Nutrient management program lifts nitrogen efficiency

By Dale Clark, Senior Agronomist, Cotton Growers Services

Over the past few seasons, Cotton Growers Services (CGS) has been developing a dedicated nutrient management program for cotton. Its basis is a specific program of soil and tissue testing, which is combined with unique guidelines specific for high yielding crops. The information the program generates is allowing growers to make significant changes to the way they manage their fertiliser inputs, with substantial savings in costs and significant improvements in yields as well.

We are seeing significant improvements in N efficiency — with growers applying less N, but achieving yields as good if not better than before.

Nitrogen based fertilisers represent the largest proportion of fertiliser applied to cotton. And with rising fertiliser prices, nitrogen fertiliser now represents a major proportion of the variable costs of production.

The rapid increase in the cost of N fertiliser has pushed growers to examine their nutrition programs to increase their return on investment from nitrogen fertiliser. But there are still many producers routinely applying very high rates of N to cotton crops — rates that are unnecessary, uneconomic and environmentally unsustainable.

By increasing fertiliser efficiency, it is possible to grow exceptional yields with much less nitrogen. Increasing N efficiency requires continuous monitoring of both soil and plant N levels, and the ability to match N supply to crop demand.

TESTING AND ANALYSIS

Soil testing and analysis prior to planting, including subsoil analysis, should be seen as a vital component of any N management program. Soil testing allows growers to identify the amount of available N in the soil prior to planting. This information can then be used to develop an application program to supply the balance of the crop's N requirement.

Soil analysis also allows deficiencies of other nutrients — such as P, K and Zn, — to be corrected prior to planting. Nutrient deficiency of any of these nutrients will substantially affect N uptake and assimilation, and lower N efficacy as a result. Soil analysis also identifies factors that can limit root expansion such as sodic subsoils or compaction layers that will also affect N uptake

For example, in situations where there are adequate levels of available N already in the soil, it may be unnecessary to apply N prior to planting if levels are sufficient to get the crop through to first or second irrigation, where supplementary applications of N can begin.

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NUTRITION CASE STUDY

Hatton Partnership
"Bellevue" Warren, NSW
Grower – Angus O'Brien
115 hectares Sicot 71BR
Drip irrigation

Initial soil test

Some mineralised N present, marginal in P and low in Zn. K levels reasonable. Very low PBI and CEC, but good Ca:Mg ratio and low exchangeable sodium. Interpretation using CGS unique guideline levels.

Pre plant fertiliser

Oct 13	Big N	60kg N/ha
	Custom blend (5:15:10:3:2)	100kg/ha

Second soil test conducted prior to planting

N levels adequate for planting, P and Zn levels also now sufficient. N application plan formulated.

Tissue testing commenced November 27, with interpretation using CGS unique guideline levels

Tissue testing indicated Zn uptake was lower than desirable, so a supplementary Zn application was applied through the drip:

Dec 13	Chelated Zinc	3L/ha

Tissue tests used to track N and K uptake during flowering and boll fill. N levels supplemented as required through the drip. Foliar K applied as required as determined by tissue test levels:

Dec 14	Urea	54kg N/ha
Dec 19	Agro K 50	5L/ha
Jan 26	Potassium Nitrate	30L/ha
Jan 29	Urea	50kg N/ha

Ginned yields

Field 12 14.2b/ha (5.75b/ac)
Field 13 14.5b/ha (5.87b/ac)
Field 14 15.2b/ha (6.15b/ac)

In situations where there is very little available N, a small proportion may be applied prior to planting, with the majority supplied during the growing period, keeping in mind the delay between application of many N products and their conversion to available forms of N.

In many cases, mineralised N together with N applied with P,K and Zn fertilisers will be sufficient to carry the crop through to first irrigation where N can be applied as water run products. Water run N at first irrigation has added benefits in southern areas where it can prevent a period of slow growth following the first crop irrigation, which is especially important with Bollgard

The efficiency of N fertiliser is substantially increased by spreading applications across the growing season, and by tailoring applications of N to meet crop demand. Cotton requires less than 30 per cent of its total N requirement prior to planting, so it makes sense to apply the majority of N during the growing period when the crop requires it most.

PLANT N MONITORING

Monitoring leaf nitrogen and petiole nitrate levels on a weekly basis through late squaring and flowering allows growers to track the crop's uptake and utilisation of N. This information enables the grower to supply N as required by the crop.

N uptake can be substantially reduced if there are deficiencies in other nutrients, such as P and K, during the growing season. Leaf analysis for other nutrients also allows the uptake of these nutrients to be monitored, and potential deficiencies can be identified before they impact on yields.

AVOIDING N LOSSES

Applications of large rates of N fertiliser in single passes, especially anhydrous ammonia, can significantly increase the potential for loss of N through leaching or denitrification. Applications of large rates in one or two passes also adversely affects crop growth, with periods of slow growth often followed by periods or rapid and excessive growth as N is converted to available forms in the soil. This can lead to issues with rank growth and its associated costs in growth regulants, insect management and water use.

N efficiency is increased by spreading applications through the season.

Where there is adequate N in the soil it may not be necessary to apply N prior to planting.

We have seen substantial improvements in N efficiency where growers have supplied adequate levels of P, K, and Zn prior to planting, and moved away from large applications of N fertiliser to a number of smaller applications in crop where N can be applied as water run urea or liquid products. Spreading applications across the growing period ensures that there is always adequate N to meet crop demand, so that supply is much better linked to crop demand. Small amounts can be supplied prior to flowering, and larger amounts can be applied as required during flowering and fruit development.

Importantly, losses from denitrification and leaching are significantly reduced because there are not big pools of N in the soil at any time. Losses of N from the soil can be significant and very costly, so the ability to eliminate these losses reduces the amount of N that needs to be applied.

LEGUME ROTATIONS

We are also seeing significant reductions in N use rates when legumes are incorporated into the rotation. The use of legume crops in rotation with cotton, or the adoption of green manure crops can provide a significant amount of N to the following cotton crop. It is not uncommon to have well over 100 kg per hectare of available N in the profile under these situations. Importantly, this organic N is slowly released over the season, which reduces the risk of N losses. Green manuring or legume rotations also substantially improves the soil structure which has a range of benefits.