

**Efficacy of hot water treatment in management of sugarcane ratoon stunting disease**

Philip, E. S.,<sup>1</sup> Muthomi, J.W.,<sup>1</sup> Narla, R. D.<sup>1</sup> & Riungu, G. M.<sup>2</sup>

<sup>1</sup>Department of Plant Science and Crop Protection, University of Nairobi, P.O.Box 30197, GPO, Nairobi, Kenya

<sup>2</sup>Sugar Research Institute (SRI), Kenya Agricultural and Livestock Research Organisation, P.O. Box 44 - 40100, Kisumu, Kenya

**Corresponding author:** james\_wanjohi@yahoo.com

---

**Abstract**

Sugarcane ratoon stunting disease (RSD) caused by the bacterium *Leifsonia xyli* subsp. *xyli* causes huge losses to sugarcane ratoon crops. Hot water treatment is commonly used in many countries to control RSD but conflicting results show that it may have either positive or negative effects on yield based on variety, temperature and duration of therapy. Effect of hot water treatment in management of RSD was determined on three sugarcane varieties (CO421, D8484, KEN 83737) at 45°C, 50°C, 52°C and 55°C for two hours. Control cane was treated with cold water at room temperature at 25°C. The treated cane was planted in the field and data collected on cane girth, cane height, number of millable stalks, cane weight and sucrose content. Hot water treatment at 45°C, 50°C and 52°C significantly reduced RSD incidence and increased cane yield while treatment at 55°C completely eliminated RSD but significantly reduced cane yield. The cane setts which were treated with cold water at 25°C were stunted and had low overall cane yield. Hot water treatments at 50°C was the most effective and produced the highest cane yield followed closely by treatment at 52°C. Therefore the two temperatures are recommended for management of ratoon stunting disease of sugarcane. Treatment of sugarcane setts at high temperatures of 55°C for two hours though effective in reducing RSD is harmful through reduction in germination of setts and thus total plant population and eventually low cane yield.

**Key words:** Cane quality, hot water treatment, *Leifsonia xyli* subsp. *xyli*, Kenya, sugarcane ratoon stunting

**Résumé**

La maladie de rabougrissement des repousses de la canne à sucre (RSD) causée par la bactérie *Leifsonia xyli* subsp. *xyli* cause d'énormes pertes aux cultures des repousses de la canne à sucre. Le traitement à l'eau chaude est couramment utilisé dans de nombreux pays pour contrôler la RSD, mais des résultats contradictoires montrent qu'il peut avoir des effets positifs ou négatifs sur le rendement en fonction de la variété, de la température et de la durée du traitement. L'effet du traitement à l'eau chaude dans la gestion de la RSD a été déterminé sur trois variétés de canne à sucre (CO421, D8484, KEN 83737) à 45°C, 50°C, 52°C et 55°C pendant deux heures. La canne témoin a été traitée avec de l'eau froide à température ambiante à 25°C. La canne traitée a été plantée au champ et des données ont été collectées sur la circonférence de la canne, la hauteur de la canne, le nombre de tiges pouvant être broyées, le poids de la canne et la teneur en saccharose. Le traitement à l'eau chaude à 45°C, 50°C et 52°C a réduit de manière significative l'incidence la

RSD et augmenté le rendement de la canne tandis que le traitement à 55°C a complètement éliminé la RSD mais a considérablement réduit le rendement de la canne. Les pousses de canne qui ont été traitées avec de l'eau froide à 25°C étaient rabougries et avaient un faible rendement global de la canne. Les traitements à l'eau chaude à 50°C ont été les plus efficaces et ont produit le rendement de canne le plus élevé, suivis de près par le traitement à 52°C. Par conséquent, les deux températures sont recommandées pour la gestion de la maladie de rabougrissement des repousses de la canne à sucre. Le traitement des repousses de la canne à sucre à des températures élevées de 55°C pendant deux heures, bien qu'efficace pour réduire la RSD, est nocif par la réduction de la germination des repousses et donc de la population végétale totale et, éventuellement, du faible rendement de la canne à sucre.

Mots clés: Qualité de la canne, traitement à l'eau chaude, *Leifsonia xyli* subsp *xyli*, Kenya, rabougrissement des repousses de la canne à sucre

---

## Introduction

Ratoon stunting disease of sugarcane (*Leifsonia xyli* subsp *xyli*) causes more cane yield loss worldwide than any other sugarcane disease (Lemma *et al.*, 2013), and reduces cane and sugar yield (Yohannes *et al.*, 2012). Minimizing the effects of ratoon stunting disease in sugarcane production should be a high priority in the sugar industries throughout the world. This can be achieved through consistent production of healthy seed cane through well managed schemes incorporating hot water treatment and careful management of the crop through proper disinfection of harvesting tools since the pathogen is easily spread mechanically (Viswanathan, 2012). Various thermal treatments have been or are being used to successfully eliminate *Leifsonia xyli* subsp *xyli* from sugarcane setts. These include hot air, steam and hot water (Tiwari *et al.*, 2012). Hot water treatment at 50°C for two to three hours is the most commonly used method of heat treatment used to eliminate the bacterium and establish pathogen free seed cane (Johnson and Tyagi, 2010). However, conflicting results show that hot water treatment may have either positive or negative effects on yield based on variety, temperature and duration of therapy (Johnson and Tyagi, 2010). Therefore the objective of this study was to determine the effectiveness of hot water treatment in management of ratoon stunting disease and its effect on cane yield and cane quality in Kenya.

## Materials and methods

Stalks of 12 months' old RSD diseased canes of varieties D8484, KEN 83-737 and CO421 were cut into three budded setts and treated at different water temperatures 45°C, 50°C, 52°C and 55°C for two hours. The control setts were soaked in distilled water for two hours at 25°C. Treated setts were planted end to end at rate of 25 setts per furrow making a total of 100 setts per treatment plot. Each of the five hot water treatment (25°C, 45°C, 50°C, 52°C, 55°C) and three varieties (D8484, KEN 83-737, CO421) were replicated thrice. The design of the experiment was 3×5 factorial laid out in a Randomized Complete Block Design (RCBD). At four months the crop was top dressed with Calcium Ammonium Nitrate (CAN) at the rate of 350 kg per hectare.

The canes were harvested after 11 months and 10 stalks were randomly selected from each plot. Data were collected on cane weight, presence of RSD bacterium and sucrose content. Cane weight of the 10 stalks was converted to kilograms per hectare. The weight was then converted to cane yield per hectare (Mt/ha). The sugar content was determined using a digital hand held refractometer. The degree brix readings obtained gave the percentage sucrose content of the cane juice. The bacterium was detected in the harvested stalks using Tissue blot enzyme immunoassay. Data were subjected to analysis of variance using ANOVA procedure of Genstat 13th Edition and differences among treatment means were compared using the Fishers Protected LSD test at 5% probability level.

## Results and discussion

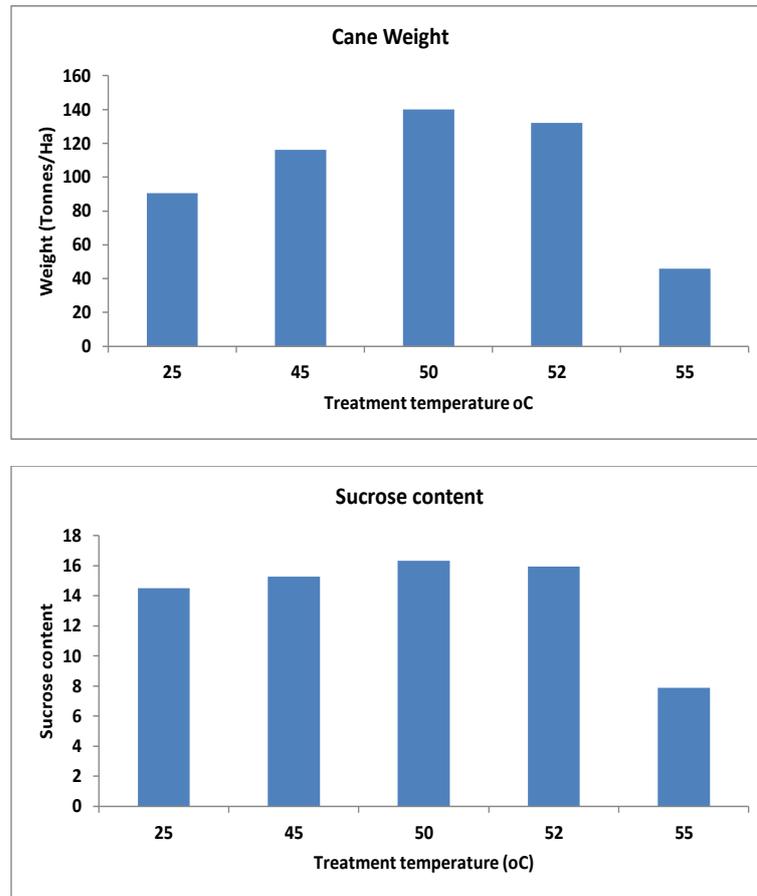
Hot water treatment significantly increased the overall cane yield and sucrose content (Table 1 and Figure 1). The percentage infected stalks were lower in the treated cane compared with the control (25°C) and reduced as temperature increased. Cane treated at 55°C had the lowest percent of infected stalks. Cane treated at 45°C, 50°C, 52°C produced higher average cane yield compared to the control (25°C). However, average cane yield was highest at 50°C and lowest at 55°C (Figure 1). These results are in agreement with Johnson and Tyagi (2010) who found out that hot water treated cane had higher cane and sugar yield than the untreated cane. Hot water treatment could have reduced ratoon stunting disease resulting to high germination and subsequent high yields in the treated cane. Heat treatment kills or eliminates the bacteria present in the sugarcane setts (Viswanathan, 2012). James (2005) reported that hot water treatment does not totally eliminate infection of ratoon stunting disease but it merely reduces it to a level to enable the grower establish a nursery with very low level of infection. The high cane yield and sucrose content at 50°C compared to other treatment temperatures, confirmed findings by Johnson and Tyagi (2010), who reported that hot water treatment at 50°C for 2 hrs, gave higher cane and sucrose yield and was the most effective. Treatment at 55°C adversely affected cane yield. Perhaps the high temperature of 55°C may have killed the buds leading to low germination and thus low plant population resulting into low yields (Johnson *et al.*, 2006).

Table 1. Percent stalks positive for Ratoon stunting disease pathogen after hot water treatment

Variety	Temperature° C					Mean
	25	45	50	52	55	
D8484	93.3	63.3	16.7	10.0	3.3	37.3
CO421	93.3	63.3	30.0	13.3	0.0	40.0
KEN83737	93.3	60.0	20.0	10.0	3.3	37.3
Mean	93.3d	62.2 <sup>c</sup>	22.2 <sup>b</sup>	11.1 <sup>a</sup>	2.2 <sup>a</sup>	
LSD ( $p \leq 0.05$ ): Temp 9.30, variety 7.20, temp*variety 16.10. CV(%)= 25.2						

Values followed by the same letters within the rows are not significantly different.

LSD= Least significant difference, CV= Coefficient of variation, Temp=Temperature



**Figure 1. Cane weight (tonnes/ha) and sucrose content for three sugarcane varieties treated at different temperatures**

### Conclusion

The reduction of the disease and increase in cane yield and sucrose content in treated cane at 45°C, 50°C and 52°C indicate the effectiveness of hot water treatment in the control of ratoon stunting disease. Treatment at 45°C, 50°C and 52°C reduced ratoon stunting disease without detrimental effect on cane. Although high temperatures of 55°C completely eliminated the disease it may not be useful because it was detrimental on cane. Hot water treatment at 50°C was the most effective and produced the highest cane yield which was not significantly different from that of temperature 52°C. Therefore, the two temperatures are hereby recommended for management of ratoon stunting disease of sugarcane.

### Acknowledgement

The authors acknowledge the financial and technical support from the Sugar Research Institute of the Kenya Agricultural and Livestock Research Institute (KALRO). This paper is a contribution to the 2018 Sixth African Higher Education Week and RUFORUM Biennial Conference.

## References

- James, G. L. 2005. Pest and diseases of sugarcane. *Sugar Cane International* 23: 3-14.
- Johnson, S.S. and Tyagi, A.P. 2010. Effect of ratoon stunting disease on sugarcane yield in Fiji. *The South Pacific Journal of Natural and Applied Science* 28: 69-73.
- Johnson, S.S., Work, S.D. and Tyagi, A.P. 2006. The distribution and incidence of the causal agent for ratoon stunting disease, *Leifsonia xyli* subsp *xyli* on sugarcane in Fiji. *Journal of South Pacific Agriculture* 13: 1-5.
- Lemma, A., Abera, T. and Amrote, T. 2013. Status of ratoon stunting disease (*Leifsonia xyli* subsp *xyli*) in the initial seed cane and seed cane fields of Wonji Sugar factory. *Global Science Research Journal* 3: 213-217.
- Tiwari, A.K, Vishwakarma, S.K., Kumar, P., Pandey, M. and Lal, M. 2012. Ratoon stunting disease of sugarcane. *Plant Knowledge Journal* 1: 20-24.
- Viswanathan, R. 2012. Handbook on sugarcane diseases and their management. Sugarcane Breeding Institute, Coimbatore.
- Yohannes, Z., Firehun, Y., Teklu, B., Abera, T. and Leul, M. 2012. Effect of *Leifsonia xyli* subsp. *xyli* concentration on yields of four sugarcane varieties in the sugarcane plantations of Ethiopia. *Ethiopia Journal Application Science Technology* 3 (2): 25-30.