CottonInfo nitrogen management trials: Macquarie

Nitrogen Fertiliser Use Efficiency in the Macquarie Valley

Amanda Thomas, CottonInfo RDO

Trial aim

Replicated Nitrogen Fertiliser Use Efficiency trials were rolled out across most of the cotton growing regions last season by the CottonInfo Regional Development Officers with an aim looking further into where our nitrogen (N) ends up and how efficiently it was used.

The trial aimed to go beyond the typical rate trial and take into account:

- The N in the soil before the crop;
- What was removed by the crop and seed N sampling;
- What N was left in the treatments after crop removal;
- The relationship between seed N percentage and Nitrogen Fertiliser Use Efficiency
- The effect on yield of the different rates of N and track the N within the cropping cycle.

Trial details

Location: Auscott Macquarie
Agronomist: Jake Hall
Soil type: Grey Clay
Rainfall: Oct-Mar (mm) 160mm
Planted: 7 October
Picked: 28 April
Treatments: Treatments were applied to plots that were eight rows wide on 1.5m beds each treatment was replicated four times across the field.

Up front N kg/ah	*Water run N kg/ha*	*Total N*
0	160	160
60	160	220
100	160	260
140	160	300
180	160	340
220	160	380

Fig 1. Nitrogen Rates and Delivery Method

The planting configuration is 60 inch (or 1.5m beds), this should be noted when looking at the final yields. The crop received the remainder of N via water run Urea.

Management Notes

Planted: 7 October
Variety: Sicot 74BRF
Previous crop: cotton/fallow/wheat
Other Nutrients: P, K, Z, 20kg N of was applied as MAP

Seasonal review

There was a gappy plant stand in some places but extensive plant counts showed these were consistent across all treatments (7–8 plants/m), once established the crop grew well and tended to fill in most of the gaps, the season had 35 cold shock days and 40 hot days above 35°C. There was 2430 DD (long term average 2140DD).

Fig 2 . Plant stand did have some gaps but was consistent across all treatments.

Trial results and discussion

Each individual plot was picked separately and yield calculated taking into account modules made on the area picked. The treatments were ginned separately to be able to gain separate 'turn out' and quality data. Quality was consistent across all treatments.

N available to the plant

The soil tests measured Nitrate N pre and post crop. The soil Nitrate N concentration reported by the soil analysis was converted to kg N /ha by multiplying the nitrate in the soil x bulk density x test depth/10. The graph below shows all applied fertiliser N and soil nitrogen (pre sowing and post-harvest) in the six treatments.

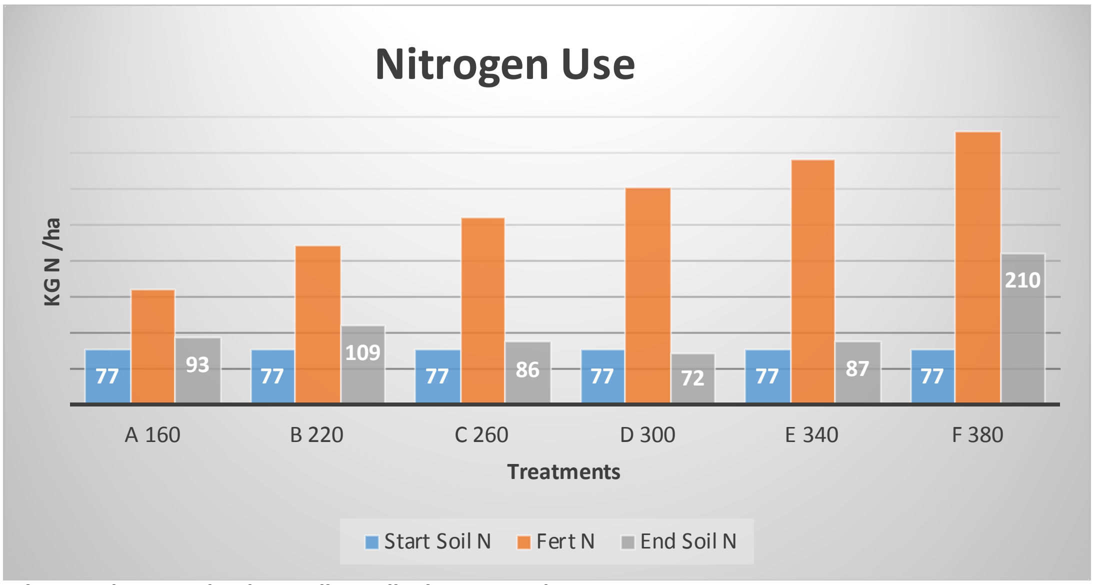

Fig 3. Nitrogen in the soil applied, pre and post crop.

The graph shows that there was no linear relationship between the amount of nitrogen applied and what was was left in the soil. This is not unsusual as much of the unused fertilser N can be lost from the soil through denitrifcation (gaseous loss), leaching of nitrate (either down the soil profile or off the field in run-off irrigation water).

Yield

The analysis of the yield results below showed that there was no statistically signifcant differnce in yield between the six treatments. Given that the field had 77kg of N when sampled to a depth of 90cm and 160Kg was applied as water run urea in the growing season, it is evident that the crop was able to mineralise enough Nitrogen to meet demands and still have some left in the soil post crop (63kg).

Analysis of variance – Lint yield

Variate: Actual_YLD					
Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
N_applied	5	2.8325	0.5665	1.30	0.289
Residual	30	13.0522	0.4351		
Total	35	15.8847			

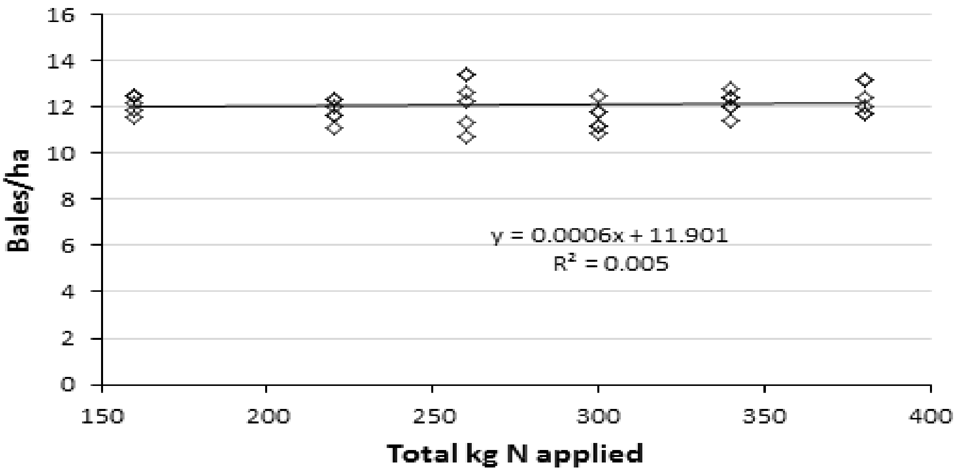

Fig 4. Yield in Bales/ha for each of the treatments .

There was essentially no increase in lint yield from adding N fertiliser in excess of 160kg N/ha. We can gain some idea of what the economic optimum N fertiliser rate may have been by examining the relationships between yield, N fertiliser applied and seed N percentage.

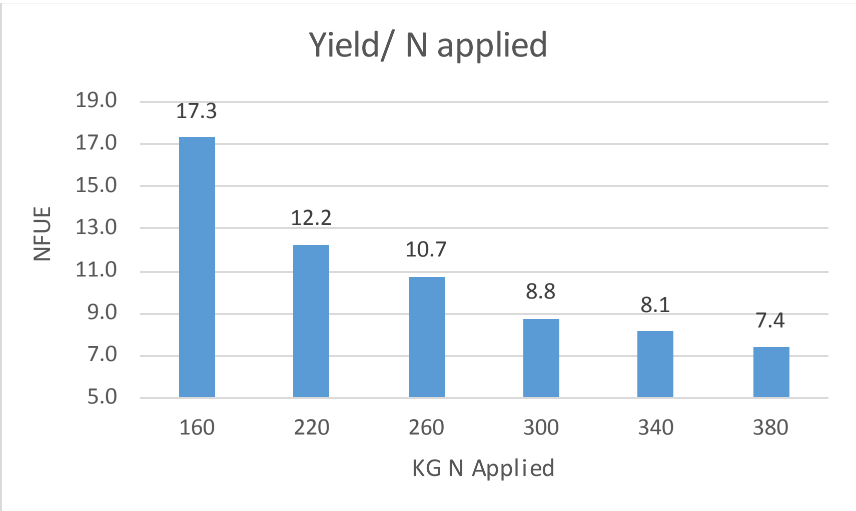

Figure 5. Applied Nitrogen Fertiliser Use Efficiency (optimum is 15.5) Rochester 2014

When the lint yield is divided by the N fertiliser applied, an index is formed which can be related to the optimum N fertiliser rate. Long term studies have shown that the optimum normally lies around 15.5 (range 13-18). Figure 5 below shows that treatments that recieved more than 160 kg N/ha showed poor N fertiliser use-efficiency and that 160 kg N/ha was probably close to the economic optimum N fertilier rate for this site. Adding more N fertiliser did not increase yield but reduced profit.

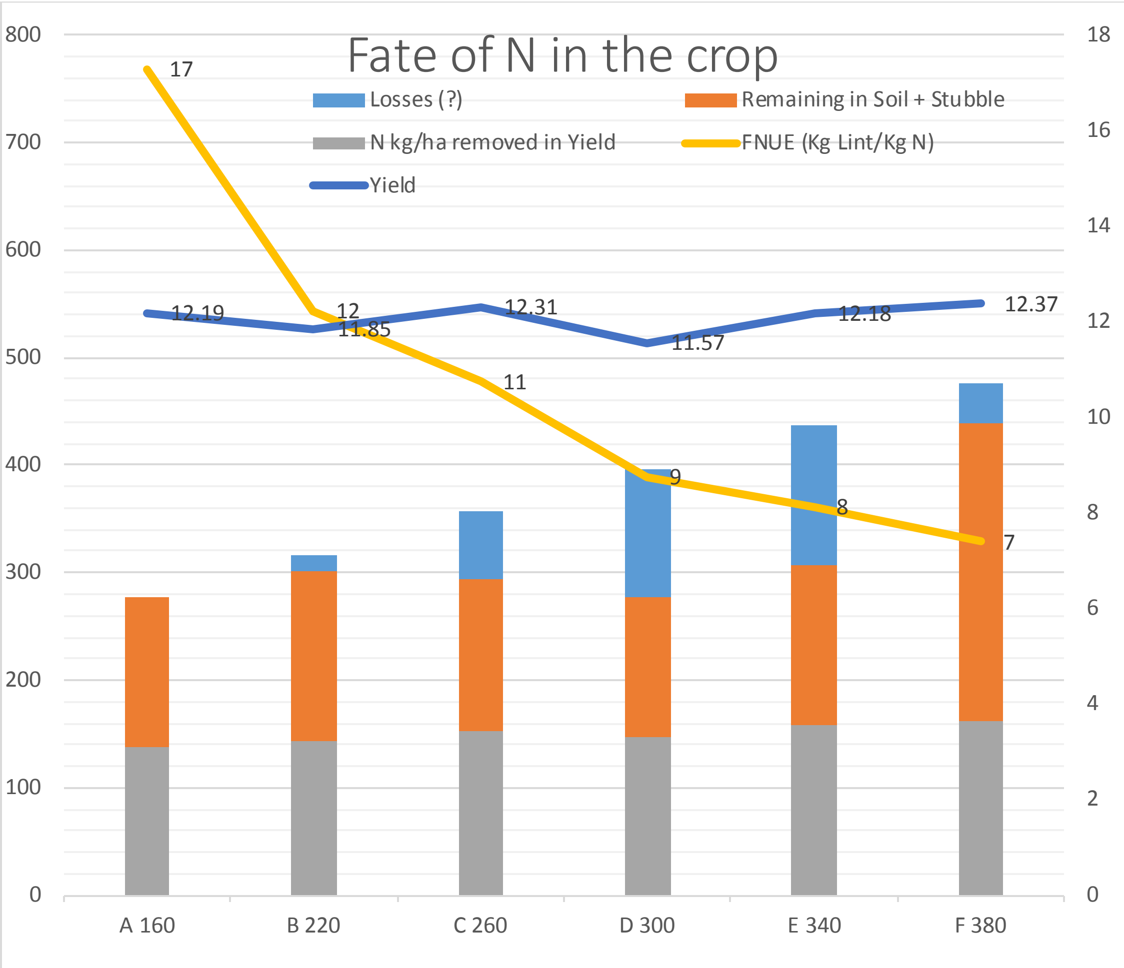

Fig 6. Nitrogen Balance, Nitrogen fertiliser use efficiency and yield.

By measuring N before and after the crop across the treatments we were able to state that Nitrogen was not a limiting factor in this trial. There was no yield difference across the treatments and the highest rate had the highest nitrogen still remaining in the soil. Figure 7 shows the location of the Nitrogen over the three depths tested. The location of N in the profile can impact its availability and losses.

Additional information on the rate of mineralisation and any major loss events in the season would be required to better understand the whole nitrogen cycle. Next season, a new soil test will be trialed that measures in crop mineralisation of nitrogen. The pre -season soil samples were taken across random sections of the whole filed and the post soil tests were taken within each treatment across two of the replications.

The Nitrogen Fertiliser Use Efficiency (NFUE) was calculated only on the applied Nitrogen and does not take into account what was already in the soil. The formula is yield in KG/Ha divided by the applied N fertiliser in kg/ha. Rochester 2013 determined the optimum NFUE to be in the range of 13-18 Kg/lint per kg/N applied. Figure 6 shows only two of the rates were within the optimum range for NFUE , the yield was not significantly affected by the more efficient rates.

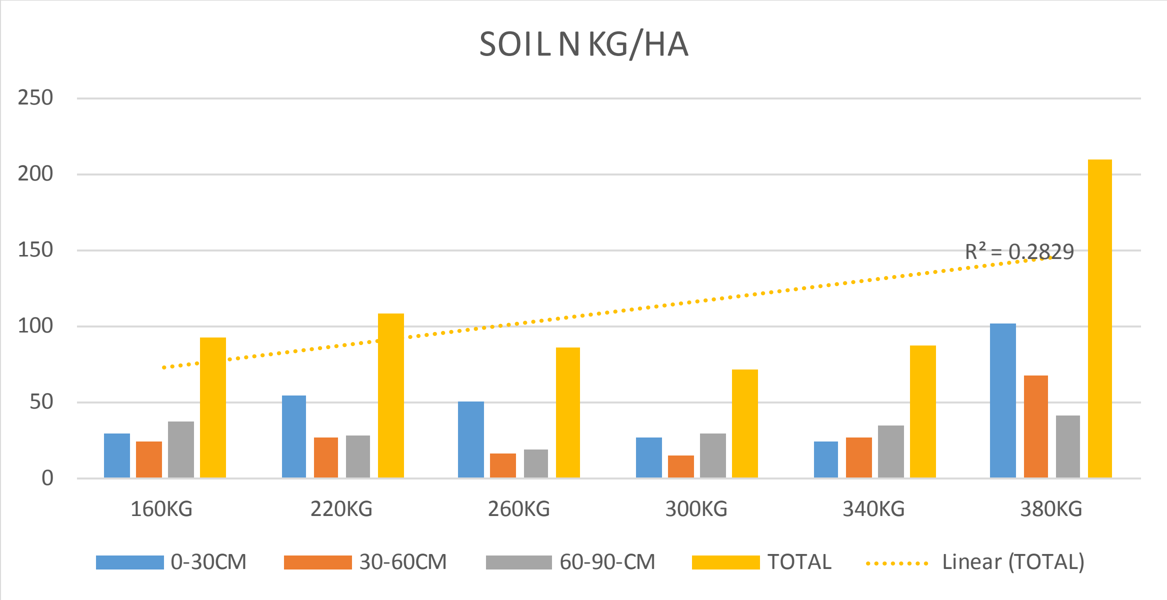

Fig 7. Soil Nitrogen post cotton crop.

Conclusion

Many relationships that can occur with in the cotton crop were examined by the CottonInfo nitrogen trial. This is the second year we have conducted the trials. The main take home message is that nitrogen was not the limiting factor for the 2014-2015 season. The results showed the same yield for $200/ha less nitrogen fertiliser applied. This yield is dependent on the contribution of the pre-plant soil nitrogen and the in crop mineralisation of nitrogen.

The RDO trials from other regions have demonstrated that both of these sources can be quite variable, emphasising the need to do pre-plant soil tests and to take the previous cropping history and soil health into consideration when developing a nutrient budget.

The trials continue to demonstrated that nitrogen availability is impacted by a range of factors, making a generic nitrogen application unrealistic. We understand that growers want to ensure that nitrogen does not limit production, but the trials would indicate that there is the opportunity in many cases to reduce nitrogen fertiliser applications while still maintaining the potential for high yields.

Next season, the RDO's will be looking more specifically at the impact of nitrogen leaching from early season irrigations, the potential to test for in crop mineralisation and the opportunity to refine in-crop nitrogen applications based on petiole testing.