Early nitrogen uptake in canola in 2001

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Abstract

Currently there are no widely accepted in-crop management tools used for determining nitrogen application requirements for canola crop growth. Measuring canola shoot nitrogen content in Victorian TOPCROP on-farm test sites using Near Infrared Reflectance technology showed that early nitrogen uptake was a good (r? = 0.79) indicator of final yield during 2001. The strength of this relationship implies that assessing early nitrogen uptake has potential for making in-crop nitrogen management decisions for canola.

Key Words

Nitrogen management, canola, TOPCROP, Near Infrared Red

Introduction

To maximise economic returns from growing canola it is critical for farmers to match in-crop nitrogen application to potential yield. To reduce the cost associated with over application of nitrogen, it is preferable to apply some nitrogen at or near seeding and then to make supplementary applications as the season unfolds. While soil tests provide part of the information needed, early season assessment of crop nitrogen demand could assist decision making about strategic nitrogen applications during crop growth.

Nitrogen uptake is a measure of how well the crop is growing and can be used to make nitrogen application decisions. Yield potential for canola is established before stem elongation and budding, so it is currently recommended nitrogen be applied before the 6-8 leaf crop growth stage. This means any assessment of nitrogen uptake needs to be done at about the 4-6 leaf stage. Near Infrared Reflectance (NIR) techniques appeared to have potential to provide this information, but early results for canola were disappointing and this tool never achieved commercial acceptance.

During 2001 the Victorian TOPCROP State Focus "Putting the *N* in ca*N*ola" was on nitrogen application in canola (1). The main aim was to compare different nitrogen application regimes - none, district practice, point of no return (on dollar invested in nitrogen) and maximum yield. As part of the program, the relevance of NIR, linked to shoot biomass measurements, as an in-crop nitrogen need assessment tool was revisited.

Methods

Fourteen sites were selected across the state by TOPCROP farmer groups (see Fig. 1). Farmers hosting the sites sowed and managed the sites using farm equipment. Plots were large (at least 5 m wide by 100 m long) so nitrogen rate treatments were not replicated. A control treatment was used every third plot to facilitate statistical analysis.

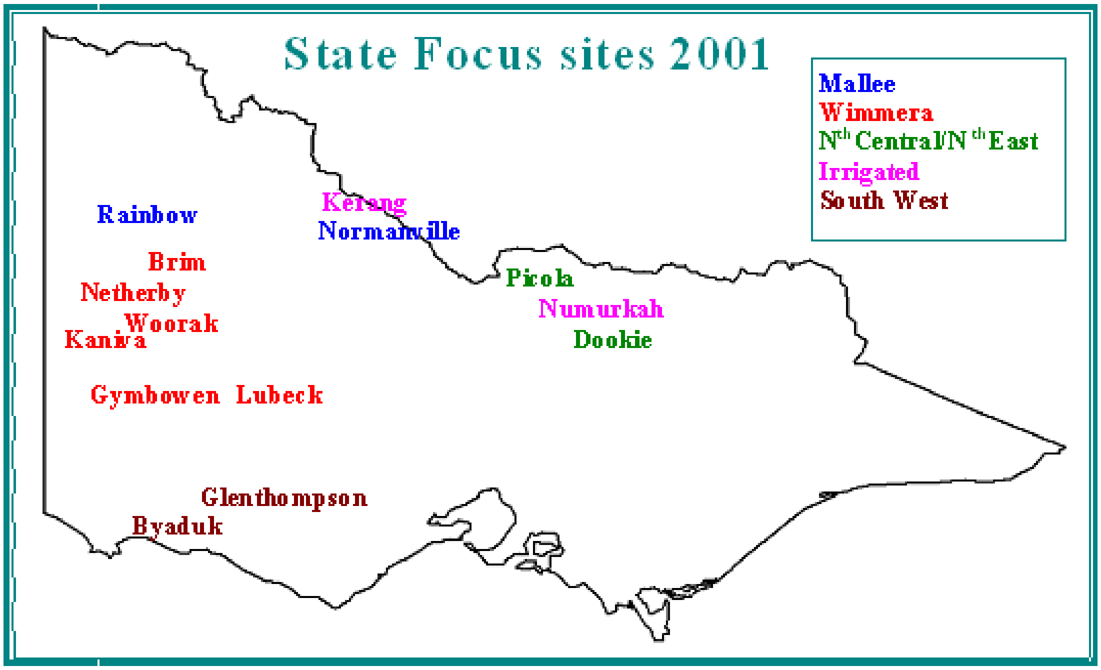

Figure 1. Sites used to assess early (4-6 leaf) nitrogen uptake by canola, Victoria 2001.

Three samples (each a minimum of 120 g of fresh plant material) were taken from every plot to determine shoot nitrogen content and plant dry weight. Areas of relative uniformity were chosen and samples were taken from different drill rows across each plot. Plants were cut at ground level and samples were kept cool and out of the sun before being taken back for processing.

Samples were dried until brittle, avoiding overdrying, weighed and the shoot nitrogen content determined using a 20 filter Percon NIR Infralyser. The NIR values were calibrated against Leco N (N% = 0.50+0.85*NIR, where NIR is the nitrogen value predicted by NIR, r^2 = 77%). The initial calibration developed predicted shoot nitrogen content with recommended mean squared deviation of 0.25% nitrogen. This calibration was maintained and adjusted using 10% of submitted tissue samples.

Results and discussion

Shoot nitrogen values have been proposed as a diagnostic tool for assessing potential nitrogen response in canola (2), although it is recognised that care needs to be taken in interpreting critical limits in terms of both sowing time and plant growth stage (3). The data reported here are drawn from diverse environments and a range of cultivars, but provide the sort of field data growers would have when making management decisions. Across the 14 sites, the shoot nitrogen values averaged 5.9?0.9% nitrogen while shoot biomass values averaged 1235?679 kg/ha. It was apparent that shoot nitrogen contents were significantly less variable than shoot biomass, which has also been reported for canola crops prior to stem elongation (3).

Early nitrogen uptake was used as a measure of nitrogen availability for each site and is the product of tissue nitrogen content and shoot biomass. Uptake was generally lower than 70 kgN/ha (Figure 2) and it is thought that this is a consequence of the relatively late sowing of these experiments due to a late break across much of Victoria. The emergence of these crops was slow and nitrification would also have been relatively slow during the winter period.

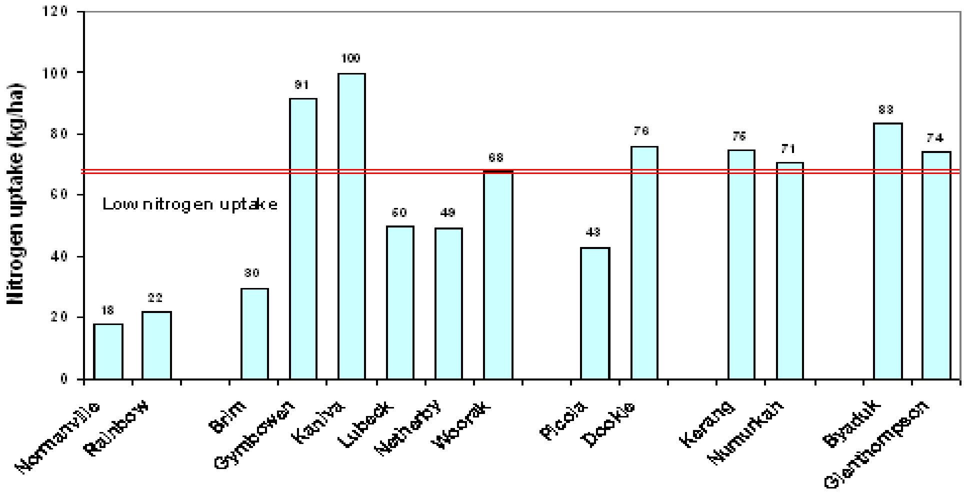

Figure 2. Early (4-6 leaf) nitrogen uptake by canola, Victoria 2001. **From shoot nitrogen content and shoot biomass measurements from control plots only.**

There was no relationship between shoot nitrogen content at the 4-6 leaf stage and canola yield across the whole data set tested. Shoot biomass at the same stage did show a good relationship to yield but this relationship was improved if nitrogen uptake was considered rather than nitrogen content or shoot biomass alone (Figure 3) - as early nitrogen uptake increased, so did yield. Only the state relationship line is displayed in Figure 3.

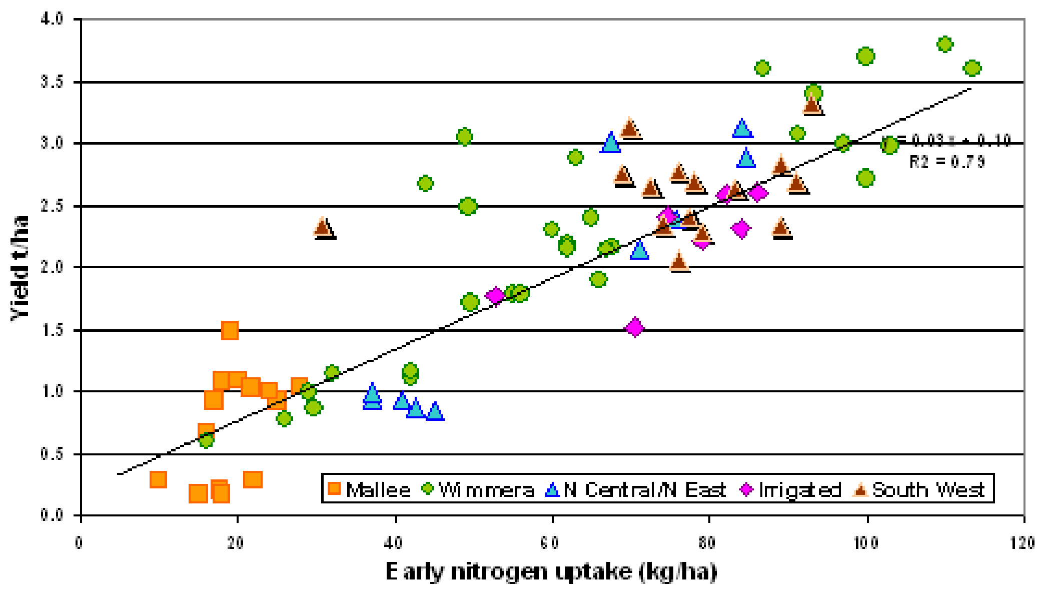

Figure 3. Early (4-6 leaf) nitrogen uptake and canola yield, Victoria 2001.

Shoot nitrogen results for all nitrogen treatments at each site are included in Figure 3. For each region the strength of this relationship appears to be slightly different. At the individual sites, there were usually 4-5 treatments tested using nearest neighbour designs. At 10 of the 14 sites, the correlation coefficient between nitrogen uptake and yield was between 0.7-0.9. The other fours sites had correlation coefficients between 0.2-0.3.

The reliability of the relationship (and the relative importance of shoot nitrogen uptake and shoot biomass to the relationship) between early nitrogen uptake and yield needs to be validated before its usefulness as a management tool can be assessed. Even if the relationship is reliable, measuring crop shoot biomass may not be practical. Shoot biomass sampling is time consuming and must be done correctly to give accurate results. Some simple and accurate shoot biomass assessment tool is needed to make this process attractive to farmers.

This information was gathered through an extension program, which raises the issue of how to appropriately follow up and validate results from one season of field sampling. Although the importance for making management decisions is obvious, the fit within current research programs is less clear.

References

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