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MEIOTIC CHROMOSOME DYNAMICS IN SOME POPULATIONS OF *PANICUM MAXIMUM* JACQ. IN SOUTHWESTERN NIGERIA

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Thirty-five accessions of *Panicum maximum* Jacq. were collected from parts of the states of southwestern Nigeria to study the meiotic dynamics of the populations. The accessions group into two field forms: the heavy tillering, robust, tall, long and broad-leafed with relatively fat culm and the low-tillering, not so robust, moderately tall, not so long .and narrow-leafed with thin culms. All accessions studied have chromosome number 2n = 32, including the accessions from the Oil Palm Plantation at Apoje, Ijebu-Igbo in Ogun State, for which a chromosome number of 2n = 28 had previously been reported. How this chromosome number could have been arrived at is discussed. Meiotic irregularities of quadrivalents and univalents occurred with high frequency. A mean of about 13 bivalents per cell with regular occurrence of 1 5 quadrivalents per cell suggest that *P. maximum* is a segmental allopolyploid.

Key words : Meioiic chromosome, dyanics, *Panicum maximum*.

INTRODUCTION

P. maximum commonly known as guinea grass is the largest species of the genus *Panicllm*. It is a tufted perennial with a. short underground root-stock. It is readily recognjzed by its robust growth and long-branched panicles. It is one of .the most important fodder and pasture species (Bogdan, 1977) with a broad application in the tropics (Usberti arid Valio, 1997). It is a valuable grass for grazing, hay and silage. Not much information is available on the cytogenetics of tropical grasses, the little available are mostly the studies by Olorode (1974); Olorode and Baquar (1976); Olorode and Morakiriyo (1980); Ene-Obong and Mba (1994).

Combes and Pemes (i970) reported that the majority of plants and populations of *Panicum maximum* are tetraploids, normally allotetraploids with 2n = 32, although hexaploids (2n = 48) occur fairly frequently. Darlington and Wylie (1956) reported that the basic chromosome number of species of *Panicum* is x = 7, 9, 10 with *Panicum maximum* having x = 9. Hamoud *et al.*, (1994) however reported that although the vast majority of the 12 taxa of *Panicum* L. he studied had the basic number x = 9 at different ploidy levels, the basic number x = 8 was recorded only in the tetraploid species *P. maximum* with 2n = 32. Olorode (1974) reported a new chromosome number of 2n = 28 for some accessions of *Panicum maximum* collected from the Oil Palm Plantation at Apoje, Ijebu-Igbo, Ogun State, Nigeria. In spite of the economic importance of, *P. maximum* and its wide occurrence in Africa and Nigeria, little work has been done on this species in Africa and in Nigeria in. particular, particularly in the area of genetic characterization. This investigation was designed to determine the chromosome numbers and study the meiotic behaviour of the accessions of the *Panicum maximum* species.

MATERIALS AND METHODS

The thirty-five accessions used for this study were collected from wild populations in the geographical southwestern part of Nigeria which falls within the lowland rainforest and derived savanna ecological zone, encompassing Osun, Oyo, Ogun, Ondo and Kwara States. These were planted in the Botanical Garden in Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. Table 1 shows the sources, locations, distinguishing characters and collectors of the accessions.

Young flower buds were harvested from the experimental field populations and fixed on the spot in 1:3 acetic alcohol. Slides were prepared by squash technique and stained in FLP Orcein (2 gm of orcein in $100cm^3$ of solution containing equal parts of Formic acid, Lactic acid, Propionic acid and water (Lasebikan and .Olorode, 1972). Pollen Mother Cells were examined and scored for associations. Good cells were photographed under the oil immersion phase contrast objective of Leitz Dialux research microscope.

RESULTS

Plates 1 and 2 show the main features of meiotic chromosomal studies in the accessions of *Panicum maximum* used in this study. The salient features of the meiotic studies are: regular occurrence of quadrivalents as chain IV or ring IV in the meiotic cells, regular occurrence of bivalents as ring II and rod II in high frequencies and occasional occurrence of univalents at rather low frequencies (Table 2).

Quadrivalents occurred in cells at a frequency of 1 - 5 per cell. Plate IA show: 3 ring IV + 2 chain IV + 5 rod II + 1 ring II. Plate 1 C shows 4 ring IV + 6 rod II + 1 ring II + 2 I while plate ID shows 1 ring IV + 1 chain IV + 9 rod II + 1 ring II + 41. Plates IB, 2C and 2D show perfect bivalent associations resulting in 16 II. Plate 2A shows 2 chain IV + 12 rod II while Plate 2B show 2 ling IV + 2 chain IV + 8 rod II. Table 2 lists these associations through all the accessions.

Plate 3 show a series of diakinesis configurations that could be misconstrued to register a chromosome number of 2n = 28. These configurations are 3 ring IV + 8 rod II (Plate 3A), 2 ring IV + 8 rod II + 2 ring II (Plate 3B), 1 ring IV + 11 rod II + 1 ring II (Plate 3C), 1 chain IV + 12 rod II (Plate 3D), 1. chain IV + 8 rod II + 4 ring II (Plate 3E), 1 ring IV + 1 chain IV + 10 rod II (Plate 3F). In comparison with the. configurations in Plates 1 and 2, it can be seen that in many of the spreads, the quadrivalents are not nearly in evidence. This makes it possible to identify a condensed quadrivalent as a bivalent associating like a ring of II or a rod of II. A loss of 2 ring IIs or 2 rod lis or a quadrivalent would also register a chromosome number of 2n = 28.

DISCUSSION

All the accessions considered in this study have a chromosome number of 2n = 32. These coUnts are similar to those reported by previous workers such as Combes and Pemes (1970) and Savidan (1980) in the *Panicum maximum* populations of Ivory Coast. It was observed that the major features of the chromosome studies are regular occurrence of quadrivalents as chain IV or ring IV in the meiotic cells at a frequency of 1 - 5 per cell, regular occurrence of bivalents as ring II and rod II in high frequencies and occasional occurrence of univalents at rather low frequencies. Bivalent pairing was generally of the order of 13 bivalents per cell (Table 2). All the accessions conformed to a chromosome number of 2n = 32.

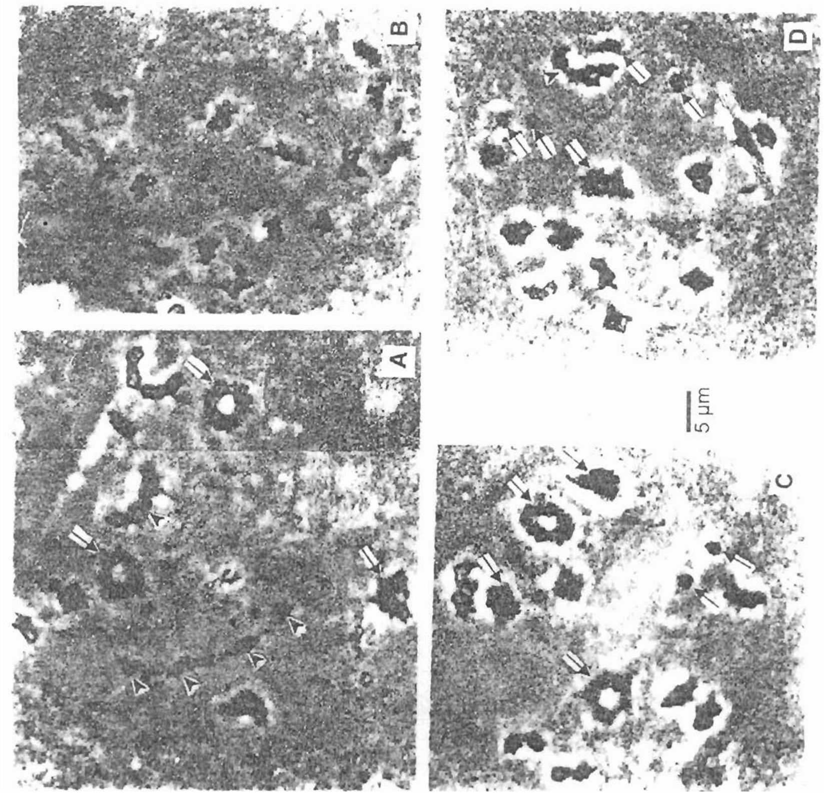

Plate 1: Meiotic chromosomes (diakinesis) of the *Panicum maximum* accessions studied (2n = 32).

A. Accession 26, showing 3 ring IV + 2 chain IV + 5 rod II + 1 ring II.

B. Accession 17, showing 16 rod II.

C. Accession 19, showing 4 ring IV + 21.

D. Accession 12, showing 1 ring IV + 1 chain IV + 9 rod II + 1 ring II + 41.

Complete arrows show ring IV and univalents; arrowheads show chain IV.

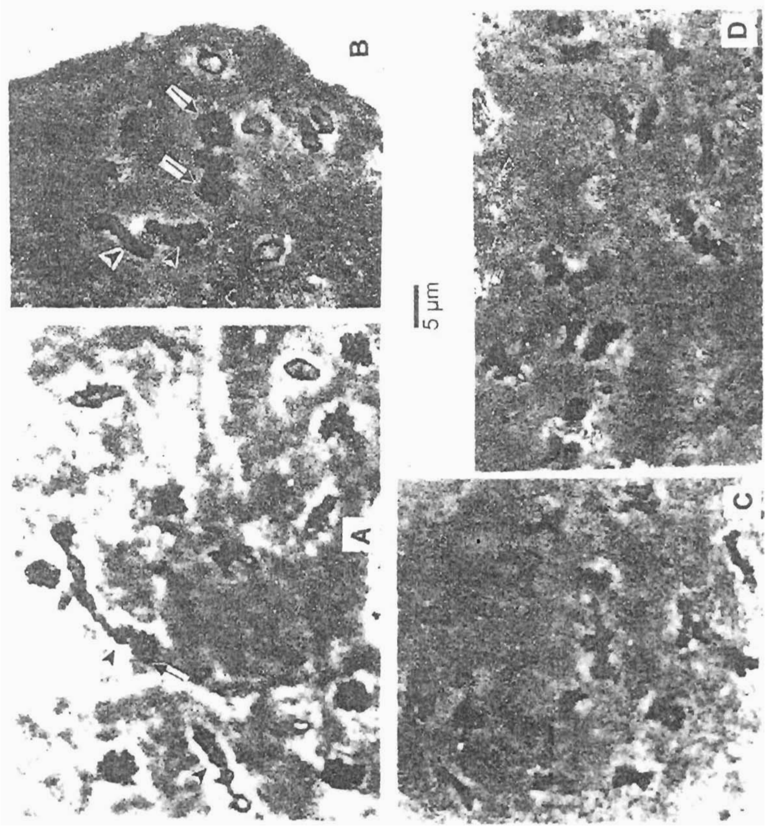

Plate 2: Meiotic chromosomes (diakinesis) of the *Panicum maximum* accessions studied (2n = 32).

A: Accession 26, showing 2 chain IV + 12 rod II.

B: Accession 25, showing 2 ring IV + 2 chain IV + 8 rod II

C: Accession 18, showing 16 rod II.

D: Accession 32 showing 16 rod II.

Complete arrows show ring IV; arrowheads show chain IV.

Table 1:

Accessions of *Panicum maximum* Jacq. Studied and their sources.

Accession number	Location	Description	Collector
1 - 2	Directly behind Faculty of Agriculture Obafemi Awolowo University campus, Ile-Ife. 7°30"N 4°31"E, Nigeria	Broad leaves, heavy tillering, culm diameter fairly big. Plant type generally robust.	Adedeji & Faluyi
3	Ruderal behind Faculty of Agriculture, on the way to quarters,O.A.U. Ile-Ife. 7°30"N 4°31"E. Nigeria.	Narrow leaves, intermediate tillering, culm diameter thin. Plant type not so robust.	
4 - 6	Inside the bush on Road 18, O.A.U. Staff quarters, Ile-Ife 7°30"N 4°31"E, Nigeria.	Mostly, broad-leafed, heavy tillering, culm diameter fairly big. Plant type robust	
7-9	Ruderal on Road 18, O.A.U., Staff quarters, Ile-Ife. 7°30"N 4°31"E, Nigeria.	Narrow leaves, heavy tillering, culm diameter small. Plant type not robust.	
10	Inside the bush on Road 8, O.A.U. Staff quarters, Ile-Ife. 7°30"N 4°31"E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust.	
11	Inside Odeda quarters, Abeokuta, Ogun State. 7°10"N 3°21"E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust.	Faluyi & Nwokeocha
12	Ruderal, Abeokuta - Ibadan Road 7°15"N 3°5"E, Nigeria.	Narrow leaves, heavy tillering, culm diameter small. Plant type robust	
13	Abeokuta - Ibadan road, inside the bush 7°15"N 3°25"E. Nigeria.	Narrow leaves, heavy tillering, culm diameter small. Plant robust.	
14 - 15	Ruderal, Abeokuta - Ibadan road, 7°15"N 3°25"E, Nigeria.	Narrow leaves, low tillering, culm diameter small. Plant not robust.	
16	National Cereals Research Institute (N.C.R.I.), Apata, Ibadan, Oyo State 7°17"N 3°30"E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust	

Table 1: Continued

Accession number	Location	Description	Collector
17	Inside the bush, Apata, Ibadan, Oyo State 7°17"N 3°30"E, Nigeria	Broad leaves, heavy tillering, culm diameter big. Plant robust	
18	Ruderal. Apata, Ibadan, Oyo State. 7°17"N 3°30"E, Nigeria.	Narrow leaves, low tillering, culm diameter small. Plant type not robust.	**Faluyi & Nwokeocha**
19 - 22	Teaching and Research farm O.A.U. Ile-Ife. 7°30"N 4°31"E. Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust.	**Adedeji & Faluyi**
23 - 24	Ruderal. Federal University of Technology, Akure (F.U.T.A) School area, Ondo State 7°15"N 5°14"E, Nigeria	Narrow leaves, low tillering, culm diameter small. Plant not robust.	**Adedeji**
25	F.U.T.A. Staff quarters, Akure, Ondo State. 7°15"N 5°14"E, Nigeria	Broad leaves, heavy tillering, culm diameter big. Plant robust	
26	Ruderal in front of a house, F.U.T.A. Staff quarters, Akure, Ondo State 7°15"N 5°14"E, Nigeria.	Narrow leaves heavy tillering culm diameter small. Plant not so robust	
27 - 28	Abandoned farmland, F.U.T., Akure, Ondo State 7°15"N 5°14"E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust.	Adedeji
29	Ruderal. F.U.T., Akure, Ondo State 7°15"N 5°14"E, Nigeria.	Narrow leaves, low tillering, culm diameter small. Plant type not robust.	"
30 - 33	Oil palm plantation Apoje. Ijebu-Igbo. Ogun State, in the open 6°58"N 4°00"E, Nigeria.	Broad leaves, heavy tillering, culm diameter big. Plant robust	Adedeji & Faluyi
34	Oil palm plantation Apoje, Ijebu-Igbo, Ogun State, in the shade 6°58"N 4°00"E, Nigeria	Narrow leaves, intermediate tillering, culm diameter small. Plant not so robust.	"
35	Ruderal, Ilorin-Offa road on the Kwara State - Osun State boundary 8°32"N 4°34"E, Nigeria	Narrow leaves, low tillering, culm diameter small. Plant not robust	Faluyi

Table 2:
Meiotic Chromosome Configurations (Diakinesis) of the Accessions Studied.

Accession Number	Modal Chromosome Configuration	Ploidy Level
1	0.85 ring II + 12.40 rod II + 0.85 ring IV + 0.5 Chain IV + 0.1 I	2n = 32
2	1.10 ring II + 13.60 rod II +0.35 ring IV + 0.3 Chain IV	"
3	1.20 ring II + 12.60 rod II + 0.65 ring IV + 0.45 Chain IV	"
4	0.65 ring II + 14.75 rod II + 0.15 ring IV + 0.10 Chain IV + 0.20 I	"
5	0.60 ring II + 14.90 rod II + 0.15 ring IV + 0.05 Chain IV + 0.20 I	"
6	1.45 ring II + 12.50 rod II + 0.55 ring IV + 0.45 Chain IV + 0.10 I	"
7	4.30 ring II + 7.50 rod II + 1.20 ring IV + 0.90 Chain IV.	"
8	4.25 ring II + 9.55 rod II + 0.70 ring IV + 0.40 Chain IV	"
9	0.65 ring II + 13.40 rod II + 0.60 ring IV + 0.35 Chain IV + 0.10 I	"
10	0.95 ring II + 13.90 rod II + 0.30 ring IV + 0.15 Chain IV + 0.50 I	"
11	2.55 ring II + 10.00 rod II + 1.10 ring IV + 0.60 Chain IV + 0.10 I	"
12	4.55 ring II + 9.95 rod II + 0.40 ring IV + 0.40 Chain IV	"
13	1.00 ring II + 13.50 rod II + 0.30 ring IV + 0.30 Chain IV + 0.60 I	"
14	3.45 ring II + 9.35 rod II + 0.85 ring IV + 0.75 Chain IV	"
15	3.90 ring II + 8.90 rod II + 0.75 ring IV + 0.85 Chain IV	"
16	4.15 ring II + 9.25 rod II + 0.65 ring IV + 0.65 Chain IV	
17	0.75 ring II + 14.40 rod II + 0.45 ring IV + 0.35 Chain IV + 0.10 I	

Table 2: Continued

Accession Number	Modal Chromosome Configuration	Ploidy Level
18	2.55 ring II + 12.80 rod II + 0.15 ring IV + 0.15 Chain IV + 0.10 I	2n = 32
19	2.75 ring II + 11.55 rod II + 0.65 ring IV + 0.60 Chain IV	
20	0.85 ring II + 13.25 rod II +0.80 ring IV + 0.15 Chain IV	
21	1.35 ring II + 11.15 rod II + 0.95 ring IV + 0.50 Chain IV + 1.20 I	
22	2.90 ring II + 12.70 rod II + 0.05 ring IV + 0.10 Chain IV + 0.20 I	
23	0.85 ring II + 13.45 rod II + 0.70 ring IV + 0.15 Chain IV	
24	2.60 ring II + 11.0 rod II + 0.55 ring IV + 0.65 Chain IV	
25	1.50 ring II + 11.8 rod II + 0.80 ring IV + 0.55 Chain IV.	
26	1.60 ring II + 12.5 rod II + 0.75 ring IV + 0.10 Chain IV + 0.40 I	
27	1.65 ring II + 12.35 rod II + 0.65 ring IV + 0.35 Chain IV	
28	1.80 ring II + 10.85 rod II + 0.60 ring IV + 1.05 Chain IV + 0.10 I	
29	1.10 ring II + 13.25 rod II + 0.45 ring IV + 0.35 Chain IV + 0.10 I	"
30	0.25 ring II + 11.35 rod II + 1.10 ring IV + 0.90 Chain IV + 0.80 I	'
31	1.10 ring II + 11.65 rod II + 0.80 ring IV + 0.80 Chain IV + 0.10 I	"
32	0.65 ring II + 12.60 rod II + 0.55 ring IV + 0.50 Chain IV + 1.30 I	"
33	0.15 ring II + 11.60 rod II + 0.70 ring IV + 1.15 Chain IV + 1.10 I	"
34	0.10 ring II + 13.05 rod II + 0.30 ring IV + 0.55 Chain IV + 0.70 I	
35	0.70 ring II + 13.90 rod II + 0.20 ring IV + 0.40 Chain IV + 0.40 I	"

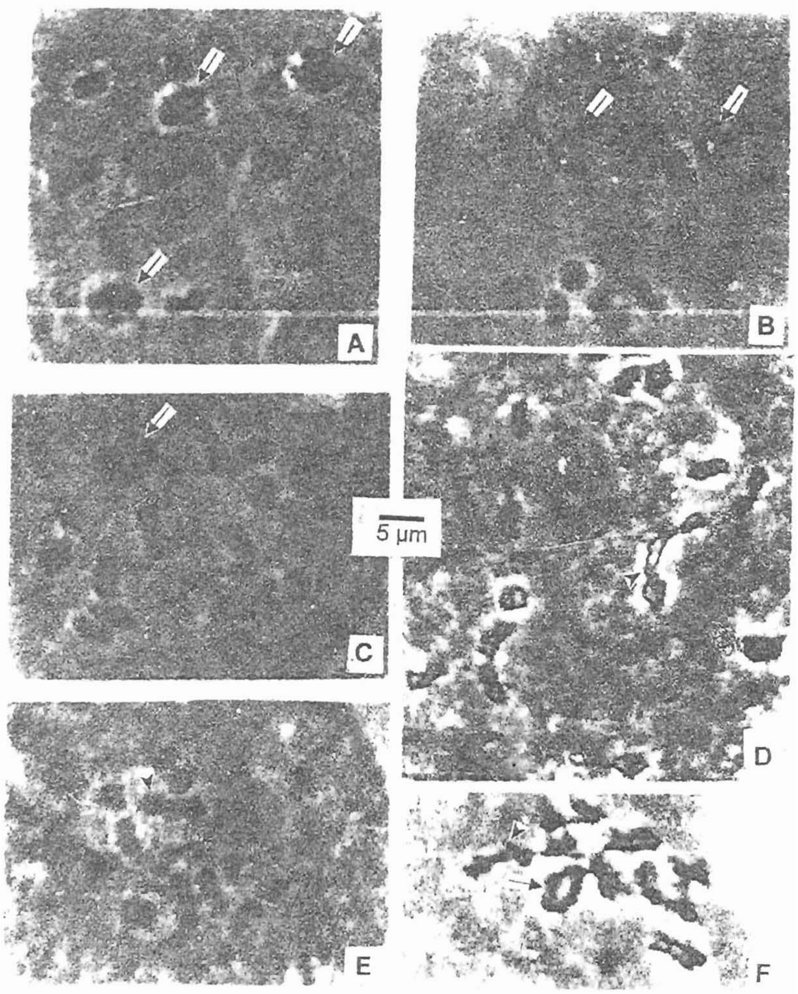

Plate 3: Diakinesis configurations in which counts can be misconstrued for numbers other than 32 in *Panicum maximum*.

A: Accession 7, showing 3 ring IV + 8 rod II.

B: Accession 31, showing 2 ring IV + 8 rod II + 2 ring II.

C: Accession 23, showing 1 ring IV + 11 rod II + 1 ring II.

D: Accession 15, showing 1 chain IV + 12 rod II.

E: Accession 11, showing 1 chain IV + 8 rod II + 4 ring II.

F: Accession 20, showing 1 ring IV + 1 chain IV + 10 rod II.

Bogdan (1977) reported diploids 2n = 16, triploids 2n = 24, pentaploids 2n = 40, octoploids 2n = 64, nonaploids 2n = 72 and also plants with irregular chromosome numbers (2n = 31, 36, 37, 38) in *Panicum maximum*. These number are obviously products of polyploidization and aneuploid decreases which lend credence to the tremendous roles played by these phenomena in evolution as was observed by Robinson *et. al.*, (1984) in the evolution of the tribe Heliantheae. Darlington and Wylie (1956) reported a basic number of x = 9 for *Panicum maximum'* but the findings of this work do not support this basic number but supports x = 8 reported by Hamoud *et al.* (1994) as the basic number. According to Faluyi and Olorode (1987), the occurrence of multivalents and univalents indicates potential for the evolution of aneuploidy and possibilities for change of chromosome number and chromosome repatteming which might lead to genic imbalance and possibly viable genetic variability in the species. Such cluomosomal events are probably responsible for the different chromosome number,s reported for species of *Panicum maximum* by different workers.

The occurrence of quadrivalent association at a frequency of 1 - 5 per cell and the occurrence of a mean of about 13 bivalents per cell present contradictory evidence for the origin of polyploidy in *P. maximum*. It is possible to posit that *P. maximum* is an autopolyploid which has acquired diploid-like behaviour over time. The cytological situation observed in this study supports this conjecture. *P. maximum* would then have been an imperfect secondary diploid because of the regular occurrence of quadrivalents in its meiosis. The other possible conjecture is that *P. maximum* is a segmental allopolyploid which has arisen from two diploids whose chromosomes are substantially homoeologous.

It is more probable that *P. maximum* is a segmental allopolyploid in which about five chromosomes are segmentally homologous (Swanson *et. al.*, 1967). The preponderance of bivalents in the meiotic cells of this species suggest that it is an allopolyploid in which there would have been perfect bivalent association were it not for the segmental relationship that about five of the chromosomes have been assumed to have.

The occurrence of chains and rings of four has posed some major problems for ascertaining of chromosome number in *Panicum maximum*. Olorode (1974) reported a diploid number of 2n = 28 in his collection of *Panicum maximum* from the oil-palm plantation in Apoje, Ijebu-Igbo. Very careful cytological studies of many accessions from this location do not support this chromosome number. A chromosome number of 2n = 28 can easily be arrived at if two chains or rings of four are recorded as 2 ring II or 2 rod II, or if one chain of four is completely missed out. Plate 3 demonstrates these events in the course of this study. High power photomicrography is very important in ascertaining the chromosome number through meiotic counts.

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