Improvement of the sucrose content of early harvested sugarcane using stabilised orthosilicic acid

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Abstract Stabilised orthosilicic acid (OSA), commercially available as SiLIXOL™ was applied by aerial spray to early harvested commercial sugarcane prior to harvest on the estate farm of Iman Khomeini Sugar Company, Iran. Aerial application of OSA (2.5 L/ha) showed appreciable improvement in quality parameters of two sugarcane varietiesCP57-614 and CP 73-21 at 45, 60 and 75 days after treatment. Its application after 60 days resulted in 0.92 and 0.45 unit improvement above the control (water) in pol% cane; 0.44 and 0.41 unit in CCS and 4.6 and 2.5 percent increase in cane weight for two cane varieties, respectively. No adverse effect was noticed on foliage and emergence of the subsequent ratoon crop. Comparably glyphosate application showed 1.04 and 0.65 unit improvement above the control in pol% cane; 0.77 and 0.59 unit improvement in CCS. However in this case, the average cane weight decreased by 3.9 and 3.2% compared to the untreated control. Both, OSA and glyphosate showed increased brix value and juice purity compared to control. This study have shown that foliar application of OSA has potential to improve sucrose content during early harvest season without any adverse effect on plant cane or succeeding ratoon crops.

Key words Orthosilicic acid, foliar spray, pol% cane, CCS

INTRODUCTION

Khuzestan province is the major sugarcane growing region in Iran. The early crushing season coincides with rains followed by low temperatures, which impedes sucrose accumulation and sugar recovery. Artificial ripening technology using chemicals such as glyphosate improves cane quality but causes reduced cane yields, drying of foliage and poor germination of subsequent ratoons (Solomon and Li 2004; Karmollachaab 2016). Commercial-scale use of ripeners is therefore limited. A bioactive product of orthosilicic acid (OSA), commercially available as SiLIXOL™, was therefore evaluated to test the impact on sucrose accumulation during early harvest season.

The beneficial role of silicon (Si) has been established for improving crop productivity, quality and reducing biotic and abiotic stress (Ma 2004). Recent findings suggest an important role of Si in plant metabolic activities (Savant *et al.* 1999; Detmann*et al.* 2013; Sahebi*et al.* 2015). Significant responses to silicon treatment on both cane and sugar yields, varying from 10 to 38% have been reported in several sugarcane growing countries including Hawaii, Mauritius, South Africa, Puerto Rico, Florida, Australia and India (Meyer and Keeping 2000; Jain *et al*. 2015).

This paper reports on an investigation aimed at evaluating the role of a stabilized form of OSA on sugar accumulation in early harvested sugarcane.

MATERIALS AND METHODS

A replicated field trial (approximately 25 ha in area, three replicates in a randomised-block design) was conducted withapplication of0.8% stabilized orthosilicic acid aqueous solution to sugarcane varieties CP57-614 and CP73-21 grown commercially on the estate farm of Iman Khomeini Sugar Company, Iran. The product was applied as a foliar spray (2.5 L in 300 L water and a surfactant) in the first week of September 2014 using a microlight aircraft during the early morning (ambient temperature 22-26°C; humidity 45-55%). A combined solution of glyphosate (0.20kg ai/ha) + sodium metasilicate (2%) was sprayed in a separate field for comparative studies, control plots were sprayed with water. Ten cane stalks from each replicate were collected randomly from each plot 45, 60 and 75 days after treatment. The weight

was recorded and then analysed for quality parameters, viz. brix, pol% juice, pol% cane, purity and commercial cane sugar (CCS).

RESULTS AND DISCUSSION

The results of the experiments on variety CP57-614 are presented in Table 1. Aerial application of OSA to sugarcane varieties CP57-614 and CP73-21 showed appreciable improvement in quality parameters at 45, 60 and 75 days after treatment. Its application resulted in 0.92 and 0.45 unit improvement above the control treatment in pol% cane, 0.44 and 0.41 unit improvement in CCS, and 4.6 and 2.5% increase in cane weight, respectively, 60 days after treatment. No adverse effect was noticed on the foliage and sprouting of subsequent ratoon crop. In comparison, glyphosate application resulted in 1.04 and 0.65 unit improvement above the control treatment in pol% cane, and a 0.77 and 0.59 unit enhancement in CCS at the same stage. However, the average cane weight decreased by 3.9 and 3.2% compared to the control. Both, OSA and glyphosate showed increased brix value and juice purity compared to the control (Table 1). Glyphosate application appeared to cause drying of cane leaves, reduction in average cane weight and poor sprouting of succeeding ratoon crop. The quality parameters showed declining trends at 75 days after application across all treatments.

Table 1. Effect of stabilised orthosilicic acid (OSA) and glyphosate application on cane weight and quality parameters in sugarcane variety CP57-614.

Treatment	Cane weight (kg, 10 stalks)	Brix	Pol % cane	Pol% juice	Purity	CCS
45 days after application						
Control	8.72± 0.06	18.34 ± 0.23	12.70 ±0.17	16.09 ±0.07	87.80±2.51	11.08±0.25
OSA	8.88 ±0.11 (+1.7%)**	19.12 ±0.19	13.39±0.08 (+0.69)**	16.86 ±0.15	88.23 ±0.91	11.64±0.11
Glyphosate	8.25 ± 0.11 (-1.1%)**	19.60 ±0.18	13.65 ±0.05 (+0.95)**	17.28± 0.15	88.20 ±0.92	11.94 ±0.24
F value*	11.45	10.15	18.70	21.55	0.022	4.41
P value*	0.009	0.012	0.003	0.002	0.98	0.066
60 days after application						
Control	9.12± 0.11	20.44 ± 0.22	13.20 ±0.13	17.75 ±0.18	86.84± 0.96	12.16±0.16
OSA	9.54 ±0.09 (+4.6%)**	21.24 ±0.30	14.11±0.10 (+0.91)**	18.40±0.29	86.65 ±1.09	12.60±0.24
Glyphosate	8.40 ± 0.10 (-3.9%)**	21.76 ±0.13	14.29 ±0.04 (+1.09)**	18.87± 0.17	86.71 ±1.26	12.92 ±0.21
F value*	39.45	8.45	0.015	6.62	0.008	3.41
P value*	0.002	0.018	0.985	0.030	0.992	0.10
75 days after application						
Control	9.16± 0.11	20.89 ± 0.07	13.80 ±0.11	18.34 ±0.21	87.75± 0.73	12.64±0.20
OSA	9.59 ±0.09 (+4.7%)**	21.59 ±0.13	14.13±0.10 (+0.33)**	18.84±0.13	87.25 ±0.31	12.94±0.18
Glyphosate	8.45 ± 0.06 (-4.6%)**	21.87 ±0.08	14.32 ±0.06 (+0.52)**	19.07± 0.07	87.21 ±0.26	13.10 ±0.06
F value*	39.45	27.89	8.31	6.14	0.39	3.11
P value*	0.002	0.001	0.019	0.035	0.69	0.12

* Values calculated using one way ANOVA.
** Values indicate increase over control.

CONCLUSIONS

Our study has shown that foliar application of stabilised orthosilicic acid has a potential to improve sucrose content and therefore sugar recovery early in the crushing season. Its application appeared to have little adverse impact on cane weight, foliage and growth of subsequent ratoon cane. Further work is needed to validate these results and assess the efficacy of the product across a range of conditions.

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French title

Résumé.

Mots-clés:

Spanishtitle

Resumen.

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