

Comparative Study on the Effectiveness of Field, Marcotte and Solution Techniques in Sugarcane Hybridization

S. R. Saha, M.A. Miah, M. A. Mannan and M. A. Karim
Sugarcane Research and Training Institute,
Ishurdi, Pabna, Bangladesh.

ABSTRACT

A comparative study on the effectiveness of field, marcotte and solution techniques in sugarcane hybridization was carried out at SRTI during the season 1983-84. The Isd. 16 was used as pistillate parent, and I-101/66 and Misrijal as staminate parents. The number of seeds per gram, the days for germination, the percentage of germination and mortality were recorded. It was observed that marcotte technique produced more seeds and seedlings per gram with lower mortality (%) over the solution and field techniques. Marcotte seeds also germinated faster than field technique but was similar to solution technique. Hence, marcotte technique is the most appropriate one for controlled hybridization. Solution technique may also be used in special cases.

INTRODUCTION

Hybridization in sugarcane is done in several ways like area cross, polycross or bi-parental cross. Usually bi-parental cross is done under controlled conditions using marcotte or solution technique. It may also be used in the field at an open location.

In the field technique, the mature florets of the desired staminate parents are collected early in the morning before dehiscence. These are dusted on the selected pistillate parents as soon as dehiscence is observed. This is done by slightly shaking the collected florets over the female flower. In air-layering (marcotting), which is one of the most useful techniques in sugarcane hybridization (Tysdal, 1956), both male and female parental varieties are marcotted at the stage of shortening of the leaf-blade which is usually 2-3 weeks before flower emergence. The marcotted stalks of desired parents are excised and placed in water trough with running tap water under the crossing-shed for controlled pollination. The use of the sulphurous acid solution, first developed in Hawaii, proved a major advance in tassel preservation (Brett, 1962). In this technique, the stalks of the desired parents (both male and female) are excised near the base and placed in buckets containing the solution under the crossing-shed for controlled pollination. In both marcotte and solution techniques, the male arrows are placed slightly above the female arrow. The set-up is enclosed with cloth lantern to prevent entry of foreign pollen.

By and large, the ultimate goal of hybridization is to produce adequate number of viable hybrid seeds from the crosses. Therefore, a study was undertaken at the SRTI to compare the effectiveness of three techniques to produce maximum viable seeds.

MATERIALS AND METHODS

Three varieties namely, Isd. 16, I-101/66 and Misrilal were utilized in this hybridization study. Isd. 16 was used as female parent whereas I-101/66 and Misrilal were used as male parents. Two bi-parental crosses were used in the study: Isd. 16 x I-101/66 and Isd. 16 x Misrilal.

In the field technique, eight male arrows (four from each of the two varieties) were collected, brought to the female arrows and dusted separately by hand in the morning to ensure pollination. The female arrows remained uncovered. In case of marcotte technique, the parental stalks were marcotted when they showed the signs of flowering (shortening of the leaf-blade). Sawdust and transparent polythene sheets were used as rooting media and wrapping material, respectively. After 2-3 weeks, when sufficient number of roots were visible and arrows have already started emerging the marcotted stalks were excised and placed in the water trough under the crossing-shed. With solution technique, 75 ml of the acid stock solution was mixed with two gallons of river water in buckets. Stalks of the desired parents were excised, brought to the crossing-shed and placed in the buckets.

In each set of the marcotte and solution techniques, there were four female and two male arrows, enclosed with muslin cloth lantern. Each cross was arranged in such a way that the males were always slightly above the female parents. Temperature is the most important factor in the production of sufficient number of viable pollen (Liu, 1965). Since night temperature at SRTI could go down as low as 7-9°C during the hybridization period one 100 watt incandescent electric bulb was placed in each lantern.

The preserving crossing solution, in each bucket, was changed every four alternate days and topping-up was performed with fresh solution every two days. For better pollen shedding each set-up was lightly tapped at every 30 minutes in the morning from 6 to 11 a.m. for 7 to 10 days.

After pollination the male arrows were discarded and the lanterns were also removed. The female arrows were left in the trough and solution for further development and maturation of caryopses. When the florets started shattering at the terminal end at the slightest whiff of wind the arrows were enclosed with paper bags to prevent loss of fuzz. Mature seeds were then harvested, stripped-off, weighed and stored in deep-freeze. Before sowing, four gram of seeds from each of the two crosses representing the three techniques were counted to find out the number of seeds per gram. Each gram of seeds was then sown in individual plastic tray with 4 replications and data were recorded on the number of days to germinate, number of seedlings germinated per gram and percentage of seedling mortality.

Number of days to germinate was counted from the date of plumule appearance to the date of maximum germination. Then the analysis of variance was done for the average data of four replications of each cross and the mean values were evaluated by DNMR test.

RESULTS AND DISCUSSION

Number of seeds per gram: The number of seeds per gram was higher in solution (Table 1). Marcotte and field techniques produced similar results. Between the two crosses, Isd. 16 x I-101/66 showed maximum number of seeds in solution (1568.75).

Table 1. Effect of marcotte, solution and field cross techniques on seeds and seedlings.

Characters studied	Bi-parental crosses	Crossing techniques		
		Marcotte	Solution	Field
Number of seeds per gram	Isd. 16 x I-101/66	1346.25 a ¹	1568.75 b	1365.00 a
	Isd. 16 x Misrilal	1389.00 a	1387.25 a	1280.75 a
	Mean	1367.63 ab	1478.00 b	1322.81 a
Number of days to germinate	Isd. 16 x I-101/66	3.50 a	3.50 a	4.00 a
	Isd. 16 x Misrilal	3.25 a	4.00 b	4.25 b
	Mean	3.37 a	3.75 ab	4.12 a
Number of seedlings per gram	Isd. 16 x I-101/66	170.00 c	82.00 b	38.50 a
	Isd. 16 x Misrilal	158.75 c	84.25 b	35.00 a
	Mean	164.38 c	83.13 b	36.75 a
Percent Mortality	Isd. 16 x I-101/66	11.46 a	22.34 a	37.60 b
	Isd. 16 x Misrilal	15.45 a	26.90 ab	36.10 b
Mean		13.46 a	24.62 b	36.85 c

¹ = Figures with common letter do not differ significantly at 5% level for number of seeds per gram and at 1% level for others.

Number of seeds per gram in the three techniques were statistically identical. The higher number of seeds in solution technique might be due to poorer seed development resulting in lighter weight of seeds.

Number of days to germinate: Days to germinate were significantly low with marcotte seeds in comparison with field technique but not significant to solution technique (Table 1). Seeds from the cross Isd. 16 x I-101/66 showed similar response to all the three techniques. In the cross Isd. 16 x Misrilal, marcotte seeds took shorter time (3.25 days) to germinate than solution (4.00 days) and field (4.25 days) techniques.

The less number of days to germinate the seeds in marcotte technique than solution might be due to better development and higher viability of seeds. The results were in partial conformity with the findings of Evans (1965) who reported that gradual accumulation of toxic materials from the preservative acid solution is the probable cause of the lower viability of fuzz from crosses completed entirely in preservative solution. Fuzz from field technique took longer time to germinate. The reason may be due to lower maturity and more number of selfed seeds caused by open pollination.

Number of seedlings per gram : Marcotte technique produced maximum number of seedlings (Table 1). The other two techniques produced less number of seedlings per gram of seeds. These results were partially agreed with the findings of Rao (1965) who found that in standardised marcotte technique seed setting was improved while under field condition the same variety found to give very poor seed-set. Similar results were also obtained by Groot and George (1962).

Percent mortality : Mortality percent was significantly lower in marcotte and higher in field technique with 13.46 and 36.82 percent, respectively (Table 1). The lower mortality in marcotte technique than solution might be due to well developed and more viable seeds. According to Evans (1965) the lower viability of fuzz from solution technique was probably due to accumulation of toxic materials from the preservative acid solution. The higher mortality in field technique may be due to presence of more number of selfed seeds and lower viability caused by uncontrolled environmental conditions in the field.

On the basis of the above results it may be suggested that marcotte technique in the hybridization programme of SRTI would produce more viable hybrid seeds. Solution technique may also be used in special cases.

REFERENCES

- Brett, P.G.C. 1962. Advances in sugarcane Breeding. *Proc. ISSCT*. 11th Cong. Mauritius. pp. 408—409.
- Evans, H. 1965. A note on a simple technique for the isolation of sugarcane stalks for crossing purposes and for other investigational purposes. *Proc. ISSCT*. 12th Cong. Puerto Rico, pp. 829—832.
- Groot, W.De. and George, E.F. 1962. Breeding of sugarcane varieties in Mauritius. *Proc. ISSCT*. 11th Cong. Mauritius, pp. 441—443.
- Liu, L.J. 1965. Sugarcane crossing techniques. *Proc. ISSCT*. 12th Cong. Puerto Rico : pp. 819—820.
- Rao, J.T. 1965. Current breeding techniques and selection procedures adopted at Coimbatore. *Proc. ISSCT*. 12th Cong. Puerto Rico, pp. 839—843.
- Tysdal, H.M. 1956. Promising new Procedures in Sugarcane breeding. *Proc. ISSCT*. 9th Cong. India, 1 : 618—631.