Nitrogen and potassium fertility in Bollgard II cotton

By Tom Kerby, Deltapine

Nitrogen and potassium crop sufficiency can be affected by source (carbohydrate production through photosynthesis) — sink (plant parts that utilise the plant sources) relations. Availability of these nutrients to the cotton plant is greatly influenced by and proportional to availability in the soil. Figures 1 and 2 demonstrate the uptake and accumulation of these two key nutrients in cotton.

Nitrogen demand

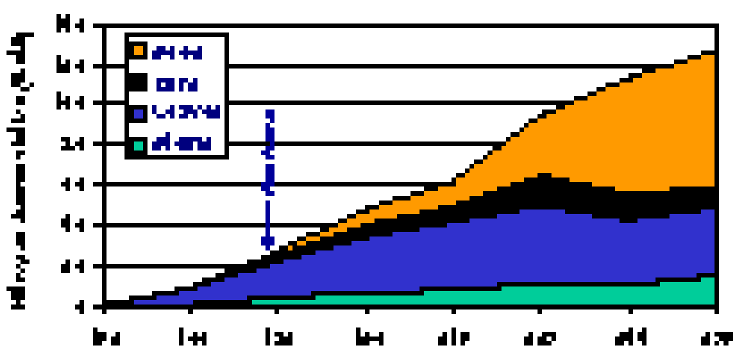
Nitrogen status of the plant (Figure 1), especially the leaf, is influenced by source to sink relations. Nitrogen requirement and removal from the field will be proportional to yield level because of the high percentage of plant nitrogen in seed at the end of the season.

As seeds develop, nitrogen requirement in high yielding crops will be higher than the uptake from the soil. Subsequent nitrogen mobilisation from the leaves can decrease photosynthesis that decreases the total supply of carbohydrates and brings about an earlier cut-out.

To meet this high nitrogen demand of seed, nitrogen either has to be present and extracted in very high levels in the soil (not feasible) so that the leaf tissue is very high in nitrogen concentration, or the plant needs to have more leaf area (temporary nitrogen storage). This describes an indeterminate type variety which has the potential to develop a greater leaf surface during early fruiting that will be less likely to have nitrogen depleted to the point of reducing photosynthetic efficiency of leaves.

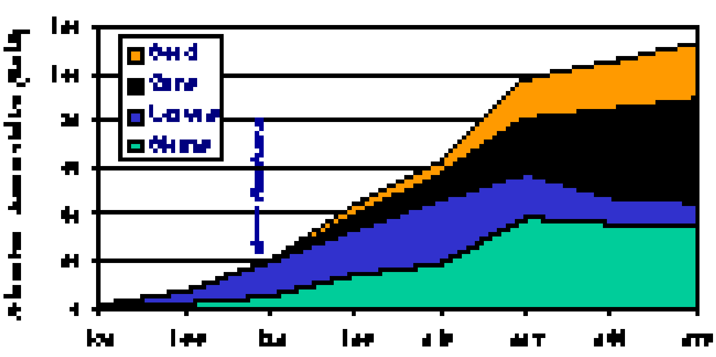
Determinate type plants with a high early boll load will have less leaf area and will experience a high nitrogen demand at an earlier stage of growth than indeterminate varieties. With the anticipated good early boll retention of Bollgard II varieties, an indeterminate variety should be less affected by nitrogen deficiencies than a more determinate variety at a similar yield level.

FIGURE 1: Accumulation and distribution of nitrogen during the growing season



Basset et el, 1970

FIGURE 2: Accumulation and distribution of potassium during the growing season



Basset et el, 1970

Potassium accumultion

Potassium accumulation is demonstrated in Figure 2. The pattern is similar to nitrogen.

It accumulates initially in vegetative tissues, and following flowering accumulates primarily in the boll wall (as opposed to seed in the case of nitrogen). As fruiting intensifies, demand is high in reproductive parts, and potassium not supplied from current soil uptake will be remobilised from leaves and stems.

Potassium is important for many functions including as a solute in stomates that help to keep them open for air and carbon dioxide exchange to cool leaves and keep photosynthesis high. It is also involved in fibre cell elongation.

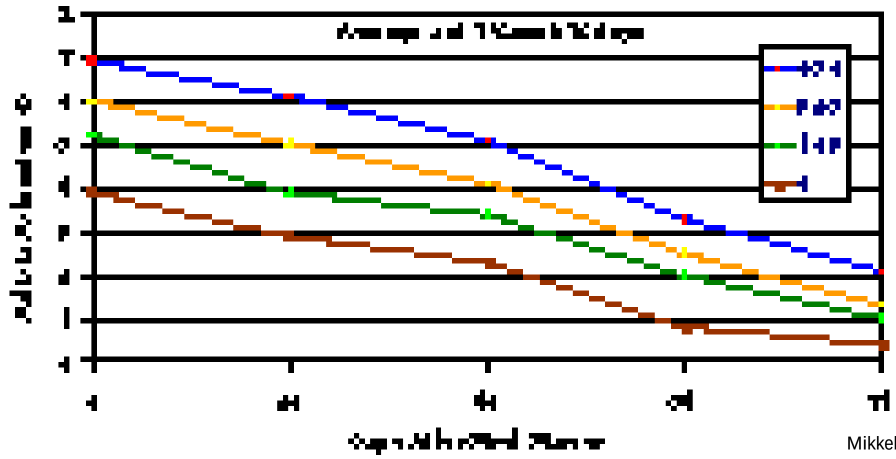
The capacity for a boll load to deplete the stored potassium in leaves is also depicted in Figure 3. Mikkelsen demonstrated that the rate of decline in potassium during the boll development period is linear. Higher fertiliser rates produced plants with higher tissue concentrations of potassium, but all rates had approximately equal percentage decline during fruiting.

As with nitrogen, potassium has the capacity to affect source to sink relationships. Determinate varieties produce less leaf area and generally have an earlier accumulation of bolls.

This higher demand for potassium earlier by plants with less leaf area, results in mobilisation from leaves to bolls (carpel walls). This decreases the function of the leaf and contributes to driving the plant toward premature cut-out. Indeterminate plants are not as dramatically affected because they typically produce more leaf area.

More information on this topic is available in Dr Kerby's publication: 'Management Considerations for Deltapine Bollgard II Varieties in Australia'. Freecall 1800 006 088.

FIGURE 3: Petiole potassium percentage during the flowering period as related to fertiliser rates



Mikkelsen et el, 1970