induced rooting. The sprouting induced by the application of Stik in *P. pashia* therefore appears to be mediated by its effect on mobilization of reserve food materials caused by enhanced activity of hydrolytic enzymes. Whatever sprouting was observed in the control set was most probably due to a small amount of endogenous auxin present at the time of cutting.

The award of a Senior Research Fellowship by CSIR, New Delhi, to AKB is gratefully acknowledged.

13 June 1988; Revised 6 December 1988

1. Thimann, K. V. and Behnke-Rogers, J. M. M., *Cobot foundation*, 1950.
2. Nanda, K. K., *Final report PL 480 Research Project*, 1970.
3. Boijink, D. E. and Broehuizen, J. T. M., *N. Z. J. For. Sci.*, 1974, **4**, 127.
4. Greenwood, M. S., Harlow, A. C. and Hodgson, H. D., *Physiol. Plant.*, 1974, **32**, 198.
5. Bowen, M. R., Howarth, J. and Longman, K. A., *Ann. Bot.*, 1975, **39**, 647.
6. Rao, Sunanda and Mohan Ram, H. Y., *Acta Bot. Indica*, 1976, **4**, 6.
7. Eliason, L. and Areblad, K., *Physiol. Plant.*, 1984, **61**, 293.
8. Singh, S. S. and Paliwal, G. S., *Curr. Sci.*, 1985, **54**, 920.
9. Sharma, S. P., Badoni, A. K. and Paliwal, G. S., *J. Swamy Bot. Cl.*, 1987, **4**, 75.
10 Nanda, K. K., Purohit, A. N., Tandon, R. and Bala, A., In: *Proceedings of International Symposium on Plant Growth Substances*, (ed.) S. M. Sircar, Calcutta University, 1968, p. 201.
11. Brakke, M. K. and Nickel, J. G., *Bot. Gaz.*, 1952, 113.
12. Wort, D. J. and Cowie, L. M., *Plant Physiol.*, 1953, **28**, 135.
13. Venis, M. A., *Nature (London)*, 1964, **202**, 900.
14. Altmann, A. and Wareing, P. F., *Physiol. Plant.*, 1975, **33**, 32.

NEW EVIDENCE ON THE PHYLOGENY OF BASIC CHROMOSOME NUMBER IN *PENNISETUM*

Y. SAIDESWARA RAO, S. APPA RAO and MELAK H. MENGESHA
Genetic Resources Unit, International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324, India

THE genus *Pennisetum* (L.) Rich., which belongs to the family Poaceae, has species with chromosome numbers in multiples of $x = 5, 7, 8$ and 9. Of the several economically important species in this genus, pearl millet (*Pennisetum glaucum* (L.) R.Br.) is an important food and fodder crop. Based on chromosome pairing in haploids and interspecific hybrids, Jauhar[1,2] concluded that the chromosome complement of pearl millet ($2n = 14$) was derived from a basic set of $x = 5$ chromosomes. This was contradicted by Manga and Pantulu[3]. The present work on the cytogenetics of wild relatives of pearl millet gives new cytological evidence on the phyletic basic chromosome number and its evolution.

The wild species included in the present study are *P. ramosum* (Hochst.) Schweinf., *P. schweinfurthii* Pilger, and *P. mezianum* Leeke, which were obtained from the wild *Pennisetum* garden maintained by the Genetic Resources Unit, ICRISAT. For cytological studies, young inflorescences were fixed in acetic alcohol (1:3). Iron acetocarmine squash preparations were made from the pollen mother cells (PMC). Photomicrographs of chromosome pairing were taken from the temporary squashes.

Meiosis in *P. ramosum* is normal, with the ($2n = 10$) chromosomes invariably formed into five ring bivalents, one of which is associated with the nucleolus (figure 1A).

Meiosis in *P. schweinfurthii* showed its chromosome number to be $2n = 14$, and the chromosomes paired mostly as seven bivalents. However, of the 60 PMC analysed, 30% showed two trivalents and four bivalents (figure 1B), 45% showed six bivalents and two univalents, 10% had one quadrivalent, four bivalents and two univalents, and the remaining 15% showed seven bivalents. The bivalents are mostly ring bivalents. During anaphase I, most of the cells showed 7:7 normal chromosome distribution. However, a few cells (8%) had 8 6 distribution. The subsequent stages of meiosis were normal. Pollen fertility, as judged by stainability with acetocarmine, was 73%.

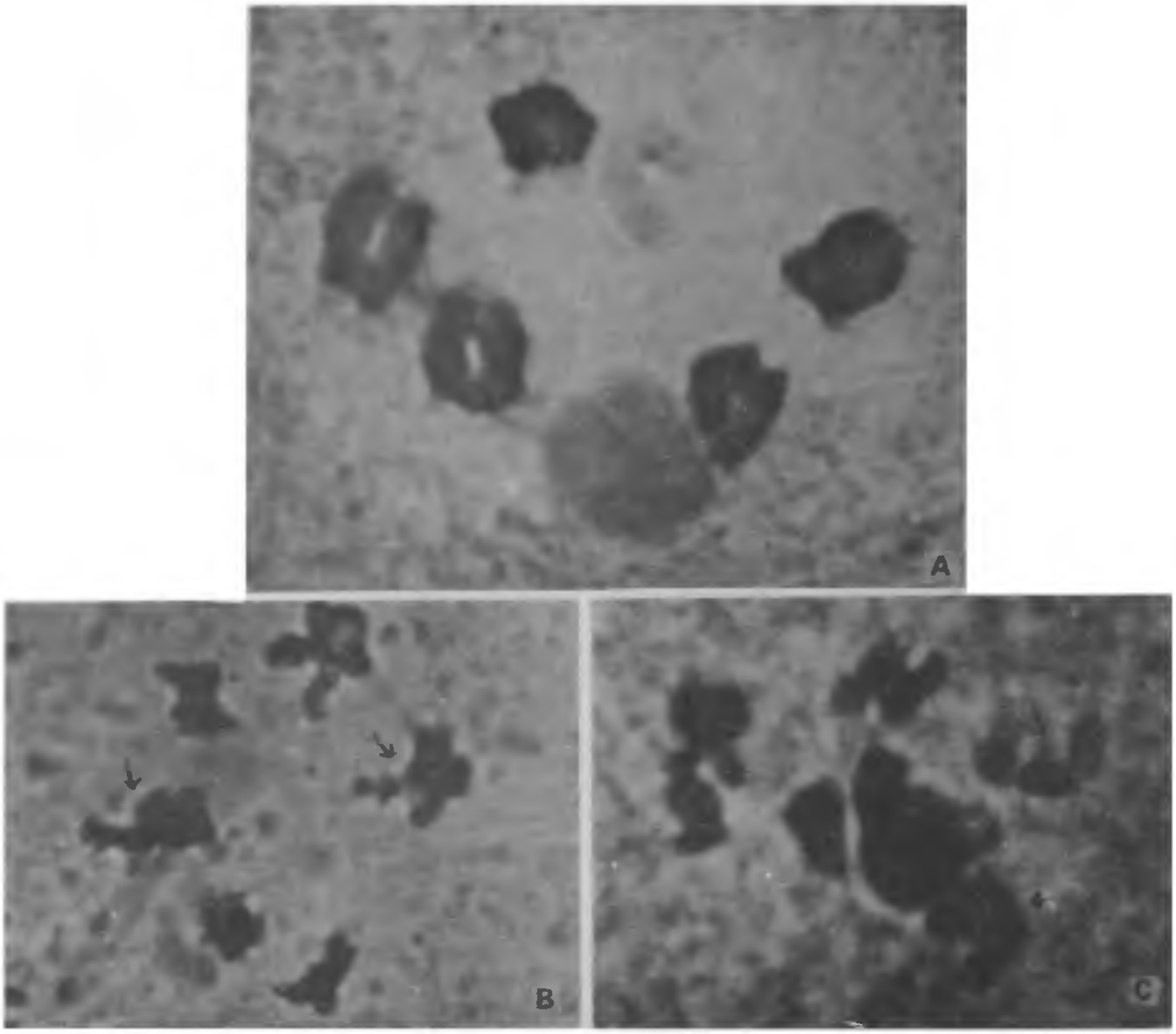

Figure 1A–C. A, Diakinesis in *Pennisetum ramosum* ($2n = 10$) showing five bivalents. B, Diakinesis in *Pennisetum schweinfurthii* ($2n = 14$) showing two trivalents (arrows) and four bivalents. C, Diakinesis in *Pennisetum mezianum* ($2n = 16$) showing two trivalents (arrows) and five bivalents.

P. mezianum showed ($2n = 16$) chromosomes, which were associated mostly as bivalents at diakinesis and metaphase I. Of the 160 PMC analysed, a maximum of two trivalents per cell were observed in 23% of the cells at diakinesis (figure 1C) and 17% in metaphase I. One bivalent was a nucleolar organizer. Various degrees of abnormalities due to these associations were observed in subsequent stages of meiosis. Stainability with acetocarmine indicated that 83% of the pollen grains were normal.

Darlington[4] pointed out that the inference of a basic number in a polyploid series is obviously an important step in fitting chromosome numbers to an evolutionary hypothesis. Sometimes the diploid members of the series have disappeared from the genus. At the same time, most of the 'polyploid' species actually show a diploid-like chromosome behaviour. Phylogenetic divergence in a large number of taxa has occurred, because of increase or decrease from the basic chromosome numbers. Some notable examples are *Frittillaria pudica*[5], where

$x = 13$ has arisen from $x = 12$; Eurasian species of *Allium*[6] ($x = 8$), which originated from the primitive North American species ($x = 7$); and *Zea mays*[7], where $x = 10$ was concluded to be a derivative of $x = 5$. A decrease in basic chromosome number has also been observed in many plants[8].

Formation of two trivalents per cell in 23% of cells of *P. mezianum* and 30% of cells of *P. schweinfurthii* suggests duplication of two chromosomes in these species. Formation of one quadrivalent in *P. schweinfurthii* was also reported earlier[9]. The occurrence of higher associations in these species could be attributed to homology to the basic complement following duplication and differentiation during the evolution of these species.

Based on the observed higher associations in the diploid complement of *P. schweinfurthii* and *P. mezianum*, it may be assumed that the chromosome complement in *Pennisetum* has evolved from a basic chromosome number like $x = 5$. The occurrence of a species with $x = 5$ in *Pennisetum*, such as *P. ramosum*, further supports this view. This is in agreement with the conclusions of Jauhar[2] and suggests that *P. glaucum* is a secondary balanced species with phyletic basic chromosome number $x = 5$.

Thanks are due to Mr C. Rajagopal Reddy, ICRISAT, for assistance in maintaining the wild species.

22 September 1988

1. Jauhar, P. P., *Genetica*, 1968, **39**, 360.
2. Jauhar, P. P., *Genetica*, 1970, **41**, 532.
3. Manga, V. and Pantulu, J. V., *Genetica*, 1971, **42**, 319.
4. Darlington, C. D., *Chromosome Botany*, Allen and Unwin, London, 1956.
5. Darlington, C. D., *Proc. R. Soc.*, 1936, **B121**, 264.
6. Leven, A., *Hereditas*, 1935, **20**, 289.
7. Molina, M. del C. and Naranjo, C. A., *Theor. Appl. Genet.*, 1987, **73**, 542.
8. Stebbins, G. L. Jr., *Variation and Evolution in Plants*, Oxford Book Co., Calcutta, 1964.
9. Hanna, W. W. and Dujardin, M., *Crop. Sci.*, 1986, **26**, 449.

INDUCED COMPLEX TRANSLOCATION HETEROZYGOSITY IN CHILLI

R. K. RAGHUVANSHI, SUBODH KUMAR, ANITA SAXENA and DALBIR SINGH
Department of Botany, University of Rajasthan, Jaipur 302 004, India

In work on induced mutagenesis in chillies, a complete sterile plant was isolated from the M_1 population of a fast-neutron treatment (2.6×10^{10} n/cm^2/4.5 min). As there was poor flowering and no fruit setting in the plant, its meiosis was studied.

Genetically pure and 'dry' seeds (moisture content 6.08%) of *Capsicum annuum* L. cv. NP 46A were subjected to fast neutron treatment at the Bhabha Atomic Research Centre, Trombay. The M_1 population was raised from the irradiated seeds along with control plants. Flower buds of suitable size were fixed in acetic : alcohol (1 : 3) and squashed in 1% acetocarmine solution.

The sterile plant differed from the control in several morphological characters (table 1). It was characterized by delayed flowering. No fruit set was obtained because of cent per cent flower abscission.

Meiotic characters of the control and sterile plants are given in table 2. Control plants showed 12 bivalents uniformly at diakinesis (figure 1). In the aberrant type, a hexavalent ring or chain was commonly found in many of 200 pollen mother cells (PMC) studied; the ring configuration was most common (figure 2). Only terminal chiasmata were observed in both the control and the aberrant type. The meiotic abnormalities included unoriented chromosomes (14.98% at MI, 2.34% at MII), laggards (11.26% at AI, 2.81% at AII), unequal distributions (4.69% at AI, 1.87% at AII) and chromosome bridges (10.32% at AI). Total meiotic abnormalities (46.47%) and pollen viability (23.15%) in the sterile

Table 1 *Comparative morphology of control and sterile Capsicum annuum*

Plant character	Control	Sterile
Plant height (cm)	38.0	27.0
Plant spread (cm)	52.0	20.0
No. of main branches	1	2
Leaf size (l × b of lamina, cm)	4.7 × 3.2	2.2 × 1.8
Petiole length (cm)	2.4	1.1
Days to flowering	80	110
Total no. of flowers formed	200	25
Flower abscission (%)	22	100
Total no. of fruits formed	178	—