Trial 4. Nutrition for Hyper Yielding Wheat (FAR NSW W23-05) cv Stockade

Key Points:

- *Following six years of pasture legume 2014-19 (Fescue/Lucerne/Clover), and three years of cropping (canola 2020, grazing wheat 2021 and canola 2022), there was no significant yield response to applied nitrogen (80-280kg N/ha), although there was a trend for higher yield up to 160kg N/ha.*
- *With 226kg N/ha in the soil 0 – 60cm on 10 July the zero N treatment (only 12kg N/ha MAP applied) yielded 8.08t/ha with a protein of 9.5% indicating the presence of 154kg N/ha in grain at harvest.*
- *If 75% of the N is assumed to be in the grain, and 25% in the straw residue, then the total N uptake at harvest in zero N plots would be 169kg N/ha indicating approximately 57kg N/ha left over from what was measured at sowing, assuming no losses.*
- *All N applications applied as 2 or 3 split urea applications only served to increase protein, but the yield increases evident up to 160kg N/ha were not statistically significant.*
- *Applying N as a three split at 200 N gave a yield increase which in 2022 was also associated with lower lodging pressure than the equivalent two split approach, but the yield difference in both years was not significant.*
- *Applying manure or the equivalent macro nutrients carried in the manure on top of 120N gave no significant yield benefit, but the manure treatment did confer higher biomass at flowering than the equivalent inorganic fertiliser treatment.*
- *There were no significant differences in harvest dry matter as a result of N application.*
- *The zero N treatment had the highest test weight and lowest screening as was the case in 2022.*

Treatments:

Stockade white wheat was subjected to 10 nutrition treatments of varying nitrogen (timing and rate) and manure rates (Table 1). The 5t/ha manure (chicken manure pellets) treatments were applied on top of 120kg N/ha applied as a two split 50% at GS30 (pseudo stem erect) and 50% at GS32 (2nd node). The manure pellets had an analysis of N 1.14%, P 0.68%, K 1.52% and S 0.38%. The total value (NPKS) of the 5t/ha application is detailed in Table 4. The available soil N was measured on 10 July with 0-10cm 43kg N/ha, 10-30cm 70kg N/ha and 30-60cm 113kg N/ha giving a total of 226kg N/ha in the 0 – 60cm horizon. Note this was applied after 120kg/ha MAP was applied. The trial site has an organic carbon content of 2.6% in the 0 – 10cm.

Table 1. Treatment details and application timings.

		Sowing	GS30	GS32	GS39
		21 April	22 July	9 Aug	5 Sep
Treatment		**kg N/ha (MAP at sowing)**	**kg N/ha**	**kg N/ha**	**kg N/ha**
1	0N	12	-	-	-
2	80kg N/ha	12	40	40	-
3	120kg N/ha	12	60	60	-
4	160kg N/ha	12	80	80	-
5	200kg N/ha	12	100	100	-
6	240kg N/ha	12	120	120	-
7	280kg N/ha	12	140	140	-
8	200kg N/ha (3 split)	12	80	80	40
9	120kg N/ha + Manure	12+5t/ha Manure	60	60	-
10	120kg N/ha + Manure Equiv.	12+ NPKS Manure equivalent	60	60	-

*Manure nutrient analysis and equivalent nutrient rates detailed in table 12.

Although all treatments applying nutrition were higher yielding than the nil N control (MAP only) the yield differences were not statistically significant. With 226kg N/ha in the soil plus 12kg N with the MAP it was more than enough to supply the nil N treatment which took off approximately 127kg N/ha in the grain. If 25% of the N at harvest was assumed to be in the crop canopy then the total offtake (grain and straw) would be approximately 169kg N/ha, which is almost identical to the nutrient input achieving the highest yield (160 N plus 12 N with the MAP – total 172kg N/ha). The results mirrored those observed in previous seasons with only small responses in grain yield to applied N up to a maximum of 160kg N/ha and then reductions in yield relative to 160kg N/ha with higher levels of N application (200 – 280kg N/ha). Although the yield did not increase above 160kg N/ha the grain protein did continue to increase significantly along with increases in screenings and trend towards lower test weights.

Table 2. Influence of nutrition strategy on wheat grain yield (t/ha) and grain quality (Protein (%), thousand seed weight (TSW), test weight (kg/hL), and screenings (%)).

		Grain Yield and Quality									
Treatment		**Yield t/ha**		**Protein %**		**TSW g**		**Test Weight kg/hL**		**Screenings %**	
1	0N	8.03	-	9.0	f	38.8	-	77.1	-	5.9	c
2	80kg N/ha	8.35	-	10.2	e	36.5	-	76.1	-	6.3	bc
3	120kg N/ha	8.33	-	10.8	d	33.3	-	76.1	-	6.3	bc
4	160kg N/ha	8.70	-	10.9	d	34.6	-	76.4	-	6.0	c
5	200kg N/ha	8.08	-	11.8	ab	33.8	-	74.1	-	7.2	ab
6	240kg N/ha	8.08	-	12.0	a	33.4	-	75.1	-	7.4	a
7	280kg N/ha	8.48	-	12.0	a	33.8	-	75.1	-	7.2	ab
8	200kg N/ha (3 split)	8.62	-	11.6	bc	34.7	-	75.6	-	6.7	abc
9	120kg N/ha + Manure	8.51	-	11.2	cd	32.2	-	74.7	-	7.5	a
10	120kg N/ha + Manure Equiv.	8.57	-	11.6	bc	34.5	-	75.4	-	7.5	a
Mean		**8.38**		**11.1**		**34.5**		**75.6**		**6.8**	
P Value		0.142		<0.001		0.115		0.146		0.004	
LSD P=0.05		ns		0.4		ns		ns		1.0	

The manure treatments did significantly affect tiller number recorded at GS31, but there were no significant effects on head number, although there was a trend which suggested the nil N had fewer heads and manure treatments had more heads, along with some of the higher N treatment applications (Table 2). There was evidence at GS31, GS69 and at harvest that dry matter (biomass) was higher where manure had been incorporated with the seeder at sowing in April (Table 3).

Table 3. Influence of nutrition strategy on plant numbers, tiller numbers and head numbers (/m^2), harvest biomass (t/ha) and harvest index (%).

Treatment		Plants/m^2		Tillers/m^2		Heads/m^2		Biomass t/ha		Harvest Index %	
1	0N	119	-	575	cd	467	-	16.3	-	43.3	-
2	80kg N/ha	123	-	596	bcd	518	-	16.9	-	43.5	-
3	120kg N/ha	116	-	566	cd	485	-	16.8	-	43.8	-
4	160kg N/ha	121	-	602	bcd	527	-	17.3	-	44.2	-
5	200kg N/ha	105	-	544	d	490	-	16.5	-	43.2	-
6	240kg N/ha	135	-	626	abc	569	-	17.2	-	41.1	-
7	280kg N/ha	111	-	612	bc	516	-	17.6	-	42.3	-
8	200kg N/ha (3 split)	124	-	642	ab	566	-	18.1	-	41.9	-
9	120kg N/ha + Manure	129	-	684	a	565	-	18.3	-	40.8	-
10	120kg N/ha + Manure Equiv	117	-	654	ab	530	-	17.1	-	43.7	-
Mean		**120**		**610**		**523**		**17.2**		**42.8**	
P Value		0.215		0.002		0.105		0.477		0.792	
LSD P=0.05		ns		61		ns		ns		ns	

Table 4. Influence of nutrition strategy on biomass production (t/ha) at three critical growth stages.

		GS31		GS69		GS89	
Treatment		**Biomass t/ha**		**Biomass t/ha**		**Biomass t/ha**	
1	0N	1.85	-	11.47	-	16.27	-
2	80kg N/ha			11.48	-	16.89	-
3	120kg N/ha			11.82	-	16.75	-
4	160kg N/ha			12.79	-	17.31	-
5	200kg N/ha			12.29	-	16.50	-
6	240kg N/ha			12.10	-	17.19	-
7	280kg N/ha			12.41	-	17.62	-
8	200kg N/ha (3 split)			12.17	-	18.08	-
9	120kg N/ha + Manure	2.10	-	12.96	-	18.29	-
10	120kg N/ha + Manure Equiv	1.72	-	12.05	-	17.12	-
Mean		**1.89**		**12.15**		**17.20**	
P Value		0.092		0.713		0.477	
LSD P=0.05		0.35		1.73		1.91	

As we have found previously, manure has significantly increased biomass at flowering, this was again the case in this trial with the manure treatment producing significantly more biomass at flowering than the equivalent treatment using inorganic fertiliser equivalents for the macro elements (Figure 1).

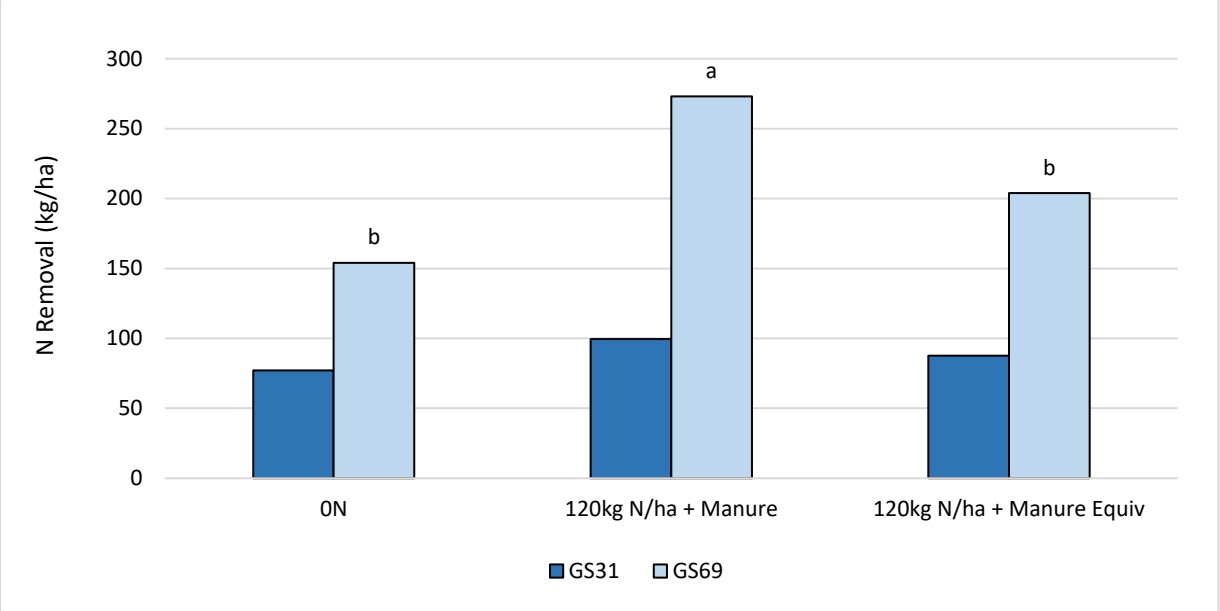

Figure 1. Nitrogen content (kg N/ha) of wheat crop.

Table 5. Nutrient value of manure applied and products used in equivalent treatment.

Trt#	Product	Rate	Nutrient Value (kg/ha)			
		kg/ha	**N**	**P**	**K**	**S**
9	Manure	5000	57.1	34.2	76.1	19.5
10	Ammonium Sulphate	81	16.8			19.3
	Monopotassium Phosphate	123		28.1	35.2	
	MOP	82			41.0	
	Urea	83	37.5			
	MAP	28	2.8	6.1		0.4
	Total		**57.1**	**34.2**	**76.2**	**19.7**

Appendix:

The following details apply to all trials unless specified differently.

Overall inputs:

Table 1. Trial input and management details.

Sowing date:		**21 April 2023**
Harvest date:		18 December 2023
Seed rate:		180 seeds/m^2
Basal fertiliser:	21 Apr	120 kg/ha MAP (12kg N/ha)
Nitrogen:	2 Aug	Urea 217kg/ha (100kg N/ha)
	5 Sep	Urea 108kg/ha (50kg N/ha)
Herbicides:	19 Apr	Sakura 118g/ha
		Avadex Xtra 1.6L/ha
		Roundup 2.0 L/ha
	1 Jun	Lontrel 60g/ha
		LVE MCPA 570 440mL/ha
		Paradigm 25g/ha
		Wetter 1000 0.2%
	25 Aug	Paradigm 25g/ha
		Chemwet (0.2%)
Insecticide	25 Aug	Cyhella 18mL/ha (tank mixed with herbicide)