A Novel Karyotype in a South Indian Tettigonid. (Subfam: Listroscelinae–Orthoptera)

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Summary 1) During a chromosomal survey of the tettigonids an unusual specimen No. 207 (in our list of specimens) was discovered which is tentatively placed under the genus *Euhexacentrus* of the subfam: Listroscelinae. 2) *Euhexacentrus* sp. (specimen No. 207) is unusual among the tettigonids as its karyotype has the lowest chromosome number of $2n=9$ ($8A+X$) with 4 pairs of metacentric autosomes and a smaller acrocentric X chromosome. 3) This karyotype is compared with the karyotype of *E. annulicornis*, whose chromosome number is 12 ($10A+XY$) and are all metacentric. 4) The karyotype details of all the known species of the subfam: Listroscelinae are presented for comparison along with the present *Euhexacentrus* sp. 5) The probable evolution of the present karyotype is discussed.

Karyotype dynamism is of paramount importance in evolution which may involve one or more structural mechanisms in the chromosomes. The chromosome study in the tettigonid group is very much less when compared with the short horned grasshoppers (Acridids). Asana *et al.* stated as early as 1938 that “Our knowledge of the tettigonid chromosomes is yet too scanty” which holds good even today though reports and descriptions of chromosomes of some species are added periodically.

Comparatively chromosome studies are most extensive in the subfamily Phaneropterinae in the tettigonid group, which exhibits a wide range of chromosome number from 16–39 (Ferreira 1977). But with the description of the lowest chromosome number of $2n=12$ in *Euhexacentrus annulicornis* (Subfam. Listroscelinae, Aswathanarayana and Ashwath 1985) the diploid number varies from 12–39. The present study deals with the chromosomes of a long horned grasshopper specimen No. 207 which has a further lower number not so far encountered and discusses its possible cytological links within this group.

Material and methods

Two young individuals, one male and another female specimen Nos. 207 and 208 were collected in the University campus, Manasa Gangotri, Mysore, South India. The chromosome preparation was made by Air-dry-Giemsa method using hepatic caecae. Only male specimen No. 207 yielded some good metaphases. Since, the present specimen had the lowest chromosome number, a thorough search of the entire area was made to collect such individuals for more than two and half years. But the attempts proved a futile exercise which means such individuals are rare. However, referring to the vast literature on the subject it was found that the specimen No. 207 had all the characteristics described by Hobard (1922) and Burman (1995). Thus the specimen is tentatively placed under the genus *Euhexacentrus* of the subfam. Listroscelinae.

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Fig. 1. Male metaphase and karyotype of *Euhexacentrus* sp. (specimen No. 207).

Fig. 2. Idiogram of *Euhexacentrus* sp.

Results and discussion

Specimen No. 207 (*Euhexacentrus* sp.) is a beautiful and interesting grasshopper. Its karyotype is unusual and novel among tettigonids with the outstanding features of the lowest chromosome number of $2n=9$ ($8A+X$) with 4 pairs of metacentric autosomes and a smaller acrocentric X chromosome not encountered so far. So it assumes much importance in the karyotype history of tettigonids (Figs. 1, 2).

Now that the specimen No. 207 is tentatively identified as *Euhexacentrus* sp. belonging to subfam. Listroscelinae, a brief account of the chromosomes of this subgroup is presented (Table 1). The first report of the chromosomes of this family is of Hareyama (1937) who reported the male diploid number of 33 ($32A+X$) in *Hexacentrus japonicus*. Though the details of the chromosomes are not clear, it appears that the autosomes are all acrocentric with a sub-metacentric/metacentric X chromosome. Later Asana *et al.* (1938) described in *H. mundus* and *H. annulicornis* a chromosome complement of 31 ($30A+X$) in both the species with all acrocentric autosomes and an X chromosome with a sub-median constriction. In *Yorikella picta*, White *et al.* (1967) reported a diploid number of 20 ($18A+XY$) consisting of 10 metacentrics and 8 acrocentric with a neo-XY sex mechanism. But *Yorikiella* sp. 1 (White *et al.* 1967) and *Yorikiella* sp. 2 (Ferreira 1969) showed 31 ($30A+X$) chromosomes with all acrocentric autosomes and a metacentric X. In 1978, Kacker and Singh presented the female karyotype of *Xiphidiopsis straminula* containing 34 chromosomes ($32A+XX$) having a pair of sub-metacentric, 15 pairs of acrocentric autosomes and a fairly large metacentric X chromosomes. In *Xiphidiopsis* sp. Aswathanarayana and Uma (1992) have also described in the male $2n=33$ ($32A+X$) but with a difference. It had one pair of metacentric, 2 pairs of sub-metacentric (one large and one small), 3 pairs of sub-acrocentric and 10 pairs of acrocentric chromosomes. A lower number of 12 ($10A+XY$) was reported in *Euhexacentrus annulicornis* by Aswathanarayana and Ashwath (1985) with 5 pairs of metacentric (4 large and one very small) and

Fig. 3. Male metaphase of *Euhexacentrus annulicornis*. Arrow indicates the secondary constriction.

Fig. 4. Idiogram of *E. annulicornis*.

an XY sex mechanism (Figs. 3, 4). The neo-XY mechanism could not be confirmed as the necessary meiotic stages were not available. The X chromosome was a little smaller than the largest autosomal pair as identified by C-banding. The smaller Y was completely heterochromatic.

The general karyotypes of *Hexacentrus* and *Xiphidiopsis* are established to be $2n=33$. But *Yorkiella* has $2n=31$. The autosomes of *Xiphidiopsis* species have undergone modification by possessing biarmed chromosomes due to pericentric inversions. Both *H. mundus* and *H. annulicornis* which have $2n=31$ are considered to be a step more advanced by tandem fusion of *H. japonicus* karyotype ($2n=32A+X$). With the above details, the general karyotype of subfam. Listroscelinae is considered to be $2n=33$.

It is possible that *Hexacentrus* species with $2n=33$ might have given rise to *E. annulicornis* ($2n=12 \rightarrow 10A+XY$) having all metacentrics by the mechanism of centric fusion, tandem fusion and pericentric inversion. Since, many structural changes are involved in the process, the differentiation must have taken considerable time.

As the karyotype of specimen No. 207 (*Euhexacentrus* sp.) is so different from the karyotypes of other Listroscelinae having the lowest chromosome number with large metacentric autosomes and a smaller acrocentric X chromosome, only the autosomes can be derived from *Hexacentrus* species by centric fusion, tandem fusion and pericentric inversion or from *E. annulicornis* by centric fission, pericentric inversion and tandem fusion. The X chromosome of the present case can not fit into the pattern of the other species of the subfamily. So it is not possible to say whether deletion is responsible for shortness. For the comparison of the karyotype morphometric data and C-banding are imperative which are not available except for *E. annulicornis*. However, the idiograms of the present case (*Euhexacentrus* sp., Fig. 2) and that of *E. annulicornis* (Fig. 4) presented here gives the impression that they are related in one feature or the other.

When $2n=12$ ($10A+XY$) karyotype was discovered in *E. annulicornis* we thought further reduction in chromosome number was remote as all the chromosomes were metacentrics. But with the discovery of $2n=9$ ($8A+X$) in the specimen No. 207 (*Euhexacentrus* sp.) one can predict the occurrence of still lower chromosome numbers by repeated random sampling.

Though the extent of variation in the chromosome number in the subfam. Listroscelinae

Table 1. Showing the karyotype details of the species of subfam: Listroscelinae

Species	2n	Autosomes	Sex chromosomes	Authors
I <i>Hexacentrus</i>				
1 <i>H. japonicus</i>	33	32 acro	X large V shaped	Hareyama (1937)
2 <i>H. mundus</i>	31	30 acro	X large Sm	Asana <i>et al.</i> (1938)
3 <i>H. annulicornis</i>	31	30 acro	X large Sm	Asana <i>et al.</i> (1938)
II <i>Xiphidiopsis</i>				
4 <i>X. straminula</i> (♀)	34	2 Sm 30 acro	X large meta	Kacker and Singh (1978)
5 <i>Xiphidiopsis</i> sp.	33	2 med. meta 4 Sm 6 sub acro 20 acro	X-large meta	Aswathanarayana and Uma (1992)
III <i>Yorkiella</i>				
6 <i>Yorkiella</i> sp. 1	31	30 acro	X large meta	White <i>et al.</i> (1967)
7 <i>Yorkiella</i> sp. 2	31	30 acro	X large meta	Ferreira (1969)
8 <i>Y. picta</i>	20	10 meta 8 acro	Large X meta Y acro Neo XY	White <i>et al.</i> (1967)
IV <i>Euhexacentrus</i>				
9 <i>E. annulicornis</i>	12	8 large meta 2 meta minute	X large meta Y meta minute	Aswathanarayana and Ashwath (1985)
10 Specimen No. 207 <i>Euhexacentrus</i> sp.	9	8 large meta	X med. acro	Present study

ranges between 9 and 33 including the present case (*Euhexacentrus* sp.), extensive studies in a large number of species are necessary to establish accurately the karyotype evolution.

The karyotype details of the species of subfam. Listroscelinae are presented for comparison (Table 1).

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