Chromosomes of some Indian tenebrionidae
(Insecta : Coleoptera)

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ABSTRACT

The diploid chromosome number in spermatogonial metaphase, the meiotic cycle, the haploid number with the chromosome formula and sex chromosome mechanism at primary spermatocyte division have been studied for the first time in five species of tenebrionid beetles, Platynotus exavatus F., Gonocephalum depressum Fabr., Pachydera arita Hbst., Himatismus fasciculatus Fabr., and Hiperops coromendelensis Sol. The first, second and the last three species belong to the subfamilies Pedininae, Opatrinae and Epitraginae respectively. The Karyotypes are uniformly viewed as $2n = 20$ or $n$ (1st div.) = 10 with sex mechanism $XY_r$ having the chromosome formula $9AA + XY_r$. Against the background of the previous study the modal chromosome number and the sex mechanism are discussed.

INTRODUCTION

The family Tenebrionidae comprises a vast number of 10,000 species described morphologically, of which our knowledge of chromosome cytology is confined to 50 species only reported by Stevens (1905), Nonidez (1914, 1915, 1920), Guenin (1949, 1950, 1951 a, 1951 b, 1953, 1956), Smith (1950 a, 1950 b, 1952, 1953, 1960), Dutta (1953), Lewis and John (1957), Takenouchi (1957), Agrwal (1960), Joneja (1960), Kacker (1968).

The present study is on the chromosome complement of five species observed for the first time belonging to three subfamilies Pedininae, Opatrinae and Epitraginae. Two species of each of the subfamilies Pedininae and Opatrinae have been studied by Smith (1953, 1960) but no cytological information of the subfamily Epitraginae has so far been reported.
MATERIALS AND METHODS

Male specimens were collected from the Institute campus either from the ground or light-trapped during the month of November 1970. The list of species is given below.

Family—Tenebrionidae

1. Subfamily—Pedininae: Platynotus exavatus F.
2. Subfamily—Opatrinae: Gonocephalum depressum Fabr.

Aceto-carmine squash preparations and sections (10–12 microns) of testes were made. Aceto-alcohol (1:3) was used as fixative and sectioned slides were stained in crystal violet.

OBSERVATIONS

1. Subfamily Pedininae

Platynotus exavatus F.

The diploid chromosome number encountered in large number of spermatogonial metaphase plates (figure 1) confirm \(2n = 20\), mostly rod-shaped or smoothly bent. The \(y\) chromosome could be ascertained by its minute dot-shaped structure taking mostly the peripheral and occasionally the central position. The \(X\), however, could not be recognised due to lack of any differential character.

The diplotene and diakinesis are not very clear.

Primary spermatocyte polar views (figure 2) show 10 round bodies, quite often interconnected with tenuous chromatin threads. In side view (figure 3) the sex bivalent can sometimes be recognised due to its \(Xyp\) configuration occupying an accessory plate or eccentric position. The first meiotic division is reductional for the sex chromosomes in beetles and is evidenced by two types of daughter cells in the second division metaphase which in polar view show 9 autosomes plus the dot-shaped minute \(y\) chromosome or 9 autosomes plus the \(X\) chromosomes. The \(X\), however, cannot be identified.

The Karyotype is \(2n = 20\) or \(n (1st \text{ div.}) = 10\) with sex mechanism \(Xyp\) making the chromosome formula \(9AA + Xyp\).
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2. Subfamily Opatrinae

Gonocephalum depressum Fabr.

Spermatogonial metaphase plates (figure 4) clearly evince \(2n = 20\) chromosomes with an average of 8 acutely or smoothly bent, 10 rod-shaped and the rest two as dots. It is interesting to note that in all the metaphase plates the dot chromosomes are conspicuously clear, situated independently without any fixed position, one of which only is suggestive of \(Y\) chromosome. The \(X\) chromosome could not be identified from autosomes.

Diplotene and diakinesis show 10 elements mostly with one chiasma per bivalent with usual configurations of cross, open cross, rod and at least one ring formed due to terminalised pricentric chiasmata. The sex bivalent shows \(Xyp\) association and there is no other dot-chromosome whatsoever. This configuration does not explain the two chromatin dots seemingly \(Y\) chromosomes at mitotic metaphase stage.

Metaphase first division polar views (figure 5) clearly exhibit 10 round bodies. In side view of the spindle (figure 6) the \(Xyp\) sex bivalent is clear and mostly shows an advance movement to the autosomal group.

The Karyotype is viewed as \(2n = 20\) or \(n\) (1st div.) = 10 with sex mechanism \(Xyp\) and the chromosome formula \(9AA + Xyp\).

3. Subfamily Epitraginae

Pachycera arita Hbst. and Hirnatismus fasciculatus Fabr.

Chromosome numerals and the details of the divisional stages of both the species \(P. arita\) and \(H. fasciculatus\) are identical. Spermatogonial metaphase plates (figures 7, 10) show \(2n = 20\) chromosomes.

The diplotene and diakinesis are with 10 bivalents having usual configurations and at least one ring; the sex bivalent forms the typical 'parachute' \(Xyp\) configuration.

Metaphase first division polar views (figures 8, 11) clearly show 10 well defined round bodies of graded size. Only in side views (figures 9, 12) at this stage the \(Xyp\) could be detected showing precocious movement from the autosomal mass.

The Karyotype in both the cases are \(2n = 20\) or \(n\) (1st div.) = 10 with sex mechanism of \(Xyp\) and chromosome formula \(9AA + Xyp\).

Hyperops coromendelensis Sol.

The spermatogonial metaphase plates (figure 13) are abundant showing uniformly 20 chromosomes with graded size difference having 10 metacentric/
submetacentric, smoothly or acutely bent and 8 rod-shaped autosomes. Of the sex chromosomes Y is always conspicuous by its minute size and dot-shape. It is randomly placed in the metaphase plate. The X chromosome is probably a large chromosome and presumably can be singled out by its non-homologous nature.

The diplotene and diakinesis are clear and of the same type as in the preceding species but with a brushy outline and the bivalents are often interconnected by tenuous chromatin threads.

Metaphase first division polar view (figure 14) clearly shows 10 bivalents which also may be interconnected by metachromatic threads. In side view (Fig. 15) the sex bivalent is in the usual XYP configuration and occupies an accessory position in the spindle.

The second division metaphase stage could not be well scored.

The Karyotype is \( 2n = 20 \) or \( n \) (1st div.) = 10 with sex mechanism XYP and chromosome formula 9AA + XYP.

**DISCUSSION**

Tenebrionidae is highly polymorphous where the diploid number of chromosomes range from 14 to 37 having all numerals except 15, 17, 21–25, 27–33 which will also presumably be encountered on further investigation of the family. But a very high frequency of \( 2n = 20 \) is suggestive of the type number.

As regards the sex mechanism, most of the Coleopteran varieties, e.g., XYP, XYR, neo-XY, XY, Xy, XO, XXXY are encountered in which the XYP is mostly prevalent. Thus the variant chromosome numerals and sex bivalents show the most basic Karyotype as 9AA + XYP, the archaic protocoleopterous forms of the Triassic (Smith 1959). This suggests that extensive structural rearrangement of archaic forms resulted in establishing hypo and hypermodal numbers and the varied sex mechanism in the recent species.

In Pedininae only three species, *Opatrinus aciculatus* (Smith 1952 b), *Blapstinus* sp. (Smith 1960) and the present one have been noted where in all cases the diploid number \( 2n = 20 \) and the sex mechanism XYP are uniformly existent.

Besides the present species, our knowledge of Opatrinae is limited to *Opatroides vicinus* (Dutta 1953), *Opatrum bilineatum* (Kacker 1968). The Karyotype is similar to Pedininae except in *O vicinus* where Xy sex bivalent does not assume a parachute-like association.

Phylogenetically Pedininae is supposed to be archaic to Opatrinae (Leng 1920) though the two species *P. exavatus* and *G. depressum*, each representative
Chromosomes of Some Indian Tenebrionidae (Insecta: Coleoptera) of the two subfamilies in the present study, do not show any cytological difference.

The subfamily Epitraginae is explored cytologically for the first time here where the three species studied show modal Karyotype of Tenebrionidae.

The diploid and haploid numbers with chromosome formula of the five species summarised below concord with the model diploid number and typical sex mechanism.

Summary of cytological determinations in five Tenebrionid species.

<table>
<thead>
<tr>
<th>Family—Tenebrionidae</th>
<th>Species</th>
<th>2n number</th>
<th>Chromosome formula (1st div.)</th>
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</thead>
<tbody>
<tr>
<td>Subfamily—Pedininae</td>
<td><em>Platynotus exavatus</em> F.</td>
<td>20</td>
<td>9AA+Xy</td>
</tr>
<tr>
<td>Subfamily—Opatrinae</td>
<td><em>Gonocephalum depressum</em> Fabr.</td>
<td>20</td>
<td>9AA+Xy p</td>
</tr>
<tr>
<td>Subfamily—Epitraginae</td>
<td><em>Pachydera arta</em> Hbst</td>
<td>20</td>
<td>9AA+Xy p</td>
</tr>
<tr>
<td></td>
<td><em>Himatismus fasciculatus</em> Fabr.</td>
<td>20</td>
<td>9AA+Xy p</td>
</tr>
<tr>
<td></td>
<td><em>Hyperops coromendelensis</em> Sol.</td>
<td>20</td>
<td>9AA+Xy p</td>
</tr>
</tbody>
</table>

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**EXPLANATION OF PLATE I**

Figures 1-3. Meiotic stages in Platynotus exavatus. (1) Spermatogonial metaphase; (2) Primary spermatocyte (Polar view); (3) Primary spermatocyte (Side view).
Figures 4-6. Meiotic stages in Gonoccephalum depressum. (4) Spermatogonial metaphase; (5) Primary spermatocyte (Polar view); (6) Primary spermatocyte (Side view).
Figures 7-9. Meiotic stages in Pachycera arta. (7) Spermatogonial metaphase; (8) Primary spermatocyte (Polar view); (9) Primary spermatocyte (Side view).
Figures 10-12. Meiotic stages in Himatismus fasciculatus (10) Spermatogonial metaphase; (11) Primary spermatocyte (Polar view); (12) Primary spermatocyte (Side view).
Figures 13-15. Meiotic stages in Hyperops coromendelensis. (13) Spermatogonial metaphase; (14) Primary spermatocyte. (Polar view); (15) Primary spermatocyte (Side view).