Online Journal of Biological Sciences 1 (7): 612-613, 2001

Chiasma Frequency and Chromosome Pairing at Tobacco Genotypes (*Nicotiana tabacum*) in the Middle Black Sea Region

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Abstract : The study covers the relationship between tobacco genotypes in terms of chromosome homology by pairing configurations and chiasma frequency growing at different areas of the middle black sea region. For this purpose, three genotypes (Samsun, Bafra and Merzifon) and their crosses were studied by acetocarmine stain technique at the stage of metaphase I of meiosis. Consequently, parents and their hybrids showed that bivalent type of chromosome pairing (0.6-1.1 rod type and 22.0-23.4 ring type) and chiasma frequency between 46.90-47.40 %. This type of pairing is considered to be from the close similarity of the chromosomes of genotypes.

Key words: Chromosome, pairing, tobacco

Introduction

Tobacco is an industrial plant and a polyploid in nature. Its species show a similarity upon genomic structure. The species growing in the middle black sea region which is *N. tabacum* 2n = 48, is a amphidiploid consisting S and T genome plant although the origin of plant belongs to America continental. The S genome of amphidiploid created from two diploid plant was transferred from *N. sylvestris*'den, whereas T genome was taken from *N. tomentosiformis*, *N. otophore* and *N. tomentosa* hybrids (Parokonny and Kenton, 1994). The complex structure of genus is getting more force to evaluate the evolution mechanism of species. The tobacco plant named as Samsun tobacco (*N. tabacum*) was used. In the studies on the origin of the genome, its genomic DNA was analyzed for displaying the similarity of them, by repetitive DNA sequence using fluorescence in-situ hybridization (FISH) techniques and physical map had been occurred by Parokonny and Kenton (1994).

Tobacco can be used to explain pairing mechanism through its complex genome formula. Up to date, some plants were analyzed both either at metaphase I or prophase I pairing behaviour using FISH techniques, electron and light microscopy (*Lolium* spp., *Festuca* spp., *Secale* spp. etc.) (Elçi, 1978; 1982; Sağsöz, 1982; Baysal, 1973; Parokonny and Kenton, 1994; Taylor and Evans, 1977; Evans and Davies, 1983; Evans and Aung, 1986; Jenkins, 1988). Samsun tobacco types were used for the quantitative analysis as phenotypic evaluation (Camaş *et al.*, 1998) but here the relationship between tobacco genotypes growing in the area were aimed to investigate chromosome pairing.

Materials and Methods

Tobacco parent plants were collected from the middle black sea region from three growth areas and were crossed each others. Pollen mother cells (PMC) of parents and their hybrids were used for the evaluation of chromosome pairing at the flowers picked up from their early buds. The plants were collected from three microclimate areas of Samsun territory (Samsun-center, Bafra, Merzifon), whose seeds were transferred and grown in the pots after germinating under the seed-beds. Three types were crossed and were grown for the meiosis analysis. The buds collected from the hybrids were saved in carnoy fixative (6:3:1) and examined for chromosome pairing configurations using light microscopy due to the acetic acid squash method suggested by some authors (Baysal, 1973; Elçi, 1982; Okumuş, 1995; Sağsöz, 1982). In the meiotic cells, interspecific relations were observed by chromosome pairing configurations and chiasma frequency as percent. The results handled from genotypes were tested using X^2 (Chi-square) test, statistically.

Results and Discussion

Pairing configurations and chiasma frequency of genotypes were summarized in Table 1. The parent plants and their crosses exhibited bivalent type of chromosome pairing configuration with close chiasma frequency. The typical bivalents were pictured in Fig. 1.

Table 1: The number chromosome pairing type (rod and ring) and chiasma frequency (%) of tobacco genotypes

Genotype	No. cell	Chromosome Rod	Pairing (Bivalent) Ring	Chiasma Frequency %
Samsun (S)	30	0.6	23.4	47.40
Bafra (Bf)	30	0.9	23.1	47.10
Merzifon (M)	30	1.0	23.0	47.00
SxBf	16	1.1	22.9	46.90
SxM	13	1.0	23.0	47.00
Total	119	4.6	115.4	235.4

S: Samsun-Merkez Bf: Bafra M: Merzifon B-Bivalent

The parents of plants showed either ring or rod bivalent pairing configurations. Samsun-Center, Bafra and Merzifon parents showed respectively, 23.4, 23.1, 23.0 ring and 0.6, 0.9, 1.0 rod bivalent and 47.40, 47.10, 47.00% chiasma frequency. Samsun x Bafra crosses showed 1.1 rod and 22.9 ring bivalent ratios; whereas Samsun x Merzifon cross line 1 rod and 23 ring bivalent configurations. The parents and their cross did not show any significant difference at the sake of pairing , statistically ($p > 0.05$).

Pairing configurations between chromosomes are controlled by the genes (Okumuş, 1995). It is implied that chromosomes can pair as bivalents as seen in tobacco, but the chromosomes can, also, make preferential pairing by increasing homology between them (John and Henderson, 1962). The similar type of pairing was observed at autotetraploids as seen at allopolyploids as well, though these chromosomes indicate some differences at the angle of homology (Sved, 1966). Besides, *Festuca arundinacea*, carries out the AABBCC genome and 2n = 6x = 42 chromosomes as allopolyploid, shows ordinary bivalent pairing and disomic inheritance (2x). Chromosome pairing is homologous and Jauhar (1975) displayed that this pairing is controlled genetically by the studies on the monosomic plants. At the metaphase I stage of this monosomic plant, chromosome configurations manifested homologous pairing rather than homologous pairing

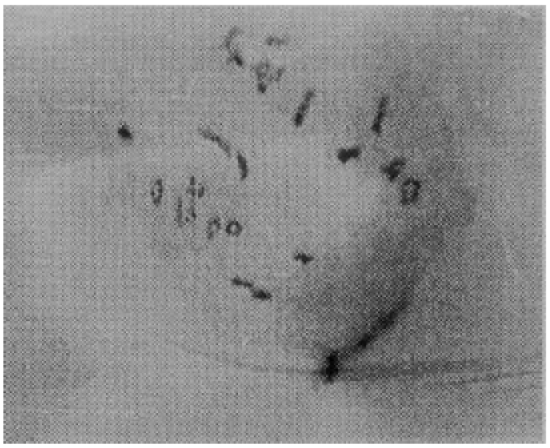

Fig. 1: The typical bivalent chromosome pairing seen at metaphase-I stage of N. tobacum (2n = 48)

at the monosomic one because of the breakage of disomic inheritance. The similar pairing was confirmed in wheat genome and it was established that the pairing is controlled by Ph locus on the 5B chromosomes (Wall *et al*., 1971). Although the pairing mechanism depends on the homology relations between chromosomes by the activity of genes limited the pairing, whose activation mode is not known. Hill and Carnahan (1962) informed that *Festuca x Lolium* crosses are sterile concerning pollen viability at the high rate. As, Springer and Buckner (1982) observed the multivalent chromosome configurations at the *Lolium multiflorum* and *Festuca arundinacea* crosses at the metaphase I of meiosis and both studies showed the similar frequency bivalent and trivalent pairing and exhibited that univalent and quadri valent frequencies are far away from each other. Similar pairing system was studied in Lolium species which there are some suppression genes the relationship between different genomes in terms of homology genome (Taylor and Evans, 1977; Evans and Davies, 1983; Evans and Aung, 1986; Jenkins, 1988). However, Taylor and Evans (1977) betrayed the exist of pairing genes in a study that two *Lolium* genotypes were used and one of them carried some genes that are suppress the pairing between chromosomes (Lp19) other carries the genes that resist the activity of genes providing pairing between chromosomes (Lp10).

There is a close relationship between genomes which are controlled by the genes obeyed in some polyploids (Parokonny and Kenton, 1993; Ekingen, 1980; Elçi, 1975). Parokonny and Kenton (1994) investigated the related genomes of Samsun originated *N. tabacum* plants by FISH-genomic DNA and rDNA sequence hybridization technique and, they were observed that some of the translocations and genes between chromosomes related to *N. silvestris*, *N. glutinosa* is similar to each other. At the other hand, Ekingen (1980) implied that the genetic control of chromosome pairing is obligatory for polyploid organisms and this specification was observed in *Avena, Lolium, Festuca, Triticum and Gossypium*. Whereas, Elçi (1975) showed that some cultivars display typical bivalent type chromosome pairing configurations.

Although the genotypes growth at central black sea region showed some differences concerning homology, it is considered that these differences come out from their DNA sequences in terms of the types of genes related rather than chromosome homology (Parokonny and Kenton, 1993). Because, the morphological differences on growth tobacco plants had been studied by Camaş *et al*. (1998). Due to these workers, these genotypes betray some morphological differences concerning dry leaf yield and number, leaf length-width and quality. Recently, it can be said that there is either a relationship between these tobacco genotypes or a similarity regarding to chromosome homology.

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