

Trial 5. Nitrogen Use Efficiency – Plant population x nitrogen interaction trial



Protocol Objective

To evaluate the influence of plant population on nitrogen use efficiency (NUE), dry matter production, grain yield and harvest index in grain maize.

Peechelba East, Victoria

Sown: 13 November 2019

Harvested: 31 May 2020

Soil Type: Red loam over clay

Previous Crop: Oaten hay

Hybrid: Pioneer Hybrid 1756

FAR code: FAR IRR M19-03

Irrigation Type: Overhead pivot

Key Messages:

- The average grain yield (header harvest) of the trial was 17.12t/ha with no indication that increased nitrogen rate (from the use of pre-drill urea) significantly increased yield when 207kg N/ha was subsequently applied in crop as fertigation.
- The lowest plant population 79,287 plants/ha resulted in the lowest yields with no grain yield difference between 91,864 and 103,620 plants/ha. 91,864 plants/ha was the most profitable.
- Normalised differential vegetative index (NDVI) assessments indicated that ground cover was significantly lower in the lowest plant population across all assessment timings up to V8.
- The most efficient recovery of nitrogen applied was recorded with plant populations of approximately 92,000 plants/ha with N applied by fertigation totalling 207 kg N/ha.

Table 1. SAGI analysis for grain yield (t/ha), test weight (kg/hl), harvest index (%) and harvest dry matter (t/ha).

Treatment		Yield		Test Weight		Harvest Index		Total DM	
Population	N Rate*	PV	SE	PV	SE	PV	SE	PV	SE
79,287	0	15.87	+/- 0.62	80.94	+/- 0.38	0.53	+/- 0.02	34.92	+/- 2.47
79,287	90	16.45	+/- 0.62	81.18	+/- 0.38	0.51	+/- 0.02	37.57	+/- 2.42
79,287	180	16.93	+/- 0.62	81.05	+/- 0.38	0.52	+/- 0.02	34.38	+/- 2.51
91,864	0	17.24	+/- 0.62	81.15	+/- 0.38	0.53	+/- 0.02	34.51	+/- 2.46
91,864	90	18.57	+/- 0.62	80.84	+/- 0.38	0.56	+/- 0.02	29.16	+/- 2.52
91,864	180	16.87	+/- 0.70	80.76	+/- 0.38	0.52	+/- 0.02	36.27	+/- 2.46
103,620	0	17.03	+/- 0.62	80.99	+/- 0.38	0.54	+/- 0.02	31.11	+/- 2.41
103,620	90	17.33	+/- 0.62	81.21	+/- 0.38	0.55	+/- 0.02	30.48	+/- 2.46
103,620	180	17.77	+/- 0.62	80.89	+/- 0.38	0.56	+/- 0.02	31.16	+/- 2.42
Mean		17.1		81		0.5		33.3	
Population P val		0.032		0.851		0.233		0.051	
N rate P val		0.25		0.829		0.995		0.811	
Interaction P val		0.36		0.928		0.056		0.351	
LSD		1.579		1.033		0.036		6.72	
CV		7.602		0.864		6.691		15.106	

PV= Predicted value, SE= Standard error

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* Levels of pre-sow N only showed in table 1. Post sowing nitrogen (207 N) was applied via fertigation with applications at V4 (46N), V8 (60N), pre-tasselling (101 N) on 10 Dec, 26 Dec, 14 Jan and 15 Jan across ALL treatments. Therefore, total N rates in this trial were 207, 297 and 387 kg N/ha. Available soil N assessed prior to sowing 33 kg N/ha (0-60cm)

Grain Yield

The trial gave an average of 17.12 t/ha. There was no interaction between plant population and the rate of nitrogen applied indicating that the effects of lower plant population were the same irrespective of the level of pre-drill (sow) urea. Varying plant population did result in significant differences in grain yield when plant populations were reduced to 79,287 plants/ha, with a significant reduction of 0.96 - 1.14t/ha in comparison to the higher plant populations of 91,864 and 103,620 plants/ha (Table 1). There was no yield difference between 91,864 and 103,620 plants/m².

NDVI

Significant differences were observed throughout the season in crop reflectance (crop reflectance measured as NDVI with the Greenseeker) indicating less crop ground cover (reduced NDVI) with the lowest plant population plots (79,287plants/ha) in comparison to the higher plant population plots (Figure 1).

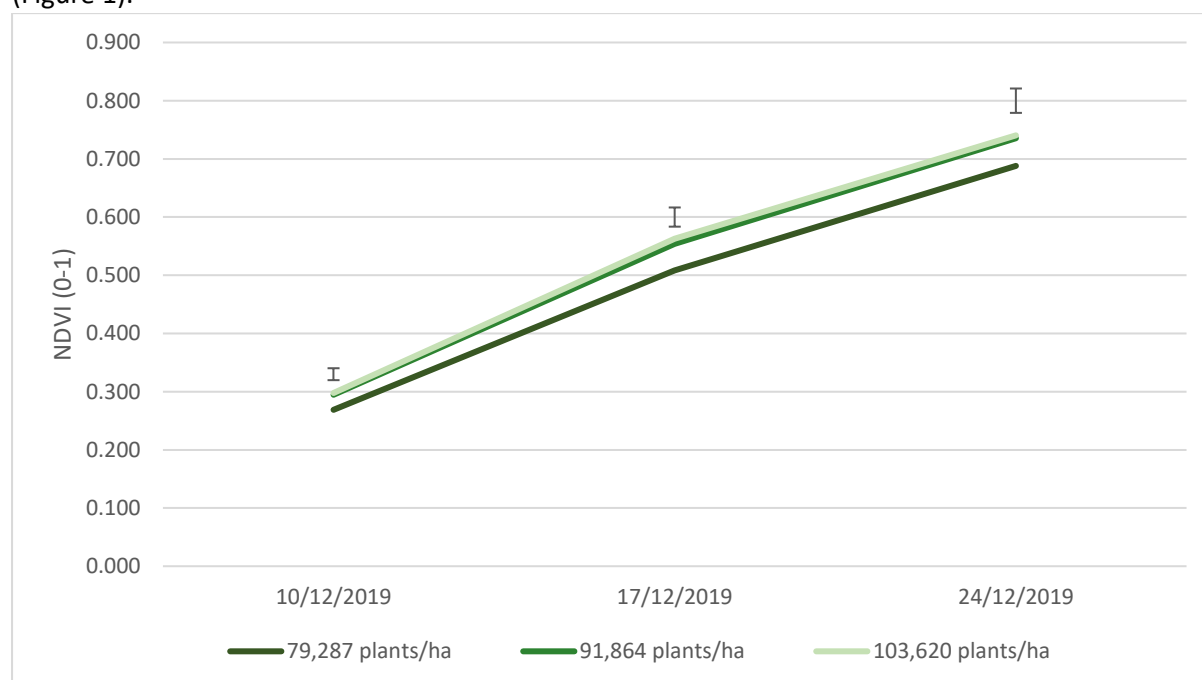


Figure 1. Influence of plant population on Normalised Difference Vegetation Index at V4 on 10 December (p=0.025), V6 on 17 December (p=0.014) and V8 on 24 December (p=0.041). Error bars are a measure of LSD.

Dry Matter at Harvest

There was no difference in dry matter offtake at harvest as a result of plant population with some evidence of more vegetative growth with the lowest plant population registered as more dry matter as stover (leaves stalk and cob husk) rather than grain (Table 2).

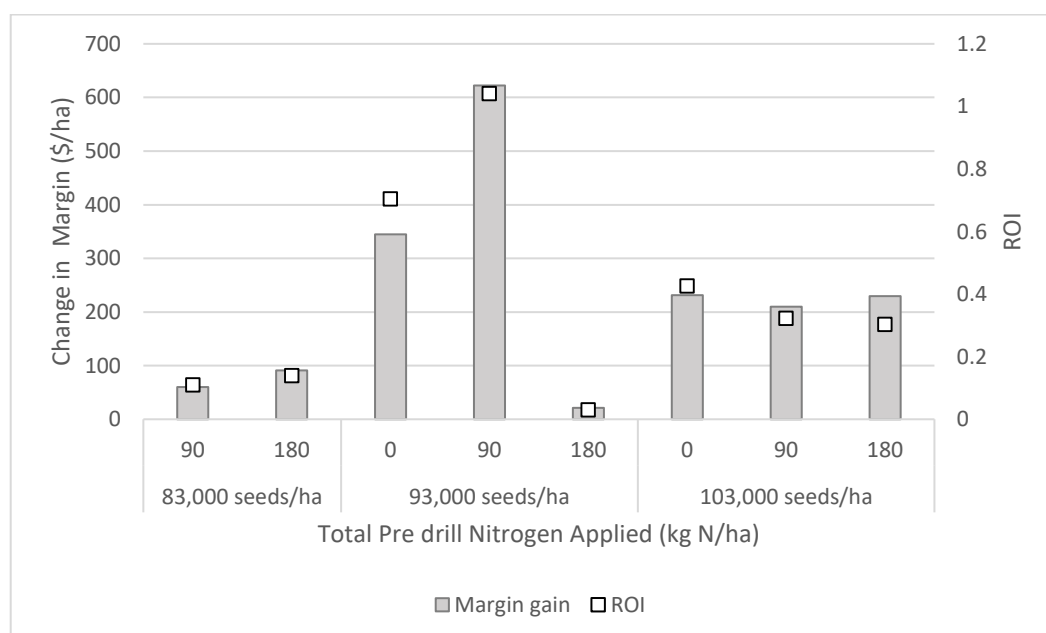
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Table 2. Dry Matter (t/ha at 0% moisture) accumulation at harvest in the different plant components.

Dry Matter (mean of 3 Pre-drill N rates)			
	Stalk	Cob husk	Grain
Plants/ha	t/ha	t/ha	t/ha
79,287	14.27 a	2.51 -	14.09 b
91,864	12.85 ab	2.47 -	15.11 a
103,620	11.93 b	2.35 -	14.96 a
Mean	13.02	2.40	14.72
LSD	1.68	NS	0.81
P Val	0.038	0.374	0.042

Table 3. Original ARM analysis of grain yield (t/ha @ 14% moisture) of three pre-drill nitrogen application rates at three different plant populations presented in the provisional results.

Total Applied Nitrogen Rate (additional pre-drill N at sowing in brackets)				
Total N kg N/ha Pre drill N (..)	207kg/ha N (0)	297kg/ha N (90)	387kg/ha N (180)	Mean N rate
Actual Plants/ha	Yield t/ha	Yield t/ha	Yield t/ha	Yield t/ha
79,287	15.89 -	16.37 -	16.88 -	16.38 b
91,864	17.21 -	18.66 -	16.84 -	17.57 a
103,620	17.18 -	17.37 -	17.63 -	17.40 a
	16.76	17.47	17.12	
LSD N Plant Pop p = 0.05		0.94	P val	0.042
LSD N Application Rate p=0.05		NS	P val	0.423
LSD Plant pop. x N Rate. P=0.05		NS	P val	0.266

**Figure 3.** Influence of Pre-drill nitrogen rate on margin over input cost compared to treatment 1 – 83,000 seeds/ha with zero pre drill N (\$/ha – value of increased grain production minus cost of inputs) and return on investment (ROI). Based on SAGI predicted yield. Yield differences in N rates were not significant. *Input costs based on price of \$1.20/kg N, Seed @ \$380/72,000 seeds, Income based on grain value of \$290/t.*

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