THE EFFECT OF DIFFERENT NITROGEN RATES ON CCS ACCUMULATION OVER TIME

By

A.R. RATTEY\textsuperscript{1,2,3} and D.M. HOGARTH\textsuperscript{2}

\textsuperscript{1}Centre for Tropical Agriculture, University of Queensland, St Lucia, Qld, Australia
\textsuperscript{2}Bureau of Sugar Experiment Stations, PO Box 86, Indooroopilly, Qld, 4068, Australia
\textsuperscript{3}CRC for Sustainable Sugar Production, Townsville, Qld, Australia

Abstract

Applied nitrogen (N) had a significant negative impact on the mean commercial cane sugar (CCS) recovery of 15 genotypes measured on seven occasions between March and September. Increasing N rates from 0 kg N/ha to 280 kg N/ha reduced CCS by up to 21%. However, the negative impact of N on CCS declined over time, indicating that it will be possible to maximise CCS for blocks to be harvested early by reducing N rates. Significant genotype*nitrogen (G*N) interactions were also detected. Variance components for G*N were compared, relative to genotype main effect and expressed as a ratio. These ratios ranged from 0.10 to 0.43, averaged 0.21 for all seven sample events, and were greatest (0.23 to 0.43 at an average of 0.32) for the three sample events early in the harvesting season (late May to early August). Therefore, genetic gains from selection for response to different rates of applied N on early CCS may be possible.

Introduction

Nitrogen application is generally essential to achieve acceptable cane yield, but N has also been well documented to diminish CCS (Borden, 1948; Muchow et al., 1995). This variation in CCS caused by N does differ as the crop ages, and may allow management of N rates to maximise CCS at different periods of the year (Muchow et al., 1995).

Schumann et al. (1998) identified that substantial benefits could be achieved if genotype-specific, N-based fertiliser recommendations could be developed. However, whilst large differences between genotypes in N uptake and efficiencies are present, the detection of significant G*N interactions for yield parameters are inconsistent (Gascho et al., 1986). Consequently, identification of genotypic-specific N rates has been difficult.

Crushing of sugarcane historically commences in mid June for the Burdekin district of Australia. Recently, this date has been brought forward, and suggestions are that it may be extended even earlier in the future. Based on this outlook, research is being conducted to identify factors that can increase profitability, especially through enhanced CCS, for the period prior to and including June.

The aims of this study were to determine if CCS could be managed through the year by manipulating the rate of applied N across a broad range of genotypes, and to identify if G*N interactions are present at different times of the year. The detection of such an interaction would indicate that genetic gains from selection for different rates of N on CCS should be possible.

Methods

A trial was established in late April 1999, containing 15 genotypes and three nitrogen rates (0, 125 and 280 kg N/ha), with three replicates. These rates compare with the recommended rate of 150 kg N/ha for the Burdekin district. The trial was planted as a split-plot, with N as the main plot factor, and genotypes planted into 4 row*10 m long plots as the sub-plots.

Sampling for CCS was initiated on 28 March, and subsequent samples were collected every three to five weeks until cessation on 11 September. In total, seven sampling events were performed. Six stalks were randomly chosen from each plot, and juice was extracted using the carver press method. Brix, pol and fibre % were measured and used to estimate CCS. Data were analysed for each individual sample event with the SAS Proc Glm Procedure (SAS Institute, 1990). Linear and quadratic effects of N on CCS were also estimated.

Results and discussion

CCS was reduced as the rate of applied N increased, with the linear contrast always highly significant (P<0.01). However, the reduction in CCS became less apparent as sampling continued through the year (data not shown). The two lowest rates of applied N were not statistically different in three of the final four sampling events. Indeed, at the final sampling time, the two lower rates of N had almost identical mean CCS values, with the quadratic effect of N approaching significance (0.05<P<0.06). The highest rate of N produced the lowest CCS at every sampling event.

Figure 1 highlights the relative change in CCS over time. While the mean CCS for all three N rates clearly increased in a linear fashion over time (r>0.99 for all N rates), the change in CCS was greatest for the higher rates of N. Indeed, the gradient of increase in CCS over time for the high rate of N was almost 65% greater than that of the low rate.

KEYWORDS: Early CCS, Genotype by Nitrogen Interaction, Managing CCS, Selection.
Rates of N should be reduced to obtain higher CCS if it is anticipated that a block is to be harvested early in the crushing season. Alternatively, blocks that received recommended rates, or higher, of N fertiliser should be harvested later in the season when the negative effects of N on CCS have diminished.

Genotypes and N rates interacted significantly (P < 0.05) at four of the seven sampling events. Three of these four events where the genotype*nitrogen (G*N) interaction was significant were the samplings on 29 May, 3 July and 7 August (sample events four, five and six). At all of these events, the ratio of the variance component for G*N relative to genotype main effect was between 0.23 and 0.43. The magnitudes of these interactions suggest that it may be possible to optimise CCS through the year by altering the rates of applied N, as the negative effect of N on CCS becomes less pronounced with time.

These results indicate that it may be possible to maximise CCS through the year by altering the rates of applied N, as the negative effect of N on CCS appears to reduce in magnitude through the year.

**REFERENCES**


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**LES EFFETS DES DIFFÉRENTS TAUX D’AZOTE SUR L’ÉVOLUTION DE LA RICHESSE DE LA CANNE À SUCRE**

A.R. RATTEY1,2,3 et D.M. HOGARTH2

1Bureau of Sugar Experiment Stations, PO Box 86, Indooroopilly, Qld, 4068, Australia
2The University of Queensland, St Lucia, Qld, Australia
3CRC for Sustainable Sugar Production, Townsville, Qld, Australia

**Résumé**

L’apport d’azote minéral avait occasionné une baisse considérable de la richesse (CCS) moyenne de 15 génotypes évalués en 7 occasions entre mars et septembre. Par rapport au témoin (0 kg N/ha) une baisse allant jusqu’à 21% de la richesse fut même observée suivant l’application de 280 kg N/ha. Cependant, puisque l’impact négatif de l’azote sur la richesse devenait moins prononcé avec le temps, la richesse dans les champs à être récoltés pourrait être optimisé en réduisant le taux de N apporté. L’interaction génotype × azote (G × N) s’était révélée significative. Les ratios des composants de la variance de l’interaction G × N et de l’effet principal génotype furent comparés. Les ratios ont varié de 0,10 à 0,43 avec une moyenne de 0,21 pour les 7 échantillons et les valeurs les plus élevées (0,23 à 0,43 avec une moyenne de 0,32) furent obtenues pour les 3 échantillons en début de la saison de coupe (fin mai à début août). Il serait donc possible d’obtenir une amélioration génétique à travers la sélection en se basant sur la réponse aux différents taux d’azote appliqués sur la richesse en début de saison.

*Mots clés: CCS au départ, interaction azote × génotype, gestion de CCS, sélection.*
EFECTO DE DIFERENTES DOSIS DE NITRÓGENO EN LA ACUMULACIÓN DE CCS EN EL TIEMPO

A.R. RATTEY¹,²,³ y D.M. HOGARTH²
¹Bureau of Sugar Experiment Stations, PO Box 86, Indooroopilly, Qld, 4068, Australia
²The University of Queensland, St Lucia, Qld, Australia
³CRC for Sustainable Sugar Production, Townsville, Qld, Australia

Resumen

El nitrógeno (N) es un elemento esencial para la producción de caña. En el presente estudio se realizó un seguimiento de los efectos de tres dosis de Nitrogéno (0, 125 y 280 kg N/ha) sobre el CCS comercial promedio de 15 genotipos de caña sembrados en siete oportunidades entre los meses de marzo a septiembre en el distrito del Burdekin. La aplicación excesiva de nitrógeno (280 kg/ha) tuvo un impacto negativo sobre el CCS en todas las fechas de muestreo, y redujo el CCS hasta en 21% cuando se comparó con la dosis baja de N. Sin embargo, el impacto negativo del N en el CCS disminuyó con el tiempo, indicando que es posible maximizar el CCS en los bloques cosechados de manera temprana al reducir las dosis de N aplicada. Se encontraron interacciones significativas entre el genotipo × nitrógeno sobre el CCS. Las interacciones fueron mayores al comienzo del periodo de cosecha (mayo a septiembre), con componentes de varianza equivalentes a la mitad del efecto del genotipo. Por consiguiente, las ganancias genéticas en la selección por respuesta a las aplicaciones tempranas de N son posibles.