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A chromosomal analysis of seven Cameroonian Acrididae species (Orthoptera: Acridinae, Oedipodinae and Spathosterninae) based on published data

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ABSTRACT:

So far, the karyotypes of seven Acrididae species from Cameroon have been reported. These species included: *Acrida turrita, Chirista compta, Coryphosima stenoptera producta, Oxycatantops spissus* (Acridinae), *Paracinema luculenta, Morphacris fasciata* (Oedipodinae) *and Spathosternum pygmaeum* (Spathosterninae). Karyotype and meiosis relationships among these species were analysed from published data. The species had a common karyotype made up of 23 acrocentric chromosomes (males), the sex mechanism in all seven species was XX♀-XO♂ and meiosis was normal and chiasmate. The chromosomes in the species occurred in three size groups of long, medium and short. The number of chromosomes per size group however varied among the species (*A. turrita* = 4LL:5MM:2SS; *C. compta* =4LL:4MM:3SS; *C. stenoptera product*=2LL:6MM:3SS; *O. spissus* =5LL:3MM:3SS; *P. luculenta* = 6LL:2MM:3SS; *M. fasciata* = 6LL:2MM:3SS; and *S. pygmaeum* = 2LL:7MM:2SS). The X chromosome was long in the Oedipodinae, medium in the Acridinae and short in the Spathosterninae. Total length of chromosomal material was in the series *C. compta > O. spissus > P. luculenta > S. pygmaeum > A. turrita > M. fasciata > C.s. producta.*

Keywords:
Acrididae, Acridinae, Oedipodinae, Spathosterninae, karyotype, relationships.

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INTRODUCTION

The use of Orthoptera material for karyotype studies dates from the inception of cytogenetics. This is simply because Orthoptera material presents large chromosomes and few chromosomes per karyotype. Chromosome size and number are of important cytotaxonomic value (Turkoglu and Koca, 2002). The Orthoptera are also well known for their karyotypic uniformity in chromosome number and morphology (Ashwathanarayana and Ashwath, 2006; Chadha and Mehta, 2011a).

It has been severally shown that analysis of karyotype differentiation between species yields better understanding of the evolutionary interrelationships and divergence (Chadha and Mehta, 2011a; Sandhu and Chadha, 2012). A survey of investigations on karyotype evolution in different groups of animals has revealed that several karyotypes are dynamic and are subject to change. Therefore, the stable karyotypes of the Acrididae are subject to change.

The cytogenetic diversity of Cameroonian acridid grasshoppers has not been investigated. During this study, published data on karyotypic characters were analysed to determine similarities and differences as well as interrelationships among seven Cameroonian Acrididae species.

MATERIALS AND METHODS

The cytogenetics of only seven Cameroonian *Acrididae* species have so far been described. The species include *Acrida turrita, Chirista compta, Coryphosima stenoptera producta, Oxycatantops spissus* (Sub-family Acridinae) *Paracinema luculenta, Morphacris fasciata* (Sub-family Oedipodinae) and *Spathosternum pygmaeum* (Sub-family Spathosterninae). The species and the sources from which karyotypic information on them was obtained for this analysis are shown in Table 1.

To analyse these karyotypes for similarities and differences, the karyotypes of the seven species were also arranged together (Figure. 1) and the morphometric characters for the seven species were arranged in a tabular form (Table 2).

RESULTS

Information on chromosome number, morphology, size, and length of X chromosome obtained for the seven species is summarised in Table 2. A perusal of Table 2 revealed that among the seven species studied *A. turrita*, *C. compta*, C. *stenoptera producta* and *O. spissus* belonged to the sub-family Acridinae, *P. luculenta* and *M. faciata* belonged to the subfamily Oedipodinae and *S. pygmaeum* belonged to the subfamily Spathosterninae (Mestre and Chiffaud, 2009). Table 2 also revealed that the seven species investigated had a common a diploid chromosome number of 2n=23 and the sex determining mechanism was XO in males. Figure 1 also revealed that the in the seven species investigated was acrocentric in morphology. The chromosomes in all seven species occurred in three size groups of long, medium and short. The number of chromosome pairs per size group varied between species

Table 1: The species analysed, their subfamilies and references from which karyotypic information was obtained

S/No	Species	Subfamily	Source of data
1	*Acrida turrita*	Acridinae	Seino *et al,* 2008
2	*Chirista compta*		Seino *et al,* 2010
3	*Coryphosima stenoptera producta*		Seino *et al,* 2010
4	*Oxycatantops spissus*		Seino *et al,* 2010
5	*Paracinema luculenta*	Oedipodinae	Seino *et al,* 2012
6	*Morphacris fasciata*		Seino *et al,* 2012
7	*Spathosternum pygmaeum*	Spathosterninae	Seino *et al,* 2012

Table 2: Morphometric characters of karyotypes of the seven species investigated

S.N	Species	Sub- family	Total number of chromosomes per cell in the male	Sex deter-mining mechanism ♀ - ♂	Number of chromosome per size group			Total chromosome length (µm)	Morphology of chromosomes			Length (µm) of X chromosome	Nature of X chromosome
					Long	Medium	Short		M	SM	A		
1	*A. turrita*	Acridinae	23	XX-XO	4	5	2	134.6±0.79	-	-	All	5.0±0.08	M
2	*C. compta*	Acridinae	23	XX-XO	4	4	3	176.3±0.14	-	-	All	7.3±0.52	M
3	*C. S. producta*	Acridinae	23	XX-XO	2	6	3	123.6±7.60	-	-	All	5.6±0.56	M
4	*O. spissus*	Acridinae	23	XX-XO	5	3	3	165.4±0.61	-	-	All	6.6±0.00	M
5	*P. luculenta*	Oedipodinae	23	XX-XO	6	2	3	164.7±2.26	-	-	All	7.7±0.59	L
6	*M. fasciata*	Oedipodinae	23	XX-XO	6	2	3	129.9±0.63	-	-	All	5.5±0.24	L
7	*S. pygmaeum*	Spathosternina	23	XX-XO	2	7	2	160.7±0.91	-	-	All	1.7±0.00	S

M= Metacentric, SM= Submetacentric, A= Acrocentric; L=long, M=Medium, S=Short

and subfamilies (Table 2; Figure. 2). The Oedipodinae showed most similarity since both of them revealed 6 long, 2 medium and 3 short chromosomes (6LL: 2MM: 3SS) in their karyotypes. The lengths of the X chromosome was in the series *P. luculenta > C. compta > O. spissus > C.s. producta > M; fasciata > A. turrita > S. pygmaeum*. However, the X chromosome was medium in the Acridinae, long in the Oedipodinae and short in the Spathosterninae species (Figure. 2). The total length of chromosomal material was in the series *C. compta> O. spissus> P. luculenta> S. pygmaeum> A. turrita> M. fasciata > C.s. producta.*

DISCUSSION

Every species has a unique karyotype which provides an identity to the species (Channaveerappa and Ranganath, 1997). Acridid grasshoppers are known to be characterised by a basic karyotype of 23 chromosomes in males. Due to this great cytogenetic uniformity Acridids are considered as an example of 'karyotypic conservation' (Aswathanarayana and Aswath, 2006).

In the present study, seven Acridids have been investigated which belong to three different sub-families that include the Acridinae, Oedopodinae and Spathosterninae. The results of this study revealed that the seven Acrididae have a chromosome number of 23 and a sex determining mechanism which is XO/XX. Similar observations have been made for several other Acrididae species. With respect to chromosome number, chromosome morphology and sex determining mechanism, Bugrov *et al.,* (1994); Bugrov (1995), Bugrov *et al.,* (1999) Bugrov and Sergeev (1997) observed similar results for *Podisma* and Eyprepocnemidinae (Acrididae) grasshoppers in Russia and Central Asia. Camacho and Cabrero (1983) also reported similar results for European species of *Acrotylus* (Oedopodinae). Yao (2006) and Chadha and Mehta (2011a) reported similar results for *Spathosternum pransiniferum* (Spathosterninae)

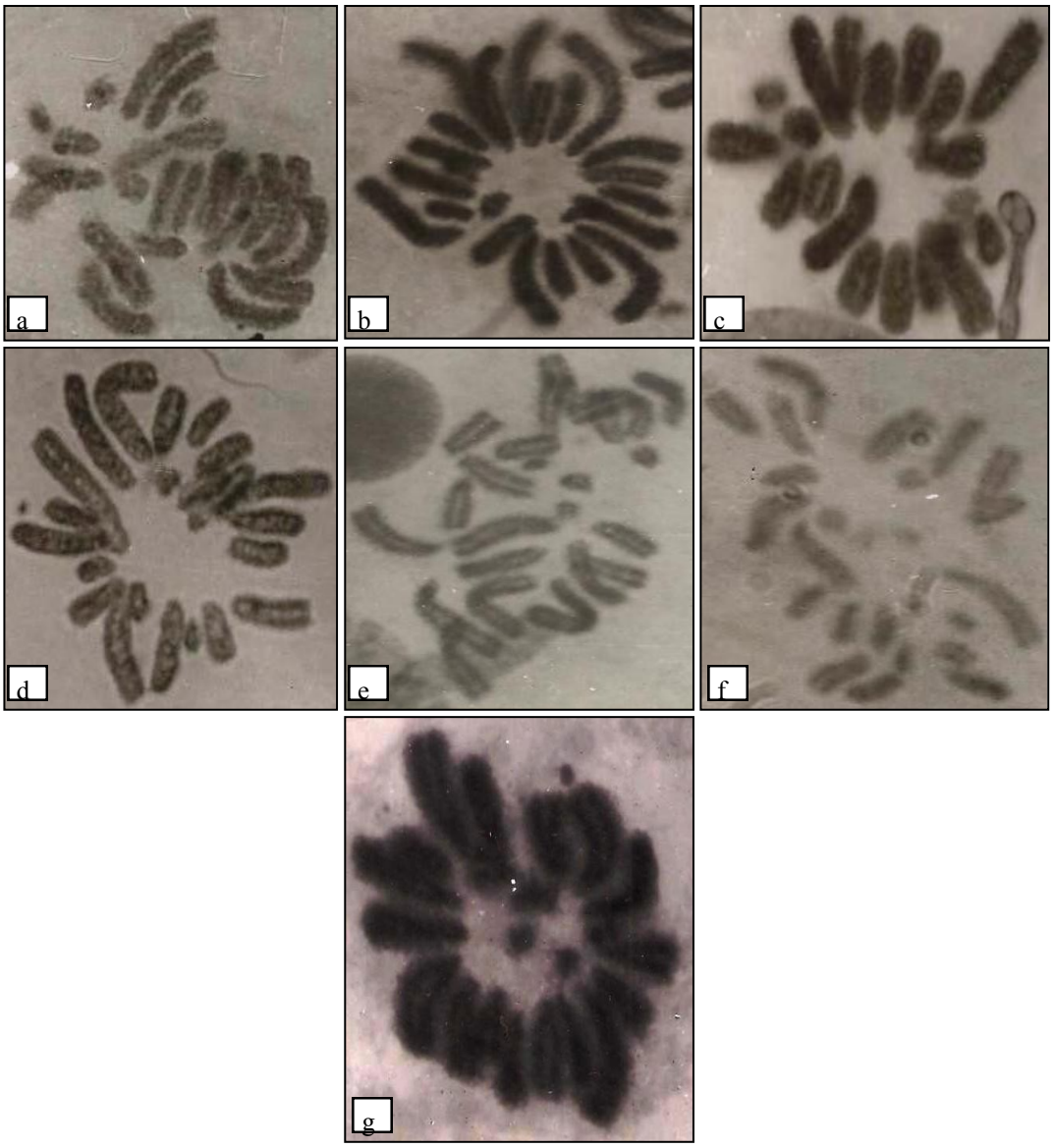
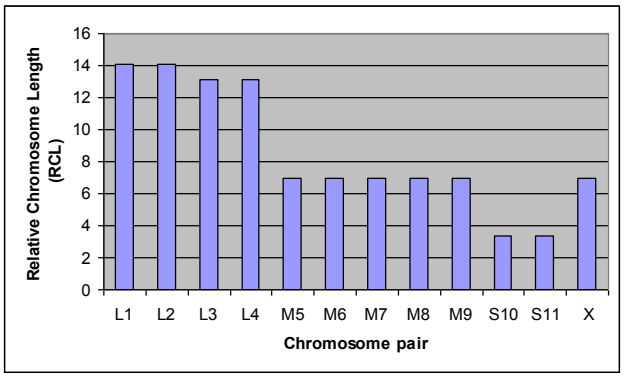
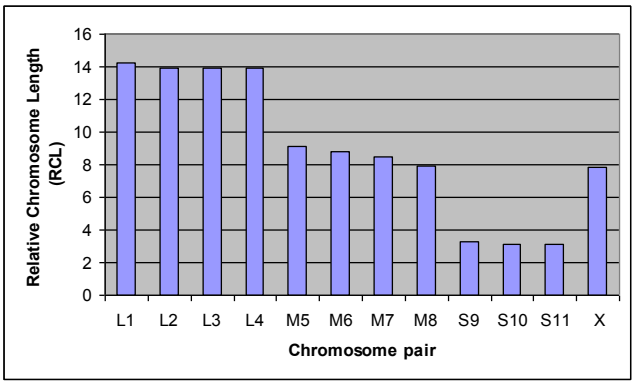


Figure. 1: Mitotic Metaphase chromosomes in the seven species investigated.
a) ***Acrida turrita*****, b)** ***Chirista compta*****, c)** ***Coryphosima stenoptera producta*****, d)** ***Oxycatantops spissus*****, e)** ***Paracinema luculenta*****, f)** ***Mophacris fasciata*****, g)** ***Spathosternum pygmaeum.*** **Chromosomes are tapered towards one end and centromeres were deemed to be towards the tapered ends of the chromosomes.**

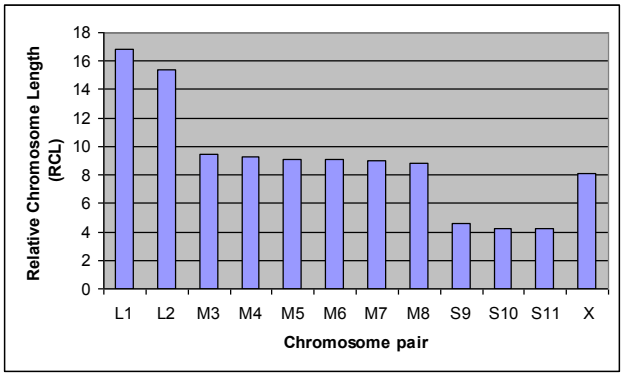
respectively from Asia and India. So the Acridid grasshoppers of different regions are showing cytogenetic uniformity regarding chromosome number, morphology and sex determining mechanism. The results of this study confirmed that the basic Acrididae karyotype is 23 acrocentric chromosomes and a sex determining mechanism of the XX/XO type. Metacentric chromosomes through fusions were not observed in the seven species here investigated even though they have been reported in several other Acrididae species (White, 1973; Sharma and Gautam, 2002; Mayya *et al.,* 2004; Chadha and Mehta, 2011a). Turkoglu and Koca (2002) reported the presence of metacentric, submetacentric and acrocentric chromosomes in the karyotypes of *Oedipoda schochi* and *Acrotylus insbricus* (Oedopodinae) from Turkey. The aberrant chromosomes were the result of centric fissions. X - autosome fusion resulting in the Neo - XY sex mechanism have been reported in some acridid grasshoppers (White, 1973). Bidau and Marti (2000)



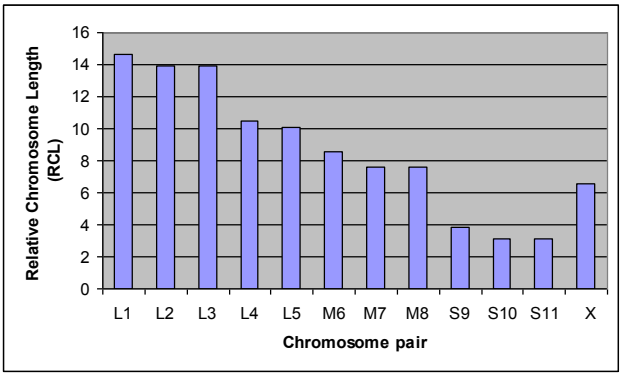
A. turrita



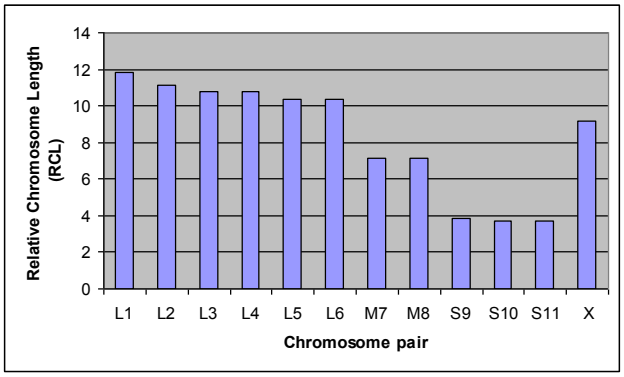
C. compta



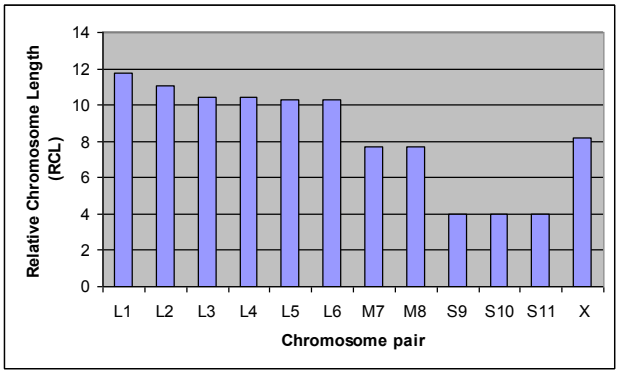
C.s.producta



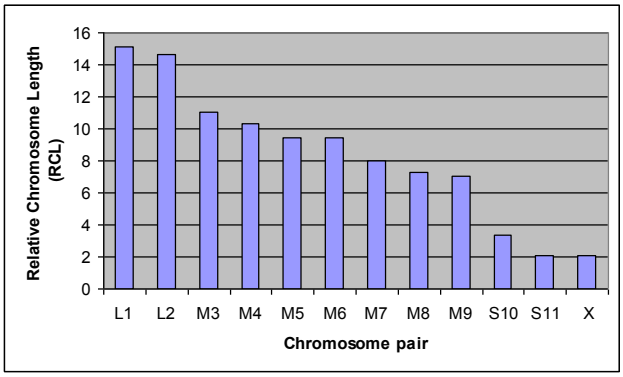
O. spissus



P. luculenta



M. fasciata



S. pygmaeum

Figure. 2: Idiograms of the seven species investigated

reported Neo-XY in *Dichroplus vittatus* (Acrididae: Melanoplinae). This type of sex determination mechanism was absent in the seven species investigated in this study.

The X-chromosome during this investigation was found to be medium in the four Acridinae. However, Chadha and Mehta (2011a), investigating Indian Acridinae observed that the X chromosome in *A. turrita* was the longest chromosome in the karyotype. There is therefore disagreement of this report with that of the present investigation. Chadha and Mehta (2011b) reported the X chromosome in *Oedaleus abruptus* (oedipodinae) to be the largest element in the karyotype. During the present study, the X-chromosome in *P. luculenta* and *M. fasciata* (Oedipodinae) were among the large chromosomes of the karyotypes. There is no doubt that the X chromosomes of different species of the Oedipodinae is one of the largest elements in the karyotype. Though this chromosome was acrocentric in the two Oedipodinae investigated here, Turkoglu and Koca (2002) found the same chromosome in Oedipodia schochi schochi and *Acrotylus insbricus* (Oedipodinae) from Turkey to be Metacentric in morphology.

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