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Tolerance of Isd-16 and I-60/74 to Hot Water Treatment

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ABSTRACT

The relative tolerance of Isd-16 and I-60/74 to hot water treatment (HWT) at varying temperatures and duration were investigated. HWT at 50°C for 1 hour enhanced germination to the extent of 10% over control (60%) in Isd-16 and 1.57% over control (69.5%) in I-60/74. Treatment of setts beyond 50°C for 2 hours resulted in gradual loss of germination. The maximum endurance limit of Isd-16 and I-60/74 to HWT was 56°C for 1 hour and 54°C for 1 hour respectively. The effects of higher HWT-temperatures and duration were more deleterious in the Clone I-60/74 than in Isd-16. HWT appeared to boost up shoot length of Isd-16 while no such conspicuous effect was observed in the case of I-60/74.

INTRODUCTION

Since the reporting of the ratoon stunting disease (RSD) in the mid 1940's and subsequent information about its heat curability, the heat therapy of sugarcane planting material has been in practice in most of the sugarcane growing areas of the world (Steindl, 1950; 1961). A heat treatment for the control of RSD was originally recommended in Australia by the use of hot water at 50°C for 2 hours. Later a treatment at 50°C for 3 hours was adopted in practice (Hughes and Steindl, 1955). In India, however, hot water treatment at 52°C for 20 min or at 50°C for 2 hours has been recommended for the control of GSD (Grassy shoot disease) and RSD (Srinivasan and Rao, 1968).

In recent years, hot air treatment involving higher temperatures and longer duration of treatment received attention (Singh, 1967 & 1968; Steindl, 1974). sporadic informations from the literature indicate that sugarcane verieties differ in their tolerance to different temperature regimes (Dillewijn, 1952 ; Humbert, 1968; Escober, 1966; Mukherjee, 1960). The fate of HWT-treated bud is not clearly known. In Bangladesh, HWT-plants have recently been installed at the different sugar mills to provide disease-free foundation seed upon heat therapy for the operation of the 3-tier seed programme. Therefore, an experiment was conducted to study the effect of HWT on buds of Isd-16 and I-60/74 to provide basic informations on the sensitivity and endurance potential of these two clones.

MATERIALS AND METHODS

The experiment was conducted at the sugarcane Research and Training Institute (SRTI), Ishurdi with Isd-16, a newly released sugarcane variety, and I-60/74, a promising clone. Seventy two bundles of sugarcane setts prepared from randomly selected uniform stalks were used in the trial. Each bundle of cane contained 25 two-budded setts. The experiment was laid out in a randomized block design with four replications. Each bundle of cane with 75 buds served as a replicate. Only setts with healthy buds were used in the experiment and precautions were taken so that no injury or damage was caused to the bud due to any factor other than hot water treatment. Eight bundles of cane, four from each clone, were subjected to each of the following hot water treatment (HWT) :

T_0 : Control (no HWT : but sett soaked in Aretan-6 as per normol practice).
T_1 : HWT at 50°C for 1 hour.
T_2 : HWT at 50°C for 2 hours
T_3 : HWT at 52°C for 1 hour
T_4 : HWT at 52°C for 2 hours
T_5 : HWT at 54°C for 1 hour
T_6 : HWT at 54°C for 2 hours
T_7 : HWT at 56°C for 1 hour
T_8 : HWT at 56°C for 2 hours

The hot water operation was carried out in a large HWT-plant (Model 48031, designed by the Davy Engineering Co., Australia) with loading capacity of about one ton cane stalk at a time allowing a temperature of 50°C to 70°C with an accuracy of + 0.2°C. Equipped with an automatic temperature control device, a secondary tank and a circulating pump, the HWT-plant functions precisely and records the operational temperature on a circular recording chart.

The treated setts were planted on raised beds prepared with a medium textured soil and uniformly watered on alternate days to provide congenial conditions for germination. At six weeks after planting, records on germination (upon thorough examination of each sett) was taken. Shoot length of ten randomly selected plants per treatment was also recorded. The germination data were subjected to statistical analysis. To find possible differences between the two clones and also between the duration of the HWT paired t-tests were done. Standard error was calculated to provide an estimate of variance associated with the shoot-length data.

RESULTS AND DISCUSSION

The sugarcane clones significantly differed in their tolerance to the hot water treatment (Table 1). HWT at 50°C for 1 hour resulted in a slight increase in germination of both the clones. There was no significant loss of germination upto 50°C for two hours; however, as the temperature was further increased, germination of both the clones declined. The effect of elevated temperatures was more deleterious in the clones I-60/74 than in

Isd-16, the latter demonstrating better endurance to hot water upto atleast 54°C (Table 1, Fig. 1). In the case of I-60/74, HWT at 52°C for 2 hours resulted in poor germination (<30%), and complete loss of viability of bud was observed at 54°C

Table 1. Effects of dif ferent hot water treatment (HWT) on the mean germination and shoot length of Isd-16 and I-60/74 at six weeks after planting.

Treatments	Germination (%)		Shoot length (cm)*	
	Isd-16	I-60/74	Isd-16	I-60/64
Control (No HWT)	60.00	69.50	4.3(±0.10)	13.6(±0.05)
HWT at 50°C for 1 hour	70.00	71.07	9.1(±0.08)	14.2(±0.06)
HWT at 50°C for 2 hours	72.50	64.50	9.0(±0.11)	14.0(±0.08)
HWT at 52°C for 1 hour	58.72	57.36	9.2(±0.06)	14.2(±0.10)
HWT at 52°C for 2 hours	58.29	23.30	9.1(±0.09)	14.0(±0.06)
HWT at 54°C for 1 hour	56.79	17.21	9.0(±0.07)	14.2(±0.10)
HWT at 54°C for 2 hours	20.50	0.00	9.3(±0.11)	—
HWT at 56°C for 1 hour	12.50	0.00	9.1(±0.11)	—
HWT at 56°C for 2 hours	0.00	0.00	—	—
LSD (0.05)	6.15	4.02	—	—

* Figures in the parenthesis indicate standard error of mean.

for 2 hours. In Isd-16, however, similar effects were noticed at still higher temperatures of 54°C - 2 hour and 56°C - 2 hour respectively (Fig. 1). The effect of duration of HWT (i. e., 1 hour vs 2 hours) which yielded a significant difference, started getting larger at temperatures higher than 50°C (Fig. 1). The effect of duration was more damaging in the clone I-60/74 than in Isd-16 indicating that Isd-16 is superior to I-60/74 in respect of tolerance to HWT for a longer duration. The maximum endurance limit, beyond which bud-viability is completely impaired, was found to be 54°C - 1 hour for I-60/74, and 56°C -1 hour for Isd-16. HWT resulted in boosting up germination of Isd-16 which had shorter shoot length under the control (no HWT) as reported in Table 1. In the case of I-60/74. no such effect was observed. It appears that I-60/74 is genetically endowed with the quality of prompt germination. These observation are in agreement with the findings reported by Parthasarathy (1972). Mukherjee (1960) reported that higher temperature initiated an early emergence of growth from the sugarcane buds, but temperatures higher than 35°C possibility injures the bud which is eventually revealed by a sharp decrease in germination (%). Escober (1966) reported that hot water treatment at 50°C for 30 min stimulates the germination of most varieties, but the same treatment has proved detrimental to some varieties. Hardy (1974) reported that variety NCO 376 was adversely affected by hot water treatment as compared to NCO 310, NCO 334 and N 55/805 subjected to HWT at 50.5°C for 2 hours. The present results agree with the above findings on germination. It may be suggested that I-60/74 is more susceptible to HWT than Isd-16.

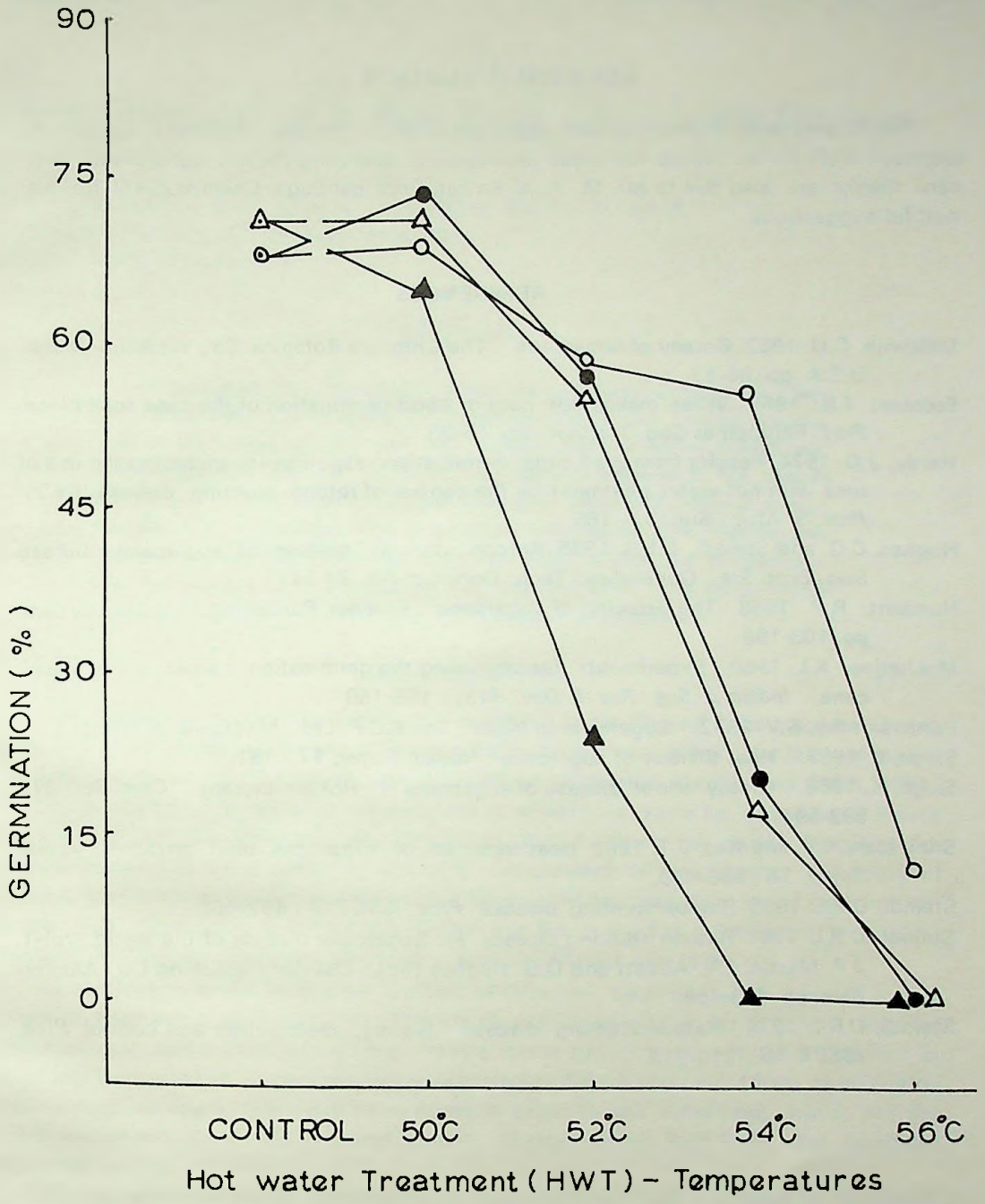

Figure 1 Effect of different temperatures in HWT on the germination of sugarcane clones Isd. 16 (reprasented by circle) and I-60/74 (represented by triangle). The open symbols indicates HWT for 1 hour while the closed symbol stands for HWT for 2 hours.

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