

## KARYOTYPES OF NINE BRAZILIAN SPECIES OF ACRIDIDS (ORTHOPTERA -- ACRIDOIDEA)

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### ABSTRACT

The chromosomes of nine species of neotropical short-horned grasshoppers were studied. *A. brunneri* (Pyrgomorphidae) is  $2n\hat{o} = 19$  with all the chromosomes acrocentric. *D. serrulata* (Ommexechidae) is  $2n\hat{o} = 23$  with one pair of submetacentric autosomes and the remaining pairs acrocentric. The following seven species belong to the family Acrididae. *B. coccineipes*, *S. megacephala*, *E. koebelei*, *S. dorsalis*, *S. guyanensis* and *R. griseipes* are  $2n\hat{o} = 23$  with all the chromosomes acrocentric. *L. hebes* is  $2n\hat{o} = 17$  with two pairs of autosomes submetacentric, one pair metacentric and the remaining chromosomes acrocentric. All the species have an  $XO\hat{o} - XX\hat{f}$  sex determining mechanism.

### INTRODUCTION

Studies on neotropical short-horned grasshopper karyotypes were first started in 1930 with the pioneering work of Prof. Francisco Alberto Saez, who continued to publish on that subject for nearly half a century. Several groups of followers from Argentina, Brazil, Chile and Uruguay, many of them his own disciples, gave continuity to Saez's endeavor and, as a result of the accumulated research, the chromosomes of nearly 300 species were reported in almost 70 papers published. A review on this information is at present in press (Mesa *et al.*).

Simultaneously, the taxonomy of the group that until 1950 included the description of approximately 1000 neotropical species, has doubled since then thanks to the dedicated work of several acridologists, and consequently it is now realistic to assume that the number of species of neotropical acridomorphs easily exceeds the 3000 mark.

Based on material already studied, it was possible to establish that the derivative karyotypes described for neotropical grasshoppers are comparable in number to those reported for other regions, though they are unusually rich in newly-arisen sex mechanisms of both the neo-XY and  $X_1X_2Y$  type.

To further extend the knowledge of the chromosomes of our fauna of grasshoppers, the karyotypes of nine species (a pyrgomorphid one, an ommexechid one and seven acridids) are reported here.

## MATERIAL AND METHODS

The specimens were dissected in the field and the testes immediately fixed with Carnoy I and then preserved in the same fixative at low temperature. Semi-permanent slides were made after the gonads were briefly immersed in 45% acetic acid and squashed in a drop of 0.4% lacto-acetic orcein.

A list of the species studied, the number of specimens and their respective identifying number as well as the collection sites are given below:

### Pyrgomorphidae

*Algete brunneri* Bolivar (5023, 5024, 5025), Brazil, Pernambuco, Bonito, 1.III.81, C.S. Carbonell.

### Ommexechidae

*Descampsacris serrulata* (Thunberg) (5026, 5027, 5028), Brazil, Sergipe, Areia Branca, 19.II.81, C.S. Carbonell.

### Acrididae

#### Leptysminae

#### Leptysmini

*Belosacris coccineipes* (Bruner) (5029, 5030, 5031), Brazil, Pernambuco, Bonito, 27.II.81, C.S. Carbonell.

*Stenacris megacephala* Bruner, (5032, 5033, 5034, 5035), Brazil, Pernambuco, Bonito, 27.II.81, C.S. Carbonell.

#### Tetrataeniini

*Eumastusia koebelei* (Rehn) (5037, 5038, 5039), Brazil, Alagoas, Fleixeiras, 24.II.81, C.S. Carbonell.

*Stenopola dorsalis* (Thunberg) (5040, 5041, 5042), Brazil, Pernambuco, Bonito, 27.II.81, C.S. Carbonell.

#### Ommatolampinae

##### Syntomacrini

*Syntomacrella guyanensis* Descamps et Amedegnato, (5036), Brazil, Pernambuco, Bonito, 27.II.81, C.S. Carbonell.

#### Pycnosarcini?

*Lagidacris hebes* Amedegnato & Descamps, (5046, 5047), Brazil, Pernambuco, Bonito, 1.III.81, C.S. Carbonell.

#### Abracrini

*Roppacris griseipes* Amedegnato & Descamps, (5043, 5044, 5045), Brazil, Alagoas, Fleixeiras, 24.II.81, C.S. Carbonell.

The bars in the figures correspond to 10  $\mu$ m, except for Figure 1C where the bar corresponds to 5  $\mu$ m.

## RESULTS

*Algete brunneri* Bolivar: This species is  $2n\phi = 19$  with all the chromosomes acrocentric and an XO $\phi$  sex-determining mechanism. The autosomes can be grouped into two large pairs, six medium sized ones and one small one. During first prophase, one of the medium sized bivalents shows a proximal block of heterochromatin (see diplotenes in Figure 1B,E). In one specimen, a medium sized pair has an interstitial heterochromatin block. In another

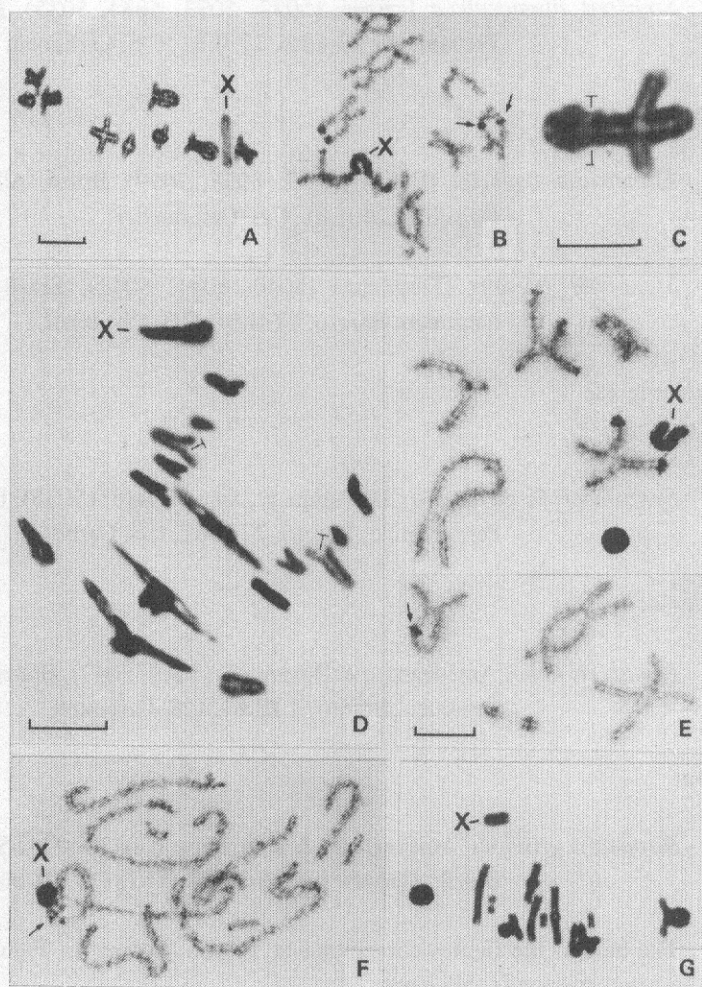


Figure 1 - A. *brunneri* - A, metaphase I; B, diplotene; one bivalent with interstitial polymorphic (in size) heterochromatin block (see arrows); C, bivalent in metaphase with a distal heterochromatin block in one of the chromosomes (bars indicate point of junction); D, first anaphase with equational division of the heterochromatin block, due to crossing-over; E, diplotene; one of the bivalents with polymorphism in the interstitial heterochromatin block. D. *serrulata* - F, late pachytene; one of the bivalents with small distal heterochromatin blocks in contact with the X; G, metaphase I. (E, F and G enlarged as A).



Figure 1 - *A. brunneri* - A, metaphase I; B, diplotene; one bivalent with interstitial polymorphic (in size) heterochromatin block (see arrows); C, bivalent in metaphase with a distal heterochromatin block in one of the chromosomes (bars indicate point of junction); D, first anaphase with equational division of the heterochromatin block, due to crossing-over; E, diplotene; one of the bivalents with polymorphism in the interstitial heterochromatin block. *D. serrulata* - F, late pachytene; one of the bivalents with small distal heterochromatin blocks in contact with the X; G, metaphase I. (E, F and G enlarged as A).

specimen this block is polymorphic in size (Figure 1 B) and in a second specimen the block is only present in one of the autosomes (Figure 1 E). A third specimen shows a large supernumerary distal block of heterochromatin in a medium sized bivalent. At first prophase, this block is frequently proximal or even in contact with the X chromosome. During first metaphase this bivalent is easily recognizable (Figure 1 C). It exhibits a single interstitial chiasma and, consequently, at first anaphase, the segregation homologues show chromatids of different sizes (Figure 1 D). The small bivalent is heterochromatic in approximately half of its proximal end, as seen in Figure 1 B,E and appears to be frequently in contact with the X as shows in Figure 1 B. Two and sometimes three chiasmata are observed in the large bivalents (Figure 1 A,B,E), one and less frequently two in the medium sized bivalents, and a single chiasma in the small bivalent.

*Descampsacris serrulata* (Thunberg): As most of the ommexechids do, this species shows a large submetacentric pair and three very small characteristic pairs (Figure 1 G) of autosomes. During first prophase there are no large heterochromatin blocks, but a medium sized pair exhibits small terminal blocks often connected with the X, as shown in Figure 1 F.  $2n\dot{o} = 23$ .

The next six species are  $2n\dot{o} = 23$ , with all the chromosomes acrocentric and an XO $\dot{o}$  sex-determining mechanism.

*B. coccineipes* (Bruner): This species has two large pairs, six medium sized ones and three small ones (Figure 2 A,B). One small bivalent and some of the medium sized bivalents show proximal heterochromatin blocks during first prophase, as can be observed in Figure 2 A.

*S. megacephala* Bruner: This species shows three large, five medium sized and three small pairs. In the last group, one pair is twice the size of the remaining two (Figure 2 C,D). Several pairs exhibit proximal heterochromatin blocks.

*S. guyanensis* Amedegnato et Descamps: This species has two large pairs, six medium sized ones and three small ones. In the last group one pair is conspicuously larger than the other two (Figure 2 E,F).

*E. koebelei* (Rehn): There are two large pairs, six medium sized ones and three small ones. The number of chiasmata must be high in this species since the two largest bivalents very frequently show three or four chiasmata (Figure 3A,B) and most of the medium sized bivalents have two and sometimes three chiasmata.

*S. dorsalis* (Thunberg): There are two large pairs, six medium sized ones and three small ones. The occurrence of proximal chiasmata is high

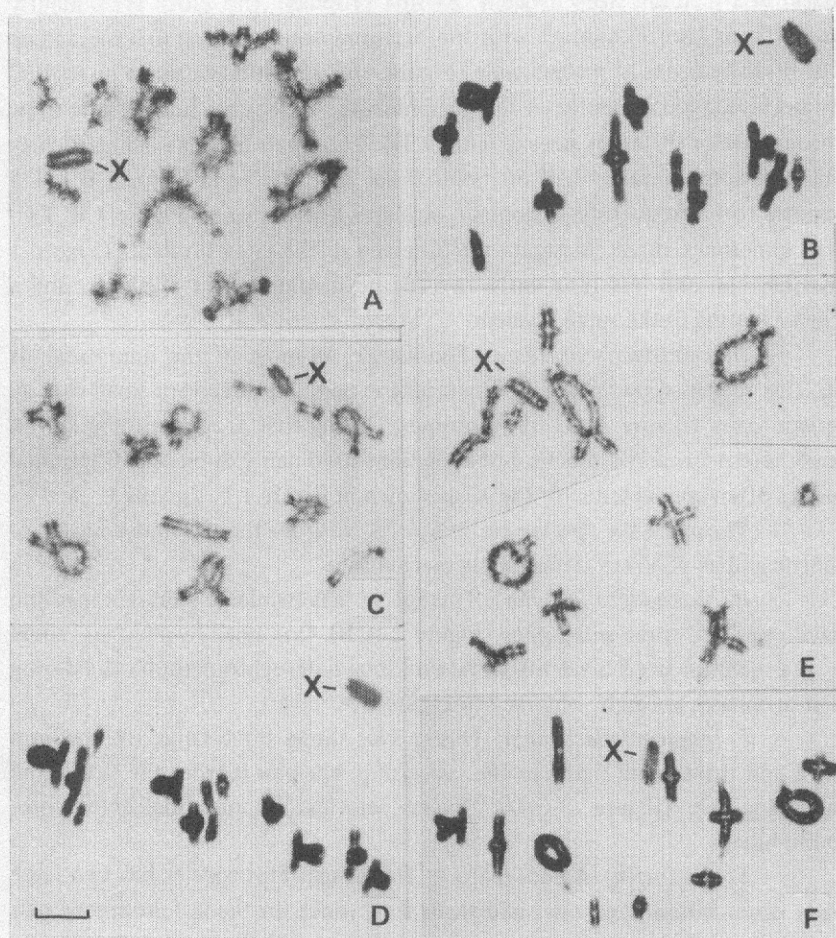


Figure 2 - *B. coccineipes* - A, diplotene; B, metaphase I.  
*S. megacephala* - C, diplotene; D, metaphase I.  
*S. guyanensis* - E, diplotene; metaphase I.  
 (All illustrations enlarged as indicated in D).



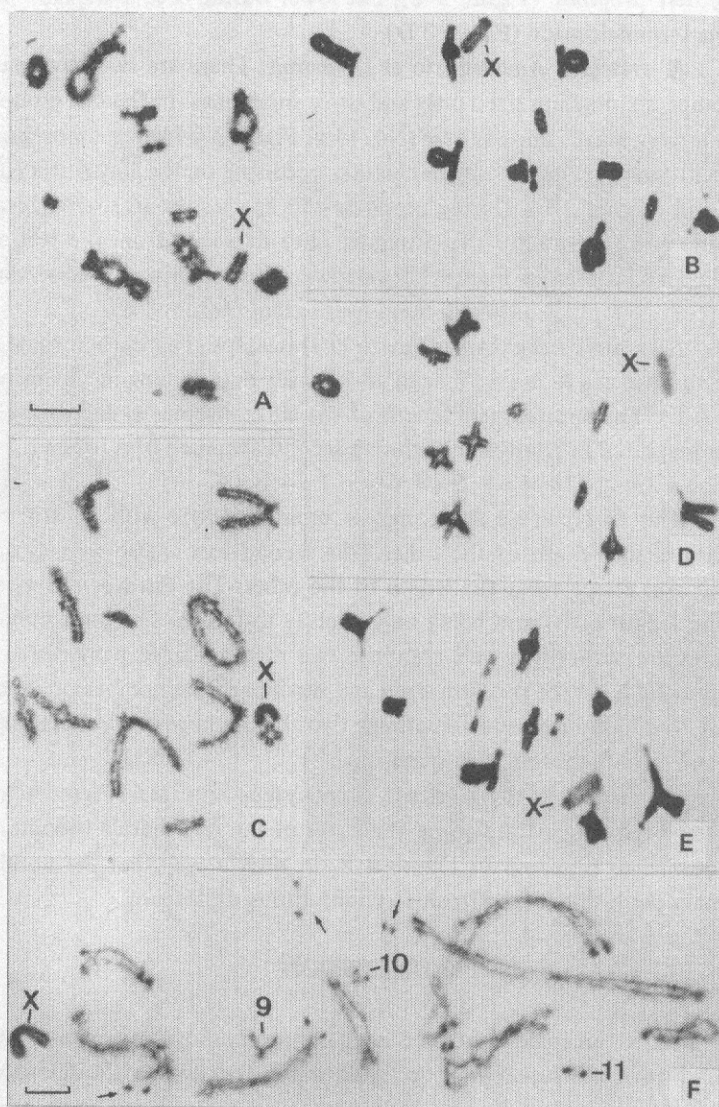


Figure 3 - *E. koebelei* - A, diplotene, B, metaphase I.

*S. dorsalis* - C, diplotene, D, metaphase I.

*R. griseipes* - E, metaphase I; F, diplotene (arrows indicate detached proximal ends).

(Illustrations B through E enlarged as indicated in A).



during first prophase (Figure 3 C), but lower during first metaphase due to chiasma terminalization (Figure 3 D).

*R. griseipes* Amedegnato et Descamps: There are two large pairs of autosomes, six medium sized ones and three small ones. In the last group, two pairs are very small, one of them (No. 11 in Figure 3 F) being almost entirely heterochromatic, with the single chiasma occurring on the tiny distal euchromatic end (Figure 3 F). During prophase this species shows several bivalents with one end (apparently the proximal one) detached from the rest of the chromosome, as seen in Figure 3 F (arrows). This condition is observed also during first metaphase although to a lower extent (Figure 3 E).

*Lagidacris hebes* Amedegnato et Descamps: The chromosome number of this species is  $2n\hat{=} 17$ , with an XO sex-determining mechanism (Figure 4 A-E). The approximate length of the chromosomes in decreasing order of size measured in relative units during second anaphase is as follows: 1 = 39; 2 = 37; 3 = 29; X = 14; 4 = 9; 5 = 8; 6 = 5; 7 = 4; 8 = 4.

The first pair of autosomes is submetacentric with an arm nearly three times the length of the other. The second pair is also submetacentric with an arm about twice the length of the other. The third pair is metacentric, the length of its arm being only slightly different. The remaining chromosomes are acrocentric and comprise two medium sized pairs, three small ones and the X. In the medium sized and small pairs the number of chiasmata is most frequently one and sometimes two. In the large pairs there are two, three and sometimes four chiasmata.

The aspect of the bivalents at pachytene is normal (Figure 4 A), but from the beginning of diplotene the gyres of the chromatids become wider than normal as observed in Figure 4 B, in such a way that the number of chiasmata per bivalent is difficult to count during diplotene.

## DISCUSSION

Based on male concealed genitalia morphology arguments, Roberts (1941) divided the superfamily Acridoidea into two groups: Chasmosacci and Cryptosacci. According to this author, the first group is the most primitive and comprises only two families, Pamphagidae and Pyrgomorphidae, while the second group comprises the remaining families. The morphological differences are confirmed cytologically, since species of the Chasmosacci group exhibit a basic  $2n\hat{=} 19$ , whereas the species of the other group are basically  $2n\hat{=} 23$ . However, White (1973) believes that  $2n\hat{=} 23$  (Cryptosacci) is a primitive karyotype, while  $2n\hat{=} 19$  (Chasmosacci) is derivative.

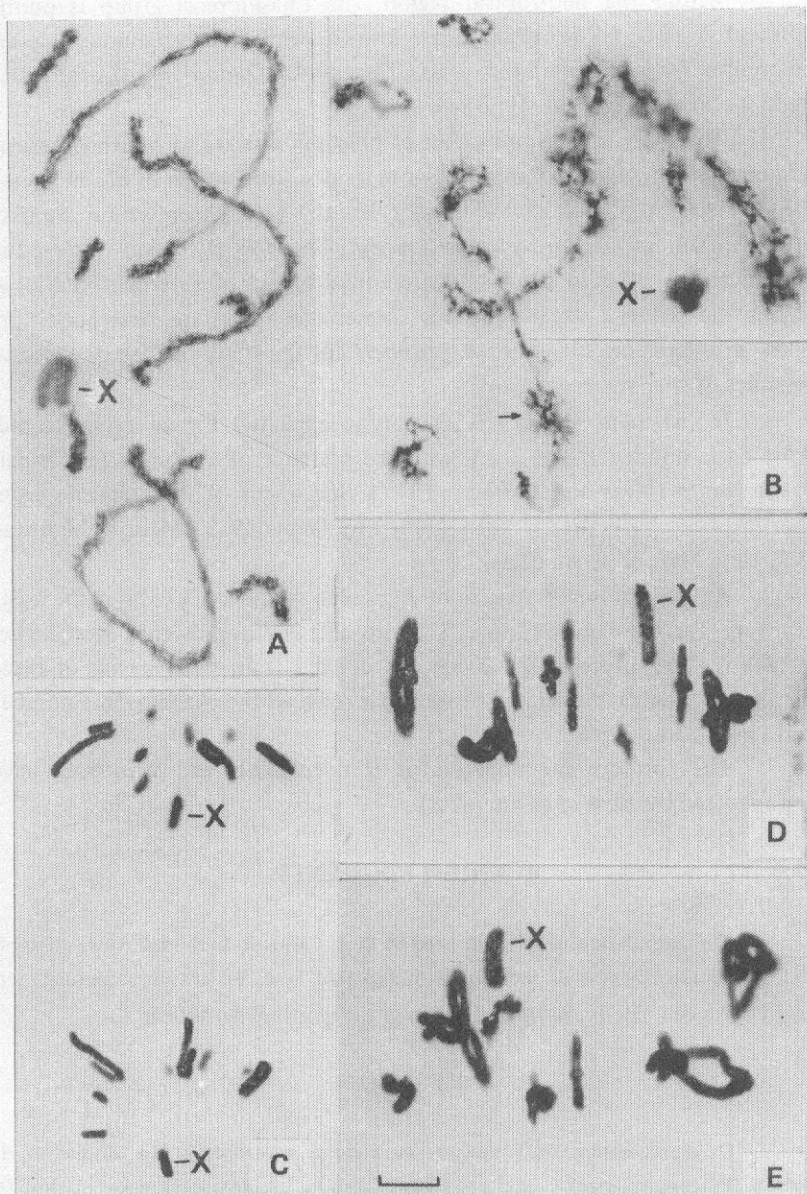


Figure 4 - *L. hebes* - A, late pachytene; B, early diplotene; C, second anaphase; D and E, metaphases I.

(All illustrations enlarged as indicated in E).

Within the neotropical region, the Chasmosacci group is poorly represented since no pamphagids are known, while the pyrgomorphids are represented by four genera (*Minorissa*, *Deraspiella*, *Omura* and *Algete*) with a single species each (Kevan, 1966).

Thus far, the chromosomes of only one species of South-American pyrgomorphid (*Omura congrua*) have been described (Mesa *et al.*, in press). The last species, as well as *A. brunneri*, has the basic chromosome number for the Chasmosacci group of grasshoppers. The polymorphism observed in the occurrence of both distal and interstitial blocks of heterochromatin, as well as the reduced vagility of this species due to its apterous condition, makes an interesting subject of *A. brunneri* for the study of the populational dynamics of such rearrangements.

*D. serrulata* shows the karyotype expected for an ommexechid, whose basic number is  $2n\phi = 23$ , with the presence of a submetacentric pair of autosomes (Mesa and Ferreira, 1977). Specimens of these species from other localities have already been studied by Mesa (1963), Mesa and Ferreira (1977) and Mesa *et al.* (in press).

Among the seven species of Acrididae studied, six exhibit the basic karyotype for the family ( $2n\phi = 23$ ) with all the chromosomes acrocentric, whereas the karyotype of *L. hebes* was derived from it by means of three independent centric autosomal fusions that reduced the chromosome number from  $2n\phi = 23$  to  $2n\phi = 17$ .

The chromosome numbers of *B. coccineipes* and *S. dorsalis* have been reported by Mesa *et al.* (in press).

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### RESUMO

Os cromossomos de 9 espécies de acridios neotropicais são estudados. *A. brunneri* (Pyrgomorphidae) é  $2n\phi = 19$  com todos os cromossomos acrocêntricos. *D. serrulata* (Ommexechidae) é  $2n\phi = 23$  com um par de autossomos submetacêntricos e os pares restantes acrocêntricos. As 7 espécies seguintes pertencem à família Acrididae. *B. coccineipes*, *S. megacephala*, *E. koebelei*, *S. dorsalis*, *S. guyanensis* e *R. griseipes*

são  $2n\sigma = 23$  com todos os cromossomos acrocêntricos. *L. hebes* é  $2n\sigma = 17$  com 2 pares de autossomos submetacêntricos, um par de metacêntricos e os cromossomos restantes acrocêntricos. Todas as espécies têm um mecanismo sexual do tipo  $XO\sigma - XX\varphi$ .

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