Effects of ethephon on growth characteristics of BJ Cultivars

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ABSTRACT

Ratoon fields of BJ7015, BJ7504, BJ78100 and BJ8252 were treated with varying rates of *ethephon* in the Wet East and Wet West zones between 2005 and 2007 to (1) determine if an application of *ethephon* to ratoon fields would promote early tillering and hence eliminate the need for supplying fields (2) determine which cultivars were responsive to *ethephon*; and (3) quantify the growth benefits of *ethephon* on sugarcane in Jamaica. Plots of ~0.01 ha were treated at 30 or 100 days with rates varying from 400 ml/ha to stimulate tillering, to 1000 ml/ha to enhance stalk formation. The data collected on #of tillers, stalk height, and leaf length were analysed by Genstat using two sample t-test on treated vs untreated samples over the period, and analysis of variance to detect differences between treatment rates. The results showed that increasing the concentration of *ethephon* reduced stalk and leaf growth significantly ($p<0.001$), while tillering remains variable. Indications are that some BJ cultivars are responsive to *ethephon*, hence the need for screening.

Key Words: *ethephon*, tillering, leaf growth, stalk growth, BJ sugarcane cultivars

INTRODUCTION

Commercially, sugarcane is propagated asexually, and requires large quantities of planting material to establish a new field. In the Jamaican sugarcane industry, as much as 12 tonnes of immature stalks (5-7 months old) are required to establish each hectare of land. Fields used as seed cane nurseries are lost for commercial production each year, hence many growers avoid seed cane nurseries on their farms in order to maximise production of mature cane for sugar extraction.

A crop of sugarcane will generally be grown on the land for several years, so it is important to ensure a good stand at re-establishment. Since not every eye on the stalk may be viable for one reason or another (insect damage, mechanical injury etc) Estates often use very high rates of seed cane to guarantee provision of enough viable seed pieces for good field establishment. However, on private farms (large and small), or where planting material of ideal age is unavailable, growers may sometimes use sub-standard material to establish or supply a field, often resulting in poor germination and establishment. A major factor that impacts sugarcane productivity in the Jamaican Industry is poor germination of cane setts (or sprouting in ratoons) and consequently low plant population densities in commercial fields.

Plant growth regulators (PGRs) act on plants by modifying some aspect of growth and development, and can be used advantageously in crop production. PGRs that enhance germination would therefore be valuable in situations where eyes are present but tend to remain dormant. Studies have indicated that certain PGRs do increase tillering in newly planted sugarcane, although responses vary with cultivar (Solomon et. al).

The application of ethephon is a technology used throughout the sugarcane growing world to regulate growth in many ways: flowering, tillering, germination, and stalk maturation (Solomon et. al; Li, Yang Rui et al). As a cultivation technique, the characteristics of ethephon that can have significant impact on sugarcane relate to its ability to improve germination rate and tillering. Both processes seem to have a high positive correlation. In India, the application of ethephon was found to promote seed cane sprouting (13-17%), and improved tillering and millable cane formation (12-16%) (**Ref**). Similar observations in Jamaica indicate increased tillering in plots treated with 500, and 750 ml/ha (Lewis, 2006). In Hawaii, *ethephon* caused an increase in the number of tillers in the media containing 50 ppm and 100 ppm of the growth regulator (Moore et al).

Application technique may also influence response. In Texas, application of ethephon in the furrow on seed pieces before covering tends to be the most effective in increasing shoot counts and heights (Wiedenfeld, 2003). Since shoot numbers in sugarcane tend to increase rapidly during early growth, then decline to an equilibrium level later in the season when the most rapid stalk elongation occurs, the beneficial effects of the early season increase of shoot counts tend to disappear. One benefit of increased early season tillering and stalk heights would be to cause quicker canopy cover and provide better competition against weeds. These are considerations that led to studies on the use of *ethephon* in Jamaica.

MATERIALS & METHODS

Ratoon fields of BJ7015, BJ7504, BJ78100 and BJ8252 were treated with varying rates of ethephon in the Wet East and Wet West zones between 2005 and 2007. The main objectives of the study were to:

1. determine if an application of ethephon to ratoon fields would promote early tillering and hence eliminate the need for supplying fields;
2. determine which cultivars were responsive to ethephon; and
3. quantify the growth benefits of ethephon on sugarcane in Jamaica

Plot size used at all sites was ~ 0.01 ha (10 m x 1.67 m x 6 rows) in completely randomised designs with four replicates. Ethephon was applied with a 15 litre Solo knapsack sprayer fitted with a Teejet TF-VP5 (floodjet) nozzle. Applications were made to the young foliage either at 30 days after harvest to promote tillering, or at 100 days to promote stalk formation. Rates of application were 400, 500, and 600 ml/ha (E400, E500, E600) for early tillering; and 800 ml/ha, 900 ml/ha, and 1000 ml/ha (E800, E900, E1000) to promote stalk formation. Volume rate of application was 180 l/ha.

Data Collection

Measurements were taken on the following variables at times outlined:

- Mean number of tillers per row (3 m section) at 30, 45, 60, 75, 90, 105, 120 days [T30, T45, ... T120]
- Mean height of five tillers measured from soil level to top visible dewlap at 30, 45, 60, 75, 90, 105, 120 days [H30, H45, ... H120]
- Mean length of leaf (last fully opened) from tip to dewlap [L30, L45, ... L120]

Data Analysis & Interpretation

The Genstat statistical package was used to do an analysis of variance on parameters measured (leaf length, stalk height, # of tillers/m) at each time period, and t-tests done comparing treated vs untreated plots using the same parameters.

RESULTS & DISCUSSIONS

Stem and Leaf Growth

At St. Thomas Sugar Co. (Wet East), no difference ($p = 0.378$) in height of stalks between the combined means of *ethephon*-treated plots (1190 mm ± 104.5 mm) and the control (1324 mm ± 107.5 mm) was seen, **Table 1.** However, an increased concentration of *ethephon* reduced stalk and leaf growth significantly ($p<0.001$). The real differences were between the control (E00), and either of the median and upper rates, **Table 2.** The combined means of leaf lengths in ethephon-treated plots (1226 mm ± 42.6 mm) vs the control (1550 mm ± 39.3 mm) showed statistically significant differences.

Table 1. Means and standard deviations of growth parameters analysed from ethephon studies in Westmoreland and St. Thomas

Location	Parameter	Control	Ethephon	Prob
St. Thomas	Stalk Height	1324 mm ± 107.5 mm	1190 mm ± 104.5 mm	0.378
	Tiller Density	18 ± 2.47	16.83 ± 3.61	0.46
	Leaf Length	1550 mm ± 39.3 mm	1226 mm ± 42.6 mm	<0.001
Westmoreland	Stalk Height	218.3 mm ± 82.5 mm	220.7 mm ± 93.9 mm	0.94
	Tiller Density	35.5 ± 14.6	33.86 ± 19.5	0.79

For stalk heights, the individual treatments showed separation between lower and upper rates. The heights of stalks treated with the lowest *ethephon* rate was not statistically different from the control. However, heights of stalks treated with the median and upper rates were both statistically shorter than that of the control or the lowest rate, **Table 2**. This could be an indicator that the rates above 800 ml/ha are disastrous to the variety BJ8252, since there are correspondingly shorter leaf and stalk as a result of *ethephon* treatment.

In Westmoreland (Wet West), the combined means for stalk height in both control and *ethephon*-treatment was not significant. However, there was statistical significance in heights of stalks treated with the two median rates, and between the lowest rate and the control, **Table 3**.

Table 2. Growth parameters as measured in BJ8252 at St. Thomas Sugar Co. between 2005 and 2007.

Treatment	#Tillers/m	Stalk Height (mm)	Leaf Length (mm)
E00 (Control)	18.1 a[1]	1324 a	1550 a
E800	20.0 a	1369 a	1338 b
E900	18.5 a	1112 b	1219 c
E1000	17.8 a	1090 b	1240 bc

Table 3. Growth parameters as measured in BJ7504 and BJ7015 on private farms in Westmoreland between 2005 and 2007.

Treatment	#Tillers/m	Stalk Height (mm)	Leaf Length (mm)
E00 (Control)	35.5 ab	218.4 ab	0.0
E400	24.9 b	191.3 c	0.0
E500	42.6 a	243.5 a	0.0
E600	34.1 ab	227.4 ab	0.0

Tillering

On private farms in Westmoreland, there was increased tillering at some sites, but also reduced tillering in plots treated at 600 ml/ha, due primarily to dieback resulting from moisture stress. There was statistical significance in tiller counts for stools treated with the two median rates of *ethephon*, *Table 3*. The median rate of 500 ml/ha of *ethephon* produced, and maintained a higher density than any other rate, or the control.

On the estate farms in St. Thomas neither of the *ethephon* treatments enhanced tillering over the control, **Table 2.**

[1]Means within a column followed by the same letter are not statistically different from each other at p=0.05

CONCLUSIONS

Indications are that the BJ cultivars tested are responsive to applications of ethephon. In the Wet East, a rate of ~ 800 ml/ha fostered stalk elongation in BJ8252 above the control without adverse effects, but seems to affect leaf extension. Higher rates of *ethephon* tends to retard stalk growth. During early tillering, 500 ml/ha seems adequate for BJ7504 and BJ7015, while up to 600 ml/ha did not retard stalk elongation nor tillering in Westmoreland. Although some of the responses were negative in early growth stages (stalk growth retardation), these could be advantages in the ripening phase. The study did not include all of the major commercial cultivars, hence more extensive study on *ethephon* to promote germination and early tillering needs to be commissioned, especially in cultivars that germinate slowly.

REFERENCES

1. Adams, Ashley and T.M. Velloza (1999). Effect of planting geometry and Ethrel rates on tiller development and yield in sugarcane.

2. Lewis, M. Edmond (2006). Ethephon in sugarcane cultivation. JAST (unpublished).

3. Li, Yang Rui & Solomon, S. (2003). Ethephon: a versatile growth regulator for sugarcane industry. Sugar Tech, 2003 (Vol. 5) (No. 4) 213-223.

4. Moore, P. H. and R. V. Osgood (1989). Prevention of flowering and increasing sugar yield of sugarcane by application of ethephon (2-chloroethylphosphonic acid). Journal of Plant Growth Regulation Volume 8, Number 3 / June, 1989

5. Nailwal, T.K., V.K. Gupta, N.K. Sand, and R.C. Pant (2004). Role of ethylene in tillering of sugarcane. Physiology and Molecular Biology of Plants, 2004 (Vol. 10) (No. 1) 127-130.

6. Rao, Manjunatha S., M. Krishnamurthi, and Pipat Weerathaworn (2005). Effect of ethephon on yield and sugar content of different sugarcane cultivars in Thailand. Sugar Tech, 2005 (Vol. 7) (No. 2/3) 48-52.

7. Solomon, S., Ishwar Singh and V.K Madan (2003). Effect of 2-chloroethyl phosphonic acid on early growth and advancement of maturity in sugarcane. Sugar Tech, 2003 (Vol. 5) (No. 4) 213-223

8. South Africa Sugar Association, (2002). Flowering in sugarcane. SASA Information Sheet.

9. Sugarcane Breeding Institute (India), (2004). Control of flowering in sugarcane. SBI Quarterly Newsletter Vol. 23, No. 4, pp. 1

10. Wiedenfeld, Bob (2003). Enhanced sugarcane establishment using plant growth regulators. Journal American Society of Sugarcane Technologists 23:48-61