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# A Vigorous Mutant Sugarcane (*Saccharum* sp.) Clone Co 527*

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Summary. A vigorous fast growing mutant which ends vegetative growth sixty days earlier than the parent variety Co 527 was isolated from gamma irradiated vegetative buds. The mutant initially segregated but stabilized in the $vM_4$ generation. Its growth rate was almost fifty per cent higher than Co 527 beginning in the early stages of growth. It produced a significantly higher early shoot population which enabled it to yield a higher number of millable canes at maturity. Economic characters like sucrose content and juice purity remained unaffected. This mutant had a chromosomal basis in that the number was 2 to 3 lower than in the parent variety.

Key words: Brix - Polyploidy - Heterozygosity - Early Vigor - Non-spinous Leaf-sheath - Chromosome Redundancy

## Introduction

Sugarcane breeders have attached great importance to early vigour in a commercial variety, by which is meant good tillering, early formation of cane and its quick elongation. It also enables the plant to overcome drought in early stages of growth. Selection for this character is made in the early growth of hybrid seedlings. Synchronous tillering to prevent wastage in competition, and uniformity in maturity without adversely affecting the internodal length, are also expected in selection made for early vigour.

The direct use of mutations in sugarcane, though limited, has been a valuable supplementary approach to the improvement of this crop particularly when it was desired to improve one or two specific characters in an otherwise well adapted variety (Rao 1972; Shumny 1977; Urata and Heinz 1972). There have always been attempts to reduce the duration of growth in this crop by introducing early maturing varieties which help to increase the recovery of sugar in factories in the early crushing season. One of the objectives of the induced mutation programme in progess for the last few years at this Institute has been to isolate disease resistant, non-flowering and early maturing types in varieties under commercial cultivation. A vigorous and fast growing mutant was isolated in Co 527, an early maturing variety, and it is described here.

## Materials and Methods

Dormant single buds (68 to 70% moisture content) were treated with 3, 4 and 5 Krad gamma rays in a gamma chamber with a 60 Co source. The dose rate was 265 Krad/hour (over dose ratio about 10%). They were grown in the field to raise the $vM_1$ generation in 1972. The morphologically identifiable mutants were isolated. The $vM_2$ generation was raised by planting all the buds from visible mutants as well as normal looking plants. The morphological changes were scored in this generation. Wherever only a few canes or one cane in a stool showed changes, the changed canes were carried forward separately to raise the $vM_3$ generation. The same procedure was repeated in $vM_3$ generation to raise $vM_4$ and $vM_5$ generations. Thus the mutants were selected repeatedly until they were stable. It normally took 3 to 4, rarely 5, generations for the mutants to stabilise.

While screening the $vM_2$ generation in 1972, one stool with good early vigour and tall canes was observed in buds treated with 4 Krad gamma rays. This was isolated and planted to raise the $vM_3$ generation in 1973. There was segregation in $vM_3$ and $vM_4$ generations and the mutant stabilised in $vM_5$ generation. This mutant was planted in February 1976 for a preliminary trial in 2 replications to study its growth and yield. (In February 1977, an experiment with this mutant, Co 527 and a few other mutants of Co 419 were planted in RCBD design with four replications.) Growth

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measurements of the primary stalk were taken at intervals of 15 days from the 15th to 360th day. Height was measured up to the first transverse mark from ground level. The number of millable canes, brix (total solids in juice), sucrose per cent in juice and purity were taken at maturity.

Chromosome numbers were determined from root-tip squashes following a method published earlier (Jagathesan and Rathnambal 1967).

## Results and Discussion

Shoot population on the 90th day or so in an early maturing variety is a measure of early vigour. When the shoot population was recorded, the mutant (M-10) had a mean of 117.25 shoots per 90 cm row while the parent variety had a mean of 91.50 shoots indicating that the mutant had significantly better early vigour. The data on the height of primary stalk (Fig. 1) showed that even when the first measurement was taken, the mutant was about 50 % taller. The same trend of faster growth rate was maintained up to the grand growth period (270 days). There was a sudden marked growth increase from the 240th day to the 285th day followed by stoppage of growth whereas the parent variety continued to grow for 65 days more. The mutant flowered eleven days earlier than the parent variety. Thus the mutant not only had better early vigour and grew at a faster rate but also stopped its vegetative growth and flowered earlier.

The data on economic characters (Table 1) indicate that the brix, sucrose and purity are the same as in the parent variety. There was a marked increase in number of millable canes per row as indicated by the higher shoot population earlier, though the weight per cane remained on a par with the parent variety. It has always been very difficult to evolve varieties combining earliness with high sugar and high yield, due to negative correlations (Herbert 1966a, b). The present mutant isolated from an early maturing commercial variety not only has better early vigour resulting in higher stalk population but also has non-spinous leaf sheath character which is desired where manual harvesting is in vogue.

A cytological study of the mutant showed that there were 114 chromosomes in the root tip cells while the parent variety had 116 to 117 chromosomes. Thus a deletion of 2 to 3 chromosomes has brought about increases in early vigour, growth rate, number of millable canes and yield. It is possible that the genes controlling growth inhibition were located in the deleted chromosomes so that when these were absent the mutant grew faster, putting forth better early vigour, which was responsible for the higher number of millable canes. Induced mutations for heterosis in millets governed by a segment of a chromosome (Burton and Hanna 1977) or by the action of specific separate genes have been reported in *Arabdiopsis* (Rao 1972).

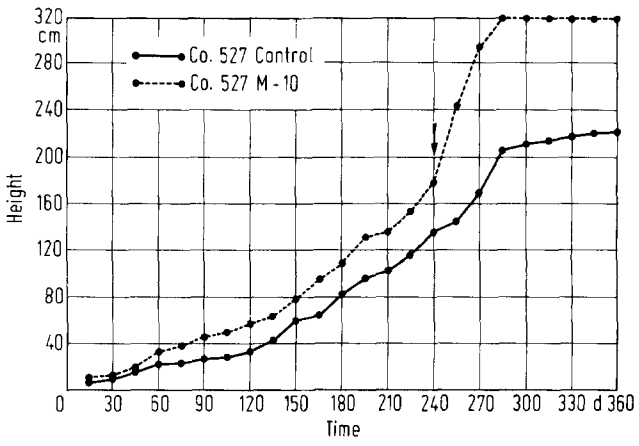


Fig. 1. Growth pattern in Co 527 and mutant M-10 from 15th to 360th day (Arrow indicates the sudden spurt in growth rate during the grand growth period from about 240th day.)

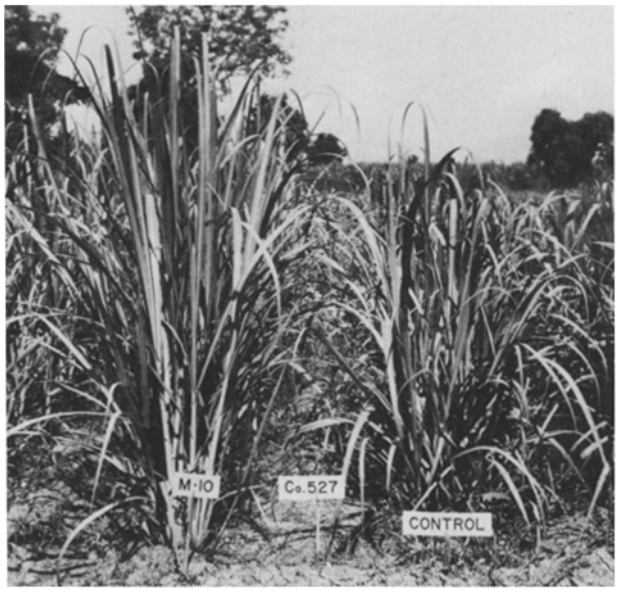


Fig. 2. Showing early vigour and growth in mutant M-10 and control on 90th day

Table 1. Economic characters of Co 527 and vigorous mutant M-10

| Character | Co 527 | M-10 |
|---|---|---|
| Shoot population per 90 cm row on 90th day | 91.50 @ | 117.25* CD 17.13 |
| Brix per cent in juice | 20.38 | 20.56 |
| Sucrose per cent in juice | 17.90 | 17.73 |
| Purity (per cent) | 87.83 | 86.24 |
| No. of millable canes per 90 cm row | 48 | 103* CD 24.38 |
| Cane weight per 90 cm row | 24.20 kg. | 55.60 kg. |

* Significant at 5 % level
@ Mean of four replications recorded in May, 1977

The deleted chromosomes did not have major genes for sucrose content and purity so had no adverse effect on cane quality. It could be also that the clonal propagation and high polyploidy resulted in genetic redundancy which had very little effect on economic characters due to absence of chromosomes. The isolation and selection of this mutant shows that it is possible to obtain economically valuable stable mutants by induction in a vegetatively propagated crop like sugarcane without disturbing the genotype per se. This type of improvement of an existing variety by hybridisation and selection is almost impossible due to high polyploidy, heterozygosity and cytogenetical abnormalities, such as functioning of unreduced gametes, en bloc elimination of chromosomes, occurrence of chromosome mosaics and each male or female gamete differing in genetic constitution.

It has never been possible to get the same genotype by selfing or recombination by repeating the crosses, in spite of raising several thousand seedlings. Hence mutation breeding was adopted and the work done so far (Jagathesan 1976) has shown that it is possible to obtain specific stable mutations by bud irradiation in sugarcane if suitable screening and selection procedures are adopted.

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