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Research Article

CHROMOSOME ANALYSIS OF THREE SPECIES OF SCARABAEIDAE BEETLES (COLEOPTERA: INSECTA)

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ABSTRACT
Karyological investigations were carried out on adult male individuals of three species of Scarabaeidae beetles viz. *Onthophagus ramosus* (Wiedemann), *Scarabaeus andrewesi* (Felsche) and *S. cirsatus* (Fabricius). All species possessed 2n = 20: 9 + Xy_p. Mitosis and meiosis have been described and discussed.

Key Words**:** C*oleoptera, Scarabaeidae, Karyotype, Autosome, Sex Chromosome Mechanism*

INTRODUCTION
Coleoptera is an order of insects commonly called as beetles. Polyphaga is the largest and most the diverse suborder of Coleoptera. Its family Scarabaeidae includes over 30,000 species worldwide (Fincher, 1981). Subfamily Scarabaeinae comprises 7,000 species. Adults of many scarab beetles are noticeable due to their relatively large size, bright colors, often elaborate ornamentation, and interesting life histories. The effectiveness of these insects in removing organic matter makes them essential components in maintaining and regulating of terrestrial ecosystems in which they live (Halffter and Matthews 1966, Hanski and Cambefort 1991), because the group forms a taxonomically and functionally well-defined community (Hanski and Cambefort 1991). For these and other reasons, the Scarabaeinae is an important group of insects which has been used as a bio indicator of fragmentation, disturbance, and diversity in tropical forests and savannas (Halffter and Favila 1993; Favila and Halffter 1997; Spector and Forsyth 1998; Halffter and Arellano 2001; McGeoch *et al.,* 2002; Davis *et al.,* 2004; Spector 2006 and Nichols *et al.,* 2007) due to its high interaction with mammals native to those ecosystems (Davis *et al.,* 2002). Keeping in view the economic importance and paucity of literature on chromosomes of this group, the present investigation was under taken.

MATERIALS AND METHODS
Adult male individuals of *Onthophagus ramosus* (Wiedemann), *Scarabaeus andrewesi* (Felsche) and *S. cirsatus* (Fabricius) constituted the materials for the present investigations. All the beetles were collected under the mercury vapour lamps during February to April 2009-2011 from Dhar, Indore and Dewas (Madhya Pradesh). Chromosome preparations were made following Yadav and Lyapunova (1983).

RESULTS AND DISCUSSION
*Onthophagus Ramosus (*Wiedemann)
The spermatogonial metaphase exhibited a diploid set of 20 chromosomes (Fig. 1). The karyotype is composed of nine pairs of autosoms and X and y sex chromosomes (Fig. 2). Autosome pairs 1-5 were metacentric, pairs 6-9 were submetacentric whereas the X chromosome was acrocentric. The spherical y chromosome is the smallest element of the diploid complement. Autosomes show gradation in size. During metaphase I nine rod-shaped autosomal bivalents were formed along with the Xy_p (Fig. 7). During the first meiotic division being reductional two types of metaphase II plates were encountered one with X chromosome and the other with y chromosome (Fig. 8).
The male chromosomal formula is 9AA + Xy_p.

Scarabaeus and Rewesi (Felsche)

Spermatogonial metaphase depicted the diploid number of 20 chromosomes (Fig. 03). The karyotype comprise of five pairs of submetacentric autosomes (Pair 1, 4, 5, 7 and 8) and four pairs of metacentric autosomes (pairs 2, 3, 6 and 9), the X and y chromosomes were also metacentric (Fig. 4). Metaphase I possesses nine dumb-bells shaped autosomal bivalents and the sex bivalent Xy_p (Fig. 9). The male chromosomal formula is $9AA+Xy_p$.

Scarabaeus Cristatus Fabricius

The diploid number of 20 chromosomes was revealed by spermatogonial metaphase (Fig. 5). The karyotype is composed of nine pairs of autosomes and X and y sex chromosomes (Fig. 6). Autosome pairs 6-8 were submetacentric, pairs 1-5 and 9 were metacentric, the X chromosome was sub metacentric and y chromosome was acrocentric. All the chromosomes show gradual decrease in size. Metaphase I possesses nine dumb-bells shaped autosomal bivalents and the sex bivalent Xy_p (Fig. 10).

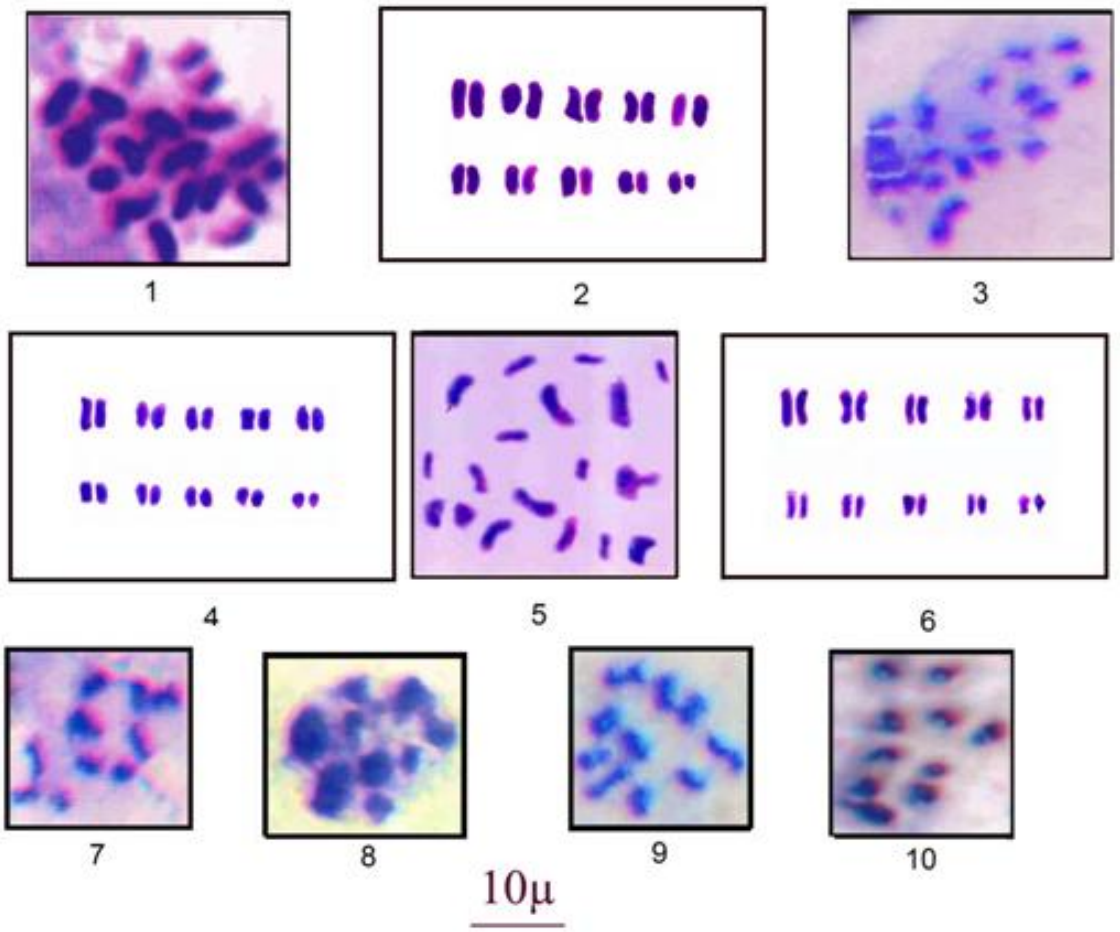

Figure1: Spermatogonial metaphase of *Onthophagus ramosus* (Wiedemann)
Figure 2: Karyotype of the same
Figure 3: Spermatogonial metaphase of *Scarabaeus andrewesi* (Felsche)
Figure 4: Karyotype of the same
Figure 5: Spermatogonial metaphase of *S. Cirsatus* (Fabricius)
Figure 6: Karyotype of the same
Figure 7: *Onthophagus ramosus* (Wiedemann) (Metaphase I)
Figure 8: *O. ramosus* (Wiedemann) (Metaphase II)
Figure 9:*Scarabaeus andrewesi* (Felsche) (Metaphase I)
Figure10: *S. Cirsatus* (Fabricius) (Metaphase I)

The male chromosomal formula is $9AA+Xy_p$.
Karyotypically subfamily Scarabaeinae is the most diverse subfamily of Scarabaeidae. The smallest diploid number 2n = 8 with neo Xy sex mechanism depicted in Eurysternus caribaeus (Cabral-de-Mello *et al.*, 2007) and highest diploid number 2n=21 with XO sex mechanism exhibited by *Copris ficator* (Joneja, 1960), which is comparable to *Apogonia* spp. (Saha, 1973) of Melolonthinae. In Scarabaeinae 143 species are known cytologically out of these 77 species posses the 'Modal number' (Duff, 1970; Dange, 1991; Kacker, 1970 and Lahiri and Manna, 1969 and Rathore, 2010). All species under the present investigations also possess the modal karyotype. Much variation was found in the form and size of chromosomes unlike other Scarabs. The total chromosome length was found to be maximum in *Onthophagus ramosus* (Wiedemann) (81.97µ) and minimum in *Scarabaeus andrewesi* (Felsche) (60.62µ). All chromosomes show a gradual decrease in size. The size of X chromosome smallest in *O. ramosus* (Wiedemann) (3.11µ) and largest in *S. cirsatus* (Fabricius) (3.17µ). *S. cirsatus* (Fabricius) has the largest y (2.82µ) whereas y was smallest in *S. andrewesi* (Felsche) (2.15µ).
Comparative studies of the karyotypes of beetles are presented in table 1.

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