-Shield products, which included two granular:

- Urea N-Shield NBPT; and,
- Urea N-Shield DUAL;

and one liquid product - N-Shield UAN Guard.

- Furthermore, BiOWiSH, a biological EEF was included to test its efficacy in light sands around Mingenew.

Background and agronomy details

The N-Shield NBPT product is formulated to reduce nitrogen losses via volatilization, while the DUAL product combines NBPT and DCD, and is designed to reduce nitrogen losses through soil leaching as well as volatilization. Wet, warm and windy conditions can result in significant N-losses for a grower, driving the interest in products which can mitigate the risk.

BiOWiSH was also included in this trial. BiOWiSH is a new biological EEF liquid containing a proprietary variety of bacillus bacteria. It was coated onto urea granules and used at seeding and post-emergent applications.

Treatments

Three seeding products were used which included urea as the control, N-Shield DUAL and BiOWiSH. All were granular products, the latter two coated onto urea. The intent was to directly compare urea to N-Shield DUAL and BiOWiSH as seeding N sources. These products, along with UAN, MAXamFLO and UAN Guard were applied as post-products at 3-leaf and mid-tillering.

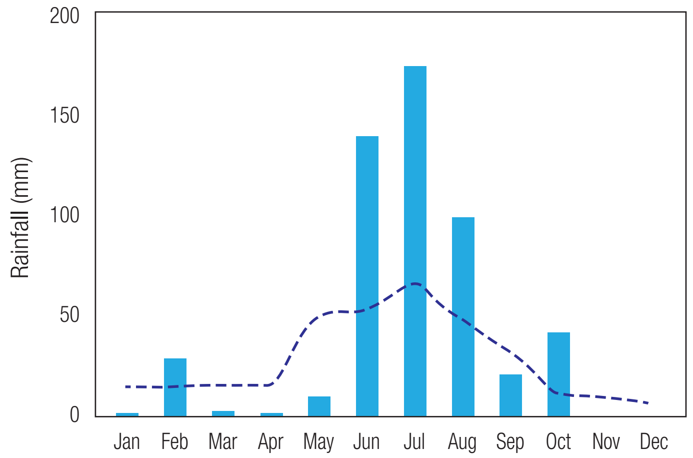

Figure 1. 2024 rainfall from Mingenew DPIRD station 6.4km NE (bars) and long-term average rainfall (dotted line).

Table 1. Soil test results

Depth cm	pH [$CaCl_2$]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	Org C %	NO_{3-} mg/kg	NH_{4+} mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	Sand %	Silt %	Clay %
0-10	4.9	12	21	28	36	14	1.4	18	2	0.2	0.7	2.9	95	3	5
10-20	4.3	7	38	7	25	8	0.9	6	1	0.1	0.2	0.7	94	4	5
20-30	4.3	5	37	7	25	8	0.6	4	1	0.1	0.1	0.3	93	5	5

Results

Emergence

Plant establishment was satisfactory with an average of 149 plants/m^2 across the trial There was no significant differences between seeding EEF products.

Biomass

Figure 2 shows N-Shield DUAL had significantly higher NDVI biomass measurements than UAN, MAXamFLO and UAN Guard ($p < 0.05$). NBPT also had higher NDVI readings, although not statistically significant. There was no NDVI difference between seeding products, only post products.

Yield

Average yield across the trial was 3t/ha, with a significant difference identified between urea and N-Shield NBPT as post products ($p < 0.05$) (Figure 3). There was no significant difference between seeding products ($p=0.95$). Both N-Shield products had notably higher yields than other treatments, although only NBPT was statistically significant. BiOWiSH yielded 3.0t/ha, which was 100kg/ha higher than urea. This was not, however, statistically significant. Protein was higher in both N-Shield granular treatments as well as BiOWiSH (10.5%), compared to all other treatments.

Gross Margins

Indicative gross margins showed GM improvement for all EEF products (excluding UAN Guard) over all other treatments (Figure 4). N-Shield NBPT had the highest indicative gross margin at $1050/ha, compared to $730/ha for urea.

Conclusions

Under 2024 conditions at Mingenew, the N-Shield EEF products were given the ideal conditions to demonstrate their effectiveness in reducing nitrogen losses. Products were applied onto moist soil at both top-ups. This, combined with the fact that rainfall occurred within a week of application, provided the optimal conditions for nitrogen losses through both volatilization and soil leaching. Both the single action NBPT product and the DUAL action product demonstrated increased NDVI in-season, higher yields at harvest and improved gross margins, indicating their effectiveness at reducing nitrogen losses. Additionally, the biological EEF BiOWiSH, while it did not perform as well as the N-Shield granular products, still showed elevated yields and margins over all other products tested, notably against the urea control treatment.

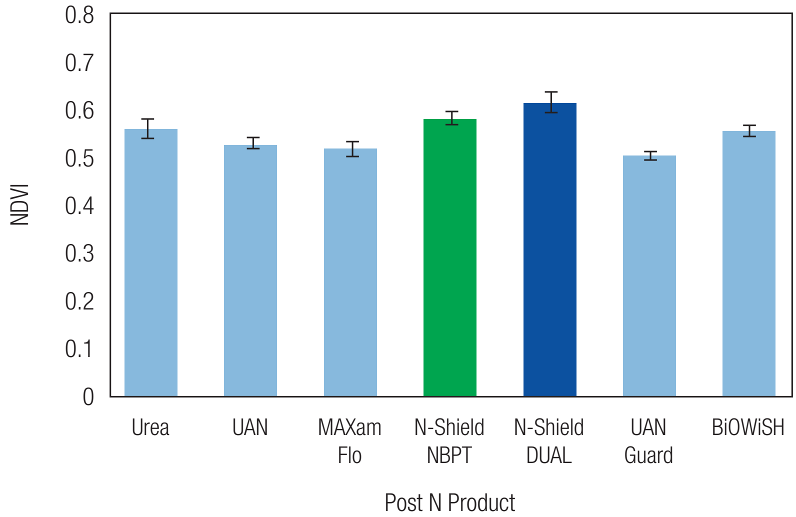

Figure 2. NDVI data measured 1st August 2024 at mid-tillering.

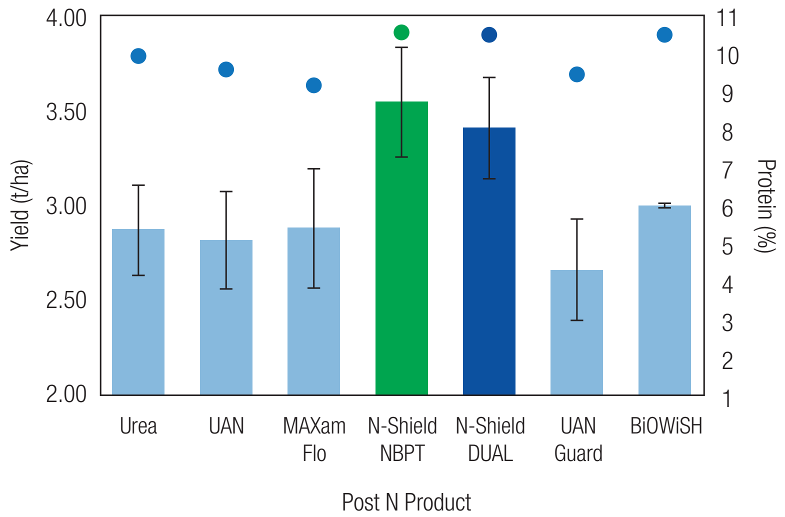

Figure 3. Harvest yield (bars) and grain protein (markers).

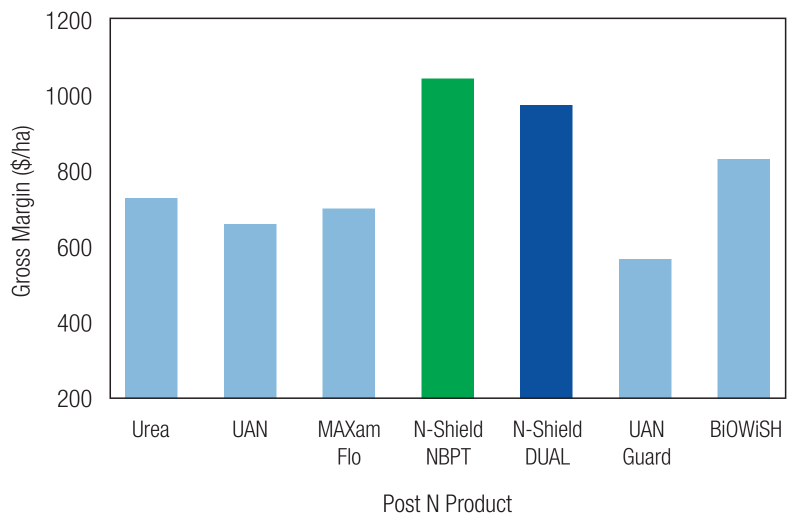

Figure 4. Indicative Gross Margins based on fertilizer cost and 2024 grain values.

Sulphur Supply & Leaching, Mingenew, Year 2 & Summary

Contact: Juliet McDonald JMcdonald@summitfertz.com.au

Key Points

- Decile 10 rainfall resulted in relatively high yields across most treatments.
- Yield results were considered inconclusive at this site in 2024.
- Despite significant yield differences, nil S yields were not significantly worse than applying S.
- S leaching did occur, but less so than at the sandy Bunjil site, primarily observable in the top 50cm.
- Post-trial soil tests identified applying SOA resulted in more plant available S than gypsum and elemental S.

Aim

To investigate S supply to modern cropping systems through multi-year trials assessing crop S requirement, different sources of S, and its leaching potential near Mingenew on a clay-loam soil.

Property	Mount Samuel, Mingenew
Crop Variety	Sceptre Wheat, sown 2nd May @ 93kg/ha
Total Nutrients	N 90, P 14, K 0. **S rates:** 0, 4, 20, 45, 90, 180.
Rainfall	371mm GSR (decile 10)

Treatments

9 of the 13 treatments were part of a factorial trial design: Three S sources (sulphate of ammonia, gypsum and elemental S) each tested with three S rates (45, 90, and 180). 2 extra SOA treatments (with S rates of 4 and 20), a DAPSZC treatment (S 4) and a nil S treatment were included also.

Aside from the DAPSZC treatment, all treatments contained 60 kg/ha MAP. MAXam was used as the SOA treatments, gypsum as the gypsum treatment and AgSul as the elemental S treatments to reach the required S rates for each.

Urea was also used at seeding in different rates to ensure all treatments had at least 45kg N/ha. Where required, UAN was applied at 3-leaf to ensure all treatments had at least 90kg N/ha in total.

Due to the amount of N present in SOA, the SOA @ 180kg S/ha treatment had 165 kg N/ha at seeding (and in total). As such, this treatment was not designed to directly compare yields, but rather to investigate leaching of S through the soil profile.

Background

This trial started in 2023 and was one of two long-term S trial sites of this design - the other being on a contrasting sandy site at Bunjil.

Combined N & S application has improved crop growth in the North Midlands area more than N alone. However, recent observations of such a response to S following substantial applications of gypsum or sulphate of ammonia in the summer before seeding or the previous season has led to questions over best practice to ensure adequate S supply.

Sulphur is often considered behind N, P and K for crop yield improvement. However, it is still essential for plant development. In clay and gravel soils, S tends to be more naturally abundant, but in sandier soils, S frequently leaches away from the root zones of crops.

Emergence

The average emergence at this site at 3-leaf was 152 plants/m^2, which is above the target. There were no differences in emergence between S rates or source.

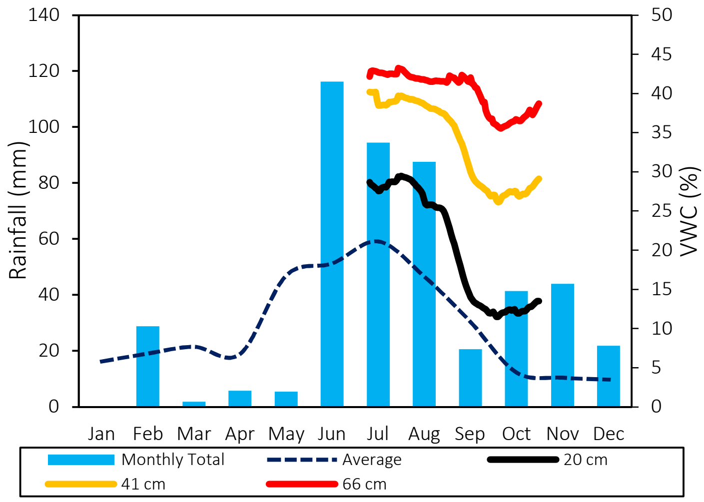

Figure 1. 2024 rainfall from Mingenew NW DPIRD station. 30-year rainfall from South Holmwood BOM station. Rainfall overlaid with soil moisture status (volumetric water content from the CropX moisture sensor installed at this site.

Table 2. Initial soil tests from June 2023.

Depth cm	pH [$CaCl_2$]	ECe dS/m	P Col mg/kg	PBI	K Col mg/kg	S KCL-40 mg/kg	S MCP mg/kg	Org C %	NO_3^- mg/kg	NH_4^+ mg/kg	Sand %	Silt %	Clay %	Gravel %
0-10	6.1	1.3	36	42	400	5	6	0.8	16	1	76	14	10	0
10-20	6.1	0.5	14	57	350	3	4	0.5	5	1	67	13	20	0
20-30	6.4	0.5	7	55	260	3	3	0.4	2	1	62	15	24	0
30-40	6.9	1.4	5	73	190	20	21	0.3	2	1	51	14	36	0
40-50	7.3	3.3	5	86	180	64	68	0.3	2	2	48	11	42	0
50-60	7.4	5.7	5	67	190	110	110	0.2	2	3	34	17	49	0
60-70	7.7	7.8	5	54	200	110	120	0.3	2	2	32	15	53	5
70-80	7.9	7.8	5	104	210	91	89	0.1	3	2	35	17	48	25
80-90	7.9	9.6	5	102	210	82	80	0.2	3	2	30	22	48	25
90-100	7.9	10.4	5	111	200	75	74	0.2	4	2	32	22	47	25

Soil

At this site, soil tests taken at various stages across the 2-year trial indicated that S leaching and soil presence varied greatly between different sources and rates. Tests taken after the second season's harvest indicated that some leaching occurred, but not as extensively as at this trial's sandy sister site (figure 2). Very high quantities of S were detected in the S180 SOA treatment, especially between 10 and 50 cm. S45 SOA recorded the second highest S in this depth range. Less overall plant available sulphur was recorded in both gypsum and elemental S.

The difference between nil S and the initial test shows how the S reserves leached from the 30-50 cm range down to below 50 cm. Much of the S movements below 50cm are likely not greatly affected by the two-year trial applications, with the heavy clay content below 50cm slowing down this leaching process.

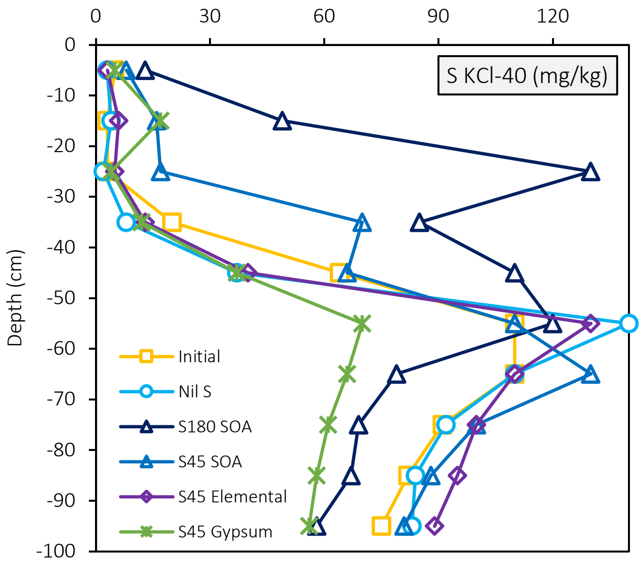

Figure 2. KCl-40 S soil tests of 2024-25 S treatment plots compared to initial testing, taken on the 11th November 2024.

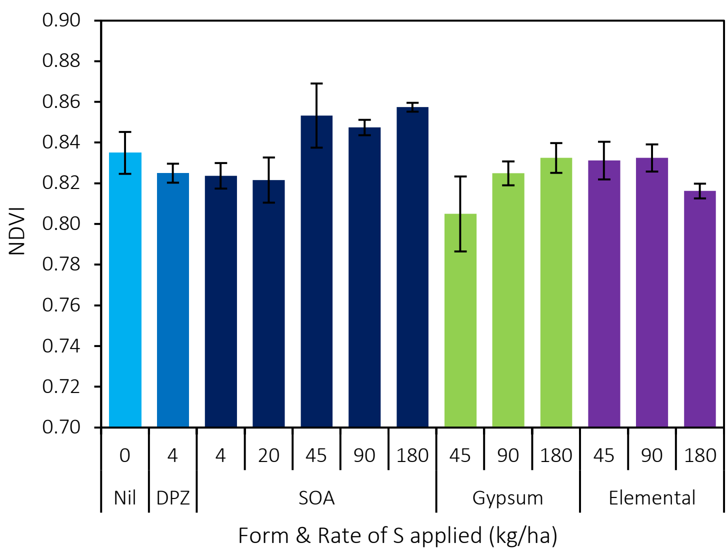

Figure 3. In-seasons biomass recorded via NDVI on 1st August 2024, at mid-tillering.

Biomass

There was a significant difference in tillering biomass measured using NDVI (figure 3) between SOA and Gypsum, and SOA and elemental S ($p<0.01$). The NDVI of each of the 3 SOA treatments (S45, S90 and S180) were much higher than that of any other individual treatments. There were no significant differences between S rates ($p=0.79$).

Yield

Harvest yield averaged 4.2t/ha, owing to the decile 10 growing season (figure 4). There were significant differences between SOA and gypsum, and SOA and elemental, but unlike the in-season biomass, SOA performed the worst ($p<0.001$). The additional N from the S180 SOA treatment may have gone towards the high protein level, being utilised late into the season. The low yields of the SOA, however, are unexpected. One explanation is that this high amount of sulphate acidified the soil enough to cause yield penalties.

This acidification can be seen in figure 5. However, a pH (CaCl2) of 5.6 is usually not a problematic pH for wheat growth.

The rate of S90 yielded significantly higher than S45 and S180 ($p<0.05$). However, with the unexplained yield differences for SOA, the yield results for the SOA treatments should be observed with caution.

Economics

The most profitable treatment was the DAPSZC at S4 treatment, since it was one of the highest yielding, receivable as a high grade, and was relatively inexpensive (figure 6). However, the low rates of SOA, as well as most of the elemental S and gypsum resulted in similar margins.

Due to the unexpected yield results, little confidence should again be taken from the gross margin findings, if using these results as a basis for recommendations.

Conclusion – 2-year trial

After two years of running this trial across both a light and a heavy soil, certain themes have become apparent. The largest takeaways from the data we gathered were the differences in leaching between both sites, as well as different treatments performed at each of these sites. In the heavy Mingenew soil, most of the differential leaching between treatments took place in the top 50cm, and the S moved at a slower rate than in the light Bunjil soil. A greater quantity of plant available S remained in the soil profile for the heavy soil across all treatments also. In both cases, the S180 SOA resulted in much greater plant available S in the soil, although this did not result in extra crop growth under 2024 seasonal conditions. S45 SOA also was higher than the equivalent gypsum and elemental S treatments in both soils, although these differences were observed in the bottom 50cm in the light soil, and mostly in the top 50cm in heavy soil.

At the Mingenew trial, yield findings from both years were largely inconclusive. This was due to a mixture of trial management issues, decile 10 rainfall and potentially other environmental impacts.

Refer to the year 1 trial report for more details on the 2023 season, and the Bunjil S reports for more information regarding S responses in a sandy soil.

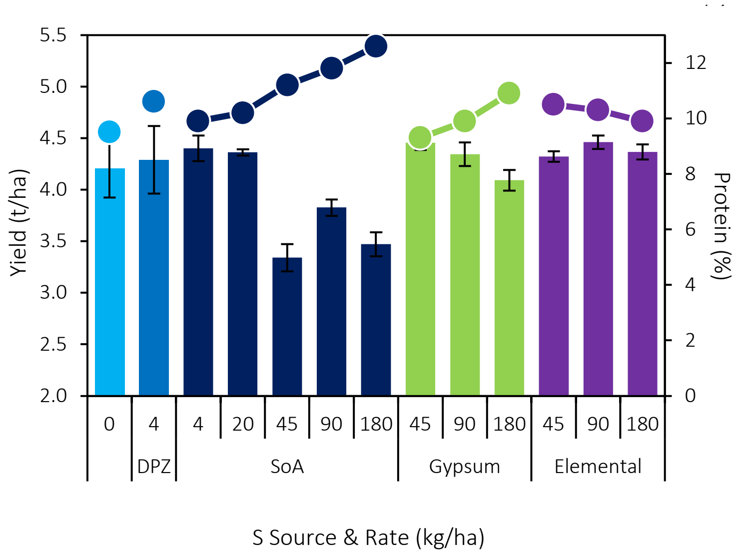

Figure 4. Harvest yield (bars) and grain protein (markers) across all treatments.

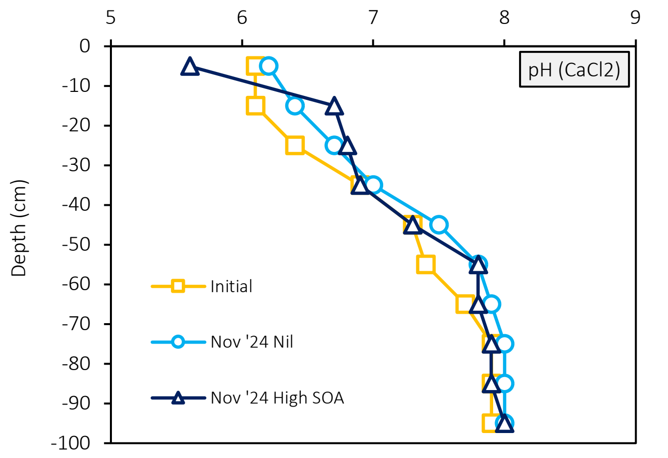

Figure 5. pH (CaCl2) of soil applied with different rates of SOA, down to 1m.

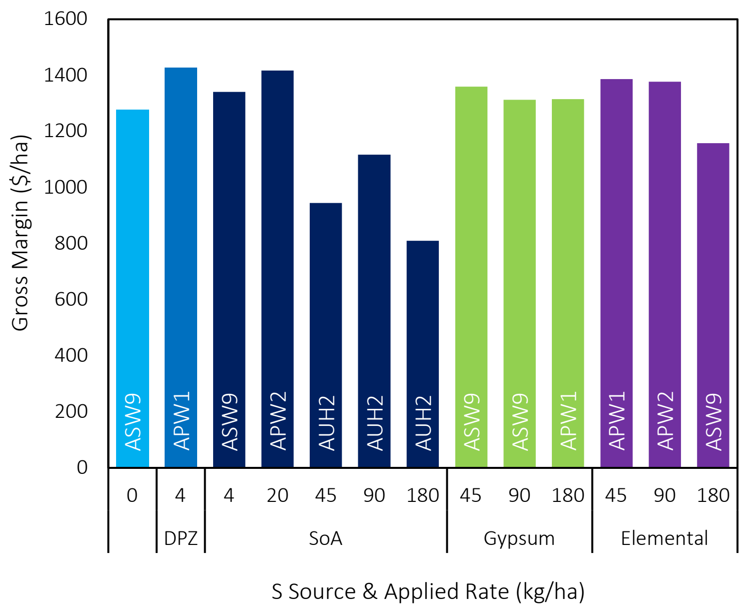

Figure 6. Indicative gross margins for each treatment, based on grain value minus cost of fertilizer.

Sulphur Supply & Leaching, Bunjil, Year 2 & Summary

Contact: Juliet McDonald JMcdonald@summitfertz.com.au

Key Points

- There were no significant differences between the yields of any S rates (including nil S), but the low average yield across the trial were not conducive to detecting this.
- Elemental S yielded lower in 2024, and significantly lower in 2023, than SOA and gypsum.
- A high amount of leaching occurred in Bunjil's sandy soil, with higher rates of S experiencing greater leaching.
- Comparative leaching differed between products and rates past 30cm depths.

Aim

To investigate S supply to modern cropping systems through multi-year trials assessing crop S requirement, different fertiliser sources of S, and its leaching potential near Perenjori on a sandy loam soil.

Property	Finiterre, Bunjil
Crop Variety	Chief Wheat, sown 22nd May @ 85kg/ha
Total Nutrients	N 90, P 7, K 25. **S rates:** 0, 4, 20, 45, 90, 180.
Rainfall	276mm GSR (decile 8)

Treatments

9 of the 13 treatments were part of a factorial trial design: Three S sources (sulphate of ammonia, gypsum and elemental S) each tested with three S rates (45, 90, and 180). 2 extra SoA treatments (with S rates of 4 and 20), a DAPSZC treatment (S 4) and a nil S treatment were also included.

Aside from the DAPSZC treatment, all treatments contained 60 kg/ha MAP. MAXam was used as the SoA treatments, gypsum in the gypsum treatments and AgSul in the elemental S treatments to reach the required S rates for each.

Urea was also used at seeding in different rates to ensure all treatments had at least 45kg N/ha. Where required, UAN was applied at 3-leaf to ensure all treatments had at least 90kg N/ha in total.

Due to the amount of N present in SoA, the SoA @ 180kg S/ha treatment had 165 kg N/ha at seeding (and in total). This treatment was designed to observe the effect of leaching, more than yield differences.

Background

This trial started in 2023 and was one of two long-term S trial sister sites with the same design - the other being on a contrasting heavy clay near Mingenew. This was the final year of the trial.

Combined N & S application has improved crop growth in the North Midlands area more than N alone. However, recent observations of such a response to S following substantial applications of gypsum or sulphate of ammonia in the summer prior to seeding or the previous year has led to questions over best practice to ensure adequate S supply.

Sulphur is often considered behind N, P and K for crop yield improvement. However, it is still essential for plant development. In clay and gravel soils, S tends to be more naturally abundant, but in sandier soils, S frequently leaches away from the root zones of crops.

Emergence

The average emergence at this site was 84 plants/m^2, which is below the target. However, this was consistent across the site and there were no significant differences in emergence between treatments ($p>0.05$).

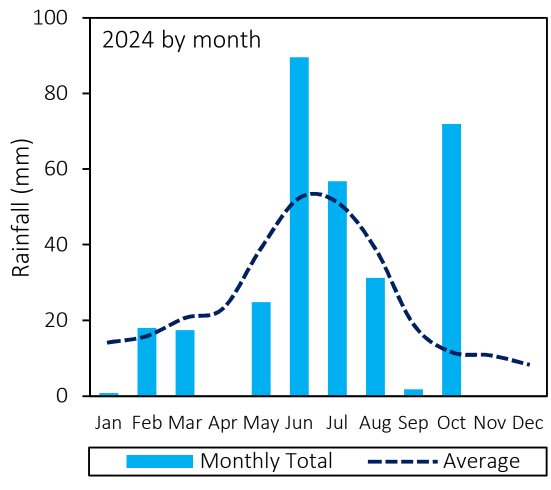

Figure 1. 2024 rainfall from on-site Goanna rain gauge. 30-year rainfall from Latham BOM station.

Table 2. Initial soil tests from June 2023.

Depth cm	pH [$CaCl_2$]	ECe dS/m	P Col mg/kg	PBI	K Col mg/kg	S KCL-40 mg/kg	S MCP mg/kg	Org C %	NO_3^- mg/kg	NH_4^+ mg/kg	Sand %	Silt %	Clay %	Gravel %
0-10	5.5	0.4	45	31	26	4	5	0.3	3	1	95	1	5	5
10-20	4.3	0.5	5	60	25	25	67	0.3	2	1	89	2	9	5
20-30	4.1	0.6	5	72	25	42	120	0.2	2	1	92	2	6	5
30-40	4.1	0.4	5	75	25	49	130	0.3	1	1	88	2	10	5
40-50	4.1	0.5	5	74	25	51	150	0.2	2	1	87	1	12	5
50-60	4.1	0.5	5	70	25	51	160	0.2	2	1	87	2	11	5
60-70	4.1	0.5	5	66	25	50	140	0.2	2	1	88	2	11	10
70-80	4.3	0.4	5	47	25	43	110	0.2	2	1	88	1	11	10
80-90	4.4	0.3	5	50	25	39	110	0.2	2	1	88	1	12	10
90-100	4.4	0.2	5	55	25	26	73	0.2	4	1	86	1	13	10

Soil

At this site, soil tests taken at various stages across the 2-year trial indicated that S leaching and soil levels varied greatly between different sources and rates, especially at depths greater than 30cm. Tests taken after the second season's harvest indicated that all S treatments resulted in most of the soil S leaching to 30cm or below in this soil type, according to the KCL-40 test (figure 2). Past this depth, the amount of S detected at each depth varied with different treatments. S180 SOA recorded the highest S, with elevated levels, especially down to 80cm. This was followed by S45 SOA past 50cm. S45 elemental and gypsum recorded lower S than even the nil S, for which there is no clear explanation.

Nil S compared to the initial testing showed how the S leached down the profile and had been removed by the crop in the two seasons since no S was applied. A lot of the S in the top 70cm had been reduced or leached down below 70cm.

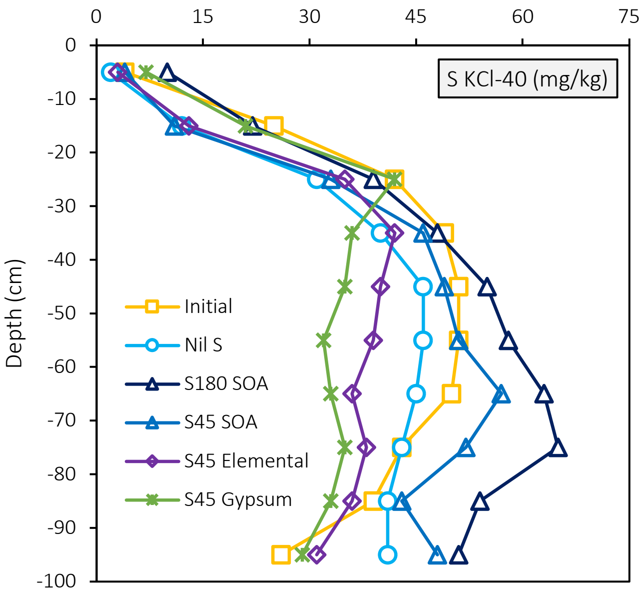

Figure 2. KCl-40 S soil tests of 2024 S treatment plots compared to initial testing, taken on the 21st November 2024.

Biomass

There was a significant difference in tillering biomass measured via NDVI between elemental S and the other 2 comparable S sources ($p<0.001$). Since elemental S does not provide an immediately usable form of S, this showed that applying sulphate had a positive impact on growth at this stage (figure 3). Applying at least 4 kg S/ha increased biomass at this stage.

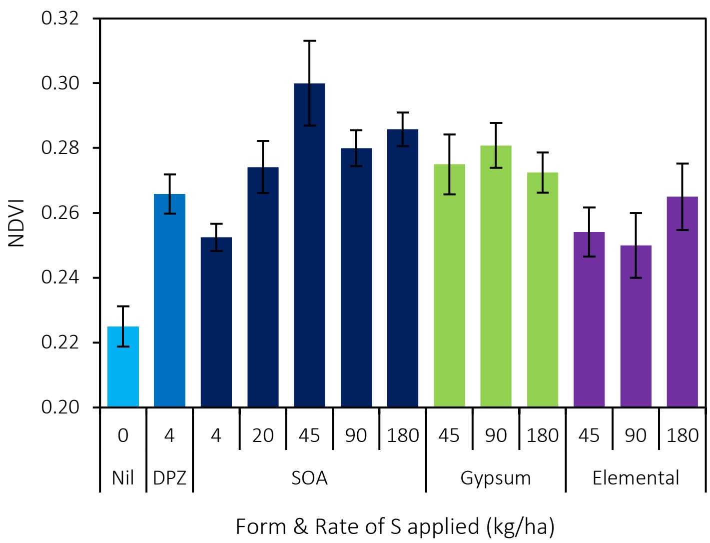

Figure 3. In-seasons biomass recorded via NDVI on 7th August 2024, at mid-tillering.

Yield

Harvest yields were low with an average of 1.2 t/ha, due to the lack of August and September rainfall, causing a dry finish (figure 4). There were no significant differences between any of the treatments ($p=0.27$), which was expected considering the conditions that led to the low average yields. Elemental S did yield at least 100kg/ha less than SOA and gypsum, but this was not significant ($p=0.08$).

Nil S was the lowest yielding treatment in the trial, implying that with better conditions the differences may have been more pronounced, increasing the chance of a statistically significant difference.

Grain protein was very similar, except in the S180 SOA treatment. However, this was likely due to the much higher N applied to this treatment.

Economics

The most profitable treatment was S45 SOA, mostly due to having the highest yield (figure 5). Keep in mind that since the yield difference was not significantly greater, if a lower rate of S was close enough to this yield, this would likely be more profitable. SOA was also more profitable than gypsum despite being a higher cost input, excluding the S180 treatments, which were mostly included in the trial to observe leaching, not compare yields.

Conclusion – 2-year trial

After two years of this trial across a light and heavy soil, certain themes have become apparent. Firstly, yields did not exceed 1.2t/ha in Bunjil in either season, which limited the ability for yields to differ significantly between treatments. This meant that even the nil S control did not yield significantly worse than all S treatments in either year. The soil already containing sufficient S reserves below the top 10cm would also have likely been enough to support the crop, given the aforementioned circumstances.

The expectation of elemental S providing delayed uptake in plants compared to sulphate application sources was supported with significantly lower yields in year 1, and lower yields (although not significant) than SOA and gypsum in year 2. The tissue tests in year 1 also supported this, with higher S detected in the crops with equivalent SOA. This was expected since plants require S in sulphate form, and elemental S takes some time to oxidise into sulphate in the soil through mineralisation, this is unlikely to have occurred within this two-year trial.

Gypsum did not yield significantly worse than SOA, despite being slightly cheaper to reach an equivalent S (units) application rate. However, given the low overall yields, however this is difficult to confidently conclude.

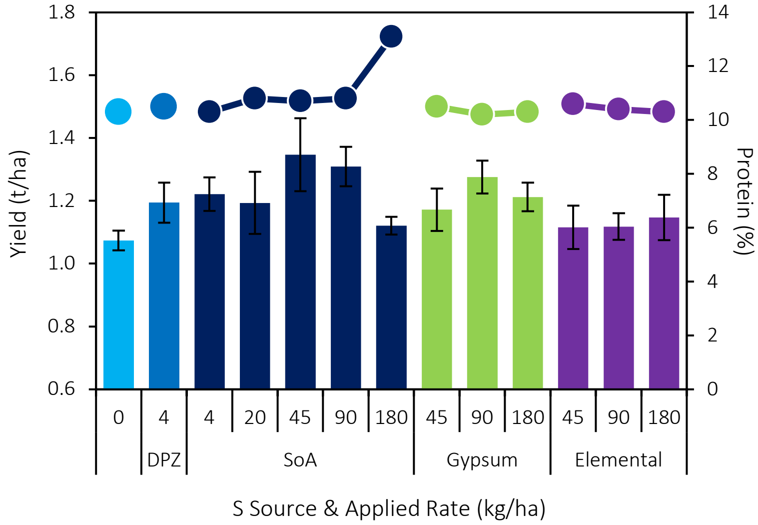

Figure 4. Harvest yield (bars) and grain protein (markers) across all treatments.

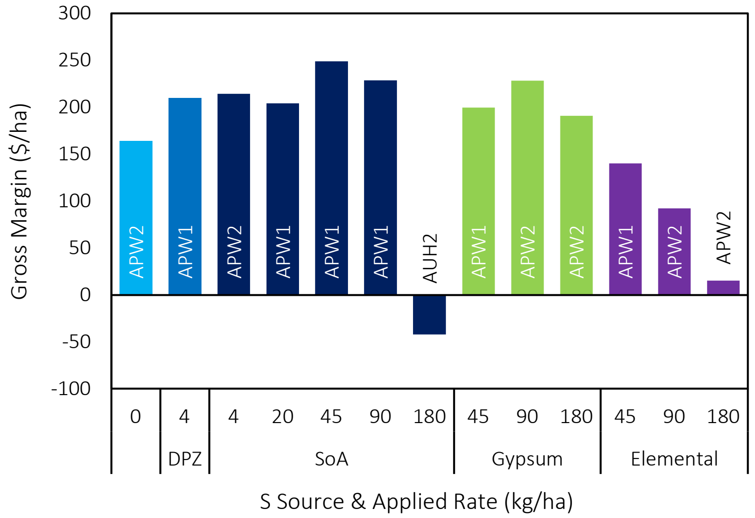

Figure 5. Indicative gross margins for each treatment, based on grain value minus cost of fertilizer.

There are also logistical concerns with using large amounts of gypsum to supply crop S requirements, including getting an even enough spread amongst all crops. As such, this study should be considered inconclusive in this regard.

The soil tests taken after the 2024 season indicate leaching differences across treatments when compared to tests prior to the start of the trial. There was relative consistency in leaching down to 30cm in Bunjil's sandy soil, with larger differences further down the soil profile. SOA leached the most compared to gypsum and elemental S, with the high rate also leading to very high S readings below 30cm. The nil S showed how much leaching had occurred compared to initial, greater than in the clay soil at Mingenew.

Refer to the year 1 trial report for more details on the 2023 season, and the Mingenew S reports for more information regarding S responses in a clay soil.

Nitrogen and potassium rates for wheat, Maya, 2024

Key points

- **In 2024 the Maya site received decile 9 GSR (above average rainfall in June, July, August, and below average in September).**
- **Vixen wheat showed increased yields with higher nitrogen rates - up to 60kg N/ha.**
  Grain protein increased significantly with higher rates of applied N.
  The highest yielding treatment was 60kg N/ha and 30kg K/ha.
- **Yields did not increase significantly with increased potassium rates, although 30kg K/ha did result in a higher average gross margin than nil K, due to a minor (200 Kg/ha) yield benefit.**

Trial aim

To improve our understanding of optimal nitrogen (N) and potassium (K) applications for wheat yield, grain quality and the most profitable returns.

Background and agronomy details

Traditional approaches to N and K management are being increasingly questioned as new developments in nutrition, soil amelioration and crop management constantly challenge conventional approaches.

This factorial designed Summit trial tested the response of Vixen wheat to N and K in the Wubin area in 2024.

Rainfall

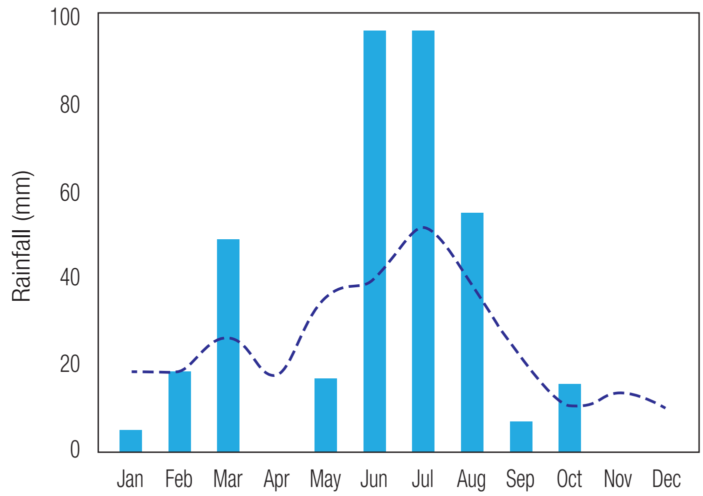

Figure 1. 2024 Rainfall for Latham (bars) and long-term average rainfall (dotted line).

Saritha Marais, Summit Area Manager Wongan Hills, taking plant samples in the Maya trial in 2024 (photo left).

Table 1. Soil test results

Depth cm	pH $CaCl_2$	ECe dS/m	P Col mg/kg	PBI	K Col mg/kg	Exch K mg/kg	S mg/kg	Org C %	NO_{3-} mg/kg	NH_{4+} mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	ECEC cmol[+]/kg
0-10	6.9	1.6	22	25	31	24	21	0.6	18	1	0.7	0.3	0.9	4.9
10-20	6.3	1.4	19	31	25	17	25	0.5	13	1	0.4	0.2	0.6	3.5
20-30	4.8	0.9	6	39	25	9	36	0.2	6	1	0.1	0.1	0.3	1.7

Trial results

Emergence

Plant emergence rates, recorded at 3-leaf on the 4/7/24, were not affected by N or K rates. Average emergence was satisfactory at 133 plants/m^2.

Biomass

NDVI readings at mid-tillering (Figure 2.) showed a significant increase in biomass with applications of at least 60kg N/ha ($p<0.001$). It also shows 30kg N/ha did not have a significant effect compared to nil N at this stage in the season. K rates did not significantly change biomass ($p=0.12$).

Harvest

Harvest results (Figure 3.) demonstrated that applying more N led to increased yields and protein, with yields generally increasing with N applications up to 60kg/ha ($p=0.02$). K did not significantly influence yields or protein content, suggesting that it was not a constraint at this site under 2024 conditions ($p=0.38$).

The highest yielding treatment was 60kg N/ha and 30kg K/ha.

Gross Margin

Indicative gross margins (Figure 4.) show increases in profitability up to 60kg N/ha, and relatively stable profitability with increased K rates (with a slight increase over nil K at 30kg K/ha applications).

Conclusions

Decile 9 growing season rainfall in the area contributed to an average yield across the trial of 4.1t/ha. The highest average yielding treatment, as well as the most profitable, received 60kg N/ha and 30kg K/ha. This was true despite K rates not significantly affecting yields on average.
There was however a 200kg/ha difference between results for nil K and 30kg K/ha, which was enough to be profitable.

The optimal amount of N in 2024 conditions at this site was at least 60kg N/ha for yields, with higher rates increasing grain protein further. This trend carried through from in-season measurements to harvest, providing a level of confidence. Note, the 90kg N/ha treatments may have provided significant yield benefits had the site received better spring rainfall in September and October, or with more replicates providing more statistical power.

The differences in grain protein (9.3% to 11.6%) influenced by N rates affected wheat receival grades greatly.

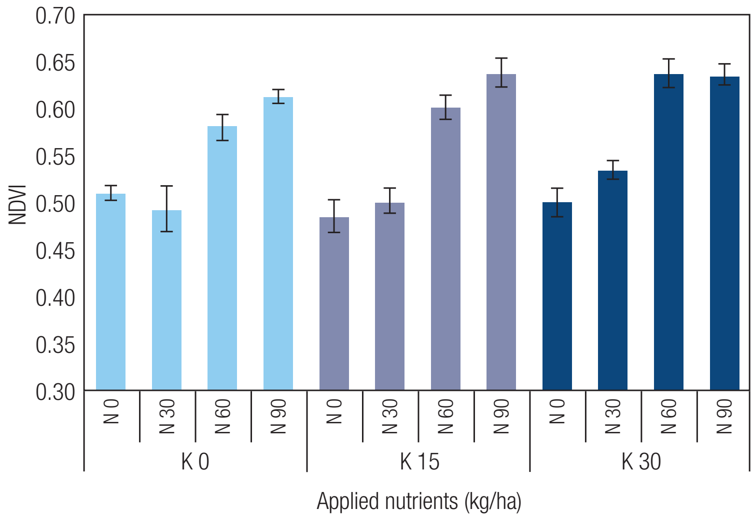

Figure 2. NDVI recorded at mid-tillering (August 8th, 2024)

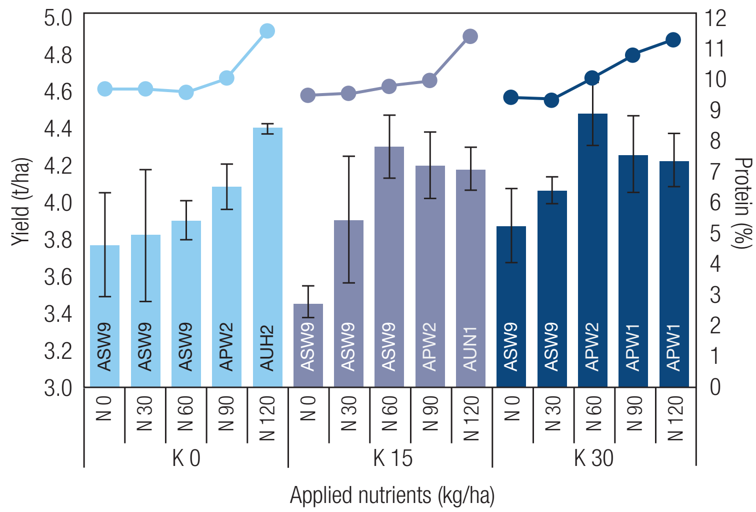

Figure 3. Harvest yield (bars) and grain protein (lines).

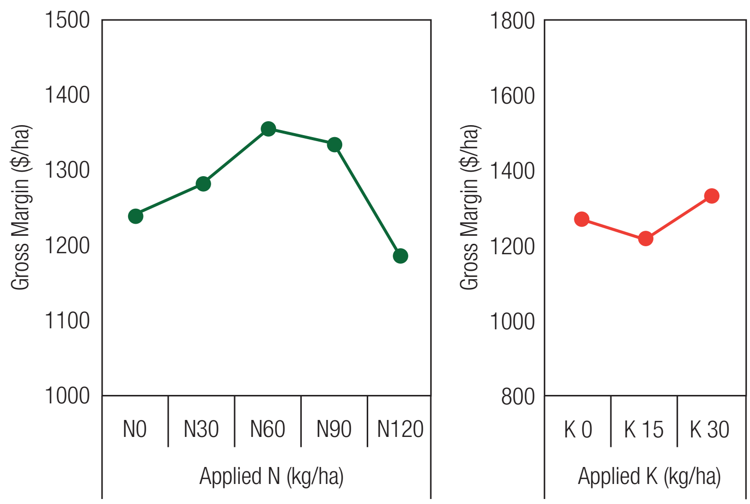

Figure 4. Indicative Gross Margins for N (left) and K (right) based on fertilizer cost and 2024 grain prices.

K rates, source and placement, Badgingarra 5-year trial

Key points

- **Over the 5 years in this Badgingarra sand, the optimal K rate for yield and profitability was 30kg/ha/year.**
- **Application of MOP and SOP resulted in similar yields, with MOP more profitable due to its lower cost.**
- **Lupins had a lower emergence with MOP compared to SOP in 2022, although with decile 10 GSR, this did not result in a yield penalty.**
- **K placement at seeding generally resulted in no difference.**
- **Soil K rundown was evident in the lower rates of K, as well as in the nil fertilizer treatment.**

Trial aim

This trial aimed to assess crop production over five seasons with various potassium (K) application rates, sources (either muriate of potash (MOP) or sulphate of potash SOP) and placement (with or below the seed).

Background and agronomy details

Growers are seeking to apply K, whenever necessary, to optimise production and returns. Some soils, such as this sandy site at Badgingarra have limited capacity to retain K due to leaching. Progressively increasing K rates therefore raises questions including crop tolerance to chloride associated with MOP compared with SOP, placement at sowing and also the cost difference between products.

This site had a low clay content and high sand content, indicating leaching could occur. The trial ran from 2020 (see trial site nutrient analysis at the time in Table 1) to the end of 2024 and assessed K rates of 0, 15, 30, 45, and 75kg K/ha. Each rate was tested either as MOP or SOP, and sown either with the seed or banded below.

The K rates were designed to run-down, maintain or build soil reserves over time i.e. treatments were repeated for every year of the trial. Other nutrients were applied equally to realise crop potential.

Crop rotation and seasonal rainfall

The crop rotation was fairly typical for the area and soil type, and growing season rainfall for the five years was highly variable:

- 2020 Ninja wheat (decile 2);
- 2021 Scepter wheat (decile 10);
- 2022 Jurien lupins (decile 10);
- 2023 44Y30 canola (decile 2);
- 2024 Vixen wheat (decile 4).

Emergence

Plant establishment was generally not affected by fertilizer treatments. However in 2022, MOP had a significant negative impact on lupin establishment as rates increased, especially when it was placed with the seed.

In 2024, all K banded with the wheat seed had lower emergence, especially as rates increased.

Biomass

In-season biomass measured using NDVI followed one of two patterns for each season: it either matched the same trend as the final harvest yield of the given year, or showed no response to any treatment.

Table 1. Soil nutrient analysis from initial testing in April 2020.

Depth cm	pH [$CaCl_2$]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	OC %	NO_3^- mg/kg	NH_4^+ mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	Sand %	Silt %	Clay %
0-10	4.9	12	21	28	36	14	1.4	18	2	0.2	0.7	2.9	93	4	3
10-20	4.3	7	38	7	25	8	0.9	6	1	0.1	0.2	0.7	91	4	5
20-30	4.3	5	37	7	25	8	0.6	4	1	0.1	0.1	0.3	90	4	6

Harvest results

Yield responses varied across seasons and crops, but several patterns emerged. These trends are made clear by the combined yield from all five seasons.

Firstly, 30kg K/ha was usually the maximum K rate that resulted in a yield increase over lower rates. This is most obvious when averaged across all the source and placement treatments. In four of the five seasons, 30kg K/ha was also the highest yielding K rate. This shows that higher K rates were not utilised by the crops in each season to increase yields, at least within that individual season itself.

Secondly, MOP and SOP yields across the five seasons totalled 15.9t/ha and 16.1t/ha respectively, indicating there was only a minor difference in effectiveness between the two (provided that the K rate was the same). Hence, any potential issues with chloride in the soil were not enough to greatly affect yields over the five year trial period.

Thirdly, K placement below the seed yielded 15.9t/ha, and with the seed 16.1t/ha. Rarely significant in any of the seasons this small difference indicate there was no agronomic reason to use one method over the other.

Below the seed was better for lupin emergence in 2022 when using MOP, but this observation did not carry on to impact on final yield.

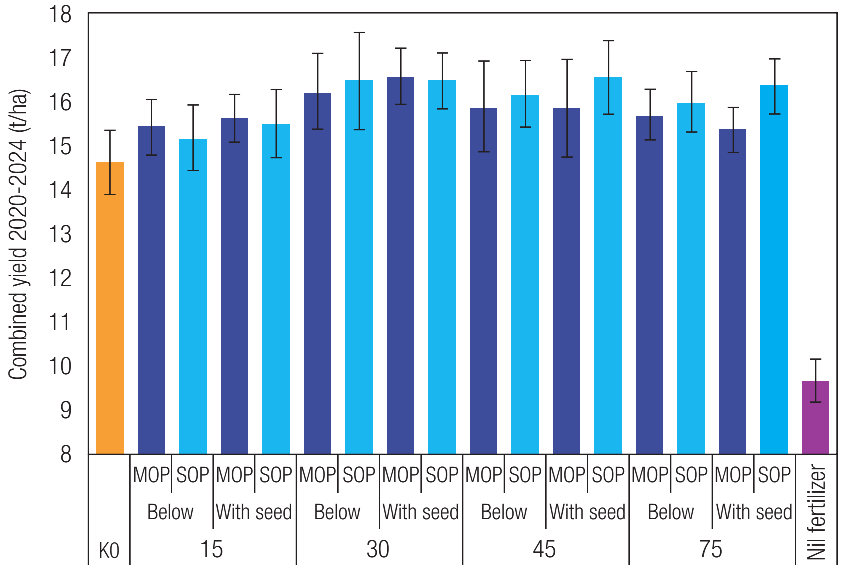

Figure 2. Combined individual treatment harvest yields from 2020-24.

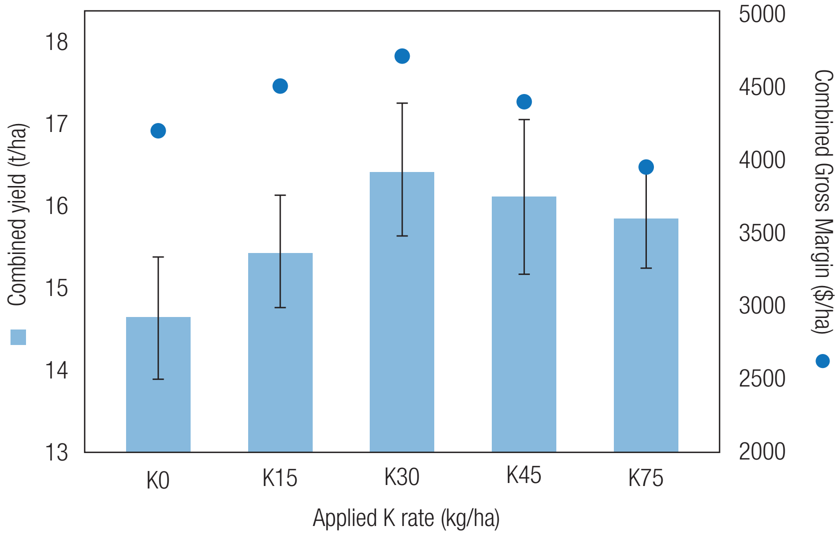

Figure 3. Combined harvest yields (bars) and gross margins (dots) for 5-year averaged K rates.

Return on investment

Gross margins from the five seasons indicates the optimal K strategy was 30kg K/ha applied as MOP (Figure 3). Gross margins dropped off at higher rates with increasing fertilizer cost and no yield increase.

Banding K either below or with the seed did not influence the gross margins any more than the yield differences. Due to the extra cost of SOP over MOP, the minor increase in average yields was not enough to compensate for this price difference. MOP was more profitable than SOP by $174/ha across the five seasons.

K rundown and build-up

When February 2025 soil sample tests were compared with 2020 results (before the trial began) they showed a clear run-down of soil K for the nil-K treatment. They also showed a rundown of plant-available K when 15kg K/ha/year was applied for the term of the trial. 15kg K/ha/year was not enough to sustain the original soil K levels down to 30cm depth.

There was also less K in the top soil in 2025 than in 2020 when 75kg K/ha/year was applied. This result differed to previous seasons, which indicated 75kg K/ha/year mostly had higher K levels in the topsoil than prior to the trial commencing.

Testing at depth in 2025 showed K from the 75kg K/ha/year treatment was still present, but had leached down the soil profile. There was higher plant-available K all depths below 10cm in 2025 compared with 2020, which indicated luxury levels led to an overall build-up of soil K. This example illustrates the importance of subsoil sampling to show K values in the different soil zones. These need to be taken into account when determining the need to apply K and if so, how much.

In 2025 SOP left more plant-available K in the topsoil than MOP, although this trend was not consistent between each season. A more complete write-up and additional information on this 5-year trial is available from your local Area Manager.

Nitrogen & Phosphorus Rates in Wheat, Mukinbudin

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SUMMIT FERTILIZERS

Key Points

- The site had a significant response to N, with all rates yielding significantly higher than N0.
- P rates did not have any significant differences either in-season or at harvest.
- The most economical treatment was 25 units of N and nil P, although P may be depleted at this site for future seasons with no further applications.
- The lack of rain in the latter half of the season limited the yield potential of earlier applied N.

Aim

This trial aims to investigate the optimal and most cost-effective rates of nitrogen (N) and phosphorus (P) for wheat in Mukinbudin.

Property	Karomin Rd, Mukinbudin
Crop Variety	Vixen Wheat, sown @ 80kg/ha
Total Season Nutrients	N Rates: 0, 25, 50, 70. P Rates: 0, 6, 12, 18. K15, S7.
Rainfall	145mm GSR (Decile 4)

Treatments

The trial was seeded on the 17th of April 2024, with basal fertilizer being made up of MAPSZC, Urea, MAXam, MOP, TSP and SSP.

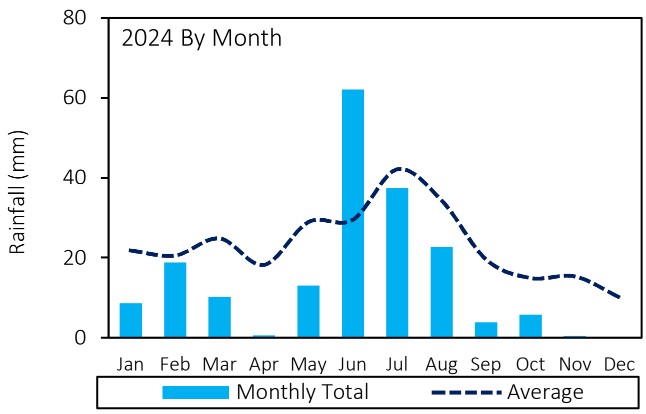
At seeding, all plots except the nil N treatments were given 25 units of N. The rest of the N for the N50 and N75 treatments were applied using UAN at 3-leaf and mid-tillering. The trial had four replicates and was of a randomised block design to improve scientific power. These nutrient rates were of a factorial nature, representing a range of N and P rates suitable for the area.

Emergence

Crop establishment at 3-leaf (9th July 2024) was satisfactory with a trial average of 124 plants/m². A significant difference ($p<0.05$) was identified between N0 and N25, with 119 and 130 plants/m² respectively. No significant differences ($p=0.18$) existed between P rates at this time.

Background

It is important to continually assess and determine the most efficient rates of nutrient input under varying climatic and economic conditions to determine the most profitable strategy. In this trial, N and P are tested at different rates to determine this and help create the most profitable program for growers in the Mukinbudin area.



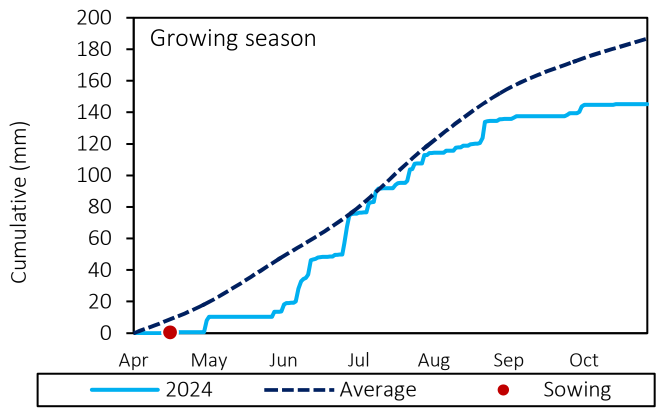


Figure 1a & b. 2024 monthly rainfall and 30-year average rainfall from Mukinbudin DPIRD station and Gum Park BOM station respectively.

Table 2. Soil test results from site, taken April 2024.

Depth	pH	P Col	PBI	DGT-P	K Col	S	OC	NO_3^-	NH_4^+	Cu	Zn	Mn	Sand	Silt	Clay
cm	[$CaCl_2$]	mg/kg		µg/L	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%
0-10	5.0	20	56	53	75	4	0.5	2	2	0.2	0.2	9.2	80.1	11.6	11.6
10-20	5.6	19	48	53	120	6	0.4	4	1	0.3	0.1	7.5	74.3	13.9	13.9
20-30	6.6	5	44	25	84	6	0.3	3	1	0.2	0.1	1.4	71.5	16.4	16.4

Biomass

NDVI readings showed a significant difference between N0 and both N25 & N50 ($p<0.01$). At the time of recording, N75 treatments had not yet received the final 25 units of N, so were not included (figure 2). No significant differences existed between P rates ($p=0.21$), although P18 did record higher readings than the lower P rates. It is also worth noting that differences between N rates were more visible between P0 and P12, but less so at P18.

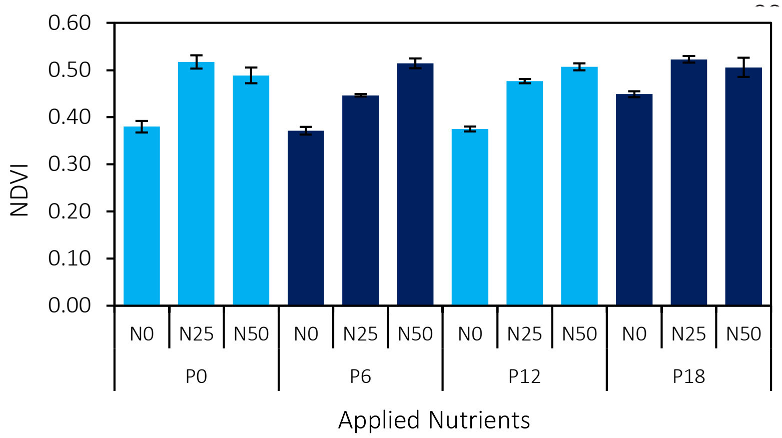


Figure 2. NDVI readings recorded on 15th August 2024, at mid-tillering.

Yield

The trial yielded an average of 1.6t/ha, with a maximum of 1.79t/ha and a minimum of 1.22t/ha (figure 3).

A significant difference existed between N0 and all other N rates ($p<0.001$), indicating a clear response to applying nitrogen. The greatest difference was expectedly between N0 and N75, with N75 yielding 400kg/ha greater than N0. The N response levelled off above N25, with only minor increases to N75 (figure 4). Grain protein continually increased with increasing rates of applied N, increasing by 2.5% from N0 to N75 (figure 3).

There were no significant differences in yield between rates of applied P ($p=0.66$).

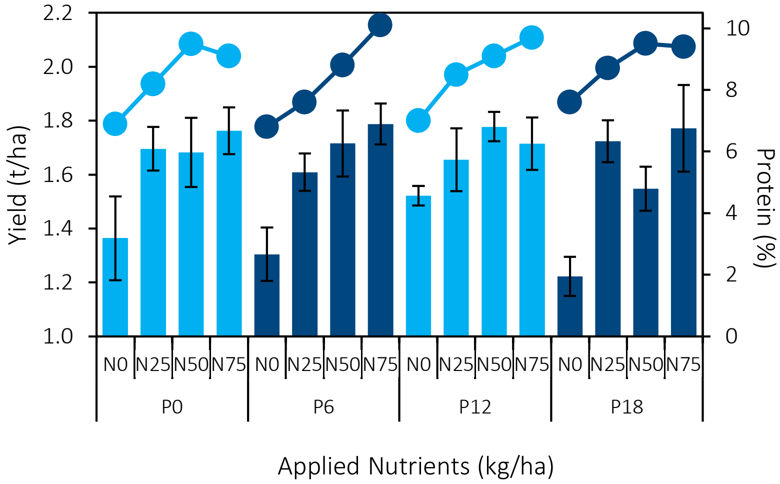


Figure 3. Harvest yield (bars) and grain protein (markers) for all treatments.

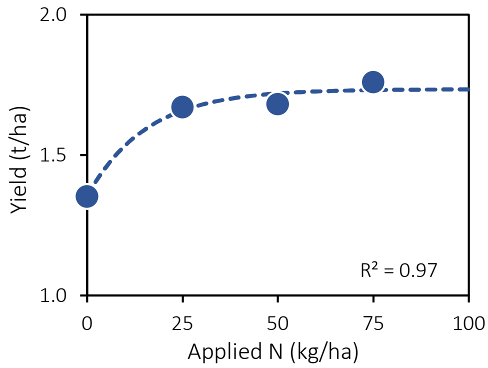


Figure 4. N response curve for harvest yields, using Mitscherlich equation.

Economics

The most profitable treatment was N25 P0, closely followed by N75 P6, which was assisted by reaching 10% protein to make APW2 (figure 5). Applying 25 units of N and no P was the most profitable combination in 2024 when margins were averaged.

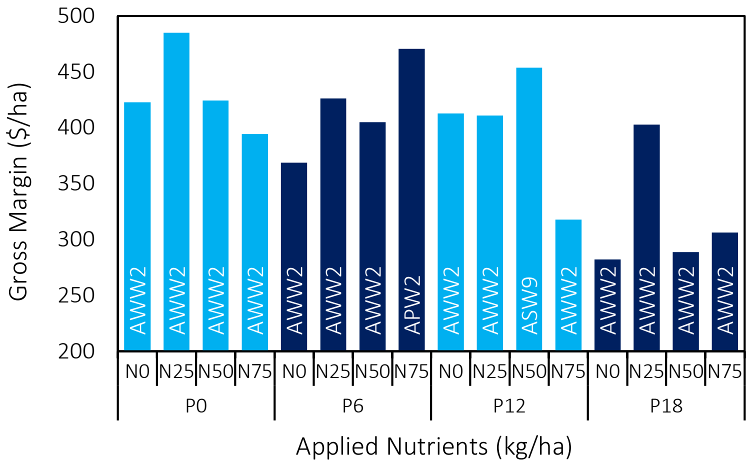


Figure 5. Indicative gross margins for all treatments, with receival grades included.

Conclusion

N25 and P0 were all that were required to optimise yields and profitability for wheat under 2024 conditions, although this restricted grain protein.

The rainfall patterns to reach a decile 4 season took place mostly in June and early July, which may have contributed to the higher N treatments (with the additional N being applied later than most of the rain) barely responding to the additional N. The P present in the soil (DGT-P of 53 µg/L) was sufficient to not limit the crop significantly, although applying P would likely still be useful to keep the reserves sufficient for future seasons.

N, P & K Rates in Wheat, Muntadgin

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Key Points

- A significant positive response was observed to both N and P at all rates above 0.
- The site was unresponsive to K, with no yield or financial gains noted in 2024.
- The most profitable application rates were N50, P12 and K0.
- Diminishing financial returns existed at rates above N50 and P12.

Aim

To assess the maximum yield potential of wheat by removing nutrient limitations in nitrogen and phosphorus, both with and without potassium, on a loamy sand in Muntadgin.

Property	Black Stump Farming, Muntadgin
Crop Variety	Wheat
Total Season Nutrients	**N Rates:** 0, 25, 50, 75; **P Rates:** 0, 6, 12, 18; **K Rates:** 0, 30. S5 across all treatments except nil control.
Rainfall	189mm GSR (decile 3)

Treatments

MAPSZC was used at the primary P source, except in nil N treatments, where a combination of TSP and SSP were used instead. MOP was used for the K source for the treatments with K. For the treatments that contained any N: MAXam was used to provide S, and urea was used to provide additional N to get to 25 units at seeding for each treatment. UAN was used at both 3-leaf and mid-tillering on the higher N treatments to get to their respective total units of N. A chelated trace element mix of Cu, Zn and Mn was applied with UAN also to minimise trace element deficiencies.

Background

The task of managing wheat nutrient inputs for both yield and protein is an ongoing challenge with seasonal rainfall variability, improvements in agronomic practices - particularly those addressing soil constraints – and the development of varieties with higher yield potentials. There is uncertainty about whether traditional approaches to N, P, and K management are allowing modern varieties to achieve their maximum potential.

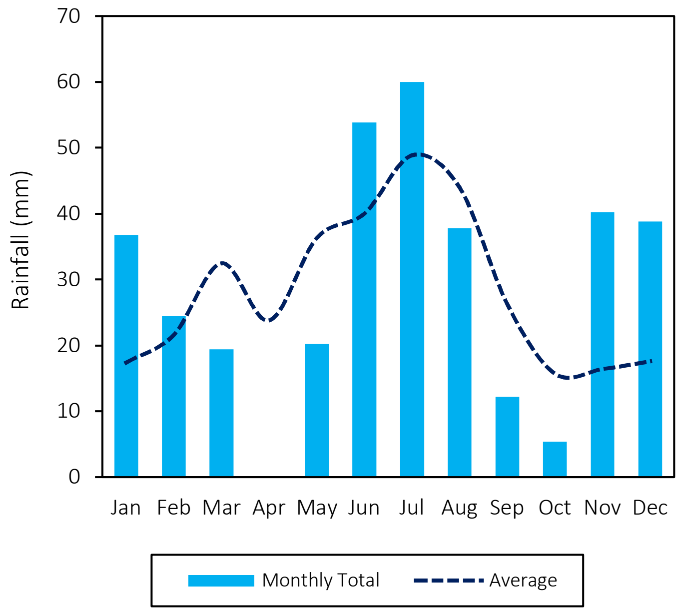

Figure 1. 2024 monthly total rainfall, overlaid with the 30-year average. Of note is the nil rainfall total in April, leading to a slow start to the season. A false break was avoided, though crop establishment was slow.

Table 2. Soil test data sampled 11th February 2024.

Depth cm	pH [$CaCl_2$]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	OC %	NO_3^- mg/kg	NH_4^+ mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	Sand %	Silt %	Clay %
0-10	4.3	1.0	24	32	40	11	0.6	4	3	0.6	1.3	2.1	87	4	9
10-20	4.1	0.8	9	43	4	18	0.4	3	2	0.3	0.3	1.2	83	5	12
20-30	4.8	0.5	5	58	4	25	0.3	1	1	0.1	0.1	0.3	85	2	13

Emergence

Emergence counts recorded at 3-leaf on 10th July showed an average emergence of 106 plants/m^2 across the trial. There were no significant differences between rates of N, P or K ($p>0.05$).

Biomass

NDVI recorded at mid-tillering showed that increasing the N rates did result in a trend of increasing biomass (figure 2), but the difference was not enough to be statistically significant ($p>0.05$). There were no significant differences in biomass between P ($p=0.07$) or K ($p=0.21$) rates, though a slight increase was observed in K30 over K0. P rates had a decreasing trend from P0 to P12, however P18 had the highest NDVI across P rates.

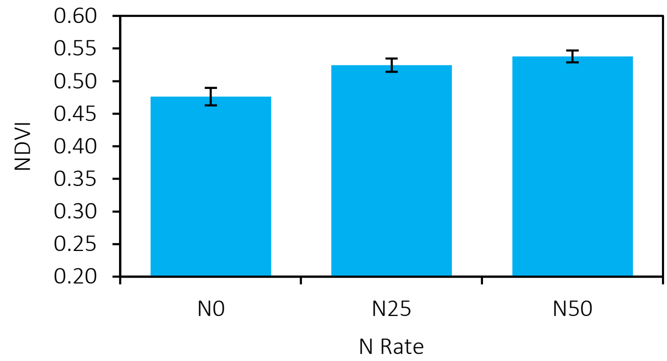

Figure 2. NDVI biomass data averaged across N rates showing an increasing trend, though not statistically significant.

Yield

Significant differences were identified in both N and P rates. N0 yielded significantly worse than all applications of N ($p<0.01$) (figure 3). P0 yielded significantly lower than P12 and P18, and P6 yielded significantly lower than P18 as well ($p<0.001$) (figure 4). There were no significant differences between nil K and K30 ($p=0.14$).

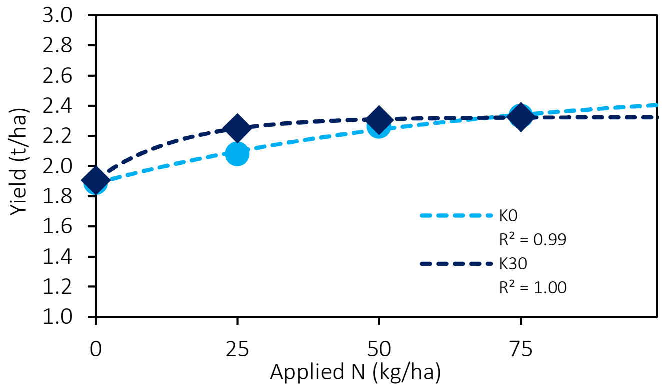

Figure 3. Harvest yield with increasing N rates, with a Mitscherlich equation representing a response curve.

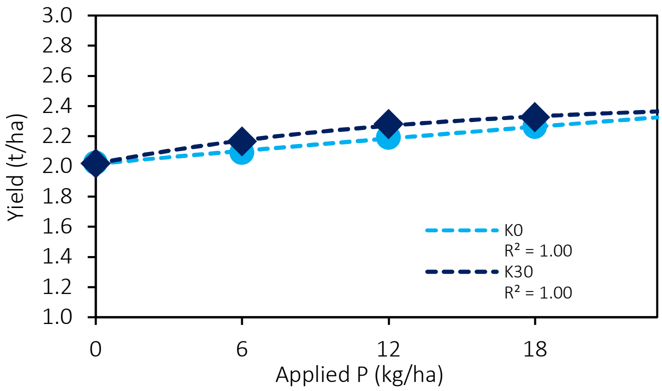

Figure 4. Harvest yield with increasing P rates, with a Mitscherlich equation representing a response curve.

Economics

A clear economic response existed across different N rates, with the most profitable treatment being N50, while N75 dropped off to a similar level as N25 (figure 5). Very little economic response existed over P rates, with a slight diminishing return as rates increased. K0 was more profitable than K30 due to no yield increase in 2024.

Conclusion

Under 2024 conditions, significant responses were identified to nitrogen and phosphorus applications in Muntadgin. Applying any amount of N gave a significant in-season and yield increase, while profitability peaked at N50, with diminishing financial returns at rates above this. A similar trend was present with P, with all applications above P0 performing better in-season and generating a yield and financial advantage, up to P12, after which diminishing financial returns were also observed. There was no clear response to potassium, with no yield or financial gains observed by applying 30 units over 0 units of K in 2024.

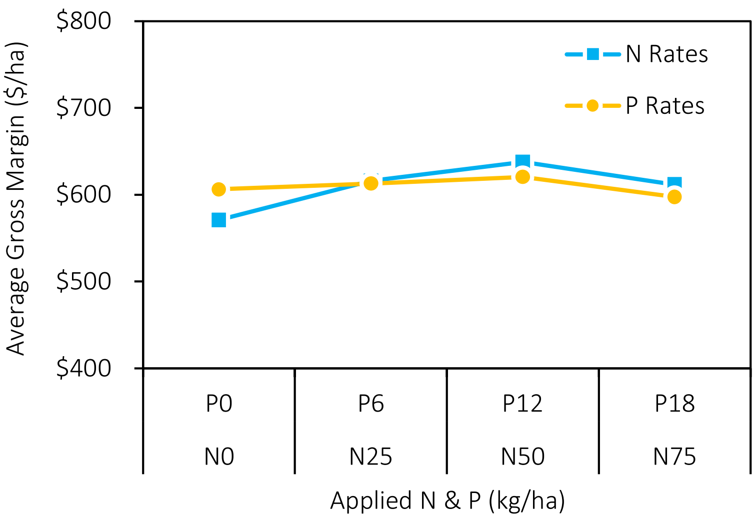

Figure 5. Indicative gross margins under all N and P rates using April 2024 fertilizer prices and December grain prices.

K Timing, Corrigin Barley

Contact: Steve Cooke scooke@summitfertz.com.au

Key Points

- The site was not K-responsive.
- No significant differences were identified between K-timings.
- No yield or grain quality advantage was observed under any treatment.
- Corrigin experienced a decile 5 season, 9mm above average rainfall.

Property	Neville Turner, Corrigin
Crop Variety	Scope Barley, sown @ 70kg/ha
Total Season Nutrients	N100, P8, K15 (except Nil), S4 (DAPSZC, MOP, Urea, UAN)
Rainfall	267mm GSR (Decile 5)
Treatments	K0, K15 (Split between seeding and 4 weeks after emergence), K15 (all at seeding)

Aim

The objective was to determine if any in-season, yield or quality advantage could be gained from a split timing application of potassium (K) as opposed to applying all K upfront in the Corrigin area.

Emergence

Average emergence across the trial was 93 plants/m^2, with K upfront having higher establishment at 100 plants/m^2, compared to 90 for both Nil K and split K. However, this was not statistically significant.

Biomass

Both K treatments had higher NDVI readings on average than Nil K, however this was not significant (p=0.85) (figure 2). No clear trend was present between the two K-timings, with the split application having a slightly lower NDVI of 0.77 compared to 0.78 for K upfront. At the time of measurements, no trends or differences were observed.

Treatments

All plots received the same basal nutrients at seeding (N30, P8, S4), with a third of all plots receiving no K, one third receiving 7.5 units and the final third receiving all 15 units of K at seeding. The split K treatments received their final 7.5 units of K at 5 weeks after emergence, on the 6th of June.

All plots received 45 units of N at the 3 leaf stage, and 25 units of N at mid-tillering, resulting in a total of 100 units of N applied throughout the season.

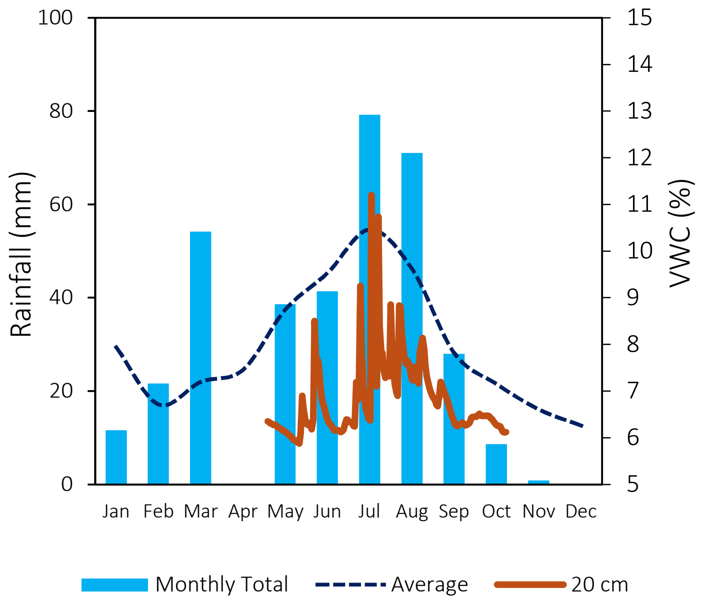

Figure 1. Rainfall from Corrigin DPIRD station. Note CropX moisture probe data (brown line) shows volumetric water content (%) at 20cm. Monthly rainfall (bars) is overlaid with 30-year average (dotted blue line).

Table 1. Site soil test data, taken February 2024.

Depth	pH	P Col	PBI	K Col	S	Org C	NO_3^-	NH_4^+	Cu	Zn	Mn	Sand	Silt	Clay
cm	[$CaCl_2$]	mg/kg		mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%
0-10	5.8	16	13	42	7	1.2	9	2	0.4	1.0	5.2	90	6	4
10-20	4.7	13	16	26	3	0.5	2	1	0.3	0.2	0.9	92	4	4
20-30	4.4	8	28	31	5	0.3	2	1	0.2	0.1	0.9	91	3	6

Yield

The average yield across the trial was 4.7t/ha. There were no significant or observed differences between yield for any treatment ($p>0.05$). Yields were slightly higher under both K treatments compared to Nil K (figure 3).

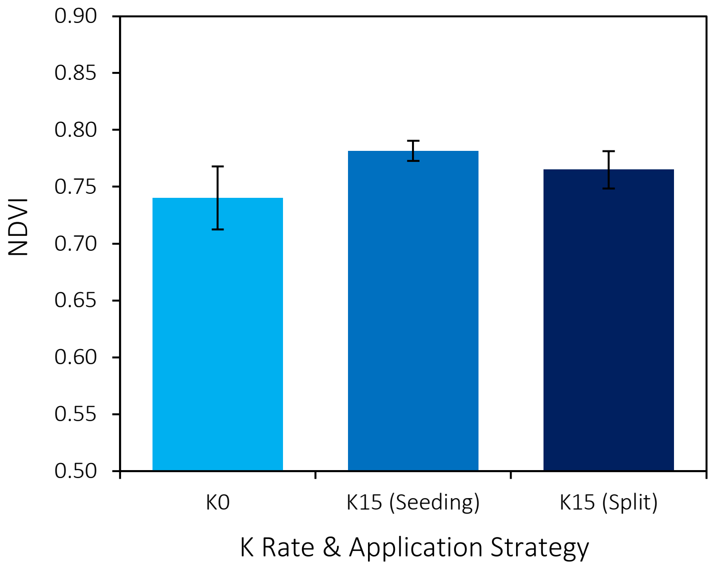

Figure 2. NDVI measurements taken 10th June 2024.

Economics

As the site was not K-responsive, and no significant differences or trends were observed either in-season or in harvest results nil K had a negative indicative gross margin and ROI.

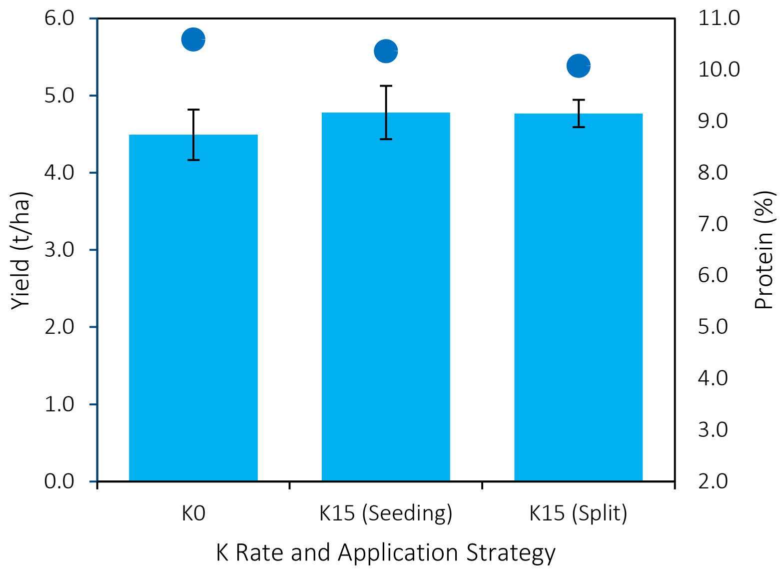

Figure 2. NDVI measurements taken 10th June 2024.

Conclusion

Unfortunately, due to the site not being K-responsive, it was unlikely to observe any significant differences or trends in response to varying K timing. Given the fact that Nil K yielded only 300kg/ha less than 15 units of K, and no clear in-season trends were identified, it is impossible to draw any conclusions as to whether an upfront or split application of K holds an advantage at this particular site in 2024 at Corrigin. Further testing on a K-responsive site is required for future testing of K timing.

Table 2. Harvest result summary.

Treatment	Yield (t/ha)	Protein (%)	Hectolitre Weight (kg/hL)	Screenings below 2mm (%)	Grade
K0	4.5	10.6	64.5	2.1	MALT1
K15 Split	4.8	10.4	65.7	0.7	MALT1
K15 Up Front	4.8	10.1	65.6	1.1	MALT1

Enhanced Efficiency Fertilizer for Pasture, Serpentine

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SUMMIT FERTILIZERS

Key Points

- Neither N-Shield NBPT or N-Shield Dual increased pasture biomass. However, conditions for nitrogen loss were not present at this site in 2024.
- BiOWiSH was also tested as there is not much information on whether it has a place in a pasture system. There was no biomass increase from BiOWiSH; this may be because the decile 10 rainfall introduced other limiting factors which capped the yield potential.

Aim

This trial aimed to identify the efficacy of two N-Shield urea coating products and BiOWiSH, a biological EEF in a sown clay loam pasture near Serpentine during the grazing season, using a top-dressing method.

Property	Shade River Dairy, Mardella
Pasture Variety	Sown ryegrass-dominant pasture: annual ryegrass, rouse subterranean clover & balansa clover.
Basal Nutrients	N 100 (across 4 applications), P 24, K 12, S 20
Rainfall	815mm Jun-Sep (Trial Period) – Decile 10

Treatments

The trial was established on the 5th June 2024, after the grower had sown the paddock. The initial fertilizer that was spread on the trial was comprised of SuperPasture, sulphate of potash & urea (coated depending on treatment). The area was fenced off and plots were separated by using glyphosate on the areas between plots.

Biomass cuts and plant samples were taken from each plot every five weeks with three recordings taken. The plots were then mown down to simulate grazing, and the urea treatments hand spread.

Background

Summit Field Research conducted thirteen independent trials across the WA growing region in 2024 to test several enhanced efficiency fertilizers (EEFs). This trial tested two N-Shield products, 'NBPT' and 'Dual', both of which were coated onto urea and subsequently top-dressed over plots to replicate grower nitrogen application practice.

The NBPT product is designed to enhance urea efficiency by reducing ammonia volatilization. The Dual product contains both NBPT and DCD, and is designed to minimize ammonia volatilization, as well as reduce nitrate leaching through the soil.

BiOWiSH contains proprietary species of *bacillus* bacteria, suspended in a liquid form which is coated onto granular fertilizer. Bacteria form a symbiotic relationship with plant roots, and operate within the *rhizosphere*, hijacking the rhizophagy cycle where they consume soil nutrients and subsequently travel into plant roots. Within the root, the plant partially digests the bacteria, releasing soil nutrients for plant uptake. Following this, the bacteria are expelled out of root hairs, elongating them as they depart, and begin the cycle once again.

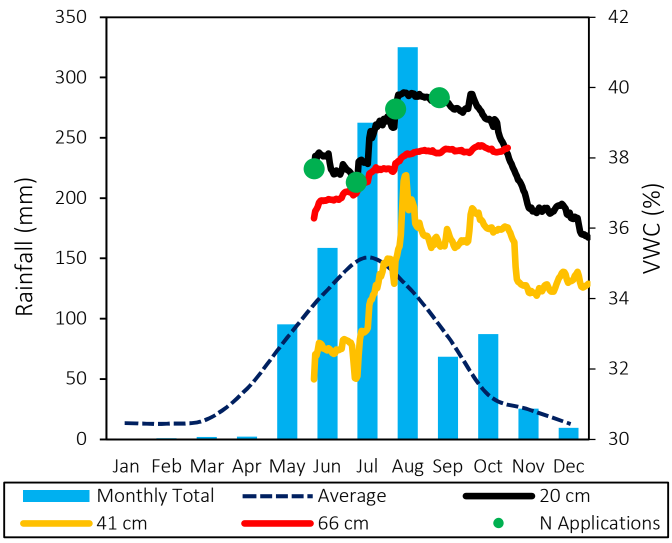

Figure 1. 2024 rainfall from Jarrahdale 2 (South) DPIRD station & on site CropX rain gauge. 30-year rainfall from Serpentine BOM station. Soil moisture status (volumetric water content %) from the CropX moisture sensor installed at the site.

Table 2. Soil test data, taken at the trial site in June 2024.

Depth	pH	P Col	PBI	DGT-P	K Col	S	OC	NO_3^-	NH_4^+	Cu	Zn	Mn	Sand	Silt	Clay
cm	[$CaCl_2$]	mg/kg		μg/L	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%
0-10	5.0	1.6	40	257	57	40	3.4	42	10	1.4	0.4	4.5	55	20	25
10-20	4.6	0.9	11	277	25	47	1.0	13	3	0.4	0.1	3.3	49	16	36
20-30	4.9	0.7	7	333	25	75	0.5	6	2	0.2	0.1	2.4	51	12	37

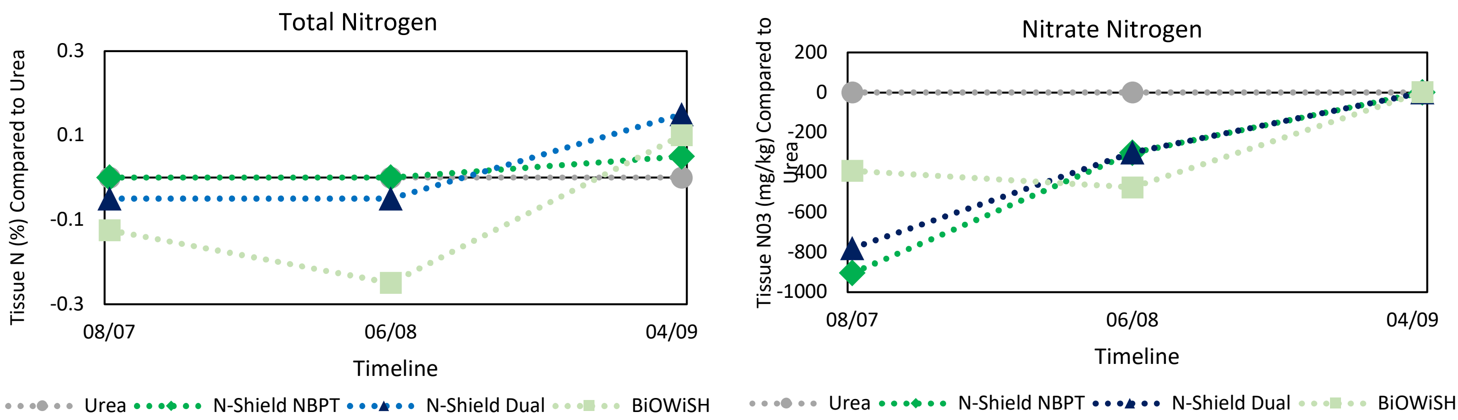

Figure 2a & b. Plant tissue test results from the three biomass cuts, five weeks apart, for total nitrogen & nitrate nitrogen levels respectively. Measurements are the difference between the straight urea and treatment product.

Tissue Tests

No significant differences were identified between EEF products at any of the three plant tissue nitrogen readings ($p>0.05$), for either total nitrogen or nitrate nitrogen. None of the EEF products outperformed urea until the 3rd sampling, in which Dual performed the best (figure 2a). A trend also appeared in which nitrate was higher in straight urea than either of the EEF coatings (figure 2b).

Biomass

No significant differences were identified between nitrogen sources at any of the three biomass readings ($p>0.3$). At the first recording, urea had the highest biomass, while at the second recording NBPT and BiOWiSH had the highest biomass. BiOWiSH also had the highest biomass at the 3rd and final recording, although all these differences were not significant. Cumulatively across these 3 recordings, NBPT and BiOWiSH had the highest dry matter biomass, and Dual had the least (figure 3).

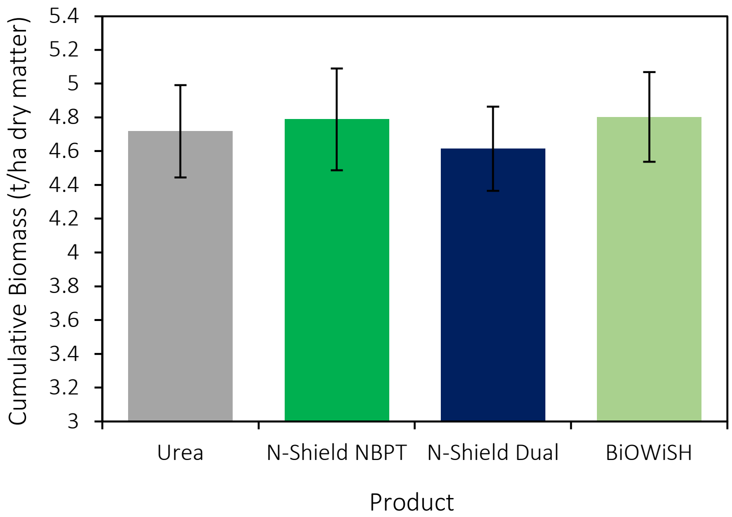

Figure 3. Cumulative dry biomass across 3 grazing cycles.

Economics

The additional biomass gained from coating N-Shield NBPT or BiOWiSH to urea was just enough to offset the extra cost, hence the gross margins being very similar for these products and urea (figure 4). N-Shield Dual had no biomass benefit so the extra cost of the EEF meant it had a negative gross margin compared to urea.

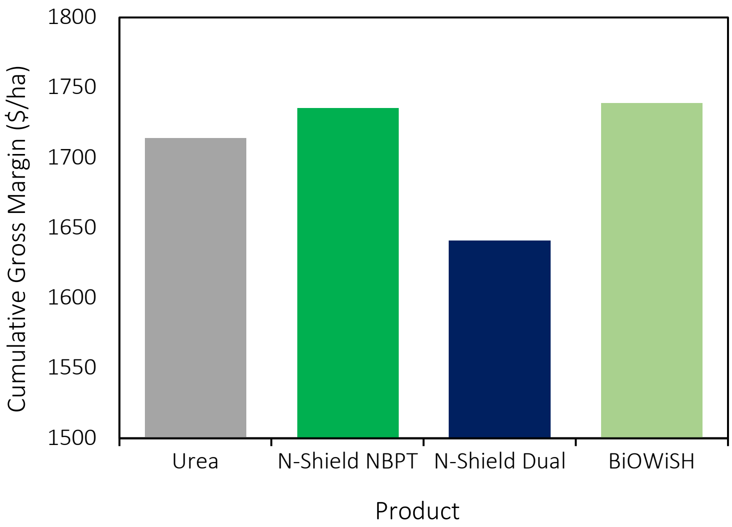

Figure 4. Cumulative gross margins across 3 grazing cycles, simulating the pasture being sold as hay.

Conclusion

None of the EEFs increased pasture biomass nor profitability significantly in this trial. However, both N-Shield products are designed as an insurance against N losses under unfavourable seasons where N loss is high resulting in reduced production, which 2024 was not. On the other hand, BiOWiSH has not been extensively tested on pastures, and it remains to be seen whether the biological mechanism of this product is conducive in a livestock grazing cycle, in terms of promoting enough additional growth to be financially viable. More testing on pasture will take place in 2025.

EEF Products & N Rates in Canola, Wandering

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Key Points

- There was a significant yield response to nitrogen rates, but no significant differences between any nitrogen inhibitor or EEF products.
- The most economical treatment was identified as nil N under 2024 conditions, yielding 2.3t/ha.
- EEF products should be considered a form of insurance, as opposed to a yield boosting product. They will protect applied nitrogen under seasonal conditions conducive to N loss, but where conditions are not conducive to N loss, they will not produce a yield benefit.

Aim

Several N-Shield Enhanced Efficiency Fertiliser (EEF) products were trialled across the WA growing region in 2024. This trial tests EEF products at different nitrogen rates, which allowed us to not only compare the EEF product efficacy at these varying rates, but also look at the economics of the EEF products compared to increasing uncoated N product.

Property	Wandering-Pingelly Rd
Crop Variety	Invigour (RR) canola, sown 8th May @ 2.5kg/ha
Treatment Nutrients	N Rates: 0, 75, 150, 225 kg/ha P 40, K 20, S 12.
Rainfall	432mm GSR; Decile 4

Treatments

Contrary to other N-Shield EEF trials completed in 2024 which used a standard nitrogen (and therefore EEF product) application rate throughout the trial, this site received four nitrogen rates. These were 0, 75, 150 & 225kg N/ha. P, K and S rates were all identical and these nutrients were applied at seeding in the form of MAPSZC & MOP.

In terms of EEF & N products - N-Shield NBPT and Dual (NBPT+DCD) coated on urea were compared to urea, and UAN Guard (DCD) and HydroGuard (DCD + wetter-humectant) mixed in UAN were compared to UAN. The HydroGuard was applied behind the press-wheel and subsequently streamed over plots at the 4-6 leaf and bulking stages. All of the urea products were only differentiated as in-season top-ups, with urea at seeding. The UAN products were applied at both seeding and in-season.

Background

EEF products are coming into focus for the Australian and international agricultural industries, as a method to improve fertilizer efficiency, and reduce environmental damage from synthetic fertilizer application. N-Shield has developed a number of nitrogen EEF products, some designed to be coated onto urea, and others to be diluted into UAN. These are intended primarily for their effect in reducing nitrogen losses via volatilization to the atmosphere (NBPT), or losses via soil leaching after rainfall events (DCD). Trialling of these products is essential to determine not only their efficacy, but also the ideal use scenarios in which to use them, and which products may be better suited to particular soil and crop types.

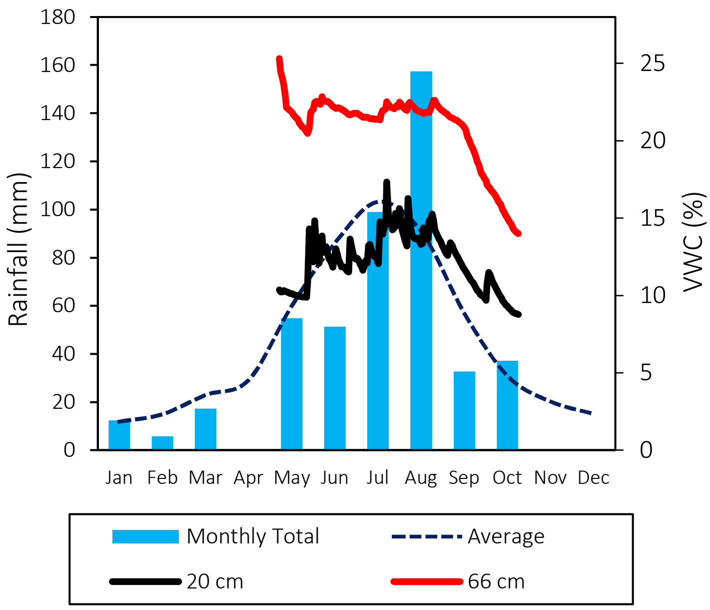

Figure 1. 2024 rainfall data from Pingelly West DPIRD station, and long-term average from Wandering BOM station, overlaid with soil moisture status (volumetric water content) from the CropX moisture sensor installed at the site.

Table 2. Soil test data from trial site, taken February 2024.

Depth cm	pH [CaCl2]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	OC %	NO_3^- mg/kg	NH_4^+ mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	Sand %	Silt %	Clay %
0-10	5.4	25	204	7	95	8	2.7	18	2	0.4	0.4	2.9	86.4	9.2	4.6
10-20	5.6	17	223	5	86	10	2.2	13	3	0.3	0.3	1.9	88.0	7.5	4.7
20-30	5.9	12	286	4	99	9	1.8	13	3	0.2	0.2	1.9	85.7	9.1	5.2

Emergence

Crop establishment was slightly patchy, with a trial average of 29 plants/m^2, however was overall satisfactory. No differences existed between any treatments at this stage.

Yield

The trial had an average yield of 2.6t/ha. There were no significant differences (p=0.31) between EEF products. However, a significant difference was identified between both N0 and N225 (p<0.05), as well as N75 and N225 (p<0.05) (figure 3). There was an increasing yield trend with increased N-rates, as shown in the response curve (figure 4). Protein levels also increased with higher N rates, with oil having the inverse trend, the lowest being N225.

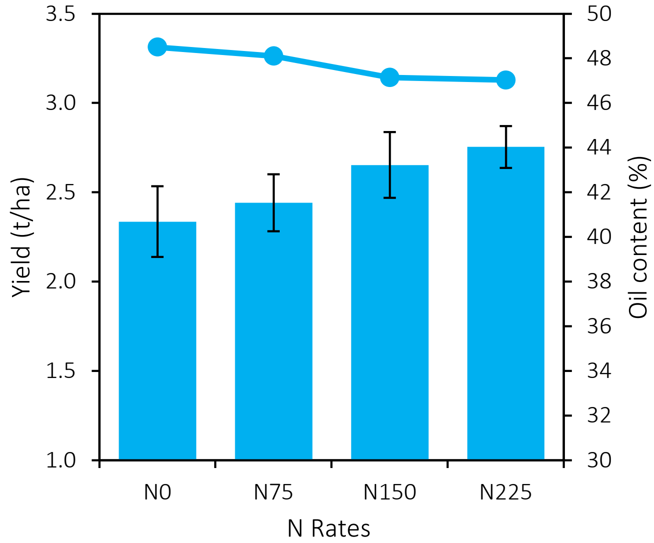

Figure 2. Yield and oil content across N rates. As there were no significant differences between nitrogen sources, the graph is not shown.

Economics

All treatments received CAG1 grade, with indicative gross margins decreasing as N rate increased (figure 3). The most economical N rate under 2024 conditions was, therefore, N0. The N0 treatment still yielded well at 2.34t/ha, making this economical result unsurprising, despite the overall N responsiveness. Since no EEF products reduced enough N losses to increase yields significantly, the most profitable N product was urea.

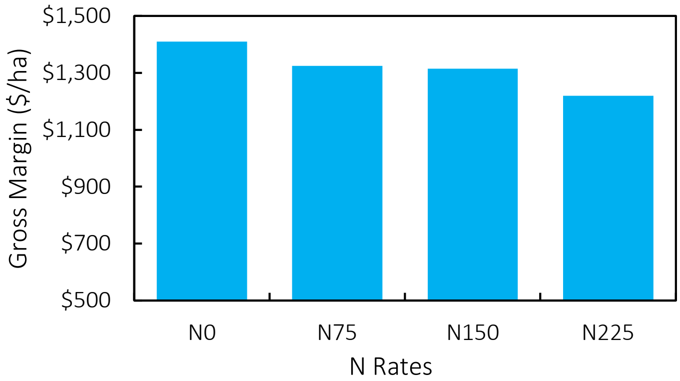

Figure 3. Indicative gross margins averaged across all N rates.

Conclusion

This trial identified a significant yield response to nitrogen rate, though not to any of the EEF products at any rate. It confirms the predicted crop response of canola to increased nitrogen applications.

EEF products should be considered a form of insurance, as opposed a yield-boosting product, as they work to reduce nitrogen losses which is heavily dependent on the environmental conditions. At this site, the patterns of rainfall and soil conditions throughout the season were not conducive to volatilisation or leaching events. As such, the N-Shield EEF products did not have the opportunity to demonstrate their efficacy at this site. Future trialling of these products will identify climatic and environmental conditions in they will prove useful in reducing nitrogen losses and increasing grower profitability.

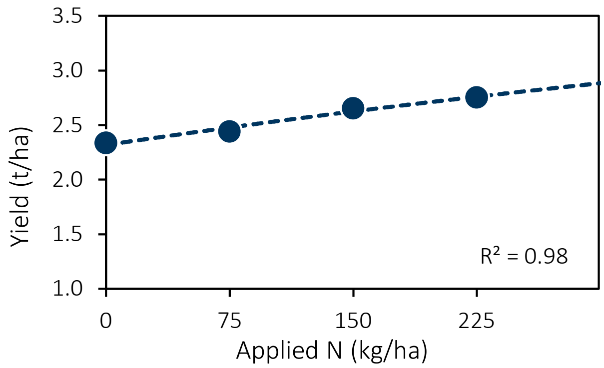

Figure 4. Nitrogen response curve for all rates. Mitscherlich function fitted.

P and K rates in barley, Nyabing, 2024

Key points

- **There was a significant yield increase observed by applying P, with the optimum rate being 12kg P/ha.**
- **A plateau effect presented over 12 units of P.**
- **The site responded to K, with a plateau effect above 25 kg/ha.**
- **The best return on fertilizer investment came from 12kg P/ha and 25kg K/ha.**

Trial aim

This 2024 trial in barley aimed to identify optimal application rates for phosphorus (P) and potassium (K), to maximise returns in a sandy soil 'leased land' situation at Nyabing.

Background and agronomy details

Challenges often face growers who take on new land with a nutrition status that is below par for the area. Soil test results for the Nyabing site are shown in Table 1.

Basal rates of 30kg/ha of nitrogen (from urea), and 10kg/ha of sulphur (MAXam) were applied to all plots.

The trial was factorial design and tested five P rates (0, 6, 12, 18 and 24kg/ha - from MAPSZC) and three K rates (0, 25 or 50 kg/ha from MOP). 40 kg/ha of N was applied at the 3-leaf stage and again at mid-tillering (both UAN). Chelated Zn, Cu and Mn was included with these UAN applications to mitigate the chance of any trace element deficiencies.

Growing season rainfall was 278mm (Decile 4).

Establishment

Maximus barley was sown at 80kg/ha and crop establishment was satisfactory with treatments averaging 123 plants/m^2.

There appeared to be no differences in plant counts between P rates. However, a decreasing trend was observed with increasing rates of K, although not statistically significant (p=0.91).

Rainfall

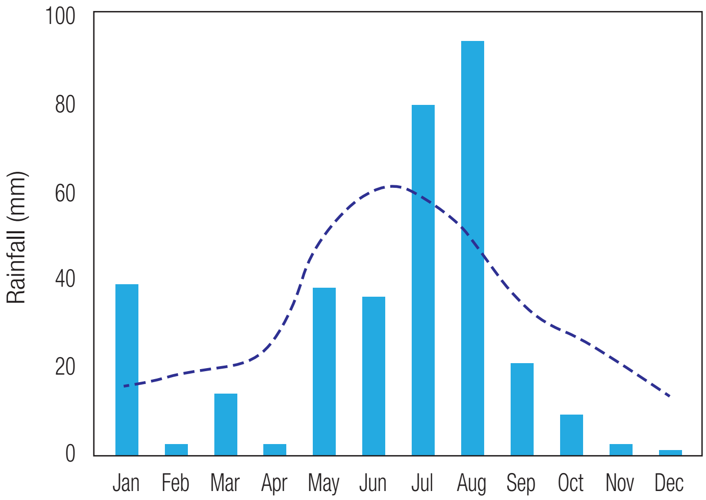

Figure 1. 2024 monthly total rainfall (bars), overlaid with the 30-year average (blue dotted line).

Table 1. Soil test results

Depth cm	pH [$CaCl_2$]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	OC %	NO_3^- mg/kg	NH_4^+ mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	Sand %	Silt %	Clay %
0-10	4.5	11.7	14.3	113.0	25.0	21	0.8	7.3	7.0	0.4	0.8	3.4	91.0	6.8	2.2
10-20	4.4	21.7	16.3	124.3	25.7	8	0.4	2.7	2.7	0.2	0.4	1.6	86.4	9.4	4.3
20-30	4.6	21.7	21.7	108.3	28.7	10	0.5	2.3	4.0	0.2	0.5	2.0	91.0	7.2	1.8

Biomass

NDVI testing, completed on July 17, identified a significant difference between P0 and all other rates of P ($p < 0.05$) (figure 3). There was also a significant difference between P6 and P24 ($p<0.05$), with P24 being higher. Biomass was not significantly affected by K rates.

Tissue test data

Tissue tests taken on the 28th of August at mid-tillering, showed an increase in P% with higher application rates. The same trend applied to K rates, with no plateau effect.

Yield

Average yield across the trial was high at 5.3t/ha (figure 4).

A significant difference was identified between P0 and all other P rates ($p<0.01$). The site was clearly responsive to P, with a plateau effect on yield observed at P12, and only very slightly higher yield at P24. A yield increase of around 300kg/ha was observed between K0 and K25, as well as K0 and K50 (averaged over all P rates) although these increases were not significant ($p=0.052$).

Economics

Due to the late timing of harvest in 2024, grain quality suffered, with hectolitre weight being lower than expected for all treatments. As such, all samples were receivable as feed grade, even though protein levels were high overall. Given this, the highest indicative gross margin was P12 with K25, with a gross margin of $1528/ha. Once averaged over all P rates, K25 was the most economical potassium application, with P6 giving the best returns for phosphorus.

Conclusion

This trial demonstrated that applying a rate of at least 6 units of P resulted in significant yield and financial gains at this site. Furthermore, application of 25 units of K gave both yield and economical gains, although soil tests and district practice indicate the optimal K rate is likely to be more like 15 units at this site. It was well demonstrated that increasing levels of P up to 12 units further drove yields, with a plateau effect after this (figure 5). A plateau was also observed at rates higher than 25kg K/ha, with 50 units being found to be surplus at this site.

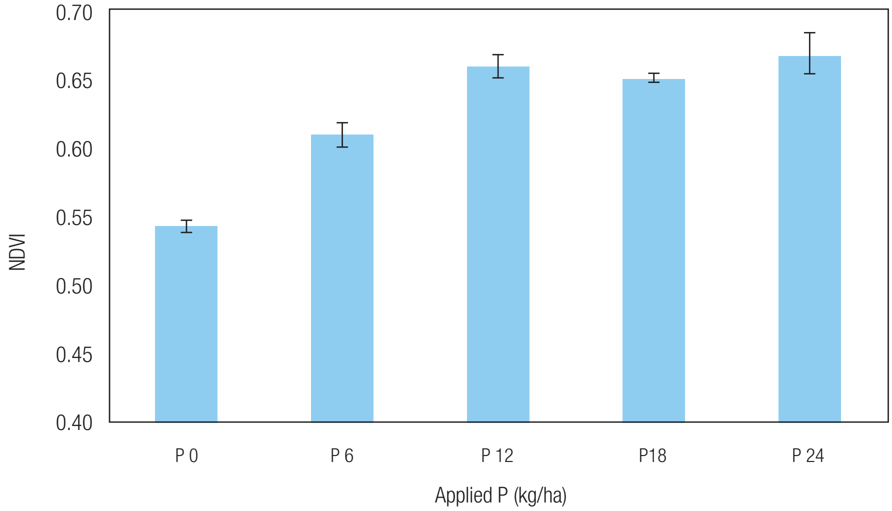

Figure 3. NDVI readings across all P rates.

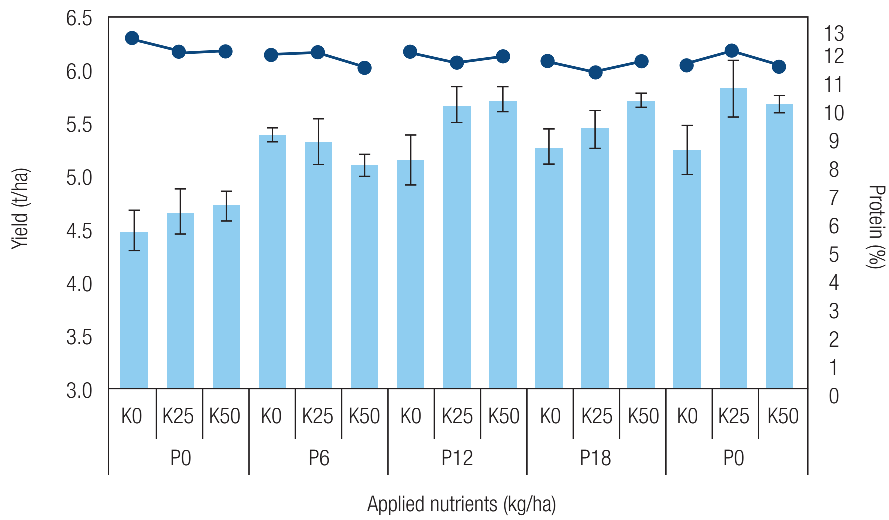

Figure 4. Yield data with grain yield (t/ha) shown in vertical bars (light blue), and protein (%) data shown above (dark blue dots).

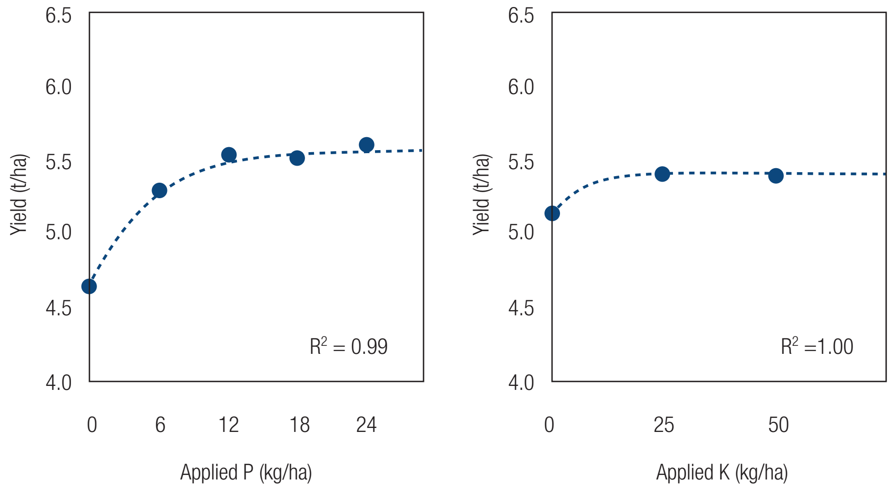

Figure 5. Nutrient yield response curves for both average P and K rates, using mitscherlich equation.

N x KS Rates Frankland, Canola

Contact: Mark Ladny mladny@summitfertz.com.au

Key Points

- Due to lodging of the crop, yield and economic data is unfortunately missing from this trial.
- In-season NDVI data revealed a significant response to N, with all treatments having significantly greater biomass than N0 and N175 having significantly higher biomass than N50.
- No K or S rate response was observed in the data available.
- A repeat or extension of the trial may reveal valuable yield and economics data in future seasons.

Aim

Summit field research, in collaboration with Stirlings to Coast Farmers (SCF), implemented this trial with the primary aim of improving understanding of optimal nitrogen (N), potassium (K) and sulphur (S) application rates for high yielding canola in the Frankland region.

Property	Hilder & Son, Frankland River
Crop Variety	RR Canola sown on the 9th May 2024 @ 2.5kg/ha
Total Season Nutrients	**N Rates:** 0, 50, 100, 150, 200, 250 P 30, **K Rates:** 25, 50, **S Rates:** 30, 70
Rainfall	377mm, Decile 5

Treatments

The trial used six factorial nitrogen rates between 0 and 250 units, in 50 unit increments, and two combined K&S rates, being low (K20, S30) and high (K50, S70) rates respectively. All plots received 30 units of P and 10 units of K at seeding, with additional nutrients added at 4-6 leaf, and bulking stages to meet the target total season rates by 12 weeks post-emergence. Basal fertilizer products used were MAPSZC (P), MOP (K), MAXam (S).

In-season treatment applications used MOP (K), MAXam (S, N) and Urea (N).

Background

Canola is known to have high nutrient requirement in comparison to cereal crops, but is a profitable crop if inputs are effectively managed. It requires much higher K & S rates compared to cereal crops. Therefore, understanding the optimal macro-nutrient rates, both for yield and economic return, is essential to farm profitability. This trial explores different N, K and S rates to determine the most economical approach to nutrient application for canola in the Frankland region.

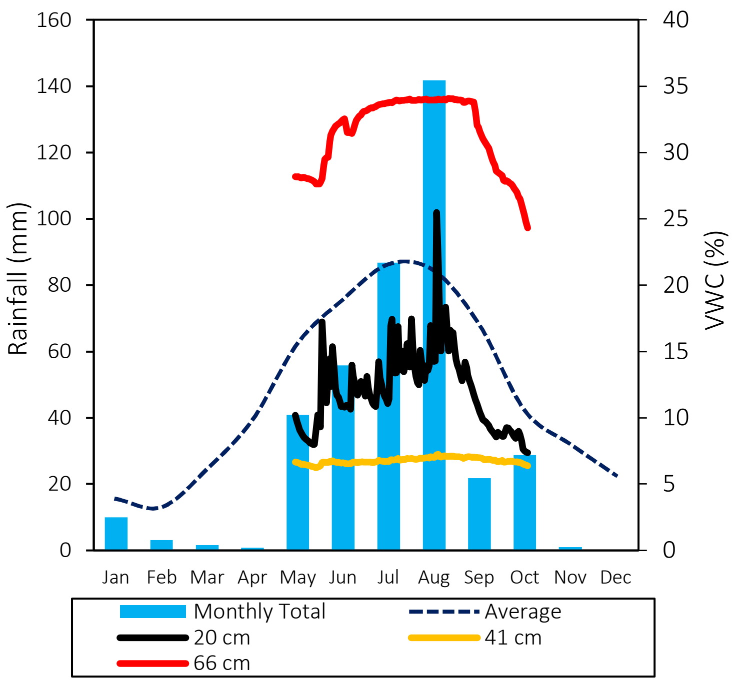

Figure 1. Rainfall data from DPIRD Frankland. CropX moisture probe data is overlaid, showing volumetric water content (%) at three depths.

Table 2. Soil test data, sampled March 2024.

Depth	pH	P Col	PBI	DGT-P	K Col	S	OC	NO_3^-	NH_4^+	Cu	Zn	Mn	Sand	Silt	Clay
cm	[$CaCl_2$]	mg/kg		µg/L	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%
0-10	5.7	53	96	40	105	12	3.2	9	4	0.9	1.6	3.9	82	10	8
10-20	4.8	38	129	8	29	5	2.0	5	1	0.3	0.4	1.0	82	7	10
20-30	4.7	26	163	6	35	5	2.2	4	1	0.3	0.3	1.0	84	6	10

Emergence

Crop establishment was satisfactory and averaged 39 plants/m^2 across the trial. It is worth noting, at the time of recording, N rates were either 0 or 30 units, and all plots had 10 units of K at this stage. N0 plots had a slightly lower emergence than N30 plots, though this trend was not strong or observed visually.

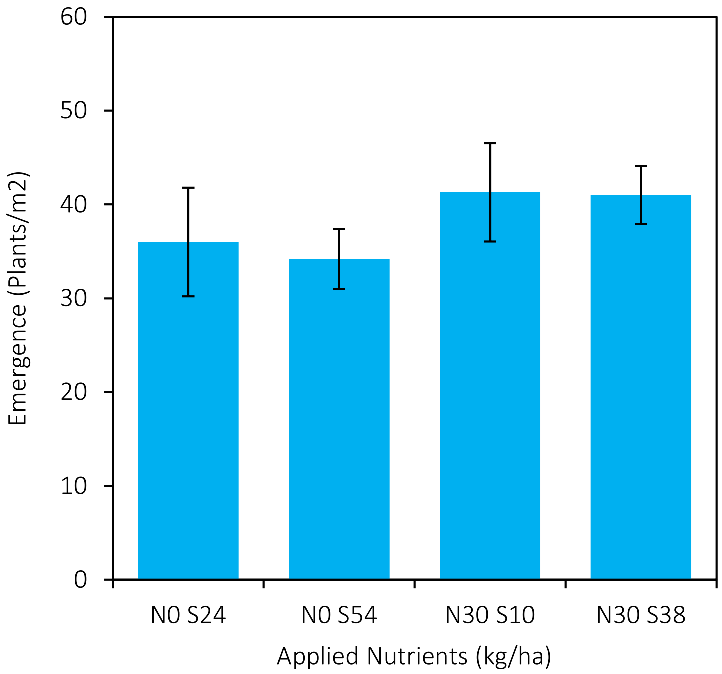

Figure 2. Crop emergence data recorded 20th June 2024.

Biomass

NDVI measurements identified a significant difference between N0 and all other N rates ($p<0.01$), as well as between N50 and N175 ($p<0.01$).

There were no significant differences between K& S rates statistically or visually. It should also be noted that NDVI readings are less accurate in canola compared to cereals, as the canopy is more consistent between treatments.

This trend was also observed visually, particularly at the flowering stage in September.

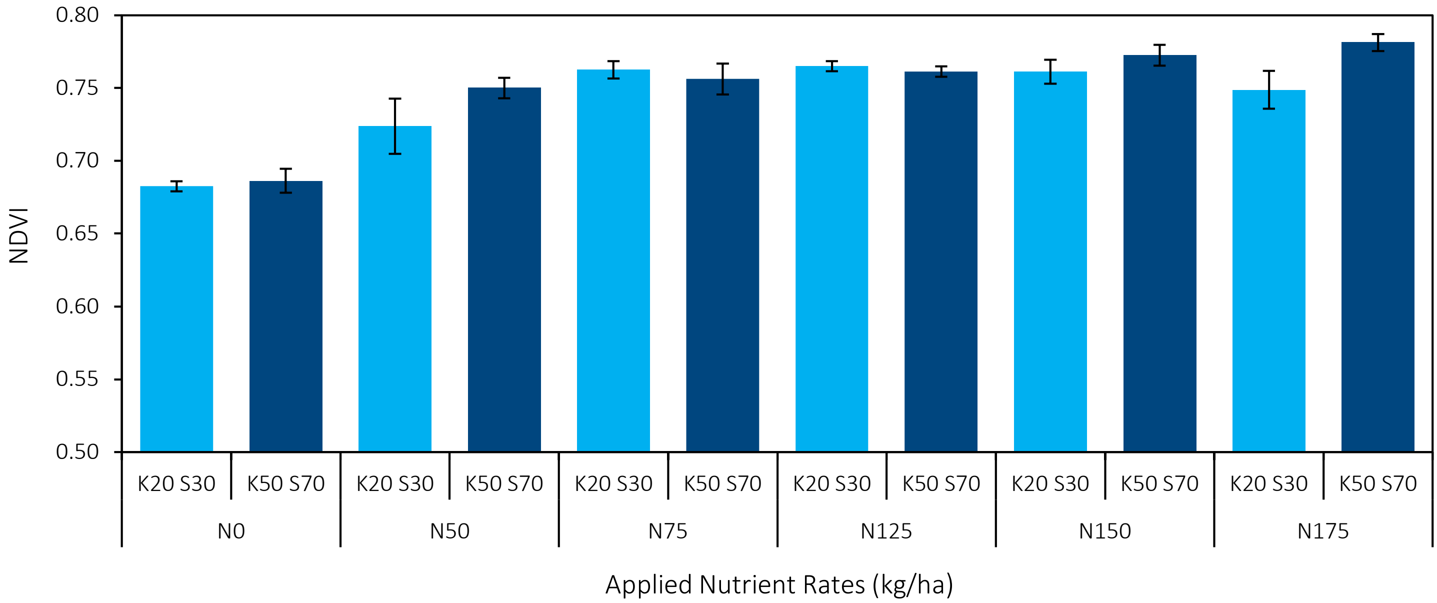

Figure 3. NDVI data recorded 25th July 2024.

Yield & Economics

Unfortunately, due to late-season rainfall and wind events, the majority of this crop had lodged by the time of harvesting. While some data was able to be saved, it is patchy and unreliable. For this reason, it has to be excluded from the results, along with any economic calculations.

Conclusion

The trial revealed a clear response to applying nitrogen, with all treatments showing significantly elevated biomass under any amount of N greater than 0, as well as a significant increase from N50 to N175. Unfortunately, given the missing yield and economics data, the optimal application strategy cannot be conclusively determined. However, the data from 2024 would indicate a nitrogen rate >50 units to likely be optimal. Further testing is required in future seasons. There was no discernible response to a high or low K&S rate, though a repeat of the trial in future seasons may reveal a yield or economic benefit.

Potassium Rates in Wheat, Jacup

Contact: Andrew Wallace awallace@summitfertz.com.au

Key Points

- Poor and uneven germination means results must be treated with caution.
- No significant responses were identified between K rates at the site.
- Emergence appeared to reduce under 30 units of K, though not significantly.
- The most economical treatment was K15, with an indicative gross margin of $1504/ha.

Aim

This trial aims to identify the optimal potassium (K) rate for maximising production and economic return on a wheat crop in the Jerramungup area.

Property	Trevor Ross, Jacup
Crop Variety	Catapult Wheat, sown @85kg/ha
Total Season Nutrients	N110, P16, S12. K rates: 0, 15 & 30. MAPSZC, MOP, Urea, $MnSO_4$, MAXam.
Rainfall	250mm GSR; Decile 5

Treatments

The trial was sown on the 15th of May. All plots received the same basal nutrients, consisting of 30 N, 16 P, and 12 S. There were three K rates, which were nil K, 15 K and 30 K. All K was applied at seeding in the form of MOP, according to the determined treatment rate. At 3-leaf and mid-tillering growth stages, 50 and then 30 units of N were applied as in-season applications respectively.

Emergence

Emergence across this trial, recorded at 3-leaf, while at an average of 96 plants/m^2, it was extremely patchy, likely due to non-wetting issues leading to poor germination in some plots. Given this, it was still noted that K0 had the highest emergence of 111 plants/m^2, as opposed only 79 plants/m^2 at K30. K15 was in the middle at 103 plants/m^2. However, no strong conclusions can be drawn from these values as the patchy germination created large variation within the trial.

Background

In order to maximise productivity, sufficient K must be supplied to crops for them not to suffer deficiencies that can lead to poor growth and yield penalties. However, K is a costly product, and applying the most efficient rate is important for maximising cropping productivity.

Identifying the quantity that both satisfies plant requirements and provides a sound return on investment is critical for growers.

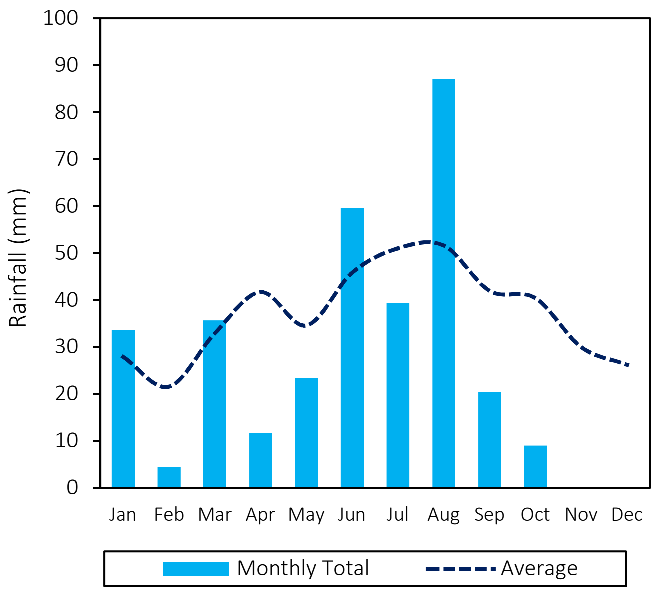

Figure 1. Rainfall data from Jacup DPIRD station. 2024 monthly totals (bars) and 30-year average (line) shown.

Figure 2. Soil test data, taken February 2024.

Depth cm	pH [$CaCl_2$]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	OC %	NO_3^- mg/kg	NH_4^+ mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	Sand %	Silt %	Clay %
0-10	4.9	12	21	28	36	14	1.4	18	2	0.2	0.7	2.9	95	3	5
10-20	4.3	7	38	7	25	8	0.9	6	1	0.1	0.2	0.7	94	4	5
20-30	4.3	5	37	7	25	8	0.6	4	1	0.1	0.1	0.3	93	5	5

Biomass

Due to uneven germination, followed by patchy crop establishment, NDVI data must be considered with some caution. Given this, no significant biomass differences were found between any treatments (p=0.10). Interestingly, NDVI decreased as K rate increased, though not significantly.

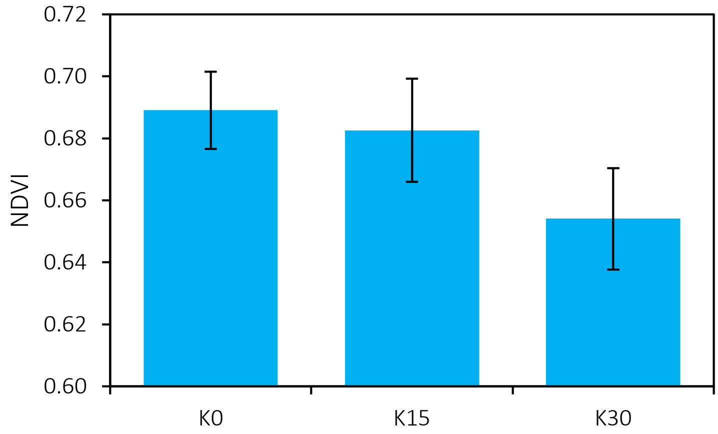

Figure 2. NDVI data recorded on 28/08/2024 at mid-tillering.

Yield

The trial had an average yield of 3.8t/ha across all treatments. No significant differences were identified in yield between K rates (p=0.65). Yields were slightly higher at K0 and K15 by approximately 100kg/ha (figure 3). Protein levels were essentially the same across all treatments, with K15 and K30 being 0.1% higher than K0. There was however, a tendency for individual K0 replicated to have lower protein values, leading to decreased CBH receival grades, compared to K15 and K30.

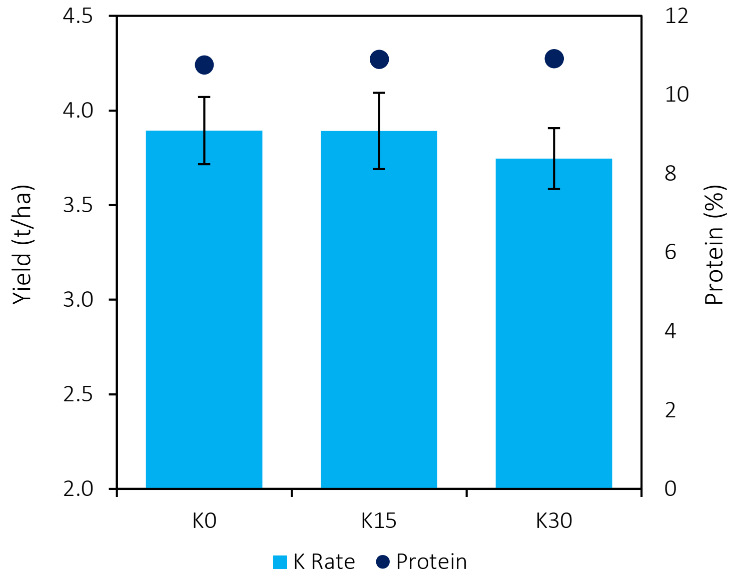

Figure 3. Yield (bars) and grain protein (markers) averaged across three K rates.

Economics

Indicative gross margins identified K15 as the most profitable treatment, with a value of $1504/ha, $28/ha greater than K0 and $43/ha greater than K30 (figure 4). The least economical was K30 at $1461/ha, $15/ha lower than K0.

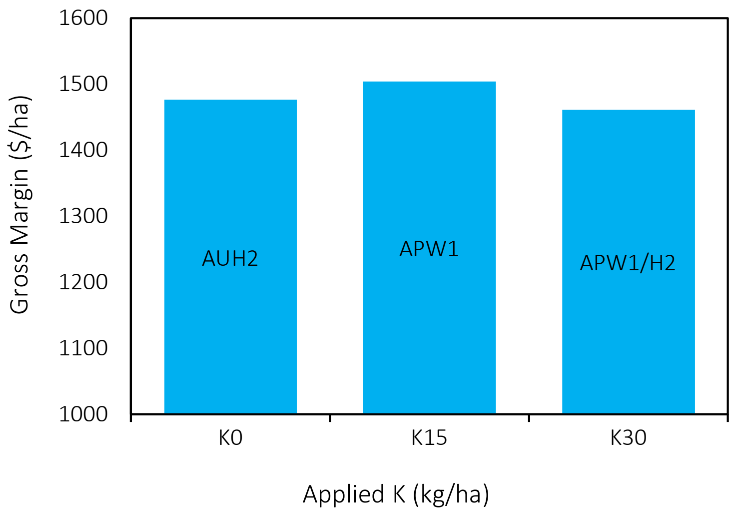

Figure 4. Indicative gross margins ($/ha) averaged over three K rates. Based on CBH grain receival standards and grain values, November 2024.

Conclusion

The Jacup site had no significant differences at emergence, in-season NDVI readings or harvest yield over three K rates. Poor germination resulted in unreliable in-season measurements and ultimately may have affected final yield and grain quality. As such, results should be treated with caution. In-field observations indicated K30 upfront may have negatively impacted crop establishment, though this was not statistically reinforced. It is likely K15 would be the optimal application rate under normal conditions, though this was not able to be demonstrated in 2024, primarily due to the poor crop establishment early in the season.

EEF Products for Wheat, Dalyup

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Key Points

- No significant differences between seeding nitrogen EEF were observed in-season or at harvest.
- BiOWiSH had the highest emergence and NDVI values, but did not yield significantly higher.
- The most economical treatment was N-Shield Dual at Seeding, with urea post, however this is due to it being the only treatment to receive AUH2 grade.
- A dry finish to the season may have prevented in-season trends being reflected at harvest.

Aim

Summit Field Research conducted fourteen trials across the WA growing region in 2024 to test several enhanced efficiency fertilizers (EEFs). This trial aimed to identify the efficacy of four N-Shield products, which included two granular (Urea N-Shield NBPT & Urea N-Shield Dual) and two liquid products (N-Shield UAN Guard and N-Shield Hydroguard). Furthermore, a biological EEF, BiOWiSH, was included to test its efficacy in sandy soils around Esperance.

Property	Kogody Farms, Dalyup
Crop Variety	Sceptre Wheat, Sown 16th May @ 100kg/ha, 9" row spacings
Total Season Nutrients	N 125, P 20, S 15, K 25
Rainfall	GSR 242mm, Decile 2, 162mm below 30-year average

Treatments

All plots received a basal application of N35, P20, K25 and S15. Seeding N products were urea, N-Shield Dual, BiOWiSH, N-Shield HydroGuard and UAN as a comparison for HydroGuard. MAPSZC and SOP were used for P, K & S supply.

At three-leaf and late tillering stages, 120L/ha and 95L/ha of UAN (respectively) was applied, amounting in a total N rate of 125 units over the 2024 growing season. All P, K & S was supplied upfront at seeding. Seeding nitrogen sources were varied to determine if any effect could be observed from altering the N source at establishment.

Background

EEF products are coming into focus for the Australian and international agricultural industries, as a method to improve fertilizer efficiency, and reduce environmental impacts from synthetic fertilizer application. N-Shield has developed a number of nitrogen EEF products, some designed to be coated onto urea, and others to be mixed into UAN, primarily to reduce nitrogen losses via volatilization to the atmosphere (NBPT), and losses via soil leaching (DCD). N-Shield Hydroguard combines DCD and a wetter-humectant product in UAN for reduction of N losses via leaching, as well as improving soil wetting ability and moisture retention.

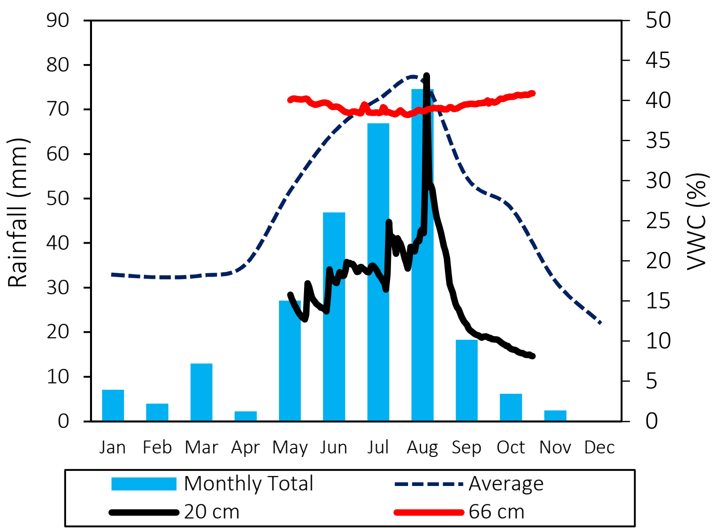

Figure 2. 2024 monthly rainfall, sourced from onsite rain gauge with 30-year long term average from the pleasant valley BOM station (15km NE) graphed (dotted line). Overlaid with CropX soil moisture probe readings from 20cm and 60cm below soil surface.

Table 1. Soil tests from site, taken February 2024.

Depth cm	pH [$CaCl_2$]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	OC %	NO_3^- mg/kg	NH_4^+ mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	Sand %	Silt %	Clay %
0-10	6.0	26	28	86	85	41	1.2	12.7	1.7	0.7	1.6	2.6	91.7	3.6	4.8
10-20	4.6	22	22	59	34	26	0.7	6.3	1.7	0.6	0.4	0.9	92.3	2.5	4.9
20-30	4.6	12	24	23	38	18	0.3	4.3	1.7	0.3	0.2	1.3	92.7	2.1	5.2

Emergence

Crop establishment was satisfactory with a trial average of 135 plants/m^2. The only observed visual and measured difference at this stage was the BiOWiSH coated urea having a notably higher emergence of 157 plants/m^2, around 20 plants greater than all other treatments.

Biomass

NDVI recordings identified no significant differences between seeding products (p=0.31), or post-products (p=0.18). However, a trend was observed in which BiOWiSH was visually more vigorous, and measurements were notably higher than other treatments (figure 3).

Yield

The trial averaged 2.9t/ha under the decile 2 growing season in 2024. There were no significant yield differences between seeding products (p=0.24) or post products (p=0.16). It was noted that the greatest yield of 3.2t/ha was found under a combination of N-Shield Dual at seeding, with Urea as the post product. A combination of Urea at seeding, followed by N-Shield UAN Guard also yielded well at 3.1t/ha. As yields increased, protein tended to decrease across the trial.

Economics

Applications of any product other than urea resulted in decreased profitability, with the exception of BiOWiSH (seeding and post), which had the second best indicative gross margin of $629/ha, behind only that of Dual seeding, Urea post at $636/ha. It is worth noting, due to high moisture at harvest and very high screenings, most treatments resulted in poor receival grades of FED1 or AUN2, with only the most profitable treatment receiving AUH2 grade. For simplification, as there were no significant differences, only the post-product graph is shown

Conclusion

Under the decile 2 growing season in 2024, no significant differences were identified between any EEF's applied either seeding or post applications. However, some trends appeared, with BiOWiSH showing the greatest emergence and NDVI values, and all treatments yielding the same. The most profitable treatment was Dual at seeding, Urea post, being the only one to receive AUH2 grade. Had the season not dried out after August, harvest and economic results may have shown more conclusive trends among the EEF products.

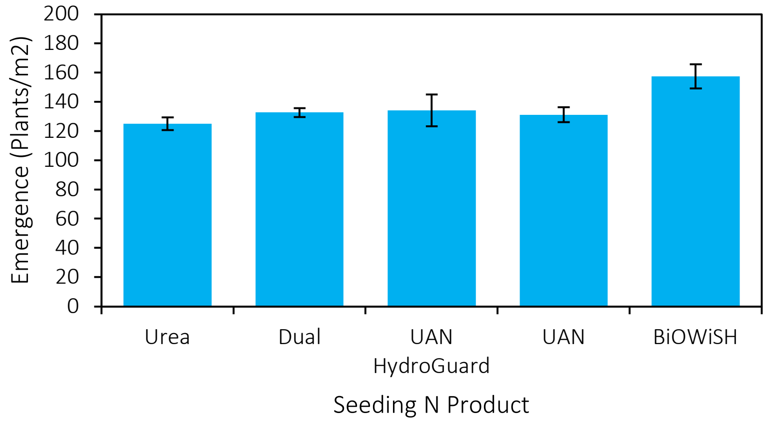

Figure 2. Emergence counts, taken 18th July.

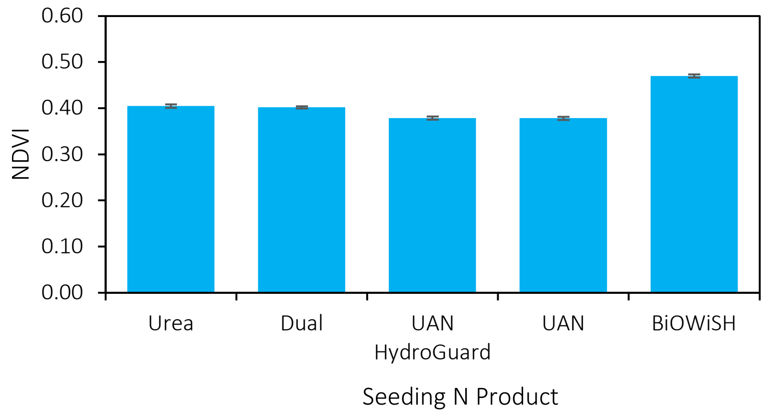

Figure 3. NDVI measurements over post N products, taken 25th July.

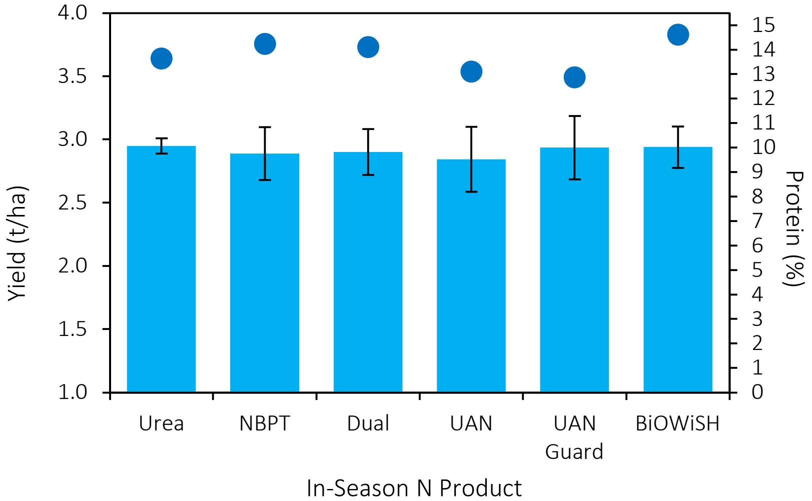

Figure 4. Yield (t/ha) and protein (%) averaged across post N products.

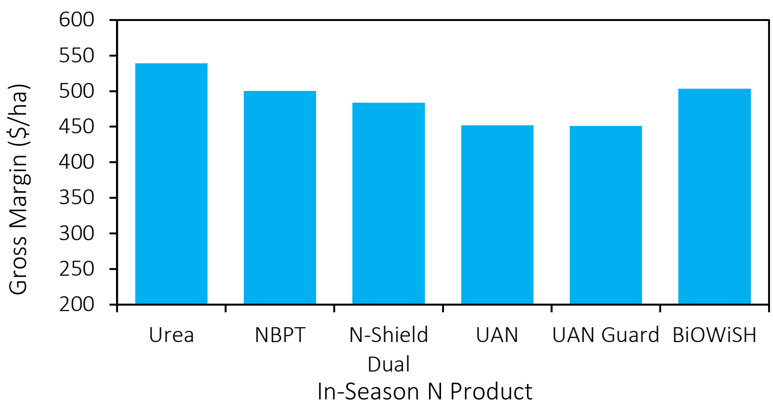

Figure 5. Indicative gross margins averaged across post N products.

For more information talk to your local Summit Area Manager

SUMMIT FIELD RESEARCH

LT K Rates, Esperance, 2024 Wheat

Contact: **Nick Donkin** ndonkin@summitfertz.com.au **Matt Ryan** mryan@summitfertz.com.au

Key Points

- Under the decile 2 growing season, no significant in-season or yield differences existed between any K treatments.
- With the exception of K45, decreasing profitability was observed with increasing applications of K.
- Below 10cm, soil K levels have increased over initial 2021 values, except under K60 treatment. All 2024 K rates were lower than 2021 levels at the topsoil under continuous cropping.

Aim

To assess the cumulative long-term effect of applied potassium (K) fertilizer and cropping rotation in building, maintaining, and drawing down soil K levels. This is the fourth year of the trial so cumulative effects from repeating previous applications will be assessed, to help improve the understanding of K application strategies on soil fertility and crop growth over a long term in a typical cropping rotation in the Esperance growing region.

Property	Kogody Farms, Dalyup
Crop Variety	Sceptre Wheat, Sown 16th May @ 100kg/ha, 9" row spacings
Total Nutrients	N 125, P 20, S 30, K 0, 15, 30, 45, 60
Rainfall	GSR 242mm, Decile 2, 162mm below 30-year average

Treatments

All plots received a basal application of N35, P22, S30 with K rates following the factorial protocol of 0, 15, 30, 45 and 60kg/ha. Seeding products were MAPSZC, MAXam, SOP, Urea and Vigour. At three-leaf and late tillering stages, 120L/ha and 95L/ha of UAN was applied, amounting in a total N rate of 125 units over the 2024 growing season. All K was supplied upfront at seeding.

Background

In order to best understand potassium application methods and rates, investigation into the long-term effects of leaching, crop rotations and environmental conditions under different application rates is being undertaken at this site in Dalyup. This multi-year trial will provide in-season data from various crops, as well as annual soil test results which can be used to identify trends and support fertilizer recommendations for growers in the Esperance area.

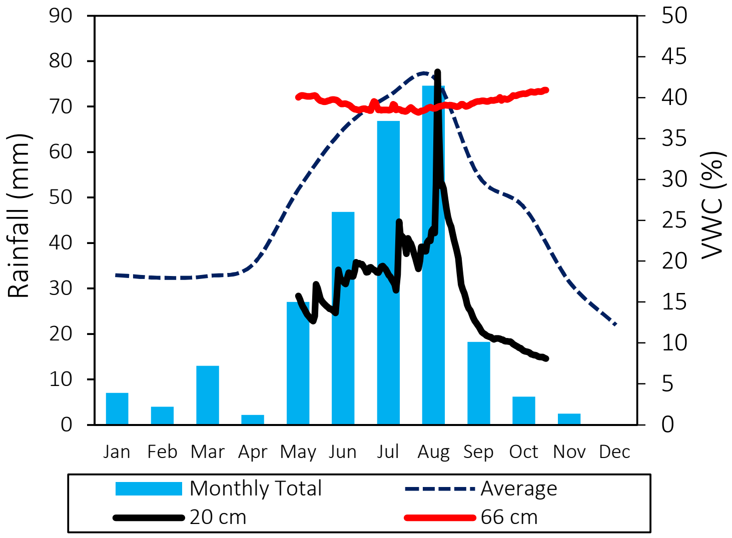

Figure 1. 2024 monthly rainfall, sourced from Pleasant Valley BOM site (14km NE), with 30-year long term average graphed. Overlaid with CropX soil moisture probe readings from 20cm and 66cm below soil surface.

Table 2. Initial site soil tests from commencement of the trial in 2021.

Depth cm	pH [$CaCl_2$]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	OC %	NO_3^- mg/kg	NH_4^+ mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	Sand %	Silt %	Clay %
0-10	6.0	26.0	28.3	86.0	84.7	41.0	1.2	12.7	1.7	0.7	1.6	2.6	91.7	3.6	4.8
10-20	4.6	21.7	22.3	59.0	33.7	26.3	0.7	6.3	1.7	0.6	0.4	0.9	92.3	2.5	4.9
20-30	4.6	12.3	23.7	22.7	38.0	17.7	0.3	4.3	1.7	0.3	0.2	1.3	92.7	2.1	5.2
30-40	4.9	5.7	36.7	-	69.3	8.0	0.3	4.0	1.0	0.2	0.1	0.9	90.3	2.1	7.5
40-50	5.4	5.0	79.3	-	150.0	10.0	0.4	3.7	1.0	0.2	0.2	0.5	76.3	2.6	21.3

Emergence

Crop emergence was satisfactory with an average of 135 plants/m^2 across the trial (figure 2). Some trends emerged, with K30 being higher than all other treatments, with a bell curve trend appearing.

Biomass

NDVI data identified no significant differences between any treatment (p=0.52) at either recording date, with no visual trends apparent either (figure 3). Nil K was predictably the lowest, however this was not significant.

Yield

No significant differences were identified across any treatments in 2024 (p=0.64). K45 yielded marginally higher with 100kg/ha more than all other treatments at 3.9t/ha. Protein had a slightly decreasing trend as K rate went up, though very minimal (figure 4).

Economics

Under 2024 growing conditions and grain prices, a similar trend was observed as that of yield and NDVI, with the K45 treatment having the highest indicative gross margin (figure 5). This was because it was the only treatment to make AUH2 grade, with all others making AWW2, with hectolitre weights falling below threshold for AUH2. However, without this grade difference, a clear, linear trend would be present with decreasing gross margins as K rate increased. This left as the K0 the most economical treatment under 2024 conditions.

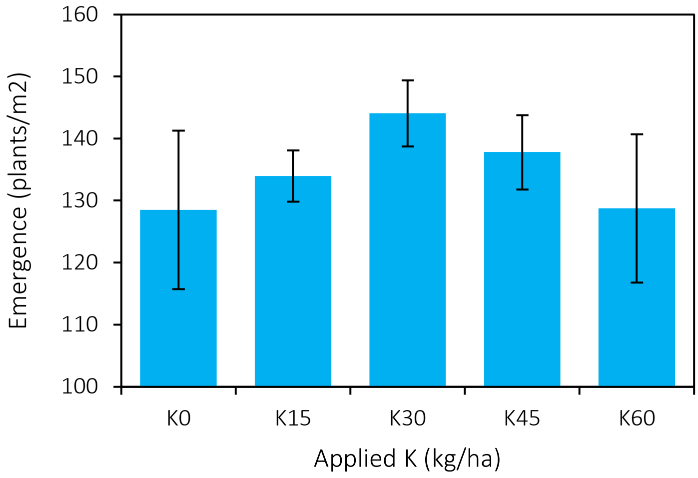

Figure 2. *Emergence counts, taken 18th July, at all K rates.*

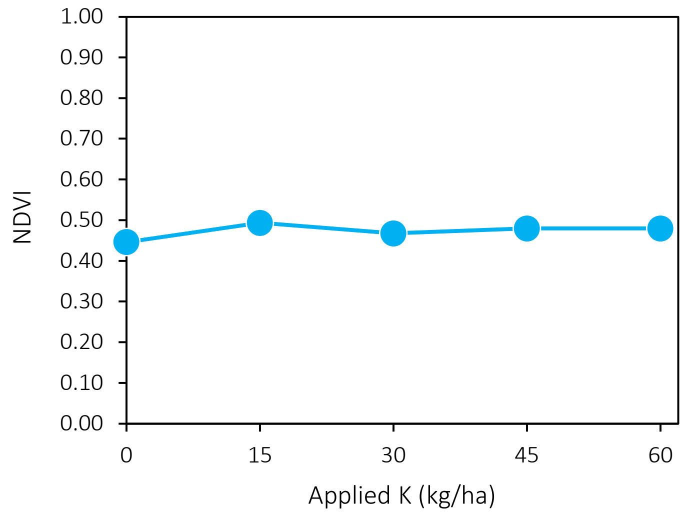

Figure 3. *NDVI values, recorded 25th July, at all K rates.*

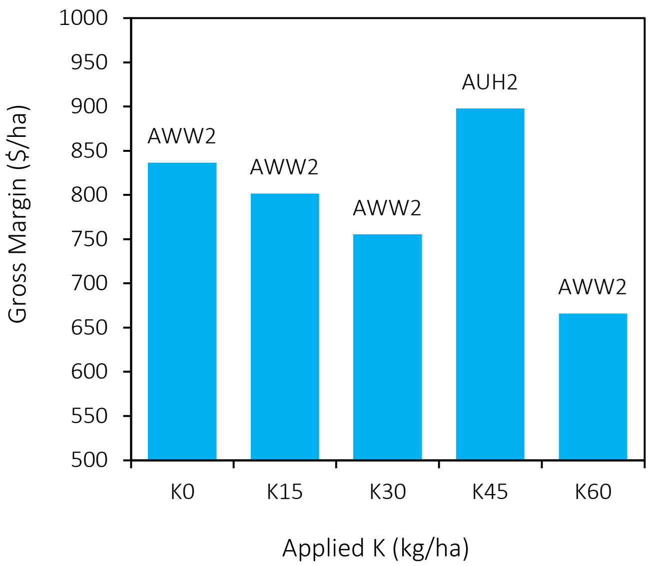

Figure 5. *Indicative gross margins across all K rates.*

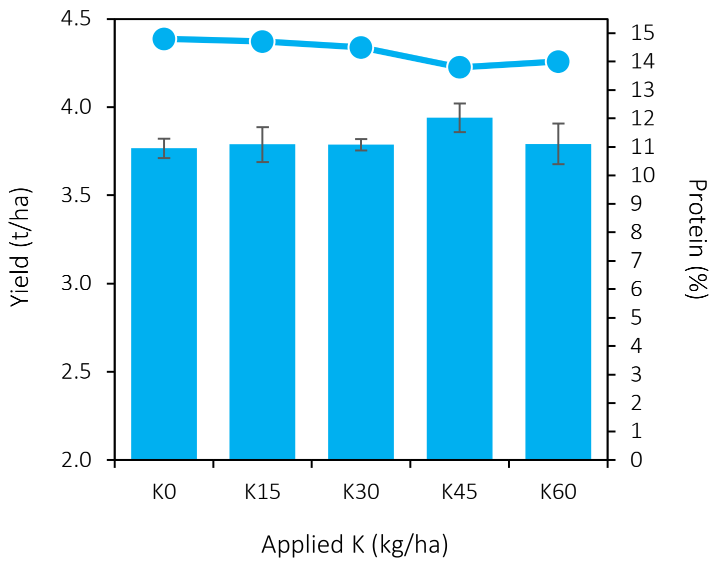

Figure 4. *Yield (bars) and protein (lines), showing no significant differences.*

Soil Tests

Soil tests taken from plots under each K rate in 2024 showed all K rates being below initial (2021) soil test values in the topsoil (0-10cm), with K30 being the closest to initial values (figure 6).

At all sub-soil levels (below 10cm), all K rates were elevated over 2021 values, with the exception of K60 below 30cm and K30 below 40cm. A general trend of increased Colwell K levels was present in the subsoil, when compared to initial 2021 values. This is expected, as applications of K surplus to crop requirements are likely to leach down the profile, with the crop consuming K in the topsoil as required - hence the lower topsoil levels, but elevated subsoil values.

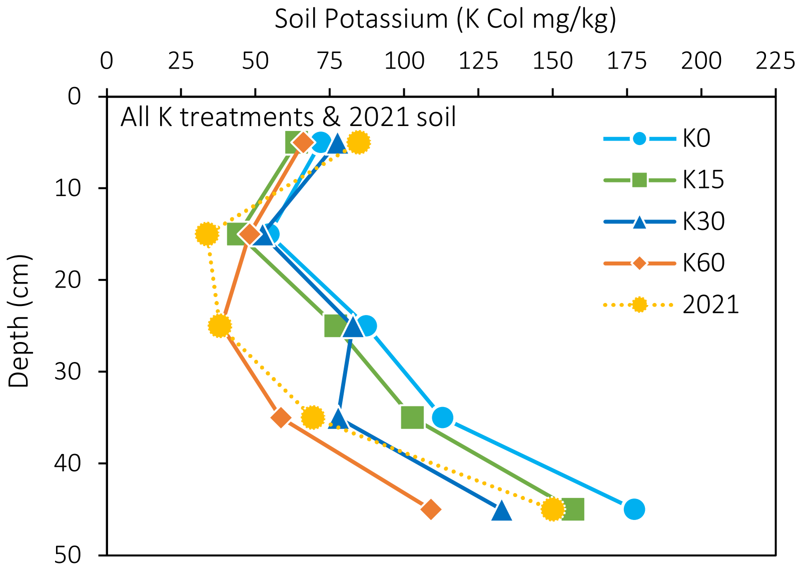

Figure 6. Soil K levels (K Col) over time. Initial (2021) results represented by dotted yellow line with 2024 test results at each K rate represented by orange, dark blue, green and light blue.

Conclusion

Given the decile 2 season, the trial site performed reasonably well, however no significant differences were identified between any treatments either in-season or during harvest. The only trends that appeared were a very marginal yield increase at K45, though this may be due to variation within replicates. Overall, there was decreasing profitability by applying potassium in the 2024 growing season. Soil testing has shown a general accumulation of K at depth, with topsoil potassium being slightly reduced under continuous cropping rotations. Future years of this trial may identify other trends that could provide valuable insight to K applications and management strategies for growers around Esperance.

LT P Rates, Esperance, 2024 Wheat

Contact: **Nick Donkin** ndonkin@summitfertz.com.au **Matt Ryan** mryan@summitfertz.com.au

SUMMIT FERTILIZERS

Key Points

- Under the decile 2 growing season, all applications of P had significantly higher in-season growth and yielded significantly higher than the P0 treatment.
- The inSITE® recommended P9 treatment was the most profitable in 2024, with diminishing returns above this rate.
- Topsoil P reserves are slowly being depleted under continuous cropping, with subsoil stores gradually increasing under high annual P applications of 18 and 30 units.

Aim

To assess the cumulative long-term effect of applied phosphorus (P) fertilizer and cropping rotation in building, maintaining, and drawing down soil P levels. This is the fourth year of this long-term trial so accumulative affect from previous P applications will be assessed to help improve the understanding of long-term effects of different P rate applications under the typical cropping rotation of the Esperance growing region.

Property	Kogody Farms, Dalyup
Crop Variety	Sceptre Wheat, Sown 16th May @ 100kg/ha, 9" row spacings
Total Nutrients	N 125, P 0, 9, 12, 18, 24, 30, S 15, K 25
Rainfall	GSR 242mm, Decile 2, 162mm below 30-year average

Treatments

All plots received a basal application of N35, K25 and S15 with P rates following the factorial protocol of 0, 9, 12, 18, 24 and 30kg/ha. Note, P9, while not factorial, was included as it was the Summit InSite recommended P rate based on modelling soil test values. Seeding products were MAPSZC, MAXam, SOP, Urea and Vigour. At three-leaf and late tillering stages, 120L/ha and 95L/ha of UAN were applied respectively, amounting in a total N rate of 125 units over the 2024 growing season. All P, K & S was supplied upfront at seeding.

Background

In order to best understand phosphorus application methods and rates, investigation into the long-term effects of leaching, crop rotations and environmental conditions under different application rates was undertaken at this site in Dalyup. This multi-year trial will provide in-season data from various crops, as well as annual soil test results which can be used to identify trends and support P fertilizer recommendations for growers in the Esperance area.

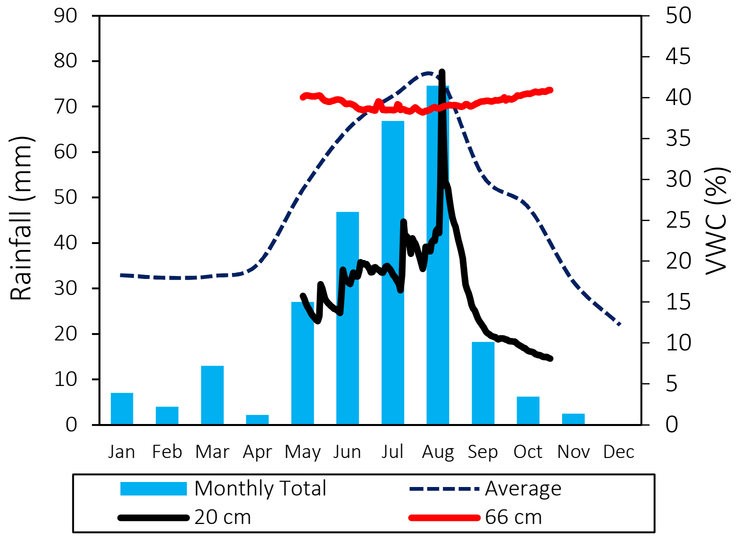

Figure 1. 2024 monthly rainfall, sourced from Pleasant Valley BOM site (14km NE), with 30-year long term average graphed. Overlaid with CropX soil moisture probe readings from 20cm and 66cm below soil surface.

Table 2. Initial site soil tests from commencement of the trial in 2021.

Depth cm	pH [CaCl$_2$]	P Col mg/kg	PBI	DGT-P µg/L	K Col mg/kg	S mg/kg	OC %	NO_3^- mg/kg	NH_4^+ mg/kg	Cu mg/kg	Zn mg/kg	Mn mg/kg	Sand %	Silt %	Clay %
0-10	6.0	26.0	28.3	86.0	84.7	41.0	1.2	12.7	1.7	0.7	1.6	2.6	91.7	3.6	4.8
10-20	4.6	21.7	22.3	59.0	33.7	26.3	0.7	6.3	1.7	0.6	0.4	0.9	92.3	2.5	4.9
20-30	4.6	12.3	23.7	22.7	38.0	17.7	0.3	4.3	1.7	0.3	0.2	1.3	92.7	2.1	5.2
30-40	4.9	5.7	36.7	-	69.3	8.0	0.3	4.0	1.0	0.2	0.1	0.9	90.3	2.1	7.5
40-50	5.4	5.0	79.3	-	150.0	10.0	0.4	3.7	1.0	0.2	0.2	0.5	76.3	2.6	21.3

Emergence

Crop emergence was strong with an average of 163 plants/m^2 across the trial. While not statistically significant ($p=0.42$), P9 and P12 had higher emergence than other treatments, with P0 having the lowest (figure 2).

Biomass

NDVI data taken over two sampling dates identified a significant difference between P0 and all other P rates ($p<0.001$) at both measurements. There was a generally increasing trend up to P18, after which a plateau was observed (figure 3).

Tissue Tests

Plant tissue tests showed a predictable and near-linear increase in crop P levels (%) as application rates increased up to P30 (figure 4). A clear trend was observed with strong uptake of soil-applied P indicated by the almost-linear tissue values.

Yield

Crop yields were reasonable considering the decile 2 season with an average of 3t/ha. Yield followed the same trend as NDVI, with a significant difference being found between P0 and all other P rates ($p<0.001$). Once again, an increasing trend was observed as P rates increased, up to P18. Interestingly, yield dipped at P24, a pattern which was also observed in the NDVI measurements. Protein levels peaked at P24, then dropped slightly at P30. A yield response curve (figure 6 below) shows a clear response to P9, followed by the aforementioned plateau effect.

Economics

Under 2024 growing conditions and commodity prices, a trend was observed in which profitability increased significantly from P0 to P9, after which returns plateaued, with the exception of P24, which dropped to a lower receival grade, and suffered greatly reduced margins. P9 was identified as the most profitable treatment with an indicative gross margin of $748/ha (figure 7 below). All treatments received AUH2 grade, except P24, as it suffered low hectolitre weight and high screenings.

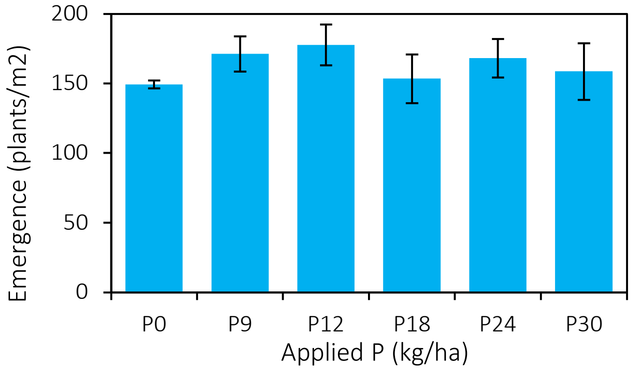

Figure 2. Emergence counts, taken 18th July, at all P rates.

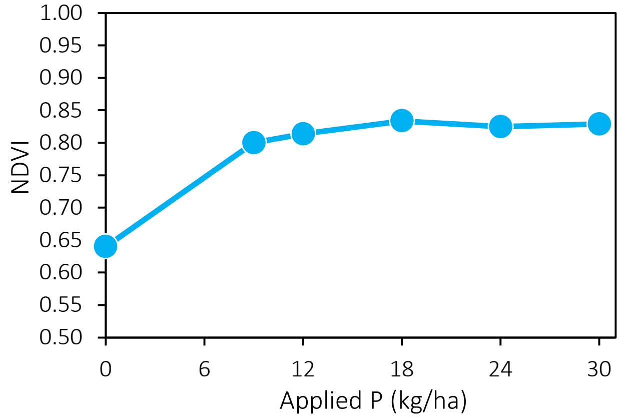

Figure 3. NDVI values, recorded 29th August, at all P rates.

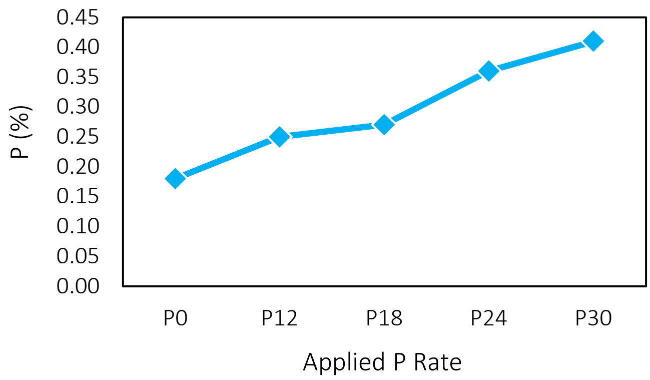

Figure 4. Crop tissue tests, taken 13th August, at all P rates.

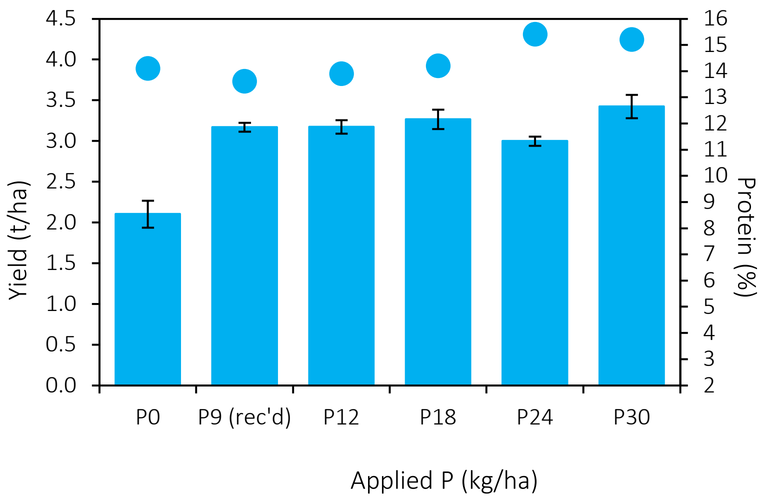

Figure 5. Yield (bars) and protein (lines), showing the significant difference identified between P0 and all other P rates.

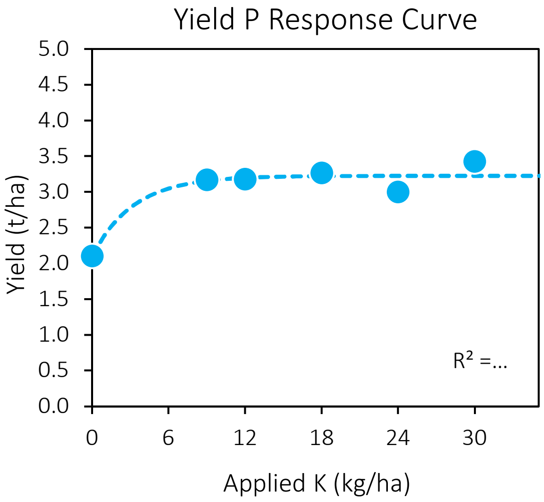

Figure 6. *Yield response curve, Mitscherlich function fitted.*

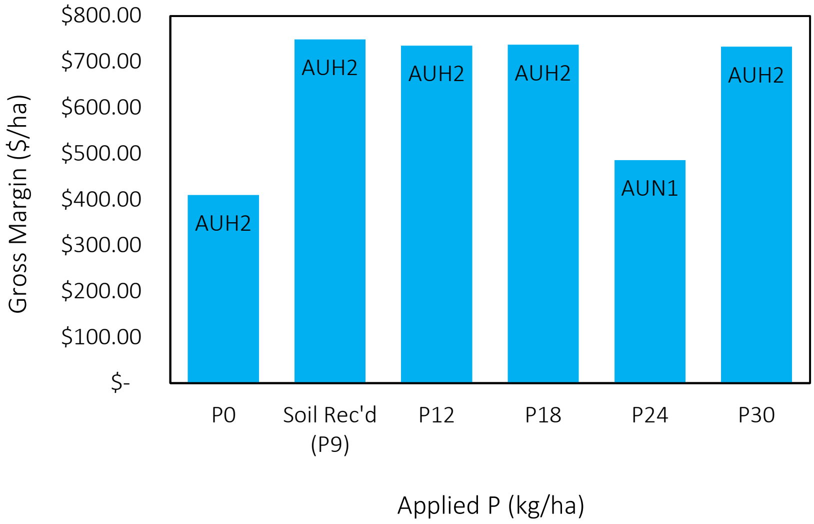

Figure 7. *Indicative gross margins across all P rates.*

Soil Tests

Soil tests taken from plots across each P rate in 2024 showed all P treatments to have dropped below initial 2021 values in the topsoil, and down to a 30cm depth. This illustrated the slow depletion/draw down of continuous cropping on soil P reserves. P0 is, as expected, the most depleted treatment, with P18 and P30 predictably having the closest values to initial 2021 results.

At deeper sub-soil levels (below 30cm), P0 and P9 were still depleted, compared to 2021 results, but P18 and P30 appear to have increased soil P levels at depth. This demonstrates a leaching and accumulation effect of high levels of P being applied consecutively under continuous cropping (figure 8). DGT-P (figure 9) had a similar, but less significant trend, with topsoil values being below 2021 results, but most sub-soil tests were very similar to initial 2021 results. One exception was P0, which appeared to have significantly higher sub-soil DGT-P levels. This may be due to leaching, although it would be expected that the applied P treatments would leach similarly also.

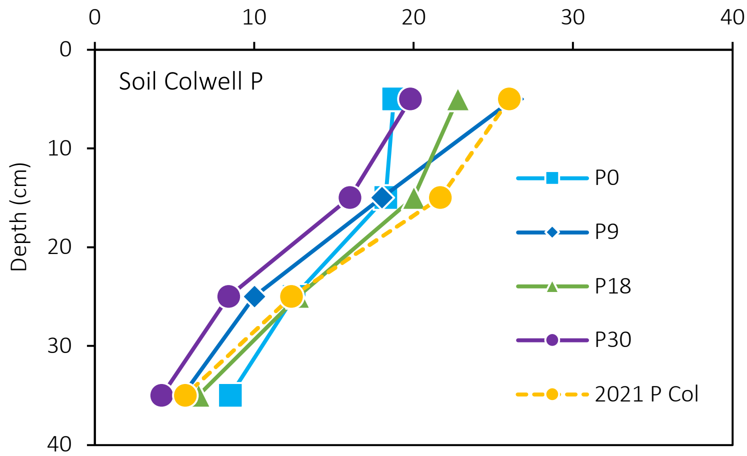

Figure 8. *Soil P levels (Colwell P, mg/kg), showing 2024 soil test results at each P treatment rate, compared to initial 2021 P values (yellow line).*

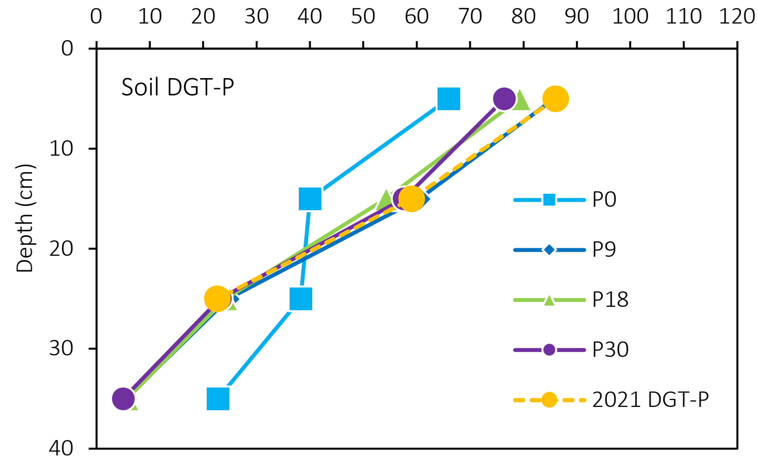

Figure 8. *Soil P levels (DGT-P µg/L), showing 2024 soil test results at each P treatment rate, compared to initial 2021 P values.*

Conclusion

Given the decile 2 season, the trial site performed reasonably well, with significant differences being identified between P0 and all other P rates in both NDVI and yield measurements. The site responded to applications of P, with the inSITE recommended P9 treatment proving to be the most profitable in 2024. P24 appeared to suffer both in-season and at harvest, with lower NVDI and yield values, though the reason is unclear. Diminishing returns occurred over 18 units of P. Soil test results show a slow draw-down/depletion effect taking place under continuous cropping, however P reserves at depth are slowly increasing under high applications of P (18 & 30 units). Further trialling at this site may reveal new trends or re-affirm those already being observed over the last four years.


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