Rev. Brasil. Genet. VIII, 2, 263-269 (1985)
(Brazil. J. Genetics)

COMPARATIVE DESCRIPTION OF MALE MEIOSIS IN TWO SPECIES OF CERAMBYCINES (COLEOPTERA: CERAMBYCIDAE)

E.S. de Vaio, A. da Silva, M. Crivel, A. Postiglioni, R. Ponce de León and M.S. Leira

ABSTRACT

The present study of male meiosis in two sympatric species of cerambycines confirms data reported by other authors for members of the Cerambycidae family. The two species differ in chromosome number and size but are conservative with respect to the Xy_p sex bivalent in the male. *Trachyderes thoracicus* has very small meiotic chromosomes and a chromosome number of 2n = 32, while *T. striatus*, with 2n = 22, exhibits larger meiotic chromosomes.

The two species also have different patterns of meiotic systems. *T. thoracicus* has a long post-pachytene diffuse stage which lacks the typical enlargement of the nucleus. After an early despiralization of the autosomal bivalents one can follow all chromosomal changes from mid-diplotene on in the diffuse stage nuclei. Diakinesis marks the end of the diffuse stage in this species. In *T. striatus*, nuclei enlarge after pachytene and a typical diffuse stage ends at full diplotene.

INTRODUCTION

The cerambicyds comprise one of the most colorful families of Coleoptera of the Neotropical region. Because of their feeding habits they are important fruit and forest tree pests. Although they have attracted the attention of many collectors and plant scientists, very little is known about their chromosomes and meiosis.

Adult cerambycines in the tribe Trachyderini are characterized by their

Departamento de Genética, Instituto de Biociencias, Facultad de Humanidades y Ciencias, Universidad de la República, Tristán Narvaja 1674, Montevideo, Uruguay. Send correspondence to E.S.V.

diurnal habits, and they are frequently seen feeding from sap on treetrunks. They are polyphagous insects which feed on wild as well as cultivated trees (Zajciw and Ruffinelli, 1962).

The genus *Trachyderes* Dalm. is well represented in Uruguay, with more than 8 species. The few species belonging to the subfamily Cerambycinae which have been cytologically studied have a rather conservative Coleopteran karyotype. In the present work we describe the chromosome number and meiosis of *Trachyderes thoracicus* Olivier, 1790 and *T. striatus* Fabricius, 1787. The two species differ in chromosome number but they both possess the typical Coleopteran sex determining system, Xy_p in the male.

MATERIAL AND METHODS

The two species were collected at Laguna Negra, Parque Nacional de Santa Teresa, Department of Rocha, Uruguay, in February, 1980. They were found feeding on *Allophyllus edulis* (Sapindacea) from a fluid secreted by the stem near the ground.

Five males of each species were studied. Testes were extracted, fixed in alcohol-acetic acid (3:1), and softened in 45% aqueous acetic acid prior to squashing in lacto-acetic orcein.

The specimens were identified by Dr. Miguel Angel Monné, Departamento de Entomologia, Museu Nacional, Rio de Janeiro, Brazil.

Observations

Trachyderes thoracicus Olivier, 1790

The chromosome number of *Trachyderes thoracicus* is n = 16♂, with 15 autosomal bivalents and an Xy_p sex determining system in the male. Mitotic chromosomes were not studied.

At early pachytene, autosomal bivalents have completed synapsis but are still seen entangled (Figure 1A). Pachytenic polarization was not observed. The *y* chromosome is seen attached to the distal end of an autosomal pair and the *X* chromosome is observed to be positively heterochromatic and associated at a distance with the *y*.

The post-pachytenic diffuse stage in this species is characterized by the lack of a noticeable enlargement of the nucleus (Figure 1, A-F). During the onset of this diffuse stage the autosomal bivalents become very despiralized but the *X* and *y* chromosomes remain condensed and adopt the typical parachute shape (Figure 1, B, C).

Although the entire diplotene stage is diffuse the progressive condensation of the autosomal bivalents can be studied in this species (Figure 1, D, E, F). At mid-diplotene (Figure 1, D), the autosomal bivalents are evident and most of them have

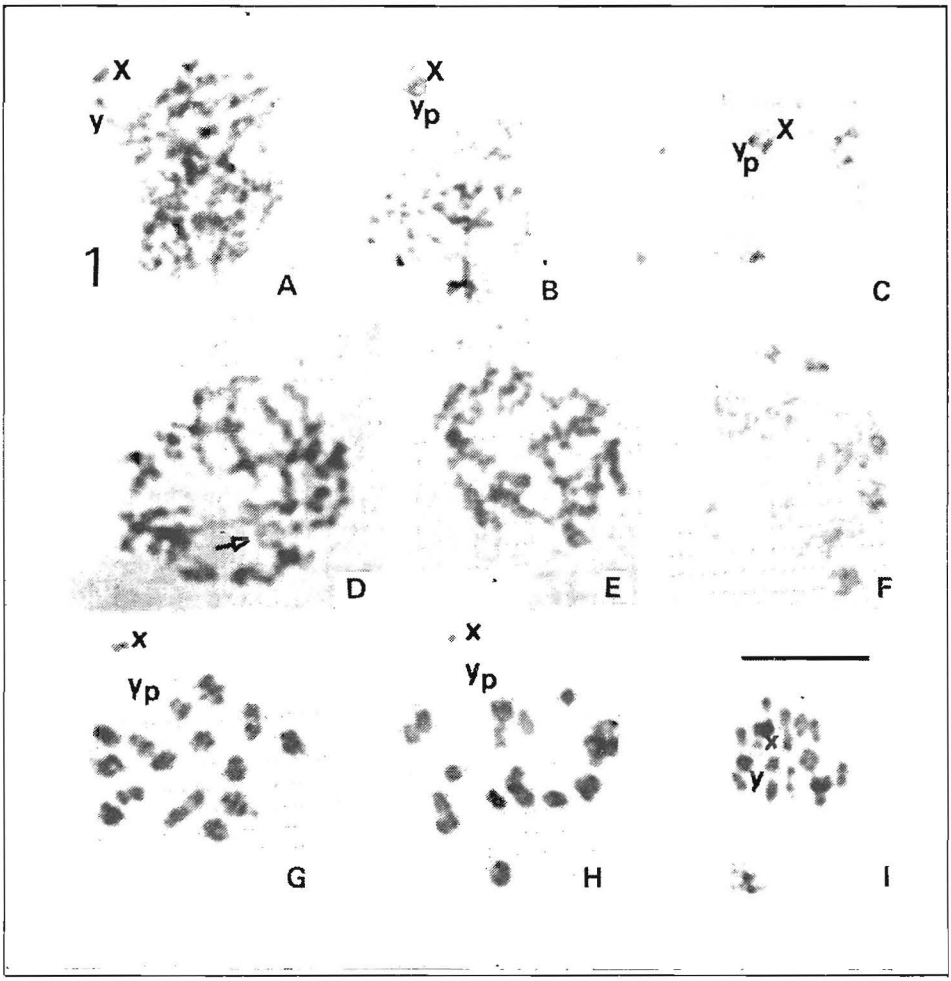

Figure 1 - *Trachyderes thoracicus*. Meiosis. A, Early pachytene; B,C, early diffuse stage; D,E,F, diffuse diplotene; G, diakinesis; H, prometaphase; I, metaphase I.

one interstitial chiasma. The Xy_p is seen enlarged and by late diplotene it is isopycnotic. All through the diffuse stage the autosomal bivalents show heterologous non-specific associations (Figure 1, B-F). At diakinesis (Figure 1, G) the 15 autosomal bivalents are individually distinguishable and the Xy_p although very small, is quite distinct. At prometaphase and metaphase I (Figure 1, H,I) the 16 elements are very small, and the Xy_p is isopycnotic but easily identified by its shape.

Trachyderes striatus Fabricius, 1787

The chromosome number of *Trachyderes striatus* is n = 11♂with 10 autosomal bivalents and an Xy_p sex chromosome mechanism. Mitotic chromosomes were not studied in this species either.

Early prophase nuclei including early pachytene look the same in both species. From early diffuse stage on *T. striatus* has quite a different pattern of meiotic chromosomal behavior when compared to *T. thoracicus*. At early diplotene (Figure 2, A) the diffuse stage begins with a marked enlargement of the nucleus, the autosomal bivalents are slightly despiralized and undergoing unspecific heterologous associations. The sex chromosomes are evident: the *y* chromosome is observed as a dot-like chromocenter at the distal end of an autosomal bivalent and both ends of the *X* chromosome appear to be associated with it.

Enlargement of the nucleus and almost complete despiralization of the chromosomes characterize the rest of the diffuse stage in this species (Figure 2, B,C). The sex chromosomes are represented by a large chromocenter but they are not seen as a "parachute bivalent". In Figure 2, C, at least five well-visible chromocenters are observed and none can be defined as the Xy_p.

The diffuse stage ends at full diplotene in *T. striatus* (Figure 2, D). Some heterologous associations still hold together some autosomal bivalents. The Xy_p is isopycnotic but easily recognized. At diakinesis (Figure 2, E) the ten autosomal bivalents are observed with only one chiasma. The Xy_p appears to be slightly negatively heteropycnotic. At first metaphase all ten bivalents have one chiasma and seem to have two arms; the Xy_p is negatively heteropycnotic.

DISCUSSION

The primitive Coleopteran karyotype is considered to have nine metacentric autosomal pairs and *X* and *y* sex chromosomes in the male (Smith, 1953, 1960; Smith and Virkki, 1978). These sex chromosomes differ very much in size, the *y* being minute, and they associate during meiosis I, adopting the shape of a parachute (Stevens, 1906). For this reason they were named Xy_p (Smith, 1953, 1960).

The members of the family Cerambycidae vary in autosome number and size but are very conservative with respect to the sex-determining mechanism (Ehara, 1956; Yadav, 1971; Smith and Virkki, 1978; Virkki, 1984). The haploid number varies from 10 to 16 and the species with high chromosome numbers have the smallest chromosomes (Ehara, 1956). This type of variation is found within the same subfamily and within the same genus (Ehara, 1956). We have found almost the extremes of this variation in two sympatric species: *Trachyderes striatus* (n = 11) and *T. thoracicus* (n = 16). These species also present the variation in chromosome size described by

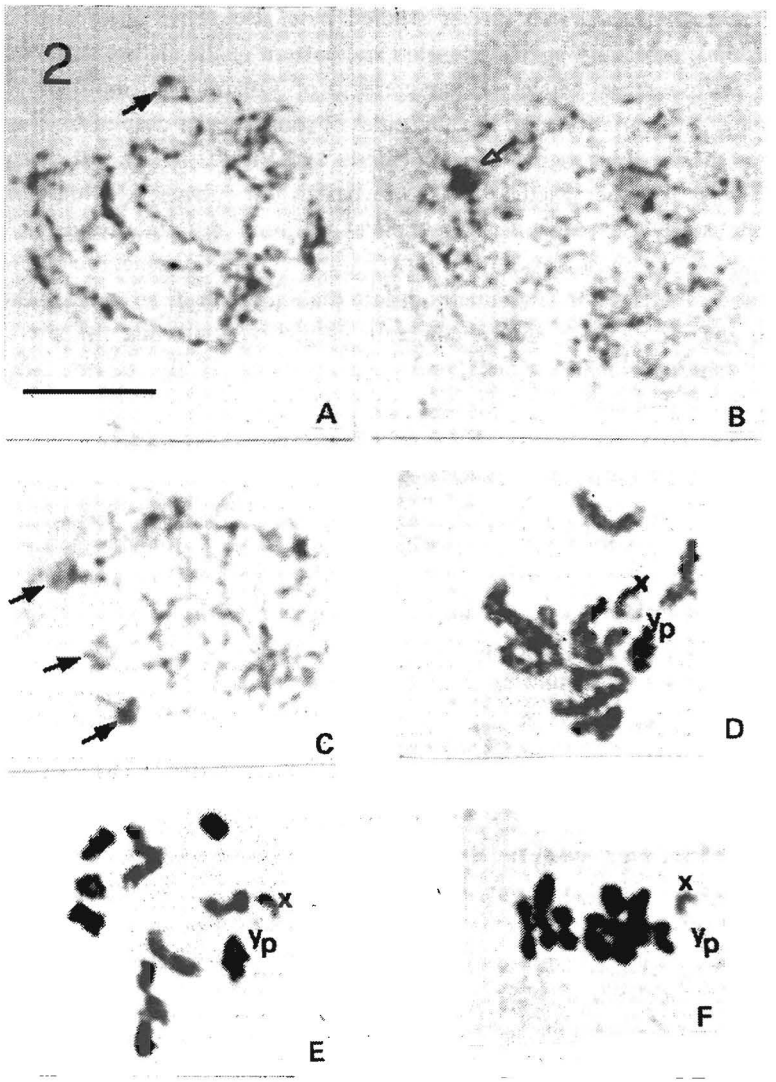

Figure 2 - *Trachyderes striatus*. Meiosis. A-C, Diffuse stage; D, full diplotene; E, diakinesis; F, metaphase I.

Ehara (1956), evidenced in their meiotic chromosomes (Figures 1 and 2). Both have the Xy_p sex chromosomes in the male, and this "parachute bivalent" is smaller in *T. thoracicus* than in *T. striatus* (Figure 1, G, H, I; Figure 2, D, E, F).

The two *Trachyderes* species studied here also show differences in their meiotic systems, especially in the extension and pattern of the diffuse stage. The post-pachytene diffuse stage which is characteristic of Coleoptera (Smith and Virkki, 1978) is subject to variation: the chromosomes of some species despiralize completely while others show only a slight fuzziness (Smith and Virkki, 1978). The diffuse stage of *T. thoracicus* is rather peculiar: 1) the nuclei do not enlarge; 2) while during the early diffuse stage the autosomes experience profound despiralization, from mid-diplotene on, all chromosomes only look fuzzy, and undergo nonspecific heterologous associations; 3) the stage ends gradually at late diakinesis. In *T. striatus:* 1) the nuclei enlarge; 2) autosomes reach almost complete despiralization while the sex chromosomes and heterochromatic blocks remain condensed; 3) the diffuse stage ends abruptly at full diplotene.

The association of the *X* and *y* chromosomes with the distal end of a pair of autosomes was observed in both species. In *T. thoracicus* this was observed at pachytene, and in *T. striatus* during the early diffuse stage. Multiple sex chromosomes have not yet been reported for Cerambycidae, but this relationship may suggest a possible mechanism for their origin in other groups of Coleoptera. A close association of the sex chromosomes with a specific autosomal pair during these stages of meiosis in which all chromosomes experience heterologous associations may well facilitate translocation and result in multiple sex chromosomes.

ACKNOWLEDGMENTS

We are very Grateful to Dr. Niilo Virkki for valuable suggestions and a critical reading of the manuscript. Thanks are due to Dr. Miguel A. Monné (Museu Nacional, Rio de Janeiro, Brazil) for identifying the specimens studied in this paper. We also wish to thank Dr. Héctor Franco and the personnel from the "Departamento de Biología Celular" for providing the facilities and for their kind collaboration. This work is part of the project "Cytogenetics of Coleoptera" and was carried out using an Olympus "Vanox" microscope obtained with a grant from Planeamiento Universitario, Universidad de la República, Uruguay.

RESUMO

O presente estudo da meiose masculina em duas espécies simpátricas de cerambícinos confirma dados relatados por outros autores sobre membros da família Cerambycidae. As duas espécies diferem quanto ao número e tamanho dos cromossomos, mas são conservadoras quanto ao bivalente sexual Xy_p no macho. Os cromossomos meióticos de *Trachyderes thoracicus* são muito

pequenos e o número cromossômico desta espécie é de 2n = 32, enquanto que *T. striatus*, com 2n = 22, apresenta cromossomos meióticos maiores.

As duas espécies também apresentam padrões diferentes de sistemas meióticos. *T. thoracicus* tem uma fase pós-paquitênica difusa, sem o aumento típico do núcleo. Após uma desespiralização inicial dos bivalentes cromossômicos a partir da fase de meio diploteno, é possível seguir todas as modificações cromossômicas nos núcleos do estágio difuso. A diacinese marca a fase final do estágio difuso nesta espécie. Em *T. striatus*, os núcleos aumentam após o paquiteno e o estágio difuso típico termina em pleno diploteno.

REFERENCES

Ehara, S. (1956). A comparative histology of male gonads in some Cerambycid beetles with notes on the chromosome. *J. Fac. Sci. Hokkaido Univ. Ser. VI 12*: 309-317.

Smith, S.G. (1953). Chromosome numbers of Coleoptera. *Heredity* 7: 31-48.

Smith, S.G. (1960). Chromosome numbers of Coleoptera II. *Can. J. Genet. Cytol. 2*: 66-88.

Smith, S.G. and Virkki, N. (1978). Coleoptera. In: *Animal Cytogenetics. Insecta 5.* (John, B., ed.). Gebrüder Borntraeger, Berlin-Stuttgart.

Stevens, N.M. (1906). Studies in spermatogenesis II. *Carneg. Inst. Wash. Publ. 36*: 3-32.

Virkki, N. (1984). Chromosomes in evolution of Coleoptera. In: *Chromosomes in Evolution of Eukaryotic Groups.* (Sharma, A.K. and Sharma, A., eds.). CRC Press, Florida.

Yadav, J.S. (1971). Karyological studies on the Indian Coleoptera. Ph. D. Thesis, Punjab University, Chandigarh, India.

Zajciw, D. and Ruffinelli, A. (1962). Fauna de los cerambícidos del Uruguay. *Bol. Nº 60, Fac. Agron. Montevideo*, 4-89.

(Received July 12, 1984)