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INTERNAL MALE REPRODUCTIVE ORGANS IN FIVE SPECIES OF HETEROPTERA (INSECTA: HEMIPTERA)

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ABSTRACT

Internal structure and characteristic features of male reproductive organs of five heteropteran species viz. *Aeliomorpha lineaticollis* Westwood, 1837, *Piezodorus rubrofasciatus* Fabricius, 1787, (Pentatomidae), *Homeocerus signatus* Walker, 1871, *Homeocerus borealis* Distant, 1918 (Coreidae) and *Serinetha augur* (Fabricius, 1781) (Rhopalidae) are described. In all the studied species, male reproductive tract typically consists of a pair of testes, a pair of vas deferens, a pair of seminal vesicles, a complex bulbus ejaculatorius, a pair of ectodermal sacs, a ductus ejaculatorius and accessory glands. Green coloured testes have been observed in *Homeocerus signatus* and *Homeocerus borealis* for the first time which are not reported in any of the heteropteran species so far.

Keywords: *Heteroptera, Morphology, Internal Male Reproductive Organs*

INTRODUCTION

In several groups of insects, internal anatomy, biology and cytology become a valuable component for taxonomic analysis where the external morphological features and other processes are not sufficient for explanation of the taxonomic issues. Internal reproductive morphology of Heteroptera has been important to study diversity and derive evolutionary trends almost parallel to those derived from other structures. Earlier classical works on internal reproductive organs of Heteroptera have been done by Bonhag and Wick (1953), Pendergrast (1957), Leston (1961), Rai and Trehan (1964), Kumar (1965b), Bhargava (1967), Abbasi (1973), Malipatil (1978), Sharma & Livingstone (1978), Akingbohungebe (1983), Grozeva and Kuznetsova (1989, 1992), Ahmad and Mcpherson (1998), Kuznetsova *et al.*, (2007), Mróz (2007, 2012), Papacek and Soldan (2008), Pluot-Sigwalt and Lis (2008), Souza *et al.*, (2009), Mróz and Wojciechowski (2011), Souza *et al.*, (2011), Kaur and Patial (2012), Gomes *et al.*, (2013), Ozyurt *et al.*, (2013a,b, 2015) and Jyoti *et al.*, (2015). In the present paper, the characteristics features of internal male reproductive organs of five heteropteran species belonging to three families viz. Pentatomidae, Coreidae and Rhopalidae have been described, and similarities and dissimilarities among different families have been discussed.

MATERIALS AND METHODS

Male specimens of *Aeliomorpha lineaticollis* Westwood, 1837, *Piezodorus rubrofasciatus* Fabricius, 1787, (Pentatomidae), *Homeocerus signatus* Walker, 1871, *Homeocerus borealis* Distant, 1918 (Coreidae) and *Serinetha augur* (Fabricius, 1781) (Rhopalidae) were collected from areas falling in the campus of Punjabi university, Patiala (Punjab) and Ghumarwin district, Bilaspur (H.P) during the period extending from July to October. Live male specimens were dissected in 10% NaCl solution to take out internal reproductive organs which were cleaned off the fat bodies and were preserved in 70% alcohol. Morphology of intact internal reproductive organs was studied under stereo-zoom microscope, line drawn using camera lucida and photographed using image processing unit.

RESULTS AND DISCUSSION

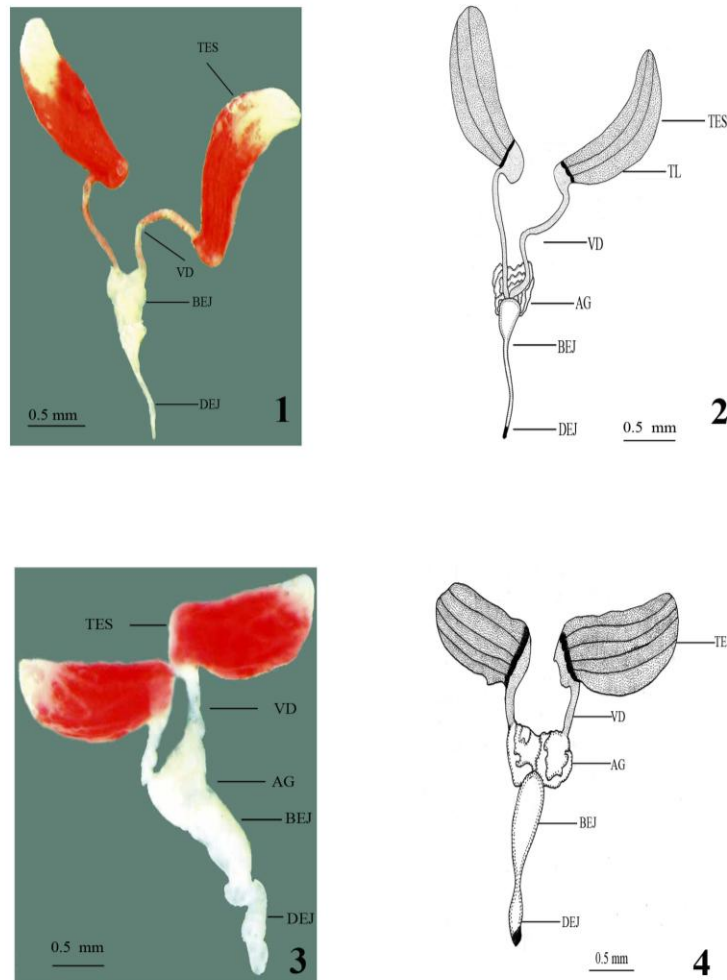
The male reproductive tract of heteropteran insects typically consists of a pair of testes, a pair of vas deferens, a pair of seminal vesicles, a complex bulbus ejaculatorius, a pair of ectodermal sacs, a ductus ejaculatorius and accessory glands. Testes are primary male reproductive organs which lie suspended in the body cavity above or below the gut often close to the midline. Each testis is composed of testicular

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lobes which are usually enclosed in a common sheath making it a fairly compact body. Testicular follicles open separately into the mesodermally derived sperm duct or vas deferens which usually expands posteriorly to form a sperm storage organ or vesicula seminalis that opens into the ejaculatory duct.

Pentatomidae (Figure 1-4)

Internal male reproductive organs of *Aeliomorpha lineaticollis* (Figure 1-2) and *Piezodorus rubrofasciatus* (Figure 3-4) have earlier been described by Abassi (1973). However, differences with respect to number of testicular follicles have been observed. In *Aeliomorpha lineaticollis*, each testis is composed of three testicular lobes which is in contrast to the findings of Abassi (1973) who reported five testicular lobes in each testis of this species. In *Piezodorus rubrofasciatus*, five testicular lobes are present in each testis instead of five as reported by Abassi (1973). Number of testicular lobes have been found to be variable in Pentatomidae being three in *Acrosternum graminea* and *Aeliomorpha lineaticollis* (Abassi, 1973; Kaur and Patial, 2012), four in *Tarisa fraudatrix* (Abassi, 1973), five in *Piezodorus rubrofasciatus* and *Graphosoma lineatum* (Kaur and Patial, 2012; Ozyurt *et al.*, 2013b), six in *Nezara viridula* and *Halys dentatus* (Abassi, 1973; Jyoti *et al.*, 2015) and seven in *A. amygdale*, *C. complanatus* and *Eurydema ventrale* (Adams, 2001; Souza *et al.*, 2011; Ozyurt *et al.*, 2015).



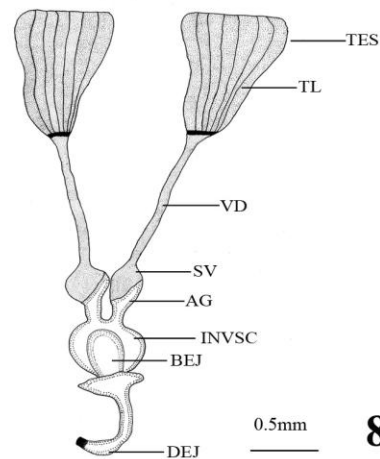
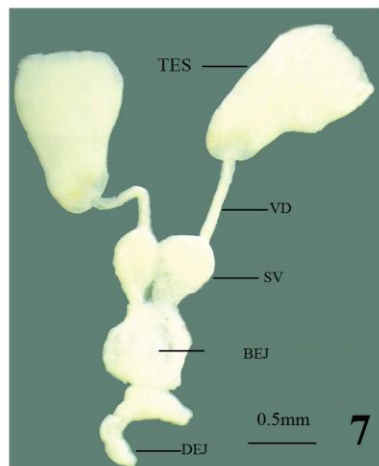
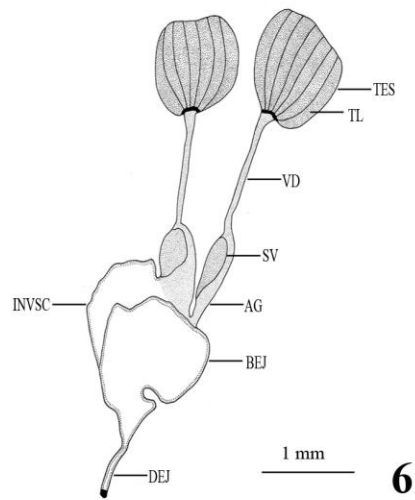
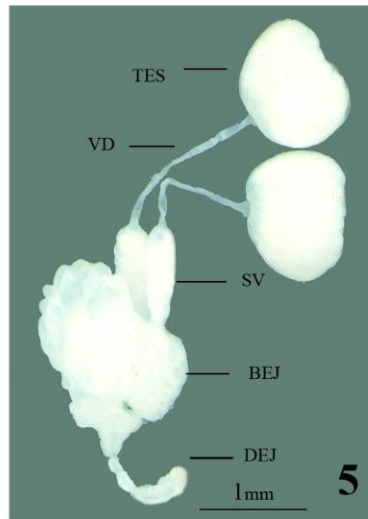
Figures 1-2: *Aeliomorpha Lineaticollis*; 1- Photomicrograph of Internal Male Reproductive Organs ; 2- Camera Lucida Diagram of Internal Male Reproductive Organs
Figures 3- 4: *Piezodorus Rubrofasciatus*; 3- Photomicrograph of Internal Male Reproductive Organs; 4- Camera Lucida Diagram of Internal Male Reproductive Organs

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Coreidae (Figure 5-8)

Testes are broad cup-shaped in *Homoeocerus signatus* (Figure 5-6) and elongate cup-shaped in *Homoeocerus borealis* (Figure 7-8), each comprising seven testicular lobes as observed also in *Homoeocerus varialbilis* by Abassi (1973). However, Qadri (1949) reported two testicular lobes in *Homoeocerus* sp. In *Homoeocerus signatus* and *Homoeocerus borealis*, testes are wrapped in green sheath. However, in *Homoeocerus varialibis*, sheath is red as observed by Abassi (1973). Green sheath has not been earlier reported in any of the coreid.

In *Homoeocerus signatus* and *Homoeocerus borealis*, accessory gland runs alongside the posteriorly placed seminal vesicle. Bulbus ejaculatorius is enclosed in an investing sac. Similar observations have been reported in *Homoeocerus varialibis* by Abassi (1973).



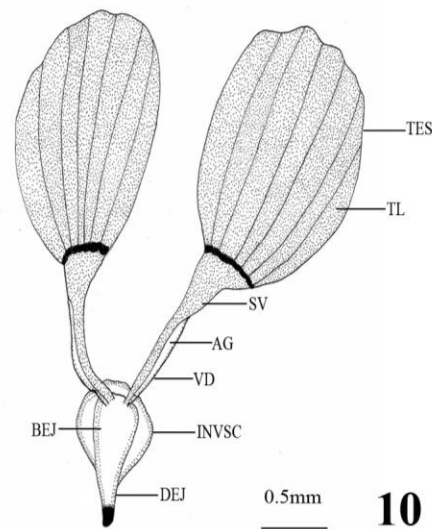
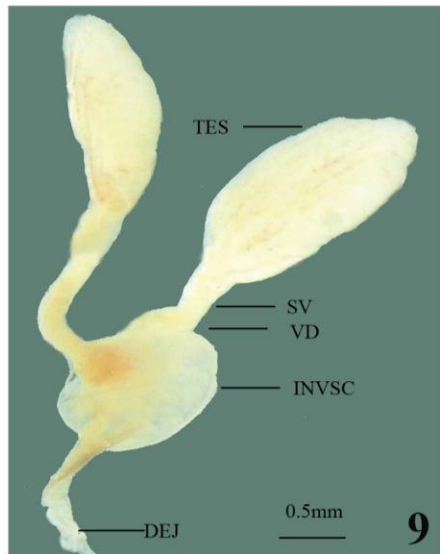
Figures 5-6: *Homeocerus Signatus*; 5- Photomicrograph of Internal Male Reproductive Organs; 6- Camera Lucida Diagram of Internal Male Reproductive Organs
Figures 7-8: *Homeocerus Borealis*; 7- Photomicrograph of Internal Male Reproductive Organs; 6- Camera Lucida Diagram of Internal Male Reproductive Organs

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Rhopalidae (Figure 9-10)

Testes of *Serinetha augur* (Figure 9-10) are spatulate-shaped, each comprising seven testicular lobes enclosed in an orange sheath. Seven testicular lobes enclosed in red sheath have earlier been recorded in *Rhopalus subrufus*, *Liorhyssus rubicundes*, *Liorhyssus hyalinus* and *Niesthrea sidae* (Pendergrast, 1957; Kumar, 1965b; Abassi, 1973; Souza *et al.*, 2009). However, Gomes *et al.*, (2013) reported four testicular lobes in *Jadera sanguinolenta* and five testicular lobes in *Jadera* sp. wrapped in orange sheath.

In *Serinetha augur*, seminal vesicles are apically placed and slightly swollen as also recorded in *Rhopalus subrufus*, *Liorhyssus rubicundes* and *Liorhyssus hyalinus* (Pendergrast, 1957; Kumar, 1965b; Abassi, 1973). In *Serinetha augur*, accessory glands run along the lateral margin of vasa deferentia to open into ductus ejaculatoris which is small and curved. Lateral position of accessory glands is also reported in *Liorhyssus hyalinus* by Abassi (1973). Ductus ejaculatoris is small and curved in *Rhopalus subrufus*, *Myrmus mirmiformis* and *leptocoris mitallata* (Pendergrast, 1957; Kumar, 1965) but straight in *Liorhyssus hyalinus* (Abassi, 1973).



Figures 9-10: *Serinetha Augur* 9- Photomicrograph of Internal Male Reproductive Organs; 10- Camera Lucida Diagram of Internal Male Reproductive Organs
 Scale bars= 0.5mm and 1mm.

Conclusion

Pentatomidae and Rhopalidae show variations in the number of testicular lobes with three, four, five, six and seven in the former and four, five and seven in the latter. In Coreidae, seven testicular lobes are present with the only exception found in *Homoeocerus* sp. which has two testicular lobes. Green coloured testes observed in *Homoeocerus signatus* and *Homoeocerus borealis* have been recorded for the first time in any of the Heteropteran.

Abbreviations

- AG - Accessory Glands,
- BEJ - Bulbus Ejaculatorius,
- DEJ - Ductus Ejaculatorius,
- INVSC Investing Sac,
- SV - Seminal Vesicle,
- TES - Testis,
- TL - Testicular Lobes,
- VD - Vas Deferens

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