RESEARCH PAPER | Clinical Research | Volume : 4 | Issue : 9 | September 2014 | ISSN - 2249-555X

Meiotic Studies in Two Diploid Mulberry Varieties *(Morus Spp.)*

KEYWORDS: Mulberry *(Morus spp.)*, Diploids, Meiotic behavior

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ABSTRACT *Meiotic behaviors of two indigenous, popular mulberry varieties in Karnataka, C_{763} and S_{36} were studied. Based on the chromosome numbers, chromosome configurations, ploidy levels and other meiotic behaviors, x=14 has been considered as the basic number of the genus. Meiosis showed marginal differences. Various meiotic abnormalities such as occurrence of one large chromosome at metaphase I, unequal separation at anaphase I, laggard, unoriented, precocious movement and unequal separation of chromosomes at anaphase II, have been observed.*

Introduction

The foliage of the mulberry plant is used mainly as a unique source of silkworm *(Bombyx mori L.)* feed and cultivated in over 40 countries (Machii & Katagiri;1991). Cytogenetical studies, which is pre-requisite for genetic improvement in plant species. Most of the cultivated varieties of mulberry are diploids with 2n=28 chromosomes, but a few are polyploids (Dwivedi et al., 1986 &Venkatesh; 2007). In Karnataka silkworm rearers practicing improved method of mulberry cultivation. V_1, M_5, S_{34}, S_{13}, C_{763} and S_{36} are popular mulberry varieties are used to rear silkworms. Venkatesh et al. (2013), studied the micro morphology and reproductive characteristics of different ploidy level of the mulberry varieties and considered diploid parents are superior to triploid and tetraploid. Many diploid varieties of mulberry considered superior than triploids and tetraploids in leaf yield and nutritive qualities of leaf and in cold and disease resistance. Venkatesh et al., (2013), studied the meiotic studies of diploid (2n=28) varieties of *morus* and confirmed the extreme difference between the 13 small pairs and one large pair of chromosomes. Venkatesh & Munirajappa (2012 & 2013), studied the meiotic behaviors of triploid (2n=42) and tetraploid (2n=56) varieties of *morus*. In the present study, an attempt has been made to understand the meiotic behaviors of two diploid popular varieties of mulberry.

Materials and methods

Mulberry varieties used in the present study are C_{763} and S_{36} which are maintained in the Germplasm bank, Department of Sericulture, Bangalore University, Bangalore, India. Cuttings of these varieties were planted in pots for experimental use. For meiosis studies young flower buds of appropriate stages of development were collected between 8.30 to 9.30 a.m. during sunny days and fixed them in 1:3 acetic- alcohol for 24 hours and preserved in 70 % alcohol. Anthers were squashed in 2% aceto-carmine. Photomicrographs were taken using labomed microscope fitted with Nikon Cool fix Digital Camera.

Results and discussion

Variety S_{36}

This variety has been evolved through artificial hybridization between S_{30} and Berhampore C_{776} at Central Sericultrual Research and Training Institute (CSR&TI), Mysore. This variety is best suited for both rain fed and irrigated condition. Under ideal agro climatic conditions this genotype yields 45 tones of leaf yield/hectare/year. Cytologically this variety revealed diploid chromosome number of 2n=28 in their pollen mother cells (PMCs) and showed marginal differences in meiosis. In metaphase I, only few PMCs exhibited, 14 bivalents are arranged in equatorial plate without any additional association (Fig. a). Majority of the PMCs exhibited 14 bivalents are scattered in the cytoplasm and of which one pair was larger than others (Figs. b & c) in which univalent frequency was very less. Hence majority of the cells showed unequal separation of chromosomes at anaphase I (Fig. f). Chances of equal distribution were meager and 13/15 distribution was observed. Another recurrent feature of anaphase I was occurrence of laggards. As expected, the disturbance in the meiosis I has adverse effect on the subsequent stages of meiosis II. Metaphase II showed many chromosomes scattered in the cytoplasm without aligning on the equatorial plate (Fig. j). This has lead to unequal anaphase II separation, non separation, grouped at less than four poles and unoriented of chromosomes due to improper action of spindle fibres respectively (Figs. k & l).

Variety C_{763}

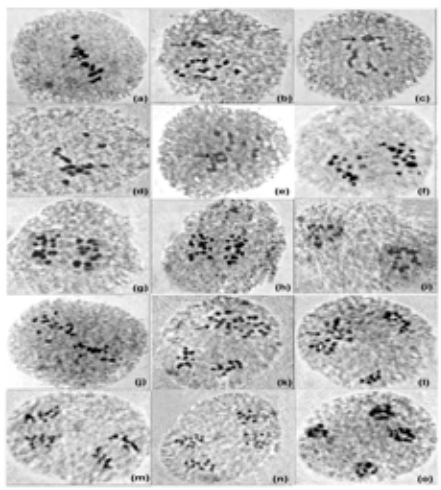
It is a beneficial mutant mulberry genotype evolved at Central Sericultrual Research and Training Institute (CSR&TI), Mysore. It has a better rooting and sprouting abilities and is capable of thriving well both in temperate and tropical climatic conditions. It is best suited for both rain fed and irrigated condition. Cytologically it is also revealed diploid chromosome number of 2n=28 in their pollen mother cells (PMCs) and normal meiosis. In metaphase I, equal chances of 14 bivalents are scattered (Fig. d) and of which one pair was larger than others (Fig. e) among

Volume : 4 | Issue : 9 | September 2014 | ISSN - 2249-555X

the PMCs observed. It is also assessed that bivalents were more frequent and frequency of univalents were negligible. Anaphase I showed equal separation of chromosomes (Figs. g & h) respectively. Regular two daughter nuclei were formed at the end of telophase I (Fig. i). Anaphase II showed normal equal separations of 14 chromatids were clearly discernible moving to the respective poles (Figs. m & n). Telophase II showed chromosomes grouped at four poles, suggesting the proper action of spindle fibres (Fig. o).

Genus *morus* as wide range of chromosome number from 2n = 28 to 2n = 308 and ploidy from x to 22x. Presence of 14 bivalents in most of the PMCs at metaphase I confirms the diploid nature of these varieties. Meiotic behavior of diploid cultivars of the present study indicated the typical feature met within diploids. One bivalent was found bigger in comparision to other as also reported by Gill and Gupta (1979) and in *Morus alba* by Das (1961) in *Morus indica*. In general meiosis in the diploid was regular and it was clear that the gametic chromosome number was n=14. The high frequency of bivalents is suggestive of a fair degree of homology between the constituent genomes and allo diploid nature of these varieties.

The present investigation showed that there were no secondary associations and multivalents, bivalents frequency was very high in metaphase I in both the varieties studied. Meiosis has been found regular with high frequency of bivalents. Observation made by Datta (1954) may be due to the large size of one pair chromosomes which may be mistaken for trivalent/tetravalent. Anaphase I & II were quite abnormal due to laggards and unequal numbers of chromosomes segregate to their respective poles during the present studies might have originated due to delayed terminalization. This is attributed to irregularities in basic process like chromosome pairing and alignment. Other meiotic abnormalities like precocious movement, non separation, unoriented of chromosomes at anaphase II may be due to inhibition and improper action of spindle fibres, leads to the formation of aberrant pollen grains with unequal number of chromosomes. Reduction in pollen fertility expected in variety S_{36} because pollen fertility is an index of meiotic behavior. Similar results were also reported by Darlington (1965) & Gottschalk (1978). Based on the present findings, C_{763} and S_{36} are diploids cultivars having 2n=28 chromosomes in their PMCs indicate the dibasic nature of these varieties. A large bivalent formed of two mega chromosomes, it can be concluded that 14 as the basic chromosome number. However presence of laggards, precocious movement, unequal separation, unoriented and unequal separation of chromosomes has been frequently observed in the PMCs. These anomalies closely associated with pollen sterility. This may be leads to formation of aberrant and unequal sized pollen grains with unequal number of chromosomes. The pollen sterility is accordingly much reduced. Formation of such aberrant sporads in some mulberry has been recorded by Osawa (1920). This information will be of much use in an establishing a phylogenetic relationship and evolution of mulberry varieties based on chromosome numbers and ploidy level.



Figures: a, metaphase I showing 14 bivalents are align at equatorial plate. b & c, metaphase I showing 13 bivalents and one large bivalent scattered in the cytoplasm. d, metaphase I showing 14 bivalents are scattered in the cytoplasm. e, metaphase I showing 13 bivalents and one large bivalent scattered in the cytoplasm. f, anaphase I (laggards & unequal separation). g & h, anaphase I (equal separation). I, telophase I. j, metaphase II (laggards). k & l, anaphase II (non- separation, un-oriented & unequal) m & n, anaphase II (equal separation). o, telophase II.

REFERENCE

1) C. D. Darlington, 1965. Resent advances in cytology J and A Churchill, London. *2) B. C. Das, 1961. Cytological studies in Morus indica. L. and Morus laevigata wall, Caryologia, 14 (1):159-165. *3) M. Datta, 1954. Cytological studies in the species of Morus. Cytologia, 19: 86-95. *4) N. K. Dwivedi, A. K. Sikdar, S. B. Dandin, C. R. Sastry, M. S. Jolly, 1986. Induced tetraploidy in mulberry 1, Morphological, anatomical and cytological investigations in cultivar RFS–135, Cytologia, 51 (2): 393-401. *5) G. S. Gill, R. C. Gupta, 1979. Cytological studies the sex types of Morus alba, L. (Moraceae). Current Science, 48 (1): 35-36. *6) W. Gottschalk, 1978. Open problems in polyploidy research Nucleus, 21: 91-112. *7) H. Machii and K. Katagiri, 1991. Varietal differences in nutritative values of mulberry leaves for rearing silkworm, JARQ, 25.202-208. *8) I. Osawa, 1920. Cytological and experimental studies in Morus, with special reference to triploid mutants. Bull. Imp. Seri. Expt. Stn. Japan, 1(3): 318-366. *9) K. H. Venkatesh, 2007. Cytogenetical investigations in the Genus Morus L Ph.D., Thesis Bangalore University, Bangalore. *10) K. H. Venkatesh and Munirajappa, 2012. Cytogenetical studies in two triploid mulberry varieties J Cytol Gen., 13 (NS) 29-34. *11) K. H. Venkatesh and Munirajappa, 2013. Cytogenetical studies in two tetraploid mulberry varieties (Moraceae). International Society of Chromosome Botany, 8:65-69. *12) K. H. Venkatesh, S. Shivaswamy and Munirajappa, 2013a. Comparative micro-morphology and reproductive studies in three mulberry varieties (Moraceae). International Journal of Science and Nature, 4 (4): 608-610. *13) K. H. Venkatesh, R. Nijagunaiah and Munirajappa, 2013b. Cytogenetical studies in some diploid mulberry varieties (Moraceae), Cytologia, 78 (1): 69-72.