



RESULTS

Optimum timings and rates for the nitrogen (N) forms applied in irrigated crops of maize.

Trial 1. Nitrogen Use Efficiency Trial – influence of rate

Protocol Objective:

To evaluate nitrogen use efficiency in grain maize under different rates of applied N fertiliser applied as pre drill urea (46% N) prior to a standard fertigation (230N) with an overhead lateral.

Peechelba East, Victoria

Sown: 4 November 2020

Harvested: 6 May 2021

Soil Type: Red loam over clay

Previous crop: Grain Maize

Hybrid: Pioneer Hybrid 1756

FAR code: FAR IRR M20-01-1

Irrigation Type: Overhead pivot

Key Points:

- Header grain yields averaged 17t/ha with no yield benefit observed from applying pre-drill urea in the trial when N was applied post sowing as fertigation (230kg N applied).
- In a trial with an overall dose of post sowing N of 230 kg N/ha applied via fertigation there was no value to the earlier pre-drill N applications of between 0 – 315kg N/ha.
- No significant differences were recorded in dry matter (DM) accumulation at V5 or NDVI at V7.
- The N offtake at harvest revealed an average N content of 420kg N/ha with a range of approximately 395-460kg N/ha in the crop.
- The N uptake at harvest indicated soil mineralisation provided up to 79kg N/ha to grow the crop with lower N efficiency recorded from applied fertiliser at higher overall N rates.
- There were no significant differences in test weight (mean 80.7kg/hL)
- Dry matter at harvest showed no differences with an average reading of 35.3t/ha and harvest index mean of 46.9%.
- Exactly two thirds of the N removed in the crop was present in the grain with an average of 280kg N/ha in the grain and 140kg N/ha in the stover.

Table 1: Grain yield (t/ha @ 14% moisture) test weight (kg/hL) and harvest index (H.I. %), 6 May 2021.

Treatment		Grain Yield and Quality			
Pre-drill kg N/ha	Post plant* kg N/ha	Total kg N/ha	Yield t/ha	Test Wt kg/hL	H.I. %
1. 0	230	230	16.03 -	80.4 -	46.0 -
2. 45	230	275	16.05 -	81.0 -	50.0 -
3. 90	230	320	17.04 -	80.7 -	47.0 -
4. 135	230	365	17.00 -	81.0 -	48.0 -
5. 180	230	410	17.68 -	80.5 -	45.0 -
6. 225	230	455	17.09 -	80.4 -	48.0 -
7. 270	230	500	17.70 -	80.7 -	44.0 -
8. 315	230	545	17.41 -	80.7 -	48.0 -
LSD			NS	NS	NS
Mean			17.00	80.7	46.9
P Val			0.478	0.167	0.150
CV			7.79	7.79	5.83

** Post sowing nitrogen (230 N) was applied via fertigation with applications on V4 (46N), V8 (69N), pre-tasselling (115 N) on 20 Nov, 20 Dec and 15 Jan*

Available soil N assessed prior to sowing 111 kg N/ha (0-60cm)

Harvest index based on grain and stover recorded at 0% moisture

There was no significant difference in grain yield as a result of applying pre-drill N rates of between 0 and 315kg N/ha, however there was a trend suggesting that 90kg N/ha pre drill and a total of 320kg N/ha was higher yielding and gave better margin after urea cost (see Table 5).

Dry matter accumulation at V5 stage averaged 0.42t/ha and showed no significant differences in DM across any rate of nitrogen applied pre-drill (data not shown). At V7 stage there was no difference in NDVI as fertigation application became available to the plant.

Table 2: Dry matter accumulation (t/ha) in maize at crop maturity, 23 April 2021.

Treatment		Harvest Dry Matter (recorded at 0 % moisture)				
Nitrogen (kg N/ha)		Stalks	Cobs	Grain	Total	
Pre-drill	Total	t/ha	t/ha	t/ha	t/ha	
1. 0	230	17.03 -	2.23 -	16.68 -	35.95 -	
2. 45	275	14.99 -	2.29 -	16.88 -	34.15 -	
3. 90	320	16.79 -	2.19 -	16.26 -	35.25 -	
4. 135	365	15.79 -	2.19 -	16.58 -	34.55 -	
5. 180	410	16.54 -	2.03 -	15.19 -	33.78 -	
6. 225	455	17.04 -	2.39 -	17.82 -	37.23 -	
7. 270	500	17.21 -	2.07 -	15.06 -	34.35 -	
8. 315	545	17.03 -	2.37 -	17.91 -	37.33 -	
Mean		16.55	2.22	16.55	35.32	
LSD		NS	NS	NS	NS	
P Val		0.803	0.339	0.235	0.746	

Grain yield is higher than machine harvest (Table 1) as data was recorded from quadrat cuts and is expressed at 0% moisture

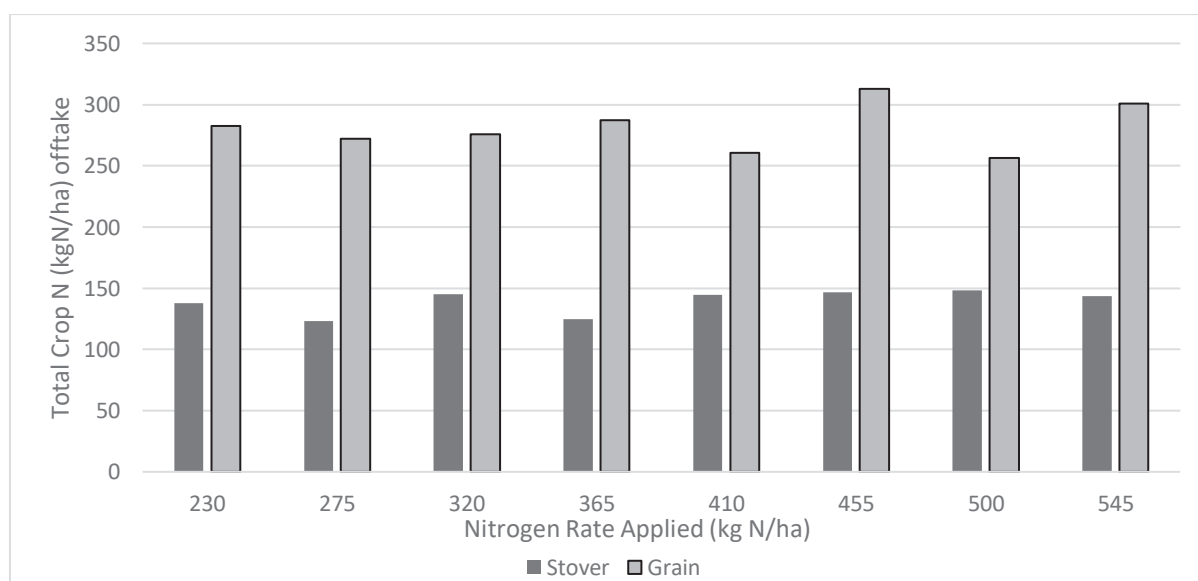


Figure 1. Total crop N (kg N/ha) offtake at harvest in the stover (stalks, leaves, husk) and grain

N uptake into the crop at harvest indicated that between approximately 395 and 460kg N/ha had been removed from soil depending on applied N treatment, although none of the differences in N uptake

were significant (table 3). Approximately 79kg N/ha was provided by mineralisation from the soil in crops where no pre-drilled urea was applied, with 111kg N/ha available in the soil at sowing, giving a total of 190kg N/ha available to crop as soil supply. At higher levels of applied N fertiliser (500 & 545kg N/ha) more N fertiliser was applied than was recovered in the crop.

If the mineralisation in the soil was assumed to be the same over the course of the season for all treatments and all plots had equal access to the same available soil N at sowing then efficiency of N recovery in the crop declined from 26.2kg N/t where 230 kg N/ha was applied as fertigation to 42.2kg N/ha where 315kg N/ha was applied as pre drill Urea and 230kg N/ha was applied as fertigation (Table 4).

Table 3: Nitrogen content (kg N/ha) in maize at harvest, 6 May 2021.

Treatment		Harvest Nitrogen Content*			
Nitrogen (kg N/ha)		Stalks	Cob husk	Grain	Total
Pre drill	Total	N kg/ha	N kg/ha	N kg/ha	N kg/ha
1. 0	230	124.4 -	13.5 -	282.3 -	420.1 -
2. 45	275	109.4 -	13.7 -	272.3 -	395.3 -
3. 90	320	131.9 -	13.3 -	275.6 -	420.8 -
4. 135	365	111.6 -	13.1 -	287.2 -	411.9 -
5. 180	410	132.4 -	12.4 -	260.4 -	405.2 -
6. 225	455	132.3 -	14.5 -	312.7 -	459.5 -
7. 270	500	135.8 -	12.2 -	256.2 -	404.2 -
8. 315	545	128.7 -	14.6 -	300.8 -	444.1 -
Mean		125.8	13.4	280.9	420.1
LSD		NS	NS	NS	NS
P Val		0.755	0.366	0.366	0.759

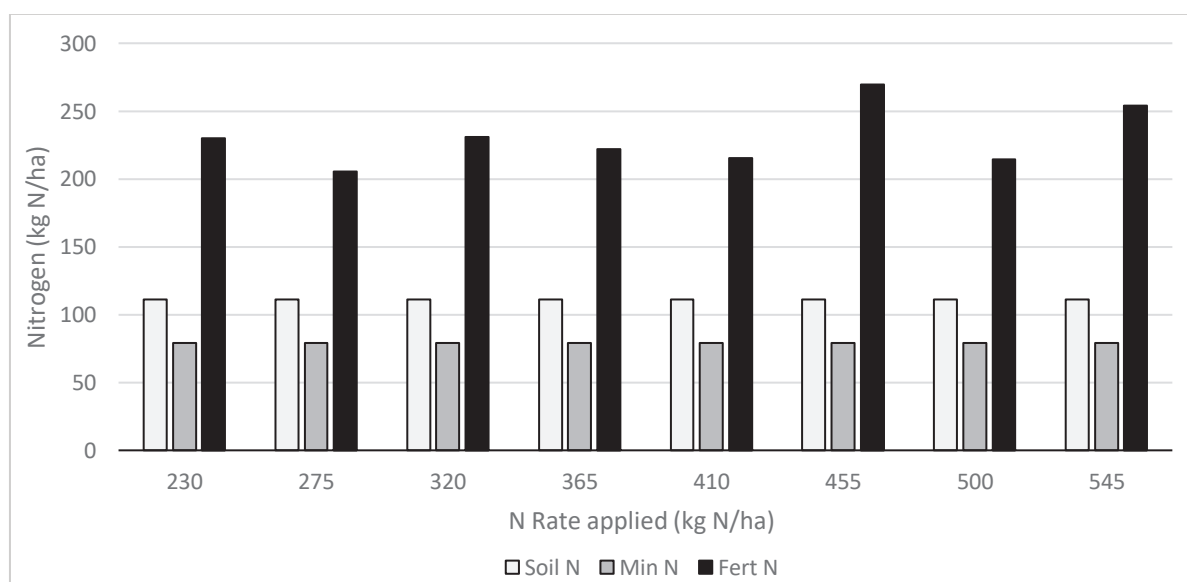


Figure 2: Assumed contribution of N fertiliser to total crop N offtake at harvest (if mineralisation was assumed to be the same in all treatments and that preferential N uptake of soil N rather than bag N was the case). Soil N available at sowing (111kg N/ha), in crop mineralisation N (Min N) (79kg N/ha), Fertiliser N (Fert N) applied as pre drill urea and post sow fertigation.

Note without specific N isotope studies it cannot be accurately calculated what proportion of N uptake by the plant came from the soil and what came from the fertiliser applied).

Table 4: Efficiency of N fertiliser application in relation to nitrogen recovered in the whole crop and per tonne of grain produced at harvest, 6 May 2021.

	Pre-drill kg N/ha	Post drill* kg N/ha	Total kg N/ha	Total N offtake in crop kg N/ha	Machine Grain Yield t/ha (14% moisture)	Fertiliser N recovered in crop (% of applied) +	NUE Kg N fert applied/t of grain (++)
1.	0	230	230	420.1	16.03	230 (100)	14.4 (26.2)
2.	45	230	275	395.3	16.05	205 (75)	17.1 (29.0)
3.	90	230	320	420.8	17.04	231 (72)	18.8 (29.9)
4.	135	230	365	411.9	17.00	222 (61)	21.5 (32.6)
5.	180	230	410	405.2	17.68	215 (52)	23.2 (33.9)
6.	225	230	455	459.5	17.09	270 (59)	26.6 (37.7)
7.	270	230	500	404.2	17.70	214 (43)	28.2 (39.0)
8.	315	230	545	444.1	17.41	254 (47)	31.3 (42.2)

+ Assumptions: Soil nitrogen available at sowing (111kg N/ha) and mineralised through the course of the season (79kg N/ha) was similarly available to all N rate treatments applied

++ Figure in brackets is Kg N/t grain if soil N supply is added to fertiliser applied (total 190kg N/ha of soil mineral N at sowing and mineralised N)

* Post sowing N applied as fertigation (see Table 1)

If the yields of the treatments were considered without statistical significance the highest margins were generated by N applications of 410kg N/ha, since the small non-significant yield increases associated with N application above 230kg N/ha applied were large enough to pay for the additional fertiliser (Table 5).

Table 5: Gross income (\$/ha) based on grain yield and income after urea costs (\$/ha)

Treatment		Pre-drill kg N/ha	Post drill* kg N/ha	Total kg N/ha	Gross income \$/ha	Pre drill urea cost \$/ha \$1.74kg N	Income after Pre drill urea cost \$/ha
1	0		230	230	4809	400	4409
2	45		230	275	4815	478	4337
3	90		230	320	5112	557	4555
4	135		230	365	5100	635	4465
5	180		230	410	5304	713	4591
6	225		230	455	5127	791	4336
7	270		230	500	5310	870	4440
8	315		230	545	5223	948	4275

Assumptions: Grain Maize valued at \$300/t, Urea fertiliser at \$800/t (\$1.74kg N)