C-banding of Mitotic Chromosomes in Natural Population of the Uzi Fly, *Exorista sorbillans* Wiedemann (Diptera: Tachinidae)

K. N. Venkatachalapathy and H. P. Puttaraju*

Department of Sericulture, Jnanabharathi, Bangalore University, Bangalore-560056, India

Accepted March 7, 2000

Summary C-banded chromosomes prepared from the 4 regional populations of *Exorista sorbillans* reveal the presence of characteristic large blocks of constitutive heterochromatin in the pericentric regions of all the autosomes. An intercalary band localized on short arm of one of the homologues of VI chromosomes in males of Bangalore population appears to be an interesting feature as it was absent in all the males and females of other populations, of Chitradurga, Kolar and Hassan. The sex chromosomes (X, Y) of all the above populations were characterized by complete C-positive heterochromatin.

Key words Brain cells, Mitotic, *Exorista sorbillans*, Heterochromatin, Intercalary band, Populations.

The uzi fly *Exorista sorbillans* a formidable tachinid pest known to silk industry, adopted as an obligate parasitic mode of life on its host silkworm *Bombyx mori*. The speculating status of its nomenclature has been posing a great challenge among the investigators of this pest (Manjunatha and Puttaraju 1992b). An attempt has been made earlier to unravel its taxonomic puzzle by providing cytological information by Manjunatha and Puttaraju (1992a, b). According to them the size, morphology and behaviour of sex chromosomes are unique to the species and its inclusion into tachinid group is enigmatic. Further, the extensive study made by Manjunatha (1993) has revealed the possibility in the existence of different ecotypes. The differential chromosome banding technique demonstrates the taxonomic relationship of a large number of closely related species which helps in identifying the status of several doubtful species (Pepescu and Paulo 1980, Nardi *et al.* 1973, Holmquist 1975, Kaul *et al.* 1978, Bedo 1980, 1987, 1991). Hence, C-banding technique was applied on the somatic chromosomes of *E. sorbillans*. It is hoped that the present investigation will throw a light in solving the aforesaid problems.

Materials and methods

The post parasitic maggots of *E. sorbillans* were collected as and when they pierced out of the host body from the populations of Bangalore, Chitradurga, Kolar and Hassan regions of Karnataka (India) and brought to the laboratory for further maintenance and investigations. 0.1 ml of colchicine (0.025%) was injected into the selected maggots of all the 4 regions and were dissected out after 30 min, for supra oesophageal ganglia and imaginal discs. The chromosomes from these tissues were prepared according to the method described by Manjunatha and Puttaraju (1992b). For the induction of C-bands, the method of Sumner (1972) was adopted with slight modifications.

All the observations and photomicrographs of C-banded chromosome complements were taken with a Leitz photomicroscope.

* Corresponding author.

Fig. 1. Normal and C-banded metaphase chromosomes in *E. sorbillans*. a, b) Male and female, c, d) C-banded male and females from Bangalore population, e) male C-banded karyotype. Arrow showing an intercalary band in Bangalore population.

Results

A total of 333 maggots of 4 regional populations of *E. sorbillans* have been chromosomally analysed. In all these, the brain cells possess a complement of $2n=12$ (Fig. 1a, b) having 5 pairs of submetacentric autosomes. These autosomal pairs are in a graded series and their identification is unequivocal. The homologues of each pair usually lie side by side. Among the sex chromosomes the X is acrocentric and dot like, while the Y chromosome is submetacentric and is larger than X chromosome. It is interesting to note that there is no karyotype variation in the large sample. This study confirms the karyotype of the earlier report of Manjunatha (1993).

For the C-banding, a total of 102 maggots of the 4 populations have been used. The centromeric bands were observed in all the autosomes. The size and the staining are generally uniform but variations in these features do occur. The centromeric bands are constant in both the sexes of all the populations (Table 2). However, a characteristic intercalary band (Fig. 1c) is present on the short arm of one of the homologues of the VI pair in all the 15 males and is absent in the females (Fig.

1d) of Bangalore population. The sex chromosomes in both the sexes are dark and uniformly C-positive.

All the 4 regional populations reveals that the L^R value of its smallest X chromosome is 40.93, whereas the L^R value of other submetacentric chromosomes which exist in the form of a graded series is ranging from 49.20 to 227.71 as shown in the Table 1. Further, the quantum of C-band heterochromatin in the male genome of *E. sorbillans* of Bangalore population is about 23.56%. Whereas, in other 3 populations of male genome is 19.79% and in case of all 4 populations of female genome is 18.96%.

Discussion

The uzi fly *E. sorbillans* looms large in the sericulture industry as it is an endoparasitoid of the silk worm *B. mori*. The first report of the chromosomes of this species was reported by Puttaraju and Chowdaiah (1984) as $2n=12$. Later cytological work is of Manjunatha and Puttaraju (1992a, b) who confirmed the $2n=12$ which includes 5 pairs of submetacentric autosomes which are in graded series. The X chromosome is the smallest and acrocentric and the Y chromosome is larger than the X and submetacentric. The sex chromosomes are homomorphic in female and heteromorphic in male.

The present series of studies establish the diploid number and also the karyotype details in both males and females.

It is interesting that a careful and critical analysis of the karyotypes of 333 maggots showed no discernible variations either in the structure or number. Therefore it appears that karyotype of *E. sorbillans* is conservative at the chromosome level.

While C-banding technique was applied to know the organizational details of the chromosomes of the karyotype and to know if there are variations in the pattern of bands, which has yielded encouraging results. The centromeric bands were seen in all the autosomes. There were some differences with reference to the size and the intensity of the centromeric bands. Only 15 male individuals procured from Bangalore population showed an intercalary C-band in the short arm of one of the homologues of the VI chromosome. Its presence in the males of Bangalore population and absence in the females of the same population and all the

Table 1. L^R values of chromosomes of *E. sorbillans* of all the 4 populations

Chromosome	L^R values
X	40.93
Y	49.20
II	160.88
III	162.40
IV	176.01
V	182.87
VI	227.71

Table 2. Response of C-heterochromatin in *E. sorbillans*

Sl. No.	Population	Sex	I	II	III	IV	V	VI
1	Bangalore	♂	C ⁺⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺ⁱ
		♀	C ⁺⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺
2	Chitradurga	♂	C ⁺⁺⁺	C ⁺⁺	C ⁺	C ⁺⁺	C ⁺⁺	C ⁺
		♀	C ⁺⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺
3	Hassan	♂	C ⁺⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺
		♀	C ⁺⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺
4	Kolar	♂	C ⁺⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺
		♀	C ⁺⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺	C ⁺⁺

C⁺⁺⁺=Completely heterochromatic, C⁺⁺=Moderately C-banded, C⁺=Low C-banded, C⁺⁺ⁱ=Moderately C-banded and intercalary band.

Table 3. Comparison of the present C-banded somatic Chromosomes of *E. sorbillans* with those of other allied species

Sl. No.	Species	X	Y	II	III	IV	V	VI
1	<i>E. sorbillans</i> * (Present study)	C ⁺⁺	C ⁺⁺	C ⁺	C ⁺	C ⁺	C ⁺	C ⁺ Si
2	<i>Lucilia cuprina</i> Bedo (1980)	C ⁺⁺	C ⁺⁺	C ⁺	C ⁺	C ⁺	C ⁺	C ⁺
3	<i>Chrysomya bezziana</i> Bedo (1991)	C [±]	C [±]	C ⁺	C ⁺	C ⁺	C ⁺	C ⁺
4	<i>Sarcophaga bullata</i> Samols and Swift (1979)	C ⁺⁺	C ⁺⁺	C ⁺	C ⁺	C ⁺	C ⁺	C ⁺
5	<i>P. ruficornis</i> Kaul <i>et al.</i> (1978)	C ⁺⁺	C ⁺⁺	C ⁺	C ⁺ Li	C ⁺	C ⁺	C ⁺
6	<i>P. Knabi</i> Kaul <i>et al.</i> (1978)	C ⁺⁺	C ⁺⁺	C ⁺	C ⁺	C ⁺	C ⁺	C ⁺
7	<i>P. argyrostoma</i> Kaul <i>et al.</i> (1978)	C ⁺⁺	C ⁺⁺	C ⁺	C ⁺	C ⁺	C ⁺	C ⁺
8	<i>P. misera</i> Kaul <i>et al.</i> (1978)	C ⁺⁺	C ⁺⁺	C [±]	C [±]	C [±]	C [±]	C [±]

C⁺⁺=Completely heterochromatic, C⁺=Moderately C-banded, C[±]=Not Completely heterochromatic, Li=Intercalary band on long arm, Si=Intercalary band on short arm.

males and females of the other population indicates that this heterochromatic block is a case of heterochromatinization and not addition of heterochromatin as the L^R values of all the populations remain the same, the quantity of heterochromatin in the males of Bangalore population is 23.56% in the males of other 3 populations and females of all 4 populations the quantum of heterochromatin is 19.79% and 18.96%, respectively.

The comparative study on C-banding of *E. sorbillans* with that of its allied species revealed that in the autosomes of *E. sorbillans* and other allied species studied (Table 3) barring *Parasarcophaga misera* are similar in having distinct diagnostic pericentric blocks of C-heterochromatin. A similar situation also exists in sex chromosomes of *E. sorbillans* and other allied species barring *Chrysomya bezziana* wherein it is not completely heterochromatic. This apparent similarity agrees with the concept that they have retained a high degree of structural integrity and might have differentiated by structural rearrangements which do not affect the gross morphology of chromosomes.

References

- Bedo, D. G. 1980. C, Q and H-banding in the analysis of Y Chromosome rearrangements in *Lucilia cuprina* (Wiedemann) (Diptera: Calliphoridae). *Chromosoma* **77**: 299–308.
- 1987. Specific recognition and differential affinity of meiotic X–Y pairing sites in *Lucilia cuprina* males (Diptera: Calliphoridae). *Chromosoma* **95**: 126–135.
- 1991. Cytological characterization of heterochromatin in mitotic and meiotic chromosomes of the old world screw worm fly, *Chrysomya bezziana*. *Genome* **34**: 631–637.
- Holmquist, G. 1975. Hoechst 33258 fluorescent staining of *Drosophila* chromosomes. *Chromosoma* **49**: 333–356.
- Kaul, D., Chathurvedi, R. and Tewari, R. R. 1978. Cytogenetics of the genus *Parasarcophaga* (Sarcophagidae: Diptera). *Chromosoma* **68**: 73–82.
- , Gaur, P., Aggarwal, U. and Tewari, R. R. 1989. Characterization of *Parasarcophaga* heterochromatin 1. Mitotic chromosomes. *Chromosoma* **98**: 49–55.
- Manjunatha, H. B. 1993. Morphological and cytological investigations on the uzi fly, *Exorista bombycis*. Ph. D. Thesis, Bangalore University, Bangalore, India.
- and Puttaraju, H. P. 1992a. Preliminary Studies on the Chromosomal Behaviour during Spermatogenesis in the Uzi Fly, *Exorista sorbillans* (Diptera: Tachinidae). In: Manna, G. K. and Roy, S. C. (eds.). *Perspectives in Cytology and Genetics* **7**. All India congress of cytology and genetics, Kalyani Univ. Kalyani, India. pp. 911–916.
- and — 1992b. An analysis of somatic chromosomes of uzi fly, *Exorista bombycis* (Diptera: Tachinidae). *Cytologia* **57**:

321–327.

- Nardi, I., Ragghianti, M. and Mancino, G. 1973. Banding patterns in Newt Chromosomes by the Giemsa stain. *Chromosoma* **49**: 41–49.
- Pepescu, N. C. and Paulo, J. A. 1980. Chromosomal interrelationship of hamster species of the genus *Mesocricetus*. *Cytogenet. Cell genet.* **28**: 10–23.
- Puttaraju, H. P. and Chowdaiah, B. N. 1984. Cytological studies of the uzi fly, *Tricholyga bombycis* Beck (Diptera: Tachinidae). *Sericologia* **24**(4): 519–524.
- Samols, D. and Swift, H. 1979. Genomic organisation in the flesh fly, *Sarcopaga bullata*. *Chromosoma* **75**: 129–143.
- Sumner, A. T. 1972. A simple technique for demonstrating centromeric heterochromatin. *Exp. Cell Res.* **75**: 304–306.
-