NOTES AND COMMENTS

FURTHER STUDIES IN SACCHARUM-ZEA HYBRID
I. MITOTIC STUDIES*

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1. Introduction

The first intergeneric hybrid in *Saccharum* was made in 1913 by C. S. Barber at Coimbatore. He crossed *S. officinarum* var. Vellai ($2n = 80$) with *Narenga porphyrocoma* ($2n = 30$) and obtained two types of hybrids. One ($2n = 95$) had a diploid gamete of *S. officinarum* ($2n = 80$). The other ($2n = 55$) had only the haploid gamete ($n = 40$).

The same variety of *S. officinarum* was pollinated with *Zea mays* var. Golden Beauty which had two additional B chromosomes, by E. K. Janaki Ammal in 1938. A single seedling was the outcome. It had 52 chromosomes, being the sum of the haploid complements of *Saccharum* ($n = 40$) and of Zea ($n = 10$) with the two B chromosomes of maize (Janaki Ammal, 1941). Tillering was most abundant and the plant which was clonally propagated survived 30 years but without producing any inflorescence. This failure to produce "arrows" was found to be due to the non-emergence of the inflorescence out of the boot leaf which when dissected was found to be lying within the flag leaf. Naidu and Ramakrishnan (1970) induced the inflorescence to emerge by the application of gibberelic acid and it was found to be similar to that of *Saccharum* (figs. 1 and 2). A fourth glume which does not occur in either parent was present in the hybrid, though some of the *S. officinarum* clones do have one. There were three stamens as in the parents.

2. Materials and methods

For the study of somatic chromosomes, root tips were treated with a saturated solution of α-bromonaphthalene for 2 hours at 10° C. They were washed in running water for 30 minutes and fixed in a fixative containing 60 ml. methanol, 30 ml. chloroform, 20 ml. distilled water, 1 g. mercuric chloride, and 1 g. picric acid for 18 to 24 hours. They were then hydrolysed in 1 NHCl for 13 minutes at 60° C., stained with leuco-basic fuchsin and squashed in 45 per cent. acetic acid. For anaphase studies root tips were fixed without pretreatment.

3. Somatic chromosomes

S. officinarum var. Vellai has 80 somatic chromosomes with median centromeres (fig. 3). There is one pair of satellited chromosomes. The

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longest chromosome is about 3·20 microns in length (Jagathesan and Ratnambal, 1967).

Maize has eight chromosomes with sub-median and two (chromosomes 1 and 5) with median centromeres. They can be distinguished by the presence of knobs at pachytene (Rhoades, 1955).

In the hybrid we find the number of chromosomes varies in root tip cells even of one cutting. In 23 metaphase plates, the number varied from 52 to 58 (figs. 4 and 5). The frequency of distribution of these extra chromosomes is shown in table 1. By length we find that out of 56 chromosomes, 40 belong to *S. officinarum* and 16 (10A+6B) to *Zea mays*. All the B chromosomes of *Zea* could be identified in the somatic plate (fig. 5 indicated by arrow). Two types could be distinguished by length.

TABLE 1

Frequency of B chromosomes in 23 root tip cells of hybrid

No. of B chromosomes	2	3	4	5	6	7	8
No. of cells	1	2	4	4	8	—	4

Anaphase was seen in 133 cells and out of these 85 were normal. Others showed abnormalities such as bridges in 40 cells, fragments and lagging chromosomes. These abnormalities had disappeared by telophase, in 80 cells which were studied.

4. Discussion

The increase in chromosome number over the early observation is due to the accumulation of B chromosomes in the course of 30 years of purely vegetative propagation. The abnormalities observed at anaphase are presumably in the A chromosomes. Since the B chromosomes are of two kinds, misdivision seems also likely to be occurring.

5. Summary and conclusions

1. A hybrid between sugarcane and maize, perhaps the widest plant cross ever made, was raised in 1938. It had the expected 40+10 chromosomes and in addition two B chromosomes.

2. The hybrid was induced to open its inflorescence by gibberellin treatment in 1969 and 1970. The anthers, however, were sterile.

3. Growth was probably restricted by irregular mitosis. But the restriction may have favoured the accumulation of B chromosomes which rose in number to six or more in the course of the 30 years of vegetative propagation.

6. References

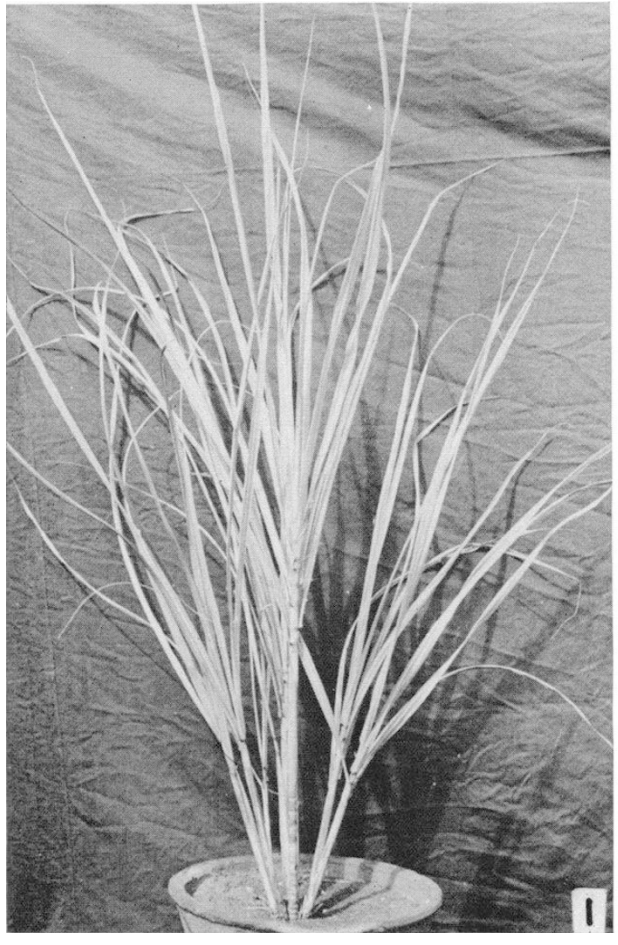
JANAKI AMMAL, E. K. 1941. Intergeneric hybrids of *Saccharum*. *J. Genetics, 41*, 217-253.

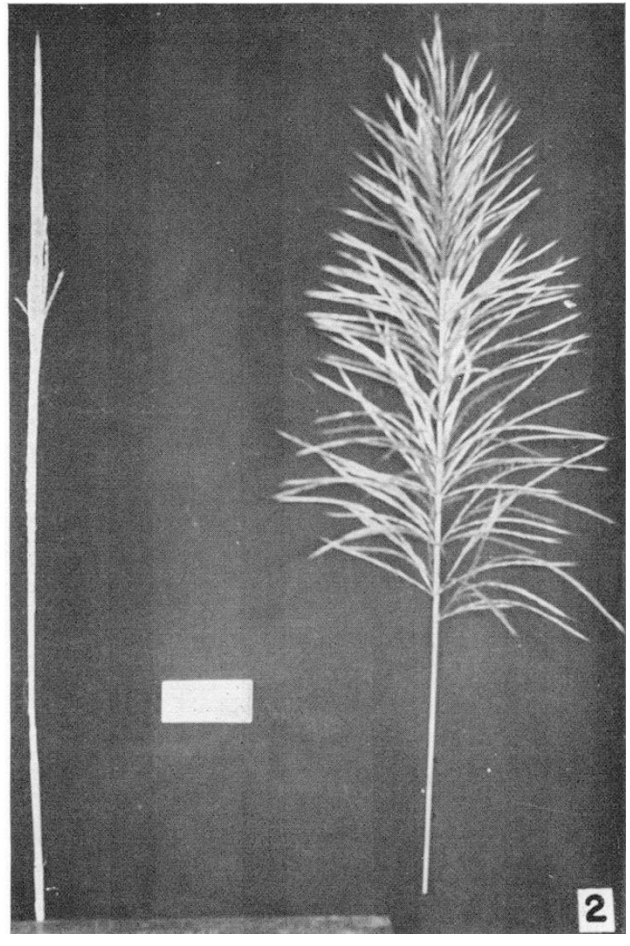
JAGATHESAN, D., AND RATNAMBAL, M. J. 1967. Karyotype analysis in *Saccharum officinarum*. *Nucleus, 10*, 159-167.

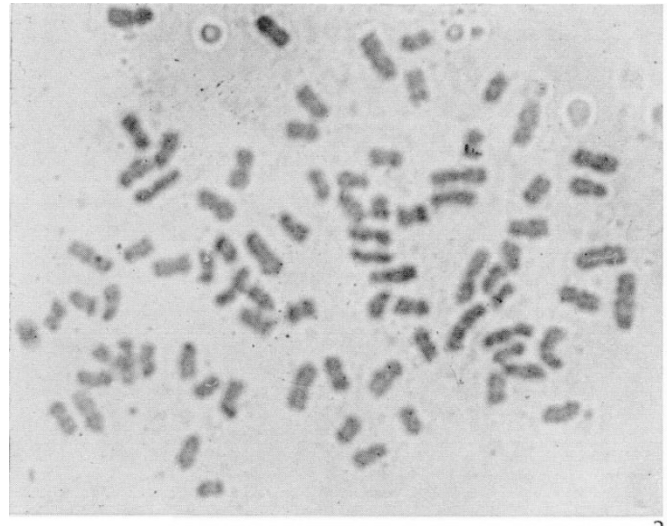
NAIDU, K. M., AND RAMAKRISHNAN, S. 1970. Flowering behaviour of sugarcane × maize hybrid and forcing its tassel emergence with gibberelic acid. *Indian J. Agri. Sci., 41*.

RHOADES, M. M. 1955. The cytogenetics of maize. *In Corn and Corn Improvement*, Ed. G. Sprague. Academic Press, New York.

Plate I







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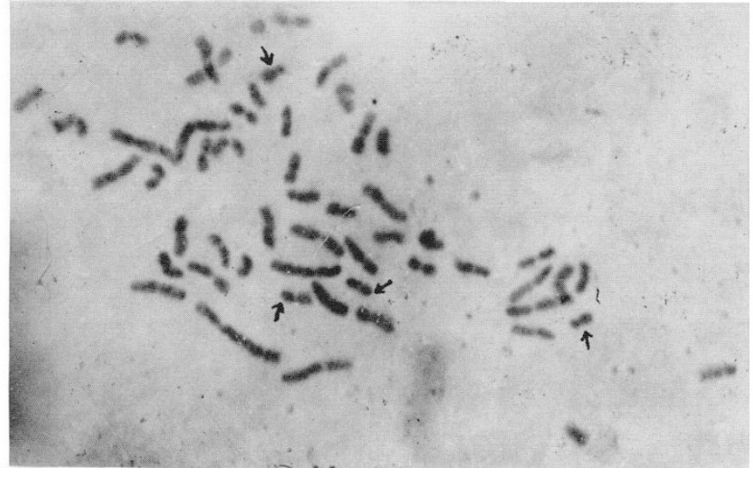

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FIG. 1.—*Saccharum* × *Zea* hybrid.

FIG. 2.—Inflorescences. *Left*: Enclosed in leaf sheath. *Right*: After emergence by gibberellic acid treatment. (Courtesy, Naidu and Ramakrishnan, 1970).

FIG. 3.—Root-tip squash of *S. officinarum* showing 80 chromosomes. × 4000.

FIG. 4.—Root-tip squash of hybrid showing 56 chromosomes (six B chromosomes arrow-marked). × 3000.

FIG. 5.—Root-tip squash of hybrid showing 54 chromosomes (four B chromosomes arrow-marked). × 4000.