

SHORT COMMUNICATION

KARYOLOGICAL DIVERSITY AMONG BRAZILIAN SPECIES OF THE GENUS *Passalus* (COLEOPTERA, SCARABAEOIDEA, PASSALIDAE)

Alejo Mesa and Vanderlei G. Martins

ABSTRACT

The karyotypes of three species of Brazilian passalids are reported. *P. coniferus* and *P. punctiger* are $2n\sigma = 12^{II} + XO$, while *P. morio* is $2n\sigma = 15^{II} + XO$. The last species is the only one from the cytologically known species within Passalini that diverges from the basic karyotypes of the tribe.

An unorthodox behavior of the X chromosome in some first anaphases of *P. punctiger* is discussed.

INTRODUCTION

A taxonomic revision of the Passalidae concerning primarily the neotropical species of the family was carried out in 1970 by Reyes-Castillo. In a subsequent cytological study Virkki and Reyes-Castillo (1972) reported the karyotypes of 24 species of neotropical passalids.

The present paper deals with the chromosomes of three species of Brazilian Passalids belonging to the genus *Passalus*. The karyotypes of these species are compared with those reported by Virkki and Reyes-Castillo. To our knowledge, no other papers on Passalinae chromosomes have been published, though information on Aulacocyclinae was reported by Mesa *et al.* (1978).

MATERIAL AND METHODS

The following species collected in Brazil (São Paulo, Rio Claro) in 1976 were studied: *P. coniferus* (Eschscholtz), *P. morio* (Percheron) and *P. punctiger* (Le Peletier et Serville).

The male specimens were dissected alive and the testes dropped in distilled water for about four minutes. The glands were then fixed in Carnoy (3:1) and kept at 4°C for several days. The testes were then macerated on a clean slide in a drop of 45% acetic acid for two or three minutes and the cell suspension was flamed until dry. The material was stained with 2% lactoacetic orcein for 20 minutes. The slides were then dehydrated in 100% alcohol, kept in xylol for two minutes, returned to 100% alcohol, and dried in an oven overnight at 36°C. Permanent mounts were made with synthetic resin.

RESULTS

The three species studied here have the following karyotypes:

P. coniferus: We studied a single specimen with $2n\sigma = 12\text{II} + \text{XO}$, (Figure 1B) whose chromosomes were all metacentric or submetacentric. During first prophase the X chromosome was heterochromatic, as shown in Figure 1D.

P. punctiger: Eight specimens were studied. All of them were $2n\sigma = 12\text{II} + \text{XO}$ (Figure 1A) with metacentric or submetacentric chromosomes, as can be observed in the gonial metaphase in Figure 2B. In a considerable number of first metaphases, the X remained in the equatorial plate in an amphytelic orientation (Figure 2A). Sometimes the two sister centromeres began moving toward opposite poles as shown in Figure 2C, though the sister chromatids remained apparently connected by a thin thread of chromatin. They finally entered together the daughter nuclei, as can be observed in the second metaphase in Figure 2D, in which all chromosomes (one of them the X) include two chromatids.

P. morio: Five specimens were studied, all of them with $2n\sigma = 15\text{II} + \text{XO}$ (Figure 1C). The chromosomes were either metacentric or submetacentric. Four pairs of autosomes were relatively large, nine of medium size and two pairs were small. The X was a medium-sized element.

DISCUSSION

According to Virkki and Reyes-Castillo (1972), cytological analysis of eight species of Passalini belonging to the three known genera of the tribe showed remarkable uniformity in chromosome number. In contrast, considerable diversity was observed within the neotropical tribe Proculini, where the species vary from $2n\sigma = 8\text{II} + \text{neo XY}$

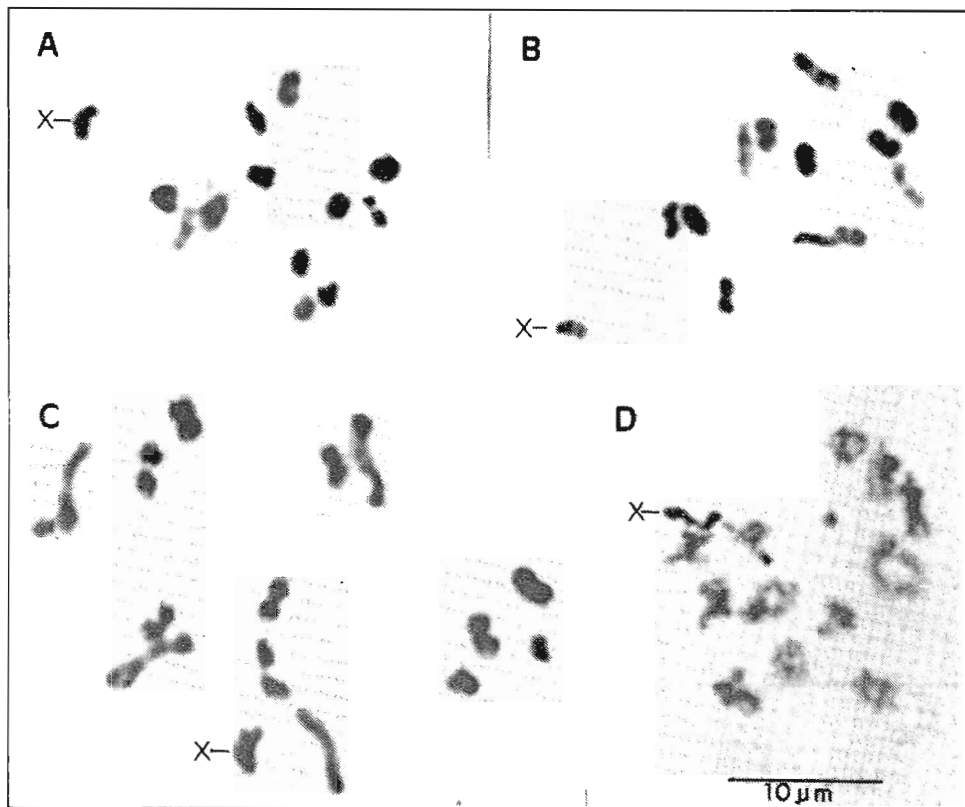


Figure 1 - A, Prometaphase I (*P. punctiger*); B, Metaphase I (*P. coniferus*); C, Metaphase I (*P. morio*); D, Diplotene (*P. coniferus*).

in the genus *Oileus* to $2n\sigma = 18^{II} + Xy$ or neo XY in the genera *Prosoclitus* and *Petrejoides*, respectively.

Two species of *Passalus* reported in the present paper (*P. coniferus* and *P. punctiger*) show the same karyotype as that described by Virkki and Reyes-Castillo for Passalini. The karyotype of *P. morio*, however, is an exception within Passalini since it shows $2n\sigma = 15^{II} + XO$. Bearing in mind that the cytologically known species of this tribe represent only slightly more than 5% of the described ones, it is reasonable to expect that more species with derived karyotypes will be found in the future.

A remarkable first metaphase and anaphase behavior of the X chromosome in *Passalus* has been observed by Virkki and Reyes-Castillo (1972) in *P. interstitialis*. According to these authors, the X chromosome must have a pole-to-pole movement similar to that reported by Nicklas (1961) for the grasshopper *Melanoplus*. This should be the reason why the X is frequently found in an apparently precessive position in relation to the autosomes during first metaphase. However, a simple precession move-

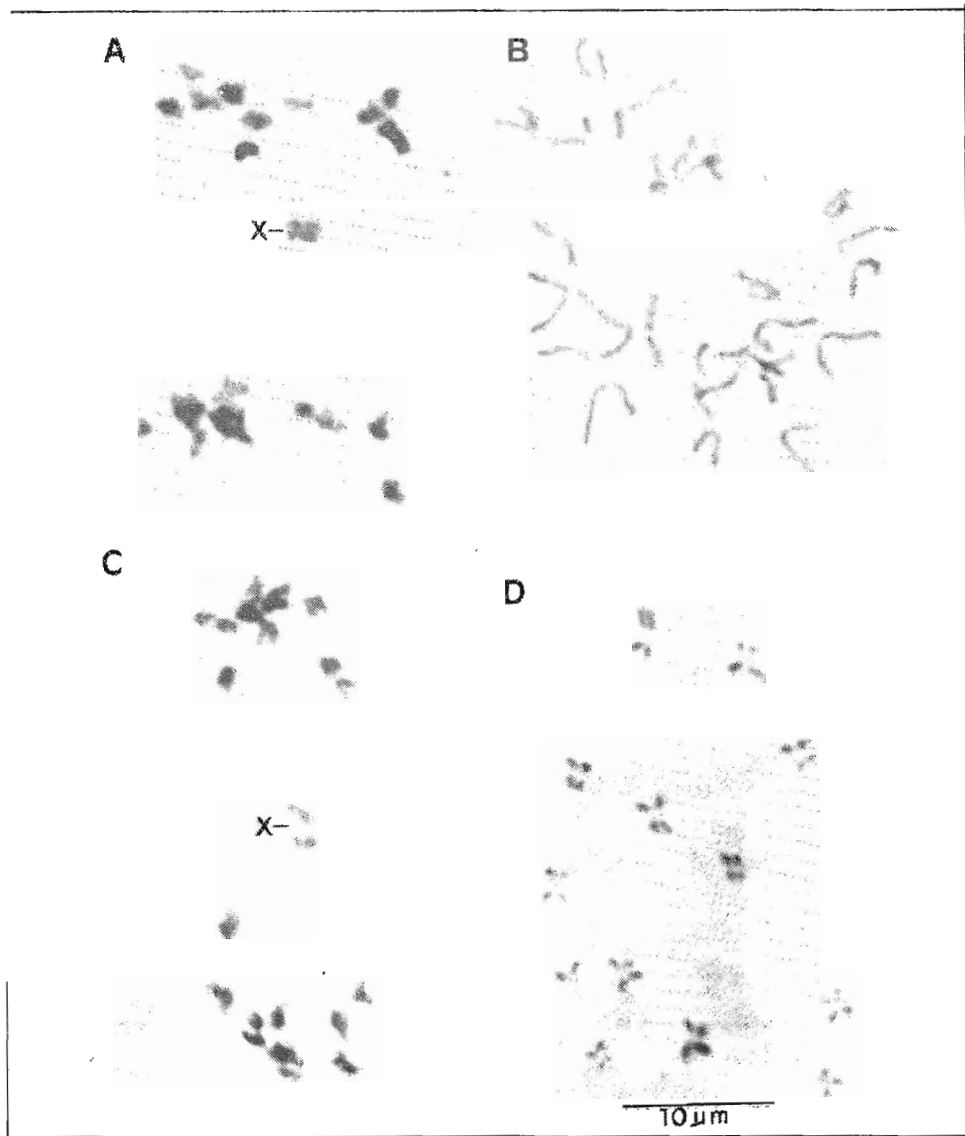


Figure 2 - A, First anaphase with the X chromosome remaining in the equatorial plate; B, Spermatogonial prometaphase; C, First anaphase with the X chromosome dividing equatorially; D, Second metaphase with all the chromosomes (including the X) divided into chromatids. (*P. punctiger*).

ment is not accepted by Virkki-Reyes-C astillo, since the X is frequently found in the equatorial plate while the autosomes are already moving to opposite poles in anaphase I.

The behavior of the X described in the present paper for the species *P.*

punctiger is similar to that reported by John and Lewis (1965) for the grasshopper *Chortippus brunneus*, in which an equatorial division of the X occasionally occurs at first anaphase. Another case was observed by Mesa (1984) in the X chromosome of the relict species of eumastacid *Daguerreacris tandiliae*. In the latter species as well as in *P. punctiger* the centromere of the X was already divided (as Lima de Faria (1956) postulated for other species) showing an amphitelic rather than a synthetic orientation. As a consequence, once the anaphase movement begins for this chromosome, the sister chromatids go to opposite poles. However, a thin thread of chromatin delays and perhaps avoids the separation of the sister chromatids. This thread should be interpreted as the "holding" zones at each side of the centromere (Lima de Faria, 1956) that remains undivided. In the gryllacridid *Anoplophilus acuticercus* (Mesa and Goñi, unpublished results), in spite of an amphitelic arrangement of the X and S chromosomes, no equational division takes place because at late telophase these chromosomes, joined in a single mass of chromatin, approach one of the daughter nuclei.

In *P. punctiger*, the rule seems to be a reductional division of the X at first anaphase. The second metaphase in Figure 2D with 13 chromosomes, all of them divided into chromatids, clearly shows this behavior. Whether or not an equatorial first anaphase sometimes occurs with the X in some nuclei is uncertain.

The behavior of the X in *P. punctiger*, as well as in the other mentioned species, is illustrative because it shows that a prereducational X mechanism may turn into a postreductional one. For this to occur, two steps are necessary. First, an amphitelic orientation of the centromere, and second, the division of the "holding" regions at each side of the centromere. Such a mechanism has been already described for the X in several species of Lampyridae (Stevens, 1909; Smith and Maxwell, 1953).

ACKNOWLEDGMENTS

This work was supported by CNPq-PIG (Conselho Nacional de Pesquisa, Programa Integradado de Genética).

RESUMO

Os cariótipos de três espécies brasileiras de passalídeos são relatados. *P. coniferus* e *P. punctiger* apresentam $2n\sigma = 12^{II} + XO$ enquanto que *P. morio* apresenta $2n\sigma = 15^{II} + XO$. A última espécie é a única citologicamente conhecida entre os Passalini, que diverge do cariótipo básico da tribo.

Um comportamento não ortodoxo do cromossomo X em algumas anáfases I em *P. punctiger* é discutido.

REFERENCES

- John, B. and Lewis, K.R. (1965). The meiotic system. *Protoplasmatologia* 6: 1-335.
- Lima de Faria, A. (1956). The role of the kynetochores in chromosome organization. *Hereditas* 42: 85-160.
- Mesa, A., Ferreira, A. and Martins, V.G. (1978). The chromosomes of an Australian Passalid, *Aulacocyclus edentulus* Macl. (Coleoptera, Passalidae, Aulacocyclusinae). *J. Aust. Entomol. Soc.* 17: 385-388.
- Mesa, A. (1984). The chromosomes of a relict species of Eumastacid, *Daguerreacris tandiliae* Descamps and Liebermann, 1970 (Orthoptera, Eumastacoidea, Morseinae). *Rev. Bras. Genet.* 8: 219-229.
- Nicklas, R.B. (1961). Recurrent pole to pole movements of the sex chromosome during pro-metaphase I in *Melanoplus differentialis* spermatocytes. *Chromosoma* 12: 97-115.
- Reyes-Castillo, P. (1970). Coleoptera, Passalidae: Morfología y división en grandes grupos; Géneros americanos. *Folia Entomol. Mexic.* 20-22: 1-240.
- Smith, S.G. and Maxwell, D.E. (1953). Post-reduction of the X chromosome and complete chiasma interference in the Lampyridae (Coleoptera). *Can. J. Zool.* 31: 179-192.
- Stevens, N.M. (1909). Further studies on the chromosomes of Coleoptera. *J. Exptl. Zool.* 6: 101-121.
- Virkki, N. and Reyes-Castillo, P. (1972). Cytotaxonomy of Passalidae (Coleoptera). *An. Esc. Nac. Cienc. Biol. Mex.* 19: 49-83.

(Received July 10, 1986)