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Chromosome analysis of two species of sugar cane pests of the genus *Mahanarva* (Homoptera, Cercopidae)

Maria Aparecida Marin-Morales[1, *], Edison Zefa[2], Maína Bertagna[1], Maria Izabel Camargo Mathias[1] and Enrico Arrigoni[3]

[1] Depto. de Biologia, I.B., UNESP, Câmpus de Rio Claro - Av 24A - nº. 1515, CEP 13 506 900, Rio Claro, São Paulo, Brasil.
[2] Faculdade União das Américas. Av. Tarquinio Joslin dos Santos, s/n, Jardim Universitário, Foz do Iguaçu - Paraná, Brasil.
3 Centro de Tecnologia Copersucar, Cx Postal 162, CEP 13400-970, Piracicaba, São Paulo, Brasil.

Abstract - Studies on the cytogenetics of Homoptera are scarce. Some references in the literature have reported a chromosome number for the genus ranging from n=5 to 19 and 2n=10 to 2n=39 chromosomes. The genus *Mahanarva* includes two species of agricultural importance as pests of sugar cane culture in Brazil. We report here the first data concerning the chromosome number and morphology of the species *Mahanarva fimbriolata* and *M. posticata.* The chromosome number observed for the two species was 2n=19 for males and 2n=20 for females. The sex determining mechanism of these species was of the XX/X0 type (for males and females, respectively), with chromosome X being the smallest in the complement.

Key Words: Cytogenetics Holocentric chromosome, Homoptera, *Mahanarva*, Sugar cane pest.

INTRODUCTION

The order Hemiptera is the fifth major order among insects and comprises the suborder Homoptera, which includes the Auchenorrhyncha series, consisting of five superfamilies (Table 1).

The genus *Mahanarva* belongs to the family Cercopidae (froghoppers). Among the *Mahanarva* species, two are considered to be emerging pests in Brazilian sugar cane fields: *M. fimbriolota*, known as root hopper since its nymphs attack the root of sugar cane, and *M. posticata*, known as leaf hopper, whose adults damage the aerial part of the plant (Mendonça *et al.* 1996).

According to Dinardo-Miranda *et al*. (2000), the species most commonly detected in the state of São Paulo is *M. fimbriolata*, which has been causing considerable damage to sugar cane plantations in the early formation stage by mainly attacking the stumps. A 70% fall in productivity has been recorded in some plantations in the Ribeirão Preto region, state of São Paulo, due to the attack of this pest.

The few studies carried out on Homoptera from Neotropical regions usually refer to biological control, while information about the morphologic and genetic characterization of this group is practically absent.

The first cytogenetic data reported for the Auchenorrhyncha series were obtained by Boring (1907), who analyzed 22 species of the group. Halkka (1959) described a chromosomal variation of n=5 to n=19 and 2n=10 to 2n=39 for the same group.

Studies by Lello *et al.* (1982) have reported the chromosome numbers of some Brazilian species of Cicadellidae. In their cytogenetic analyses, these investigators recorded a variation in chromosome number of n=7, n=9, n=11, n=12 and 2n=17. In the descriptions provided by these authors the chromosomes were always well individualized, with one of them, of considerably smaller size, being always separated from the remaining ones. The chiasma types observed in these materials were: central, subterminal, terminal, interstitial and median.

* Corresponding author: e-mail: mamm@rc.unesp.br.

Table 1 – Modern classification of the suborder Homoptera (DALY *et al.*, 1998).

Suborder	Series	Superfamily	Family
		Psylloidea	Psyllidae
	Sternorrhyncha	Aphidoidea	Aphididae Adelgidae Phylloxerdae
		Aleyrodoidea	Aleyrodidae
Homoptera		Coccoidea	Pseudococcidae Margarodiade Eriococcidae Diaspididae
	Auchenorrhyncha	Cicadoidea Fulguroidea Cercopoidea	Cicadidae Fulguridae Cercopidae
		Ciccadeloidea	Ciccadelidae Aetalionidae Membracidae

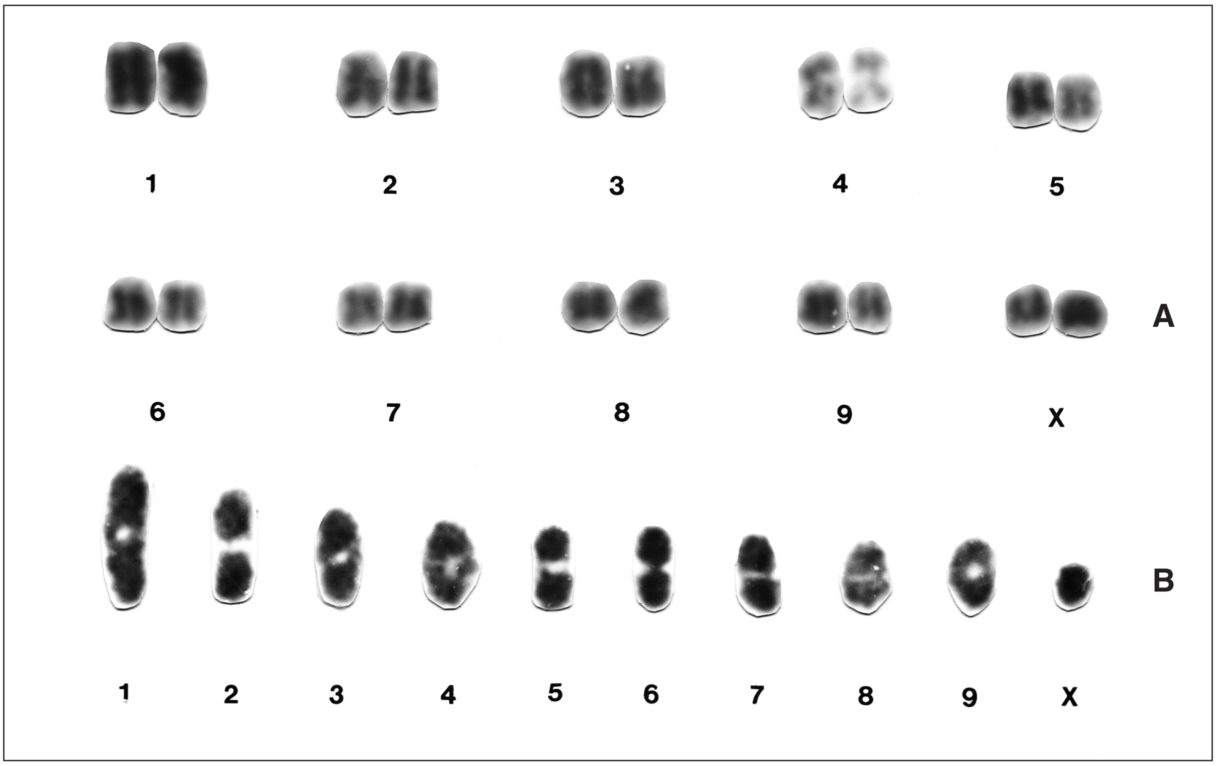

Fig. 1 – Mitotic and meiotic chromosomes of *Mahanarva fimbriolata*. A. Karyotype of a mitotic metaphase from a female. The chromosomes of pair 4 present a chromosome break in one of their chromatids. B. Karyotype of a metaphase I from a male. Most chromosomes present terminal and subterminal chiasmata. Chromosome X is the smallest in the complement.

In Cicadellidae, metaphase cells showed chromosomes with non-localized centromeres, i.e., without primary constrictions (BORING 1907; HALKKA 1959; LELLO *et al.* 1982).

LELLO *et al.* (1982) showed a mechanism of sex determination of the X0 type for males and of the XX type for female of most species of the family Cicadellidae. This mechanism seems to be typical for the Auchenorryncha series as a whole since these data agree with those reported by HALKKA (1959). LELLO *et al.* (1982) also observed a mechanism of sex determination of the XX/XY type, which they suggested to be a neo-XY mechanism.

Cytogenetic studies conducted on Brazilian Cercopidae by MARIN-MORALES *et al.* (2000) have shown that this group presents the holocentric condition for its chromosomes, as also observed in other species of this family. The sex determination described for the species of this group was of the X0/XX type.

The rich diversity of the insect fauna of the neotropical region and the few studies conducted on this material justify investigations of basic cytogenetics, since these data can offer important information for studies on the systematics and evolution of little known groups. Thus, the objective of the present paper study was to characterize cytogenetically two species of the genus *Mahanarva* (*M. fimbriolata* and *M. posticata*).

MATERIAL AND METHODS

The specimens analyzed here were collected at two different sites: a sugar cane culture in the municipality of Piracicaba, São Paulo state, Brazil, and a sugar cane culture in the municipality of Miracatu, also in São Paulo state, and respectively identified as *M. fimbriolata* and as *M. posticata*.

Cytological preparations were obtained from testes and ovaries. Some specimens were injected with a 0.05% aqueous solution of colchicine and the tissues were dipped in hypotonic 0.075 M sodium citrate solution and fixed in Carnoy I. After one hour in the fixative the cells were macerated in 45% acetic acid 45% and squashed in a drop of 0.5% lactoacetic orcein.

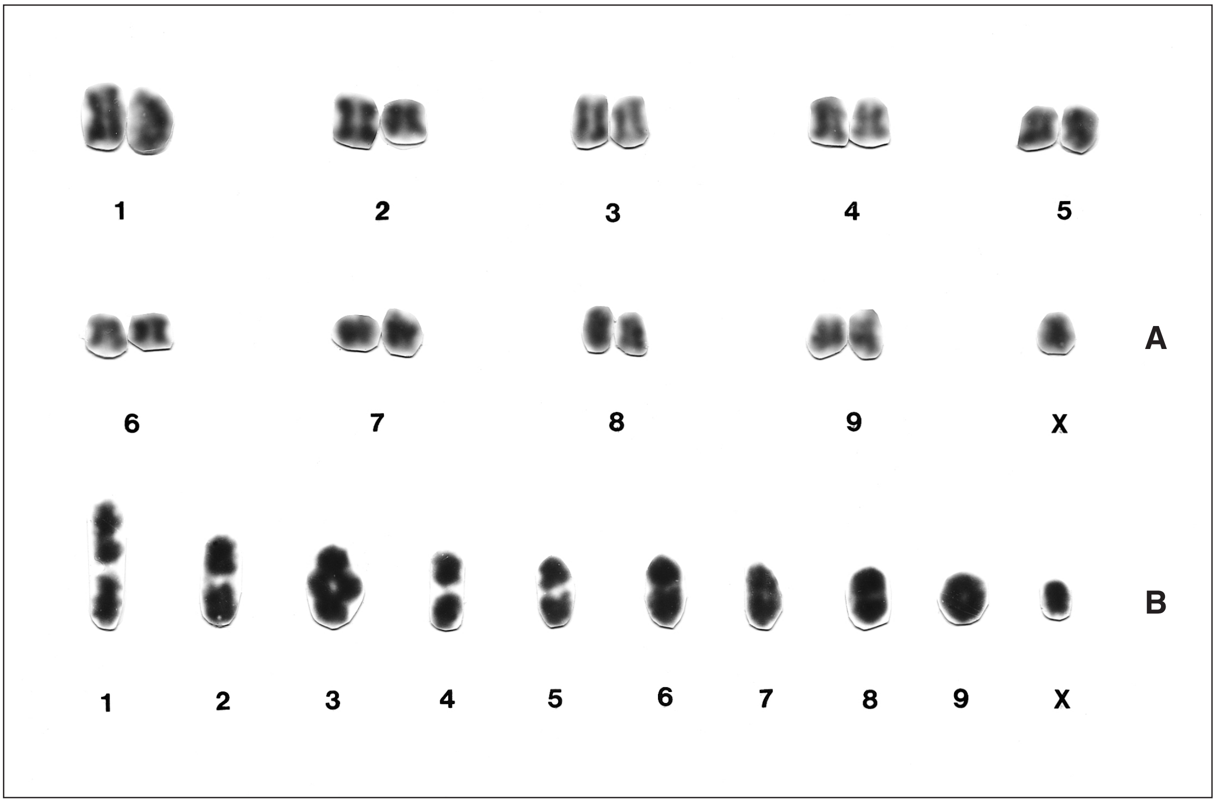

Fig. 2 – Mitotic and meiotic chromosomes of *Mahanarva posticata*. A. Karyotype of a mitotic metaphase from a male. B. Karyotype of a metaphase I from a male. Most chromosomes present terminal and subterminal chiasmata, except for pair 3, which presents an interstitial chiasma. Chromosome X is the smallest in the complement.

RESULTS

The two species analyzed in the present study have karyotypes with $2n$=19 (males) and $2n$=20 (females). The mechanism of sex determination is of the XX/X0 type for females and males, respectively. Chromosome X is the smallest in the complement (Figs. 1A and B and 2A and B).

In *M. fimbriolata*, chromosome pair 4 presents a break of one chromatid in both chromosomes (Fig. 1A). In the karyotypes of *M. fimbriolata* and *M. posticata*, organized from metaphase I, the bivalents have terminal or subterminal chiasmata (Figs. 1A and 2A). The species *M. posticata* presents an interstitial chiasma in chromosome 3 (Fig. 2B) that was not observed in *M. fimbriolata.*

DISCUSSION AND CONCLUSION

From the viewpoint of conventional cytogenetics, *M. fimbriolata* and *M. posticata* present the same karyotypic configuration, although finer details of chromosome morphology cannot be visualized by light microscopy due to the reduced size of their chromosomes.

The present results concerning the characterization and chromosome number of species of the genus *Mahanarva* are reported here for the first time both for the genus and the family Cercopidae as a whole.

The chromosome number observed for *M. fimbriolata* and *M. posticata* was $2n$=18/X0 for males and 18/XX for females, in agreement with the descriptions of variation in chromosome number and in the sex determining system reported by HALKKA (1959) and by LELLO *et al.* (1982) for other species of other families of the Auchenorrhyncha series.

Chromosomes in mitotic metaphase submitted to the action of colchicine presented chromatids separated throughout their extension, as observed in most of the elements in the karyotype. The apparent absence of a primary constriction supports the suggestion that the chromosomes of this insect group are of the holocentric type.

The study of several anaphases led us to conclude that the chromosomes move to the spindle poles without any change occurring in their aspect; at metaphase I they tend to become round (isodiametric), a common characteristic of chromosomes with non-localized centromeres. According to WHITE (1973), holocentric chromosomes are characterized by the presence of mobility in various points of their structure at the time of anaphase segregation.

The behavior of metaphase bivalents with a single terminal chiasma with an axial orientation agrees with the characteristics of holocentric chromosomes described by WHITE (1973).

The suggestion of holocentrism for the chromosomes of this insect group has also been cited by LELLO *et al.* (1982), who described 24 species of the family Cicadellidae bearing holocentric chromosomes.

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REFERENCES

BORING A.M., 1907 – *A study of the spermatogenesis of 22 species of the Membracidae, Jassidae, Cercopidae and Fulgoridae with special reference to the behaviour of the odd chromosome*. J. Exp. Zool., 4: 469-514..

DALY H.V., DOYEN J.T., PURCELL A.H., 1998 – *III. Introduction to Insect Biology and Diversity*. Second Ed. Oxford University Press, New York, 680 p.

DINARDO-MIRANDA L.L., FERREIRA J.M.G., DURIGAN A.M.P.R., BRAGA V., 2000 – *Eficiência de inseticidas e medidas culturais no controle de Mahanarva fimbriolata em cana de açúcar*. STAB - janeiro-fevereiro, Vol. 18: 3.

HALKKA O., 1959 – *Chromosome studies thr Hemíptera, Homóptera, Anchenorryncha*. Ann. Acad. Sci. Fernn., Series A. IV. Biológica, 43: 1-71.

LELLO E., MENEZES M., COELHO M.I.P., 1982 – *Chromosomes studies on leafhoppers (Homóptera: Ciccadellidae)*. Rev. Brasil. Genet., 1: 69-93.

MARIN-MORALES M.A., ZEFA E., BERTAGNA M., 2000 – *Estudos citogenéticos em duas espécies do gênero Mahanarva (Homóptera - Cercopidae), Cigarrinhas Pragas de Cana de açúcar*. Genetics and Molec. Biol., 23 (3-suppl.): 3.

MENDONÇA A.F., BARBOSA V.S.B., MARQUES E.J., 1996 – *As cigarrinhas da cana-de-açúcar (Hemiptera: Cercopidae) no Brasil*. Insetos and Cia, 200 p. il.

WHITE M.J.D., 1973 – Animal, Cytology and Evolution. Cambridge University Press. Third Edition. London. 961 p.

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