

SHORT, NON-REFEREED PAPER

EFFECTS OF LODGING AND ANTI-LODGING CHEMICALS ON THE PRODUCTIVITY OF VARIETY N25: PRELIMINARY FINDINGS

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Abstract

The potentially serious consequences of lodging on sugarcane productivity have not yet been quantified under local growth conditions. In addition, the efficacy of chemicals (Ethepon and Moddus) to reduce the severity of lodging has not yet been adequately investigated. To address these knowledge gaps a field experiment was conducted at Pongola, where lodging of variety N25 was prevented with bamboo scaffolding for comparison with cane that was free to lodge. In other treatments, Moddus (400 ml/ha) and Ethepon (750 ml/ha) was applied to young plants at the ninth leaf stage and its efficacy to improve lodging resistance was assessed. Adverse weather caused the onset of lodging 257 days after spraying (DAS). At that stage Moddus reduced the severity of lodging by 39% compared to the unsprayed control. Adverse weather 270 DAS resulted in severe and widespread lodging, which diminished treatment differences. The bamboo scaffolding was highly effective in physically preventing lodging of a crop that yielded 196 t cane/ha at harvest. Cane that was kept upright with scaffolding achieved ERC yields that were 26% (4.5 t/ha) higher than those of cane that lodged severely 10 weeks prior to harvest. Ethepon did not reduce the severity of lodging, while Moddus, which initially did reduce the severity of lodging, failed to improve ERC yields compared to unsprayed lodged cane. The above observations, possible varietal differences in response, and the possibility of Moddus enhancing root growth will be investigated further in a follow-up experiment using varieties N25 and N36.

Keywords: Ethepon, lodging, Moddus, sugarcane, sugar yield

Introduction

Lodging is known to reduce the productivity of sugarcane through lower biomass production and a reduction in cane quality (Muchow *et al.*, 1995; Singh *et al.*, 2002; Berding and Hurney, 2005). These effects are introduced through a reduction in radiation use efficiency, stalk smothering, stalk death and stalk snapping in lodged crops (Muchow *et al.*, 1995; Singh *et al.*, 2002; Park *et al.*, 2005). There are very few reports of field trials specifically designed to quantify the effects of lodging. In a novel study conducted in Australia, sugarcane crops that were physically prevented from lodging by means of bamboo scaffolding achieved 11-15% and 15-35% higher cane and sugar yields respectively compared to lodged crops (Singh *et al.*, 2002). Similar studies to quantify the effects of lodging on sugarcane productivity in the South African sugar industry have not

yet been conducted. In addition, a largely unexplored possibility is the use of Ethephon (2-chloroethyl phosphonic acid) and Moddus (trinexapac-ethyl), to modify sugarcane growth for increased lodging resistance. To address these knowledge gaps a field trial was conducted to quantify the effects of lodging on sugarcane productivity under South African growth conditions and to assess the potential of Ethephon and Moddus as anti-lodging chemicals.

Materials and Methods

An irrigated field trial at the South African Sugarcane Research Institute's experiment farm at Pongola was planted to N25 on 11 September 2008. At planting, 300 kg/ha superphosphate and 250 kg/ha urea was applied, followed by a second application of 250 kg/ha urea four months later. The plant crop was slashed back on 31 March 2009. The first ratoon was fertilised with 480 kg/ha urea applied as two equal split applications. The experiment design was a randomised block with six replications.

On 25 June 2009 Ethephon and Moddus were applied to the leaves of the young crop (ninth leaf stage) by means of CO₂ pressurised spraying equipment at application rates of 750 ml/ha (360 g active ingredient/ha) and 400 ml/ha (100 g active ingredient/ha) respectively. The remaining plots constituted two control treatments. In the one control treatment the cane was allowed to grow through bamboo frames that would physically prevent lodging in the mature crop, while in the other control, the cane was not supported and thus free to lodge. From the time of spraying to harvest growth measurements, which included stalk heights, population counts and top visible dewlap leaf length/width were conducted on a two-weekly basis.

The first sign of lodging was observed on 6 March 2010 where after the degree of lodging within each plot was captured on a weekly basis by a rating that ranged from 1 to 9, where 1 = fully erect cane and 9 = completely lodged cane. The trial was harvested on 20 May 2010, at which time stalk samples were collected for quality analysis and cane yields were determined in each plot.

Results and Discussion

Moddus and Ethephon application induced prolonged and chemical-specific effects on subsequent growth of individual stalks without altering population dynamics. Moddus reduced stalk lengths for at least 160 days after spraying (DAS), with the maximum affect observed 90 DAS when the stalks were 35% shorter than the unsprayed control. However, after 160 days, stalk lengths were rapidly restored to control values (results not shown). Ethephon induced only minor (less than 10%) and inconsistent reductions in stalk length. Moddus and Ethephon both induced a pronounced reduction in the lamina length (up to 30%) and lamina surface area (up to 31%) of successive top visible dewlap (TVD) leaves formed after application. The effect on lamina length persisted at least until 130 and 180 DAS for Ethephon and Moddus-treated plants respectively (results not shown).

Strong winds accompanied by rain 257 DAS caused the onset of lodging. At this stage Moddus, but not Ethephon, lowered the severity of lodging by 39% compared to the unsprayed control (results not shown). Heavy rain in excess of 100 mm accompanied by strong wind 270 DAS resulted in severe and widespread lodging within the field. This

diminished any remaining treatment difference.

The bamboo scaffolding was highly effective in preventing lodging in a crop that attained cane yields of 196 t/ha at harvest (results not shown). Prevention of lodging resulted in statistically significant higher ERC yields (t/ha) of 26% (4.5 t/ha) compared to the control plots, where severe lodging occurred 10 weeks prior to harvest (Figure 1). The improvement in ERC yields could be ascribed to improvements both in cane yield and cane quality (results not shown). These results are in very good agreement with findings from Australia where physical prevention of lodging resulted in 15-35% higher sugar yields (Singh *et al.*, 2002). Moddus, which initially reduced the severity of lodging, did not improve ERC yields compared to the control, where severe lodging did occur (Figure 1, control-lodged).

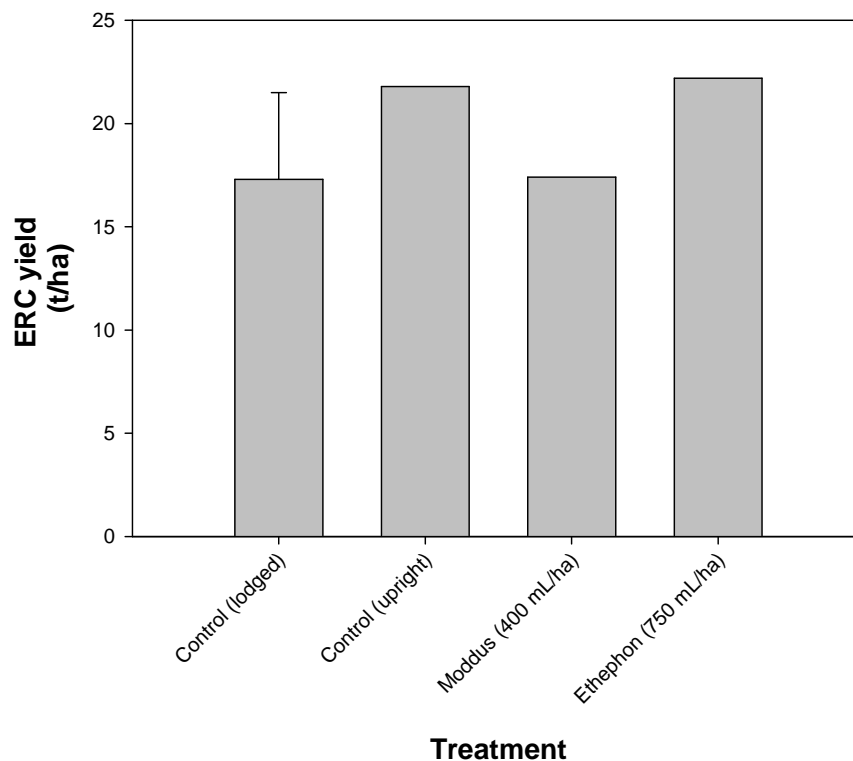


Figure 1. The effects of Moddus and Ethephon on ERC yields in irrigated N25. ERC yields within the chemically treated plots were compared to yields achieved in unsprayed control treatments where lodging was either physically prevented (control-upright) or where lodging occurred freely (control-lodged). Values represent the mean of six replicates and the vertical scale bar indicates $LSD_{0.05}$.

Interestingly, Ethephon, which did not ameliorate the severity of lodging, resulted in statistically significant higher ERC yields (t/ha) of 28% (4.9 t/ha) compared to the unsprayed control where severe lodging occurred (Figure 1). Ethephon thus improved ERC yields to levels achieved in the scaffolded plots where no lodging occurred (Figure 1, control-upright). Because Ethephon was not applied as a ripener, but at a crop age of only 2-3 months, the physiological reasons for this large improvement in ERC yield warrants further investigation.

Because of the adverse weather events that induced widespread lodging, the full potential of Moddus to reduce lodging could not be fully assessed. Although Moddus did not increase stalk base diameters (results not shown), the observed lowering of lodging severity initially could have been related to changes in canopy architecture caused by prolonged chemical alteration of leaf area and stalk growth. Findings from Brazil indicate that sugarcane treated with Moddus as a ripener have more extensive root systems than untreated controls (Resende *et al.*, 2000), which raises the possibility that Moddus could ameliorate lodging through enhancement of rooting strength. These aspects, and possible varietal differences in response, will be investigated further in a follow-up experiment with varieties N25 and N36.

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