Proc. Aust. Soc. Sugar Cane Technol., 20: 248–250 1998

SOIL SODICITY: ITS INFLUENCE ON CANE YIELD IN THE BURDEKIN

By

Paul NELSON and Gary HAM

BSES Burdekin, and the Cooperative Research Centre for Sustainable Sugar Production

Abstract

Soil sodicity is known to reduce cane yields, but little quantitative information is available, especially for areas depending on irrigation. The aim of this study was to determine the influence of sodicity on cane yield in the Burdekin district. Seventeen sites with variable sodicity were chosen throughout the district. At each site, cane yield was measured in plots 3 rows wide by 20 or 30 m long. Soil salinity was measured at all sites and sodicity was measured at six sites. Over all measured sites, cane yield was reduced by approximately 2.4 t/ha for every 1% increase in exchangeable sodium percentage (ESP) in the subsoil. There was also a significant negative correlation between yield and salinity. The effect of sodicity on yield was greater than that measured previously in Mackay, primarily because potential yield at low ESP was greater in the Burdekin.

Introduction

Soil sodicity is known to reduce cane yields, but little quantitative information is available. The nature of the relationship between yield and sodicity is important for assessing the feasibility of management options. A study in a rain-fed block in the Mackay district showed a decrease in cane yield of 1.5 t/ha for every increase of 1% ESP in the subsoil (Spalding, 1983). However, it is not known whether the same relationship holds in irrigated areas such as the Burdekin and Atherton Tablelands. The aim of this work was to assess the influence of soil sodicity on cane yield in the Burdekin district.

Materials and methods

Seventeen sites with variable sodicity were selected from throughout the Burdekin district in 1997. Crops included plant to fourth ratoons of the varieties Q96, Q117, Q127, Q124 and Q133. At each site, 3 adjacent rows (1.52 m spacing) that intersected sodic and non-sodic parts of the block were selected. Cane yield was measured in 10–14 plots (20 or 30 m long sections of the 3 adjacent rows) using a weigh truck.

At each site, soil was sampled from 5–8 plots, chosen to cover the range of yields. Samples consisted of 4 cores (0.125 m depth increments to 0.75 m) taken from the interspaces of each plot. Soil from the cores was combined for each depth increment in each plot.

Soil samples from six of the sites were ground to pass through a 2 mm sieve, and analysed for pH, electrical conductivity (EC) and exchangeable sodium percentage (ESP). pH and EC were measured in 1:5 soil:water extracts. Samples were analysed for exchangeable cations using 1 M NH_4Cl as the extractant. The extractant was adjusted to pH 7 for samples having pH <8 and pH 8.5 for samples having pH >8. Samples with EC >0.3 dS/m were pre-leached with ethanol (Rayment and Higginson, 1992). Cation exchange capacity (CEC) was calculated as the sum of exchangeable Ca, Mg, Na and K, and exchangeable Na percentage (ESP) was calculated as exchangeable Na multiplied by 100 and divided by CEC.

Apparent earth conductivity was measured using an electromagnetic induction (Geonics EM38) meter adjacent to the location of each core sample. With this technique, readings taken in the horizontal mode measure soil salinity to a depth of approximately 0.75 m and readings taken in the vertical mode measure salinity to a depth of approximately 1.5 m.

KEYWORDS: Sodicity, Sodic Soil, Salinity, Cane Yield.

Results and discussion

Cane yield was negatively correlated with soil salinity and sodicity at each site. The relationship between yield and salinity over all sites is shown in Figure 1. Over all the sites, EM38 readings in the horizontal mode (EMH) were highly correlated with, and slightly less than, EM38 readings in the vertical mode (EMV) (Equation 1), indicating that salinity increased with depth. The relationship of yield with salinity was not expected, because there were no obvious salinity problems at most of the chosen sites.

$$EMH = 0.85\ EMV - 1.03 \quad r^2 = 0.956 \qquad [1]$$

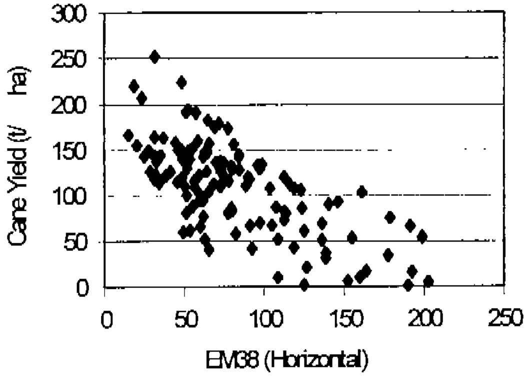

Fig. 1—Relationship between cane yield and soil salinity (EM38 reading).

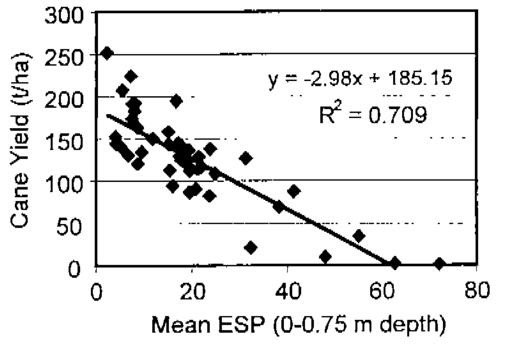

Fig. 2—Relationship between cane yield and soil sodicity (exchangeable sodium percentage, ESP) in the 0–0.75 m depth layer.

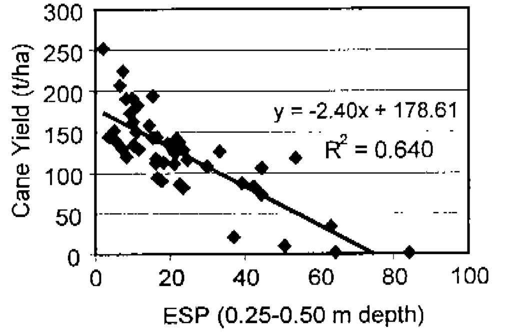

Fig. 3—Relationship between cane yield and soil sodicity (exchangeable sodium percentage, ESP) in the 0.25–0.50 m depth layer.

Cane yield was also negatively correlated with sodicity at each site. The relationship between yield and mean sodicity of the whole sampled layer, over all six sites, is shown in Figure 2. Spalding (1983) found that the best correlation was between yield and ESP of the 0.25–0.5 m depth layer. The equivalent correlation for these data is shown in Figure 3. Yield decreased by 2.4 t/ha for every 1% increase in ESP of the subsoil. When compared to the effect of sodicity in the Mackay district (decrease of 1.5 t/ha of cane for every 1% increase in ESP of the subsoil), these results indicate that the effect of sodicity is considerably greater in the Burdekin district. The difference is mainly due to the fact that potential yield at low levels of sodicity was much greater in the Burdekin (179 t/ha at ESP = 0) than at Mackay (100 t/ha at ESP = 0).

Based on the results of Spalding (1983), it has been conservatively estimated that soil sodicity reduces the annual Australian production of cane by 500 000 tonnes (Ham *et al.*, 1995). These results indicate that this figure is a considerable underestimate.

The negative effect of salinity on yield, even at levels normally considered too low to be detrimental, indicated that the combination of salinity and sodicity reduced the availability of water to the crop.

The main treatment recommended for sodic soils is the application of gypsum (Ham *et al.*, 1997). Recommendations for the diagnosis and management of sodic soils are currently being compiled into a "Toolkit" in a project funded by the Cooperative Research Centre for Sustainable Sugar Production.

Conclusions

Soil sodicity has a marked influence on sugarcane yield. In irrigated sugarcane in the Burdekin, the effect is greater than previously measured under rain-fed conditions at Mackay.

Acknowledgments

This work formed part of a project (BS197) supported by the Sugar Research and Development Corporation. The technical assistance of Kimberley Mallon is gratefully acknowledged.

REFERENCES

Ham, G.J., Cox, A.Z. and McMahon, G.G. (1997). A review of sodic soils research in the Queensland sugar industry. Proc. Aust. Soc. Sugar Cane Technol., 19: 200–207.

Ham, G.J., McMahon, G.G., Elliot, P.J. and Smettem, K.J. (1995). Cropping sodic soils in the Burdekin River Irrigation Area, 139–146. In: Naidu, R., Sumner, M.E. and Rengasamy, P. (eds), Australian Sodic Soils: Distribution, Properties and Management. CSIRO Publications, Melbourne.

Rayment, G.E. and Higginson, F.R. (1992). Australian Laboratory Handbook of Soil and Water Chemical Methods. Inkata Press, Melbourne.

Spalding, R.D. (1983). Cane yield investigations on a sodic soil. BSES Report, Project 103.10.324, BSES, Brisbane.