

Short Communication

Interchromosomal connections and metaphase 1 clumping in meiosis of two *Capsicum* Linn. species in Nigeria

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The occurrence of interchromosomal connections in two species of *Capsicum*; *Capsicum annuum* L. and *Capsicum frutescence* L., from Nigeria is reported. Clumping of metaphase 1 chromosomes is also reported for these two species. The degrees of incidence of the interchromosomal connections and metaphase 1 chromosomes clumping have been determined. The probable relationship between the chromosomal connections and metaphase 1 clumping and the possibility of their being a useful ecological adaptation are discussed.

Key words: Interchromosomal connections; *Capsicum annuum* L.; *Capsicum frutescence*; Metaphase 1 chromosomes clumping and Ecological adaptation.

INTRODUCTION

Capsicum annuum and *Capsicum frutescence* are the two main species of pepper cultivated in Nigeria. They are grown in many areas in tracts located away from big cities where their fruits are harvested and taken to the market for sales. *C. annuum* has blue anthers, milky white corollas, inconspicuous calyx lobing and one peduncle per node whereas *C. frutescence* has blue anthers, milky-greenish or yellowish white corollas and two or more peduncles per node (Heiser, 1976).

These two species form an important ingredient in the diet of Nigerians and the whole world for which the pungency is the most important property of the fruits. *C. frutescence* has wide distribution as a wild weedy or semi-domesticated plant in the tropics. These are extremely pungent peppers that are commonly called bird chillies. *C. annuum* on the other hand is said to be the most widely cultivated and economically important species of *Capsicum* and are commonly known as chillies, red or sweet peppers. They include the sweet and a wide range of pungent peppers (Purseglove, 1968; Heiser, 1976).

Considerable variability exists within these species for fruit and vegetative characters (Anand et al., 1987). The occurrence of interconnections between non-homologous chromosomes in some stages of mitosis and meiosis in a number of plants and animals has been reported by a

number of workers (Myhra and Brogger, 1975; Viinikka and Nokkala, 1981; Akpabio, 1990). Chromosomes during cell division usually occur as separate entities but sometimes they occur as chromatin threads connecting the individual chromosomes.

Often these interconnections are so thin that they cannot be picked with the light microscope (Akpabio, 1990). Myhra and Brogger (1975) observed that the interconnections contain DNA. Generally, the occurrence or existence of these interconnections has been overlooked, thus their functions are not understood. This report is the first of the occurrence of interconnections in the genus *Capsicum* and the first report of its probable relationship with chromosome clumping.

MATERIALS AND METHODS

Four accessions of pepper (*C. annuum* L. and *C. frutescence* L.) were investigated (Table 1). They were grouped into three varieties of *C. annuum*; *grossum*, *abbreviatum* and *accuminatum*, and one variety of *C. frutescence* *baccatum* after Purseglove (1968). The plants were raised to maturity in plastic buckets and flower buds from them were harvested at the appropriate stage of pollen mother cell development for meiotic studies. The flower buds were harvested between 9.30 a.m. and 10.00 a.m. and fixed in ethanoacetic acid for twenty-four hours. For squash preparation, they were rinsed in water and hydrolysed in 18% hydrochloric acid for 2 min.

Table 1. Description of the pepper (*Capsicum spp*) plants that were used in this study.

Code number	Source	Local name	Botanical name	Description
TA3	Ikare Ondo State	"Tatase"	<i>C. annum var grossum</i> L.. Sendt.	Small annual plant, medium size, bell-shaped fruits with mild taste one pedicel per node.
RO2	Ilorin Kwara State	"Ata-rodo"	<i>C. annum var abbreviatum</i> Fingerh	Medium sized annual plant, small oblong and wrinkled fruits with hot taste one pedicel per node.
SO1	Akure Ondo State	"Ata-Sombo"	<i>C. annum var acumminatum</i> Fingerh	Medium sized annual plant, long pointed and pendant fruits with hot taste one pedicel per node.
WE1	Ado-Ekiti Ekiti State	"Ata-wewe"	<i>C. frutescens L. var baccatum</i>	Large perennial shrub, small pointed fruit with very hot taste, 2-4 pedicels per node.

Table 2. Frequencies of interchromosomal connections at diplonema and diakinesis, and clumped metaphase 1 in two species of *Capsicum*.

Species	Chromosome Number	No. of cells	% of cells with bivalents linked in Diplonema			Number of cells	% of cells with bivalents linked in Diakinesis			% Clumping at Metaphase 1
			2	3	4		2	3	4	
TA3	2n=24	100	12.5	3.2	11.2	90	10.6	6.8	5.5	16.8
RO2	2n=24	100	11.2	12.6	13.8	90	12.8	10.5	8.1	25.8
SO1	2n=24	100	15.5	14.5	13.2	90	12.4	9.3	5.3	27.5
WE1	2n=24	100	40.2	27.5	20.9	90	30.6	25.3	18.5	30.4

**Figure 1.** Chromosome interconnections at diplonema in *C. frutescens*.**Figure 2.** Chromosome interconnections at diplonema in *C. annum*.

The hydrolysed flower bud was rinsed in water and one anther at a time was squashed in FLP orcein (Olorode, 1973). Photomicrographs of suitable cells were taken for illustration. Records of number of cells with interconnections and the number of bivalents involved per cell at diplonema and diakinesis were also kept. Pollen grain viability was estimated by staining in cotton blue-in-

lactophenol and pollen diameter was measured at x 400. Pollen grains that were deeply stained and that had spherical shape were considered viable.

RESULTS AND DISCUSSION

The percentage frequency of cells showing interconnections and clumping is summarized in Table 2. Interconnections were more visible at diplonema and diakinesis while clumping was more evident at metaphase 1 in the two species. At diplonema (Figures 1 and 2), many interconnections between the heterochromatic regions could be seen. This was most intense in *C. frutescens* and least in *C. annum*. There were fewer interconnections in diakinesis than at diplonema. The interconnections were usually terminal and between the three largest bivalents. Clumping at metaphase 1 was also a significant observation (Plates 3 and 4). The clumping was most prevalent in *C. frutescens* than *C. annum*.

The occurrence of chromosome clumping has always been associated with sterility and degeneration (Falusi et al., 2005). But this was not so for *C. annum* and *C. frutescens* in this study. The high percentage frequency of occurrence of chromosome clumping had no adverse effect on pollen viability, which was high in the two species (Table 3). In later stages of division, clumping and interconnections were less evident. Thus there was no evidence of these events during the second meiotic division.

Falusi (2003) observed that the meiotic elements of *Capsicum* species have a high tendency to cluster together.

Table 3. Pollen data in the plants studied.

Plant	Pollen number	Pollen viability (%)	Mean pollen size \pm SD (μ)	CV (%)
TA3(2n=24)	960	71.2	26.8 \pm 2.51	9.44
RO2(2n=24)	753	68.3	26.2 \pm 2.51	9.58
SO1(2n=24)	825	64.0	29.5 \pm 2.26	7.66
WE1(2n=24)	769	84.0	29.3 \pm 2.40	8.18

**Figure 3.** Metaphase 1 in *C. frutescence* showing clumped chromosomes.**Figure 4.** Metaphase 1 in *C. annuum* showing clumped chromosomes and interchromatin connections.

her as evident at metaphase 1 (Figures 3 and 4). This present study therefore suggests that there is a direct relationship between chromosome interconnections and clumping. The heterochromatic regions of some of the chromosomes could have fused together early in the first meiotic division. This probably resulted in the formation of chromatic knots, which lead to the formation of prominent interconnections that were observed at diplonema and diakinesis. A similar situation was reported in *Crotalaria* species by Akpabio (1990).

The reduction in the number of these interconnections as meiosis progressed must have resulted from repulsion and chromatin breaks. The intensity of the occurrence of such events could be a characteristic of the species and their distribution. This explains why *C. frutescence*, which

had the widest distribution, has more chromosomal interconnections. The non-occurrence of interconnections and clumping in later stages of meiotic division and the fact that pollen viability was high (Table 3), seem to compliment the view that these events are a useful strategy for survival rather than aberrations.

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