N REPLACEMENT: A SIMPLE APPROACH TO IMPROVING NITROGEN USE EFFICIENCY IN SUGARCANE

By

AJ WEBSTER, PJ THORBURN, JS BIGGS,
IM BIGGS, MF SPILLMAN, SE PARK

CSIRO Sustainable Ecosystems
Peter.Thorburn@csiro.au

KEYWORDS: Environmental Impacts, Fertiliser, Nutrition, Nitrogen Cycling.

Introduction

SUGARCANE IS THE main crop grown in catchments of the Great Barrier Reef, Australia, and the greatest user of nitrogen (N) fertiliser in these regions. Concerns about reef water quality are focussing scrutiny onto the environmental impacts of agriculture in this area.

At the same time, N fertiliser prices are increasing, leading farmers to investigate practices that minimise N fertiliser applications and maximise N use efficiency of their cropping systems.

We have previously suggested that features of sugarcane cropping systems in Australia (i.e. deep rooted crop, infrequent fallows, significant cycling of N fertiliser in soil organic matter and large soil N stores) might combine to reduce fertiliser N losses from the system and so there may be scope to increase N use efficiencies (Thorburn *et al*., 2004).

To achieve this, we proposed a simplified N balance approach, called the 'N replacement' (N_{Rep}) system, for guiding N fertiliser applications.

To field test this system, experiments with different N treatments, including N_{Rep} and farmers' conventional N fertiliser management (N_{Farm}), were established on commercial farms from Murwillumbah to Mossman in 2003 or 2004 as described by Thorburn *et al*. (2007).

In this paper we summarise results from these experiments, including information from additional crops grown to those reported by Thorburn *et al*. (2007).

Results

On average, N fertiliser additions were more than 30 % lower in the N_{Rep} treatment than the N_{Farm}. Despite this reduction in fertiliser, yields in both the treatments were similar. Across all crops and sites, the average difference in yield between these treatments was only –1 t/ha (or –1 %). At no site was there a consistent tendency through time for yields in the N_{Rep} treatment to be lower than those in the N_{Farm} treatment. On the contrary, there was a general tendency for yields in the N_{Rep} treatment to increase relative to N_{Farm} through time. For example, in the first crop the average yield difference across the sites was –3.1 t/ha, in comparison to a difference of –1.2 t/ha in the third crop. When the results of the first crop are excluded from the yield comparison, the average yields N_{Rep} treatment are 0.2 t/ha higher than in the N_{Farm}. CCS did not differ between the N treatments, nor was there any indication of greater N stress (indicated by leaf N) in the N_{Rep} treatment. Given the similarity in yields in

the N_{Rep} and N_{Farm} treatments, the lower N fertiliser additions in the N_{Rep} treatment equate to a 45 % increase in N use efficiency across all crops.

At some sites, a third (N_{Low}) treatment with low (e.g. < 50 % of $N_{Farm)}$ N fertiliser application was included. After the 2nd or 3rd crops, yields reduced in this treatment at some sites, but not all. Low yields were generally accompanied by low leaf N concentrations.

Discussion

The similarity in sugarcane yields and CCS values at farmers' current and 'replacement' N fertiliser rates over two to four years at the experimental sites suggests that there is scope for more comprehensively investigating markedly lower N fertiliser applications to sugarcane, so increasing N fertiliser use efficiencies and potentially reducing N losses to the environment. Further, these results suggest that a balance approach, as employed in the N Replacement system, may be a good method of determining the N requirements of sugarcane crops. Insights into the processes underpinning the success and longer-term sustainability of these lower N fertiliser applications will be gained from studying N balances in these experiments.

Acknowledgements

We gratefully acknowledge the farmers who have kindly volunteered to test the N Replacement concept on their farms, and funding from the Australian Government and sugarcane industry through the Sugar Research and Development Corporation.

REFERENCES

Thorburn PJ, Horan HL, Biggs IM, and Park SE (2004) Which is the most important crop when assessing nitrogen applications – the next or the last? *Proceedings of the South African Sugar Technologists Association* **78**, 383–391.

Thorburn PJ, Webster AJ, Biggs IM, Biggs JS, Park SE and Spillman MF (2007) Innovative management of nitrogen fertiliser for a sustainable sugar industry. *Proceedings of the Australian Society of Sugar Cane Technologists* **29**, 85–96.