RESULTS FROM SEEDCANE GERMINATION EXPERIMENTS, INCLUDING THE USE OF UREA WITH HOT WATER TREATMENT FOR THE CONTROL OF RATOON STUNTING DISEASE (R.S.D.)

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Abstract

The paper describes three experiments which were designed to test the effect of various factors on the efficiency of germination after hot water treatment of sugar cane. The results have shown that the use of urea in hot water treatment can be beneficial to germination. The superior germination of whole stalks as opposed to cane setts after hot water treatment has been confirmed and the importance of immediate planting and covering after ridging-out has been illustrated. The possible need for further study into the minimum immersion-time required for efficient R.S.D. treatment has been posed.

Introduction

Germination of seedcane following hot water treatment depends on many factors such as the quality of treatment, the variety, the age of the seed material, mechanical damage to the buds and conditions at planting. It is also well known that germination of most cane varieties after heat treatment is not as prolific as it is without heat treatment. For this reason field experiments to test methods of improving germination after hot water treatment were conducted by the author on various sites.

Experiments were laid down—

(i) To test under local conditions, the findings of Antoine (1) in Mauritius that the addition of urea to the hot water tank improved germination.

(ii) To test the germination efficiency of seedcane of different physiological ages after hot water treatment, *and*

(iii) To compare the germination of setts versus whole stalks, following hot water treatment.

Experimental method and design

Two experiments were laid down to determine the effect of urea on the germination of heat treated seedcane.

Experiment 1

This experiment was planted on the 30.3.71 at Ubombo Ranches Ltd., Swaziland, under irrigated conditions.

The experiment comprised split plots in a randomised block design with three replicates. Whole plots were used for different varieties (NCo 376, NCo 310, NCo 334 and N 55 / 805), and the sub-plots were made up of three treatments—

(*a*) Control.

(*b*) Hot water treatment.

(*c*) Hot water treatment + urea.

Each nett sub-plot consisted of 4 lines × 60 buds per line.

All the seedcane used was 11 months of age. Whole stalks were used for treatments (*b*) and (*c*) and three-budded setts for treatment (*a*). In all cases the seedcane was treated with an organo-mercuric fungicide at a concentration of 0,03% Hg and Dieldrin w.p. at 208 gms. per 100 litres water. The temperature of the hot water tank was constant at 50,5°C for 2 hours.

For treatment (*c*), urea was added to the hot water tank at the rate of 0,3% W / V (3 Kg / 1 000 litres).

Primary shoot counts were conducted at intervals between the 12.4.71 and 22.5.71.

Experiment 2

This experiment was planted on the 21.1.72 at Doornkop Sugar Co. (Pty.) Ltd., under rainfed conditions.

The same design as for Experiment 1 was used. Variations from Experiment 1, are listed below—

Varieties — NCo 376, N 55/805 and CB 36/14.

Treatments — (*a*), (*b*) and (*c*) same as in Experiment 1.

An additional treatment (*d*), hot water treatment + β — indole-butyric acid, was included to test the effect of this growth hormone at a concentration of 2,5 ppm. in the dip tank.

Age of Seedcane — 14 months for NCo 376 and 13 months for the other two varieties.

Net Sub-plot — 3 lines × 90 buds per line.

Primary shoot counts were carried out at intervals between the 4.2.72 and 17.3.72.

Results and discussion

Experiment 1

From Table I and Figure 1, the following observations are noted:

(*a*) *NCo 376*

(i) This variety is adversely affected by hot water treatment. ($P = < 1\%$)

(ii) Addition of urea significantly improved the germination of this heat treated seedcane. ($P = < 1\%$)

(iii) It would appear that the addition of urea promoted early germination, compared to the other treatments. Germination in the hot water treatment + urea plots was 62,5%, nineteen days after planting; an equivalent germination in the control plots was only achieved 35 days after planting. See Fig. 1 (*a*).

(*b*) *NCo 310*

No significant differences could be noticed between the treatments for this variety.

(*c*) *NCo 334*

(i) This variety is adversely affected by hot water treatment (P = 1%), although to a lesser extent than NCo 376.

(ii) Addition of urea did improve germination compared to hot water treatment, but not significantly so.

(*d*) *N 55/805*

No significant differences were recorded between the treatments, although hot water treatment (with and without urea) appeared to promote early germination, compared with control.

This experiment was harvested on the 15.5.72, and the results indicated certain trends as follows—

(*a*) *Stalk Population*

(i) The effect of initial better germination of NCo 376 in hot water treatment + urea plots appeared to have been maintained up to harvest, although not significantly so. The very high co-efficient of variation of 14% could have had a masking effect on these results. See Table II.

TABLE I

Experiment I — Percentage germination of buds as at the last count

Varieties	Treatments			Mean
	Control	H.W.T.	H.W.T. + Urea	
N:Co. 376	67,9	55,6	65,6	63,0
N:Co. 310	84,7	79,2	81,0	81.6
N:Co. 334	71,3	62,5	65,3	66,3
N. 55/805	78,6	76,7	76,9	77,4
Mean	75,6	68,5	72,2	72,1
S.E. = ±	2,74			
L.S.D. 5%	5,8			
1%	8,0			
C.V. %	4,7			

TABLE II

Experiment I — Stalk population at harvest (1 000's/ha)

Varieties	Treatments			Mean
	Control	H.W.T.	H.W.T. + Urea	
N:Co. 376	109	98	114	107
N:Co. 310	97	100	96	98
N:Co. 334	111	99	101	104
N. 55/805	100	108	105	104
Mean	104	101	104	103
S.E. = ±	11,9			
L.S.D. 5%	25			
C.V. %	14			

(ii) No significant differences were noticed between the treatments for other varieties.

(*b*) *Stalk Height and Stalk Diameter*

No significant differences were found between the treatments for any of the varieties tested.

Experiment 2

From Table III and Figure 2 the following observations are noted—

TABLE III

Experiment II — Percentage germination of buds as at the last count

Varieties	Treatments				Mean
	Control	H.W.T.	H.W.T. + Urea	H.W.T. +I.B.A.	
N:Co. 376	74,5	61,5	70,4	63,7	67,4
N. 55/805	81,5	73,3	72,2	70,7	74,5
CB 36/14	69,6	66,7	67,0	65,9	67.4
Mean	75,2	67,0	70,0	66,7	69,6
S.E. =	±2,73				
L.S.D. 5%	5,7				
1%	7,9				
C.V. %	4,8				

(*a*) *NCo 376*

(i) Results were very similar to those of Experiment 1, in that the addition of urea did improve germination significantly, compared to hot water treatment alone. (P = < 1%)

(ii) Although the addition of urea did promote early germination, compared to hot water treatment alone, the effect was not as marked as in Experiment 1. One possible reason for this could be that Experiment 2 was planted during good growing conditions (January), whereas Experiment 1 was planted at the end of March when growing conditions were poorer. Furthermore, in Experiment 1 whole stalks were used for hot water treatment, whereas in Experiment 2, three-eyed setts were used and as can be noted from Figure 5, results of Experiment 3 showed that hot water treatment of whole stalks promoted early germination compared with hot water treatment of setts.

(*b*) *N 55/805*

(i) Contrary to results of Experiment 1, this variety was adversely affected by hot water treatment. (P = 1%)

(ii) Addition of urea did not improve germination of hot water treated seedcane. These results also contrast with the generally accepted behaviour of N 55/805 after hot water treatment and no suitable explanation can be submitted for the results recorded in this case. Due to the method of conducting the experiment and the hot water treatment, in particular, the maltreatment of this variety compared to others in the experiment can be ruled out as an explanation of the results.

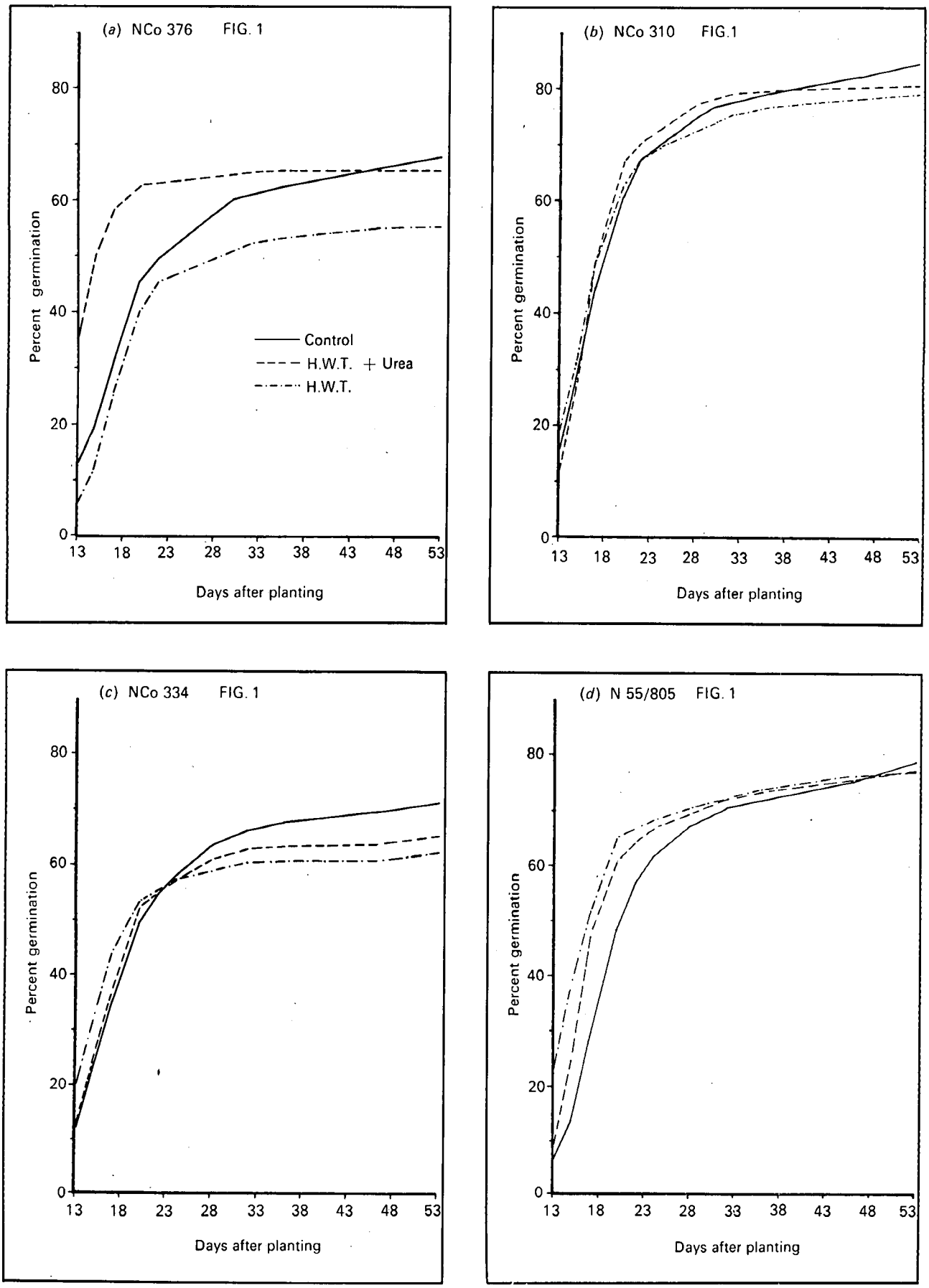

FIGURE 1: Percent germination of buds for the different varieties with the various treatments. (Experiment 1.)

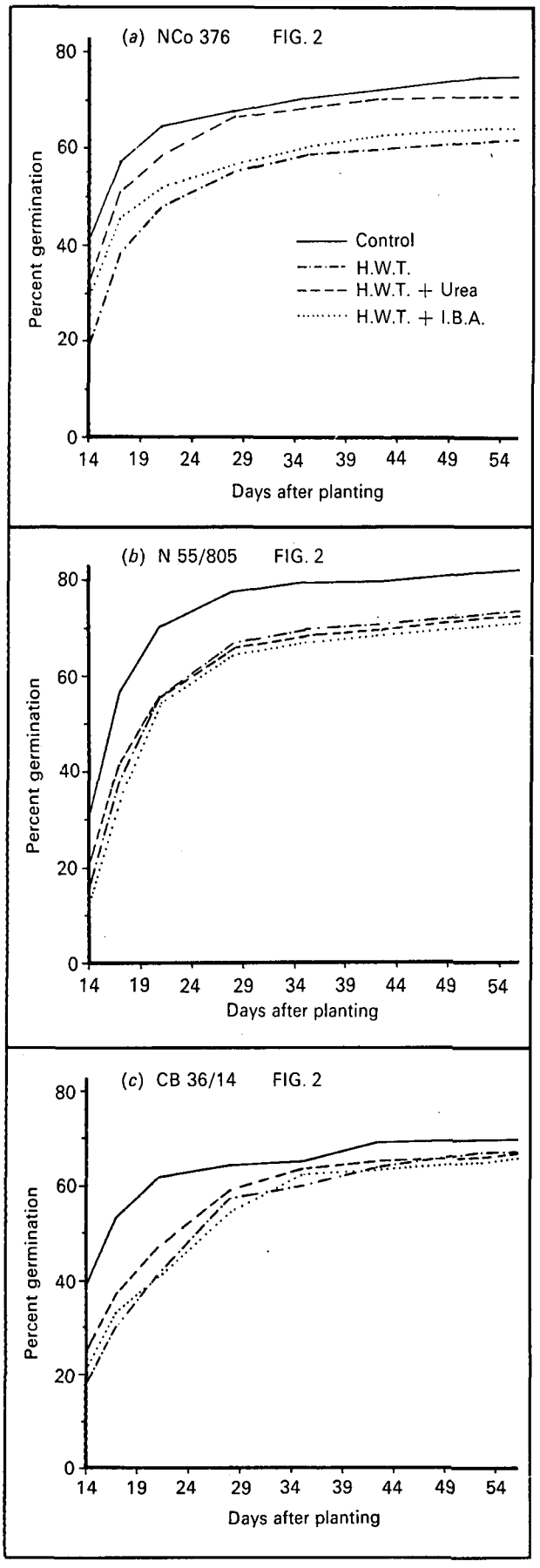

FIGURE 2: Percent germination of buds for the different varieties with the various treatments. (Experiment 2)

(*c*) *CB 36/14*

No significant differences were noticed between the treatments.

The addition of I.B.A. in the dip tank did not seem to have any effect on the germination of the varieties tested, at the concentration used, except in the case of NCo 376, where initial germination was slightly improved, compared to hot water treatment alone. It is possible that a greater concentration of this material would have had a beneficial effect but the cost of such treatment would probably be unacceptable.

Experiment 3

The object of this experiment was to determine—

(i) Germination efficiencies of different portions of the cane stalk after hot water treatment, *and*

(ii) To compare germination of setts versus whole stalks following hot water treatment.

The variety used was NCo 376. In all cases urea was added to the hot water at the rate of 0,3 % W / V.

The experiment was planted on the 25.2.72 at Doornkop Sugar Co. (Pty.) Ltd., under rainfed conditions.

The experiment comprised two incomplete latin squares with a missing column in each one. Five treatments were included, viz.

(1) Hot water treatment of "top portion" of the cane stalk,

(2) hot water treatment of the "middle portion" of the cane stalk,

(3) hot water treatment of the "bottom portion" of the cane stalk,

(4*a*) hot water treatment of whole stalks, *and*

(4*b*) hot water treatment of whole stalks.

The sampling technique for the seedcane used was as follows—

Cane stalks comprising 18 - 20 eyes were chosen in a nursery field. All stalks were topped below the sixth leaf and the required number of stalks comprising eighteen eyes were used. The setts were obtained by cutting each stalk into three portions, each consisting of 6 buds. Whole stalks consisted of eighteen buds.

The nett plot was 2 lines × 90 buds per line. All seedcane were 14 months of age.

Results and discussions

TABLE IV

Experiment III — Percentage germination of buds as at the last count

Treatments		
Top portion of stalk	43,3	S.E. = ± 1,29
Middle portion of stalk	50,0	L.S.D. 5 % = 3,8
Bottom portion of stalk	40,6	1 % = 5,1
		C.V. % = 7,6
Average of setts	44,4	
Whole stalks (*a*)	53,0	
Whole stalks (*b*)	52,7	
Average whole stalks	52,8	

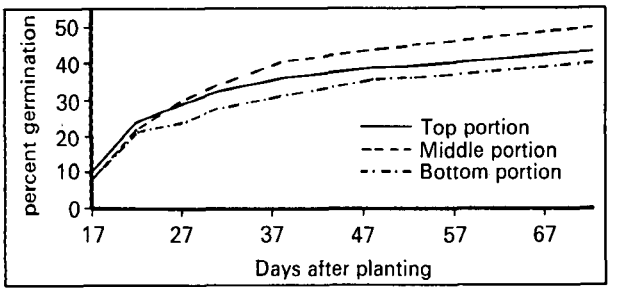

FIGURE 3: Germination of different portions of the sugarcane stalk following hot water treatment.

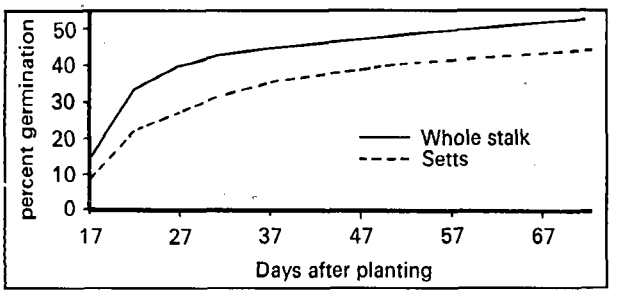

FIGURE 4: Germination of whole stalks and setts following hot water treatment.

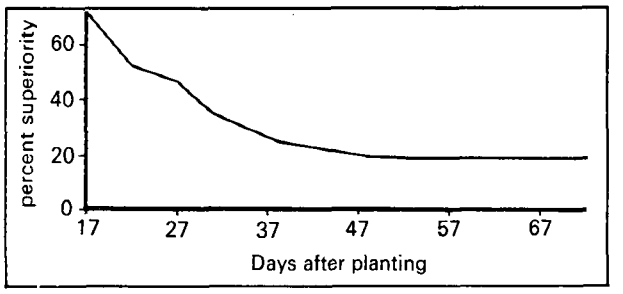

FIGURE 5: Illustrating the superiority of whole stalk germination over setts at various intervals after planting.

With reference to Table IV and Figure 3 and 4, the following points can be noted—

(i) The mean germination of whole stalks was significantly superior to the mean germination of setts. (P = < 1%)

This result appears to indicate a trend in sympathy with results obtained by the Mauritian Sugar Industry Research Institute (Ricaud, 2), where it was found that single-eyed setts were more affected after hot water treatment than those comprising three eyes.

(ii) Germination of the middle portion of the stalk was significantly better than either the top or bottom portions. (P = < 1%)

(iii) There was no significant difference in germination between top and bottom portions of the stalk, although the top portion appeared to be slightly superior on the basis of recorded results.

In Mauritius, Antoine (1) found that the top third of the stalk germinated best, followed by the middle and bottom third, respectively.

On first reflection this result contrasts with that obtained at Doornkop. However, it should be noted that the Mauritian work was conducted using portions of stalks sub-divided on a geometric basis into thirds of equal length. On this basis it can be stated that the stalks used in the Doornkop experiment were sub-divided into the top fifth of the stalk, two fifths in the middle and two fifths at the bottom. If this is borne in mind it could be suggested that the results obtained at Doornkop are complementary to the Mauritian results. See Figure 6.

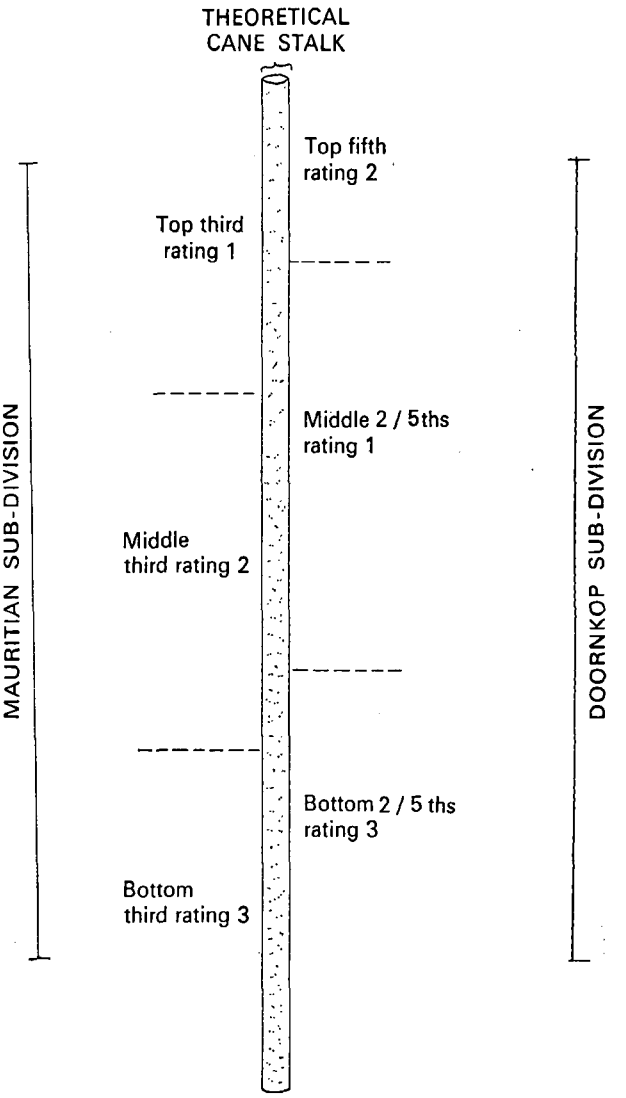

FIGURE 6

In spite of the complementary nature of the results if viewed on the basis of Figure 6 it is submitted that for the purpose of assessing the reaction of portions of the cane stalk of different physiological age, to various treatments, the sub-division into equal numbers of eyes is the preferable method.

General discussion and conclusions

1. Comparing the germination of setts of NCo 376 (hot water treatment + urea) of Experiments 2 and 3, it can be seen that there is a large difference in the percentage germination although the experiments were planted only four days apart and their seedcane was drawn from the same nursery. Factors which

could have been responsible for this discrepancy are shown below.

	Experiment 2	*Experiment 3*
Percentage germination ..	70,4	44,4
RAINFALL		
1 week before planting ..	43 mm.	61 mm.
1 week after planting	53 mm.	Nil
TREATMENT		
Time taken for water temperature to reach 50,5°C after immersion of seedcane	9 mins.	20 mins.

The difference in time taken for the water temperature to reach 50,5°C after immersion of seedcane between the two experiments can be explained by the fact that in Experiment 2 the mass of seedcane treated at one time was approximately half that of Experiment 3.

The data on rainfall and time taken to reach requisite water treatment temperature when considered in relation to germination performance would seem to indicate the following:—

(*a*) It is vitally important to ensure minimal moisture loss from the furrow during planting operations. A simultaneous ridging, planting and covering operation would be ideal. Furthermore, the rainfall shortly after planting in Experiment 2 probably had a compacting effect on the soil which, in addition to the extra moisture, was beneficial.

(*b*) It would seem to be important to ensure that the immersion time in the hot water tank should be kept to the absolute minimum consistent with efficient destruction of the ratoon stunting virus. It is suggested that the results also indicate a need for further study into the immersion time required once the temperature has reached 50,5°C — because if this could be reduced without affecting the efficiency of the treatment, germination of hot water treated seedcane may be improved.

2. The data show that germination of NCo 376 following hot water treatment can be significantly improved by the addition of urea in the hot water tank. Other varieties tested did not seem to be affected.

3. Hot water treatment of whole stalks (and planted as whole stalks) is beneficial compared with hot water treatment of setts. This is also advantageous in that there is less handling of the seedcane, and therefore, a reduced possibility of mechanical damage to the buds.

It is possible that the efficiency of the treatment might not be as good when using whole stick as with setts. However, work done by the M.S.I.R.I. (Ricaud, 2) has shown that the diameter of setts is far more important than their length, and then only in the case of oversize cuttings (4,5 cm in diameter) are appreciable differences observed (Table V). It would seem, therefore, that with the local average stalk diameter of approximately 3,0 cm the efficiency of the treatment would be unaffected by the use of whole stalks.

***TABLE V**

Time taken to reach 50°C at the centre of one-eyed and three-eyed setts of different diameters

Diameter (cm)	One-eyed setts (mins.)	Three-eyed setts (mins.)
3,0	25	28
3,9	40	43
4,5	50	65

***Note.** Table V is re-printed from a report by C. Ricaud, published in the Mauritius Sugar Industry Research Institute Annual Report for 1967, Page 54.

4. In the case of setts being hot water treated, discarding a fair proportion of both ends of the stalk prior to cutting the setts will probably provide for a more uniform germination in the establishment of nurseries.

Acknowledgements

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