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Effect of Crossing Solution in Preserving the Excised Stalks of Sugarcane

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ABSTRACT

An experiment using mixed acids as preserving solution diluted in river and tap waters with different concentrations, ranging from 50.00 to 200.00 ml was conducted to determine their effect on the survival of male and female arrows, number of days to germinate the seed, number of seedlings per gram and mortality. Varieties I-101/66 and Isd.16 were used as male and female parents respectively. River water was better than tap water under SRTI conditions and among the different concentrations, 75.00 ml in river water was found most suitable in all respects for controlled crosses.

INTRODUCTION

Crossing or hybridization is one of the most important methods in sugarcane breeding. In attempting a cross with sugarcane is to set the stage for the pollen of the desired male to reach and fertilize the ovules of the desired female to produce adequate hybrid seed. In sorghum and in most other crops, the female is emasculated before cross-pollination but in sugarcane it is practically impossible to ensure adequate seed by this method (Stephens and Quinby, 1933). Moreover, sugarcane being a cross-pollinated crop it's control pollination is needed to get the true seed. Now-a-days, it is done by surrounding with cloth lanterns a group of females and males desired for the cross or crosses (Liu, 1965). But the problem is to keep the excised tassels alive during the crossing period.

The use of a sulphurous acid solution, first developed in Hawaii, proved a major advance in tassel preservation (Brett, 1962). However, the degree of success obtained has varied widely from place to place. In Bangladesh, specially in SRTI condition, there is no detail information on solution cross. Corkill (1981) conducted very small experiment on solution cross but failed to give detail information and recommended for further study.

However, on the basis of the above facts, the present experiment was undertaken with a view to determine the appropriate concentration of solution (both in river and tap water) required to keep the excised stalks alive upto maturity; the number of days to germinate; number of seedlings germination per gram and seedling mortality.

MATERIALS AND METHODS

Stock solution, prepared in the laboratory, was used in five concentrations of river and tap waters such as 50.00, 62.50, 75.00, 87.50 and 100.00 ml to determine their ability to keep the excised stalks alive and their subsequent effects on germination and seedling mortality. The stock solution was prepared as per recommendation of Corkill, 1981. In preparing the acid preserving solution, each of the concentrations of mixed acids was diluted with two gallons of water and poured in buckets separately which were then kept ready for male and female arrows. The experiment was set on 1st December, 1982 where I-101/66 and Isd. 16 were used as male and female parents, respectively. The desired male and female arrows in the field were cut after top emergence. The cut arrows were placed in buckets with water. Then the excised stalks were brought to the crossing shed and placed in buckets with the different concentrations of the preserving solution. The male arrows were placed a little above the female arrows, This was done to ensure pollen shedding on the stigma. There were four male and four female arrows placed in each concentration so that a total of 40 arrows in five concentrations were used in river water. Similarly, another experiment was set up using tap water.

The arrows of each set were enclosed under one lantern to avoid contamination by foreign pollens. All the leaves were trimmed off except the flag leaf which was kept to identify the dryness of the arrow. This trimming was done to reduce transpiration. Since temperature is the most important factor to produce the sufficient number of viable pollen (Liu, 1965) in each lantern one 100 watt incandesant electric bulb was placed, because night temperature at SRTI was as low as 7 9°C during hybridization period. All the operations were same for both the river and tap waters. The crossing solution in each bucket was changed once in every four days. Topping up was performed in every two alternate days. This was done by pouring one gallon of freshly prepared solution to the old solution The lower part of the lantern were tied-up in the morning and opened after 11.00 a. m. when the chance of pollination by foreign pollen was less. For better pollen shedding each set-up was lightly tapped, 2-3 times, in the morning. The crosses were inspected regularly. Whenever any male arrow showed symptom of drying up it was replaced with a fresh one. After pollination, when

all the florets have opened-up the male arrows and lantern were removed. Then the female arrows were placed outside the crossing shed on a rack, protected by a wind-break, for ripening. During this period arrows were still kept alive in acid preserving solution, changed and topped-up as in cross-pollination. When the florets of the inflorescences started shattering at the terminal ends, the seeds were harvested, cleaned and weighed. Then four gram seeds were taken from each concentration and sown in four replications in plastic tray in a heated germination chamber Inside the glasshouse. Each replication contained one gram of seeds.

The following data were recorded :

1) Survival of the male and female arrows in solution;
2) Days to germinate the seed;
3) Number of seedlings germinated per gram of seed and
4) Mortality percent of seedlings.

Survival was determined by duration of survival of arrows. Data on number of germinated seedlings per gram was recorded when the maximum number was counted. Mortality percent was determined after three weeks when seedlings were removed from the glasshouse and transplanted to pvc pipes. Data were analysed and the values were evaluated by Duncan's test.

All the male and female arrows in tap water died before maturity. Therefore, no data, except survival, was available for tap water. As such, another experiment with higher concentrations in tap water was tried. The concentration of mixed acids were increased to 125.00, 150.00, 175.00 and 200.00 ml in two gallons tap water. The same procedure was followed as in the first experiment except the analysis of variance for the survival of male arrows which showed same number of days for all the concentrations.

RESULTS AND DISCUSSION

Male arrow : The mean survival of male arrows increased with the increase of concentration (Table 1). Results showed that the male arrows preserved in river water, survived longer than in tap water. The male arrows in river water survived for 12.0 days while those in tap water survived for 9.15 days. All the concentrations with river water kept the arrows alive for the same number of days but in tap water survival was variable and increased with higher concentrations.

The longer survival of arrows in higher concentration of mixed acids in tap water might be due to the longer period of time taken to neutralise the acids by calcium and iron present in weter than the lower concentration (Corkill, 1981).

The results partially agreed with the findings of Verret (1925) who used water free from dissolved materials, and was able to keep the male arrows alive for a period of 20.30 days adding sulphur dioxide with solution.

Female arrow : The survival of female arrows showed that duration of survival increased with the increase of concentration (Table 2). Survival of arrows in 100.00 ml. was significantly longer than at lower concentration. The mean duration of survival of female arrows in river water was statistically higher (37.15 days) than tap water (13.35 days). From the results of concentration and water it was observed that in both river and tap water the number of survival days of female arrows increased with the increase of concentration excpet the last three higher concentrations in river water which showed the same survival. In case of tap water, the highest survival duration was observed in 100.00 ml which was significantly longer than all other concentration.

It was observed that there were no statistical difference in survival of female arrows kept in the higher concentrations of mixed acids in tap water (Table 2). Comparatively, highest number of survival days (33.00 days) was obtained from 125.00 and 175.80 ml followed by 150.00 of (32.25 days) and 200.00 ml (31.00 days).

Table 1. Mean survival (in days) of male arrows in solution cross.

First Experiment		
Concentration (ml)	River water	Tap water
50.00	12.00 a*	7.50 c
62.50	12.00 a	8.00 c
75.00	12.00 a	8.25 c
87.50	12.00 a	10.00 b
100.00	12.00 a	12.00 a
Mean	12.00 a	9.15 b

*Figures followed by the same letter are not significantly different at 5% level as per DNMR test.

The results were partially supported by the findings of Brett (1962) who used water having high lime content and failed to preserve the stalks. The stalks died in tap water with lower concentration might be due to the presence of large amount of calcium and iron which neutralises the solution (Corkill, 1981). The results also agreed with Verret (1925) who adding sulphur dioxide with solution was able to keep alive the stalks for a period of 20-30 days.

Seed germination : The number of days to germinate the seeds in river water decreased with increase of concentration except 87.50 ml (Table 3). The maximum and minimum number of days to germinate were observed in 50.00 (6.25 days) and 100.00 ml (4.00 days), respectively. The time to germinate in 50.00 ml was statistically longer than all other concentrations which did not differ significantly from one another.

Table 2. Mean survival (in days) of female arrows in solution cross.

First Experiment			Second Experiment	
Concentration (ml)	River water	Tap water	Concentration (ml)	Tap water
50.00	28.75 c*	8.50 c	125.00	33.00 a
62.50	37.00 b	9.00 c	150.00	32.25 a
75.00	40.00 a	10.25 c	175.00	33.00 a
87.50	40.00 a	12.00 b	200.00	31.00 a
100.00	40.00 a	27.00 a	—	—
Mean	37.15 a	13.35 b	—	—

*Figures followed by the same letter are not significantly different at 5% level as per DNMR test.

Table 3. Mean number of days to germinate the seeds in solution cross.

First experiment			Second experiment	
Concentration (ml)	River water	Tap water **	Concentration (ml)	Tap water
50.00	6.25 a*	—	125.00	10.00 a
62.50	4.50 b	—	150.00	7.00 b
75.00	4.50 b	—	175.00	8.75 ab
87.50	5.00 b	—	200.00	6.50 b
100.00	4.00 b	—	—	—

*Figures followed by the same letter are not significantly different at 5% level as per DNMR test.

**All tassels in tap water had premature death.

The number of days to germinate the seeds in tap water decreased with the increase of concentrations except 175.00 ml. There was no statistical difference between days to germinate in 125.00 and 175.00 ml concentrations, The number of days to germinate in 125.00 ml was significantly longer than 150.00 and 200.00 ml. No significant difference was observed among 150.00, 175.00 and 200.00 ml concentrations (Table 3).

Table 4. Mean number of seedlings germinated from one gram of seed in solution cross.

First Experiment			Second Experiment	
Concentration (ml)	River water	Tap water**	Concentration (ml)	Tap water
50.00	12.25 c*	—	125.00	2.75 c
62.50	89.50 b	—	150.00	37.00 a
75.00	105.00 ab	—	175.00	4.75 c
87.50	89.00 b	—	200.00	18.00 b
100.00	149.00 a	—	—	—

*Figures followed by the same letter are not significantly different at 5% level as per DNMR test.

**All tessels in tap water had premature death.

The lesser number of days to germinate the seeds with higher concentrations in the river and tap water was probably due to better maturity of the seed. This means with higher concentration, the arrows remained more fresh. Hence the seed development was enhanced. This may have resulted from high concentration taking less time to germinate.

Number of seedling per gram : The germination of fuzz, collected from arrows preserved in river water, increased with higher concentrations (Teble 4). The highest number was obtained from 100.00 ml (100.00).

Maximum number of seedlings per gram of fuzz in tap water was obtained from 150.00 ml concentration which was significantly higher than in the other concentrations. The number of seedlings counted' from 200.00 ml was significantly more than those from 125.00 and 175.00 ml concentrations.

Table 5. Mean mortality (%) of seedlings germinated from one gram of seed in solution cross.

First Experiment			Second Experiment	
Concentration (ml)	River water	Tap water**	Concentration (ml)	Tap water
50.00	91.39 a*	—	125.00	82.50 a
62.50	83.54 ab	—	150.00	68.81 a
75.00	69.57 ab	—	175.00	85.18 a
87 50	54.68 bc	—	200.00	67 63 a
100.00	38.46 c	—	—	—

*Figures followed by the same letter are not significantly different at 5% level as per DNMR test.

**All tassels in tap water had premature death.

The increasing tendency of the number of seedling with the increase of concentrations in river water may be associated with the number of viable seeds which was probably due to the freshness of the excised stalks in the solution. As the concentration increased the degree of freshness of the arrow was also enhanced. Hence, viable seeds produced were higher resulting in better germination with higher concentrations. In case of tap water, this tendency was not observed. However, it was noted that although concentration of mixed acids in tap water was higher, the number of seedlings obtained in each concentration was less than the river water. The results were in conformity with the findings of Groot and George (1962) who found that the number of seedlings in river water was about double the number in tap water.

Seedling mortality : The mortality of seedlings in river water decreased with the increase of concentrations (Table 5). Comparatively, the highest mortality (91.39%) was observed at 50.00 ml. The mortality in 50.00 ml differed significantly with 87.50 and 100.00 ml concentrations. The lowest mortality (36 48%) was demonstrated by 100.00 ml concentration.

There was no significant difference in mortality among the higher concentrations. However, the highest mortality was observed in 175.00 ml.

The decreasing tendency of mortality with increase of concentration in river water might be due to the higher viability of seed in higher concentrations backed by freshness of the excised stalk in solution. In case of tap water, the different concentrations showed no significant effect on mortality.

From the results of the experiments, it is suggested that river water is better than tap water under SRTI conditions and among the different concentrations, 75.00 ml in river water may be considered the most suitable in all respects for controlled crosses.

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