

RECENT EXPERIMENTS IN THE CANE BREEDING GLASSHOUSE AT THE EXPERIMENT STATION

By K. J. NUSS

South African Sugar Association Experiment Station, Mount Edgecombe

Abstract

Experiments were conducted, over three years, to increase the survival rates of sugarcane flower initials after marcotting. By placing the cut ends of sleeved stalks (rooted before cutting) in a nutrient solution, the survival rate was significantly increased. The effect of temperature on time of flowering was investigated. Higher temperatures (minimum 21°C) caused varieties to flower 62 days earlier than the same varieties did when kept under natural temperatures (minimum 15,3°C).

Introduction

The cane breeding glasshouse with heating facilities was built at the Experiment Station to keep marcotted boents above a minimum temperature for the stalks to flower and for the pollen to be fertile. Developing boents are placed on racks on mobile trolleys so that they can be moved outside during the day and back at night when the temperature falls below 20°C. The crosses are also made in the glasshouse and it has subsequently been used to induce flowering in sugarcane varieties growing in soil bins on the trolleys.²

To make room for the flowers brought in from the field, stalks growing in the glasshouse were marcotted before, or at the time of, the first visible boents. Only 40% of these stalks produced flowers, although the proportion of stalks with flower initials was around 90%. Part of this paper deals with experiments conducted in an attempt to reduce the high mortality of flowers due to the marcotting process.

The standard photoperiod treatment in the glasshouse² is a constant, artificial dawn at 05h30. In another part of this paper flowering times in this treatment are compared with those of natural daylength in the heated glasshouse, and with those of natural daylength and temperature outside the glasshouse.

Experimental procedure

Marcotting is a procedure that has already been described.¹ Briefly, it entails cutting the stalk at or near ground level, placing the base in a nutrient solution and, above the base, attaching a 40 x 15 cm metal cylinder which is filled with a potting soil. New roots develop in the area covered by the soil and after 2 weeks the stalk no longer requires the nutrient solution. It is then cut at the base of the cylinder and maintained by watering. This procedure enables the plant breeder to move the flowering stalk at will.

Sleeving is a procedure whereby a black polythene sleeve, 40 x 15 cm, is placed on stalks by pulling the leaves through the tube and tying the lower end 20 cm above ground level. The tube is three-quarter filled with moist potting soil to cover three to four internodes. The top of the sleeve is tied to the stalk and sleeved stalks are left to grow. At the predetermined stage of flowering the stalks are cut below the sleeve, which is then placed in a metal cylinder. The top of the sleeve is opened and the soil is watered regularly. At the time of cutting the stalks should have rooted in the area covered by the potting soil in the sleeve.

Three experiments were conducted in attempting to improve the survival of flower initials as expressed in terms of proportion of stalks flowering, and one experiment to study the effect of natural daylength on flowering in a heated glasshouse.

Experiment 1

Stalks of eight varieties growing in the glasshouse were marcotted in 1974 at the following times and stages:

- A — Marcotted on 5th April
- B — Marcotted on 12th April
- C — Marcotted on 19th April
- D — Marcotted on 26th April
- E — Marcotted at the time of boents appearing
- F — Marcotted at the time of tassels appearing
- G — Sleeved 5th April, cut 6th May
- H — Sleeved 5th April, cut as flowers appeared

Experiment 2

Sleeves were placed on stalks of eight varieties, growing in the glasshouse, on two dates in 1975, 19th April and 26th April. The stalks sleeved on each date were subsequently cut at the following times:

- A — 2 weeks after sleeving
- B — 3 weeks after sleeving
- C — at the appearance of the tassels.

Experiment 3

Six stalks of each of 16 varieties were sleeved on 19th April, 1976. The stalks were cut three weeks later. The cut ends of three stalks of each variety were placed in the nutrient solution and compared with three other stalks whose bases were cut off immediately below the sleeve and not placed in solution. In the control treatment stalks of all varieties, except Co 285, were marcotted at the time when the tassels appeared. Early sleeving was thereby compared with the best marcotting time.

Experiment 4

Several varieties were subjected to the standard glasshouse photoperiod treatment (GP1), to natural daylength in the glasshouse (GP2) and to natural daylength and temperature (GP3).

Results

Experiment 1

The flower initiation was good in all treatments as shown in Table 1. Initiation was completed by the first marcotting date but the proportion of stalks that flowered was low. On all marcotting dates, the mortality of the flower initials was high. The early marcotting date with the highest survival rate

TABLE 1
Flowering data of 6 marcotting dates and 2 sleeving treatments in Experiment 1

Treatments	No. of stalks	No. of flower initials	No. of tassels	% stalks flowering
Marcotting 5/4 . . .	39	38	19	49
" 12/4 . . .	40	40	18	45
" 19/4 . . .	40	40	22	55
" 26/4 . . .	39	39	20	51
" as visible boents .	40	40	17	42
Control, marcotting as tassels emerge . . .	38	38	32	84
Sleeve 5/4, cut 6/5 . . .	40	39	26	65
Sleeve 5/4, cut as tassels emerge	40	40	39	98

was 19th April. Sleeving and cutting the stalks four weeks later improved the survival rate to 65%. The best rate of flowering was obtained from sleeved stalks that were cut at the time of flowering.

Experiment 2

As in Experiment 1, the initiation of flowering was good in all treatments (see Table 2). The proportion of stalks flowering, following cutting two or three weeks after sleeving, was very low and varied from 26% to 38%. This was lower than in a similar treatment in Experiment 1, the main reason being that, in Experiment 2, several varieties were used that do not marcot well. Flowering of sleeved stalks when cut as the flowers appeared was reasonably good but the date of sleeving and time of cutting did not appreciably affect the emergence of flowers.

TABLE 2
Flowering data of 2 sleeving dates and 3 cutting times of Experiment 2

Sleeving date	Treatments		No. of stalks	No. of flower initials	No. of tassels	% stalks flowering
	Cutting time					
19th April	2 weeks later . . .		40	39	15	38
	3 weeks later . . .		39	39	10	26
	as flowers appeared . . .		40	38	33	82
26th April	2 weeks later . . .		40	40	14	35
	3 weeks later . . .		40	40	12	30
	as flowers appeared . . .		39	39	34	87

Experiment 3

As in the previous experiments the initiation of flowering was good in all treatments (Table 3). CB 38/22 had only one flower initial at the time of cutting which indicated that the time of flower initiation is later than in the other varieties. Placing the cut ends of the sleeved stalks in nutrient solution improved the flower survival rate from 51% to 77%. In 11 of the 16 varieties the flowering was better in the MS treatment which, however, is not yet as good as the control where 97% of the stalks flowered.

TABLE 3
Results of two sleeving treatments and the control in Experiment 3

	Sleeved stalks cut, no solution	Sleeved stalks cut, base in solution	Marcotted at time of flower emergence
No. of varieties . . .	16	16	15
No. of stalks . . .	47	48	60
No. of flower initials . . .	44	46	59
% of stalks initiated . . .	94	96	98
No. of tassels . . .	24	37	58
% stalks flowered . . .	51	77	97
No. of males . . .	16	23	26
% male flowers . . .	67	62	45

Experiment 4

The flowering data comparing natural daylength, GP2, with constant dawn, GP1, are given in Table 4. The initiation of flowering in GP2 was not as good as in GP1. This is possibly

TABLE 4
Flowering data of two glasshouse photoperiod treatments

Variety	GP1 Dawn at 05:30 hrs						GP2 Natural daylength					
	Stalks	Initials	Males	Tassels	Mean flowering date	Days spread	Stalks	Initials	Males	Tassels	Mean flowering date	Days spread
CB 40/35	10	10	9	10	8/6	5	12	12	12	12	4/6	12
CB 40/69	6	6	0	6	7/6	2	6	6	2	3	23/6	7
Co 419	6	6	0	6	9/6	7	6	0	0	0	—	—
Co 453	6	6	2	6	1/6	2	6	6	0	6	24/5	7
N7	6	6	5	6	28/5	5	6	6	0	6	12/5	4
N52/214	6	6	5	6	31/5	4	6	6	3	6	19/5	4
N55/805	12	12	3	12	5/6	9	6	6	2	6	29/5	6
NCo 310	12	12	0	11	30/5	4	12	12	0	12	18/5	6
NCo 376	12	12	0	12	1/6	4	12	12	0	12	22/5	15
Totals	76	76	24	75	3/6	5	72	68	19	63	26/5	8
% Flower initiation			100						87			
% Flower emergence			99						93			
% Male flowers			32						30			

TABLE 5
Flowering data from natural temperature and heated conditions in Experiment 4

Variety	GP2 In glasshouse at night						GP3 Natural temperature					
	Stalks	Initials	Males	Flowers	Mean flowering date	Days spread	Stalks	Initials	Males	Flowers	Mean flowering date	Days spread
CB 40/35	6	6	6	6	1/6	17	6	6	0	6	23/7	23
N55/805	6	6	2	6	29/5	6	6	6	0	4	29/6	28
NCo 310	6	6	0	6	18/5	7	6	6	0	3	5/8	19
NCo 376	6	6	0	6	20/5	18	6	3	0	2	12/8	12
Total	24	24	8	24	25/5	12	24	21	0	15	26/7	21
% Flower initiation			100						88			
% Flower emergence			100						71			
% Male flowers			33						0			

due to the daylength decline which is approximately 35 seconds per day in GP1 compared with approximately 70 seconds per day in GP2. The emergence of flowers was good in both treatments and they had a similar effect on male fertility. The mean flowering date was eight days earlier in GP2 and the varieties flowered over a longer period.

The flowering of four varieties under natural conditions of daylength and temperature (GP3) was compared with GP2 (in a glasshouse heated to above 21°C at night). The flowering data are given in Table 5. The flower initiation, emergence and male fertility were adversely affected by the colder temperatures to which GP3 was exposed, and these results confirm those of previous experiments.³ The most important finding is the delay in flowering date caused by the lower temperature (mean minimum temperature of 15,3°C). The delay in mean flowering date was 62 days and the mean spread of flowering was increased from 12 to 21 days.

Discussion and conclusion

The marcotting procedure plays an essential part in the production of true sugarcane seed. With an unlimited supply of boents, and when all varieties flower freely, a mortality of some stalks can be compensated for by increasing the number of stalks marcotted. Many varieties do not flower freely in Natal and for this reason the photoperiod facilities were erected. With the flowering of most varieties being good in the glasshouse photoperiod, it is a wasteful process to marcot these before the flowers appear. Any improvement in flower emergence would increase the number of flowers available for crossing.

The sleeving process does not affect the flowering of sugarcane stalks to any extent. When sleeved stalks are cut at the

time of flower emergence, the survival rate of the flowers is very high. However, cutting at any time before the appearance of flowers increases the mortality rate. This is due to the severing of the stalk from its primary roots in the sand, since the roots in the sleeve do not compensate for the roots in the sand. An improvement to the sleeving procedure was, at cutting, to place the bases of the sleeved stalks in a nutrient solution. The improvement is of such significance that a fair proportion of stalks will be sleeved in a glasshouse photoperiod treatment in 1977.

The initiation and flowering rates in the natural daylength treatment in the glasshouse are lower than in the standard glasshouse treatment. However, the mean flowering date is 8 days earlier and the flowering peak in the glasshouse is spread.

The effect of temperature on flowering time was unexpectedly large. Increasing the mean minimum temperature to 21°C in the glasshouse induced varieties to flower 62 days earlier. Other detrimental effects of the colder temperature were the main reasons for creating the extensive cane breeding facilities.

Acknowledgements

The author gratefully acknowledges the guidance of Dr P. G. C. Brett in these experiments and the technical contributions of G. H. Paxton, R. L. Harding and E. Edwards.

REFERENCES

1. Anonymous (1975). Ann Rep Exp Stn S Afr Sug Ass. 1974/75: 51.
2. Brett, P. G. C. (1973). The use of a cane breeding glasshouse for photoperiod induction. ISSCT Sugarcane Breeders. Newsletter 32: 45.
3. Brett, P. G. C. (1974). Early experiments on the artificial induction of flowering at Mount Edgecombe. SASTA Proc 48: 78-81.