Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231-6345 (Online)
An Online International Journal Available at http://www.cibtech.org/jls.htm
2012 Vol. 2 (1) January- March, pp. 317-324/Kaur and Patia
Research Article

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

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ABSTRACT
Characteristic features of internal male reproductive organs of ten species of suborder Heteroptera *viz. Carbula sutellata* Distant, 1887, *Erthesina fullo* (Thurnberg, 1783) and *Tropicoris punctipes* Stal, 1876 (Pentatomidae), *Cletus pallescens* Walker, 1871, *Cletus punctulatus* (Westwood, 1842) and *Brachytes bicolor* Westwood, 1842 (Coreidae), *Dysdercus evanescens* Distant,1902 and *Ectatops gelanor* Kirkadly & Edwards, 1902 (Pyrrhocoridae), *Physopelta gutta* (Burmeister, 1834) (Largidae) and *Repipta taurus* (Fabricius, 1803) (Reduviidae) are described and compared to identify family-specific characteristics. In all the studied species, internal male reproductive organs are comprised of paired testes, vasa deferentia, seminal vesicles, a bulbus ejaculatorius, ductus ejaculatorius and paired accessory glands. The present paper revealed that internal male reproductive system of Pentatomidae is in its simplest form without a well demarcated seminal vesicle. In Pyrrhocoridae and Largidae, seminal vesicle is apically placed while in Coreidae, it is distally or centrally placed. Accessory glands in Pentatomidae, Pyrrhocoridae and Largidae cover the vasa deferentia distally while in Coreidae, they laterally wrap three fourth portion of the seminal vesicle. In Reduviidae, accessory glands alongwith their ducts constitute a separate system which opens directly into the bulbus ejaculatorius.

Key Words: *Heteroptera, Morphology, Male Reproductive Organs*

INTRODUCTION
Heteroptera is a large group of insects consisting of 75 families and approximately 90,000 species found in all climates from tropical to arctic (Schuh and Slater, 1995). It is economically an important group as it includes both useful (predators) and harmful insects (pests). The presence of distinct scutellum on the back and elongate piercing-sucking mouthparts are the characteristic features of this suborder.
Morphology of male reproductive organs, like any other character, has undergone modifications to overcome stresses and strains of habitat and environmental ecology (Abbasi, 1973). Various aspects of comparative morphology of internal reproductive system have been investigated in the past decades and evolutionary trends have been discussed on the basis of variations recorded in the structure of testes, vasa deferentia, seminal vesicle, ductus ejaculatorius, bulbus ejaculatorius and accessory glands (Pendergrast, 1957 and Abbasi, 1973). In India, major works on morphology of internal reproductive system have been done by Rai & Trehan (1964), Bhargava (1967) and Sharma and Livingstone (1978). In the present paper, the characterstics features of internal male reproductive organs of ten heteropteran species belonging to five families *viz*. Pentatomidae, Coreidae, Pyrrhocoridae, Largidae and Reduviidae have been described, and similarities and dissimilarities among different families have been discussed.

MATERIAL AND METHODS
Male specimens of *Carbula scutellata* Distant, 1887, *Tropicoris punctipes* (Thurnberg, 1783), *Erthesina fullo* Stal, 1876 (Pentatomidae), *Cletus pallescens* Walker, 1871, *Cletus punctulatus* (Westwood, 1842), *Brachytes bicolor* Westwood, 1842 (Coreidae), *Dysdercus evanescens* Distant, 1902, *Ectatops gelanor* Kirkadly & Edwards, 1902 (Pyrrhocoridae), *Physopelta gutta* (Burmeister, 1834) (Largidae) and *Repipta taurus* (Fabricius, 1803) (Reduviidae) were collected from areas falling in the campus of Punjabi university, Patiala (Punjab) and Ghumarwin distt., 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

Testis is the basic component of the male reproductive system suspended in the body cavity by fat body. Each testis is composed of testicular lobes which are usually enclosed in a common sheath making it a fairly compact body. Male reproductive organs of ten species belonging to five different families of Heteroptera are described and their characteristic features are compared to identify family specific characteristics, if any.

Pentatomidae (Figure 1-6)

Testes are elongate-ovoid in *Carbula scutellata* (Figure 1-2) and elongated in *Tropicoris punctipes* (Figure 3-4) and *Erthesina fullo* (Figure 5-6) as has earlier been observed in other pentatomids by Pendergrast (1956), Abbasi (1973), Santos *et al.* (2003) and Walkymario *et al.* (2011). There are five testicular lobes in *Carbula scutellata* but in *Erthesina fullo* and *Tropicoris punctipes*, the number is not evident from outside. Testicular lobes are enclosed in red sheath in all of them. From the base of each testis arises red coloured vas deferens which is slightly swollen in the apical region but not demarcated into a distinct seminal vesicle. In most of the pentatomids, distinct seminal vesicle is absent with exceptions observed in *Nezara viridula*, *Brachymena cincta* and *Dolycoris indicus* (Pendergrast, 1956; Abbasi, 1973, Santos *et al*. 2003).

Accessory glands are tubular and wrap each vas deferens at its distal region before its junction with bulbus ejaculatorius in the three studied species as has been observed in other pentatomids by Abbasi (1973) and Santos *et al*. (2003).

Bulbus ejaculatorius is pear-shaped in *Carbula scutellata* and is enclosed in an investing sac. In *Tropicoris punctipes*, it is bulbous apically and tapers down basally while in *Erthesina fullo*, it is elongated. Investing sac is absent in both of these species. Presence of investing sac has been recorded in *Nezara viridula*, *Piezodorous lituratis* (Pendergrast, 1956 & 1957), *Dalpada versicolor* (Kumar, 1962), *Piezodorous rubrofasciatus*, *Aeliomorpha lineaticollis* and *Eysarcoris inconspicuus* (Abbasi, 1973). However, in *Oebalus poecilus* and *Podisus nigrispinus*, it has been found to be absent (Santos *et al*. 2003, Lemos *et al*. 2005).

Coriedae (Figure 7-12)

Testes are rosette-shaped in *Cletus pallescens* (Figure 7-8) and *Cletus punctulatus* (Figs 9-10) as has been observed in most of the coreids by Pendergrast (1957) and Abbasi (1973). In *Brachytes bicolor* (Figs 11-12), however, testes are narrow-elongated which is an exception not reported so far in Coreidae. There are seven testicular lobes in *Cletus pallescens*, *Cletus punctulatus* and *Brachytes bicolor* similar to other coreids (Pendergrast, 1957; Kumar, 1965b; Abbasi, 1973). Entire internal reproductive system is wrapped in orange coloured sheath in *Cletus pallescens* and *Cletus punctulatus* while in *Brachytes bicolor*, only testes are covered and the sheath is green.

A distinct seminal vesicle is present in all the species. It is placed in the middle of vas deferens in *Cletus pallescens* and distally placed in *Cletus punctulatus* and *Brachytes bicolor*. In Coreidae, mostly the seminal vesicles are placed distally except *Cletus rubidiventris* in which seminal vesicle is apically placed (Kumar, 1965b; Abbasi, 1973).

In *Cletus punctulatus,* bulbus ejaculatorius is enclosed in the investing sac while in *Cletus pallescens* and *Brachytes bicolor,* investing sac is absent as is also observed in *Coreus marignatus* by Pendergrast (1957). In all the three studied species, accessory gland starts from anterior region of the seminal vesicle and wraps the seminal vesicle laterally as is commonly observed in other coreids (Abbasi, 1973).

Pyrrhocoridae (Figure 13-16)

Testes are comma-shaped in *Dysdercus evanescens* (Figs 13-14) and bean-shaped in *Ectatops gelanor* (Figure 15-16). The sheath enclosing the testes is light yellowish-orange in *Dysdercus evanescens* and

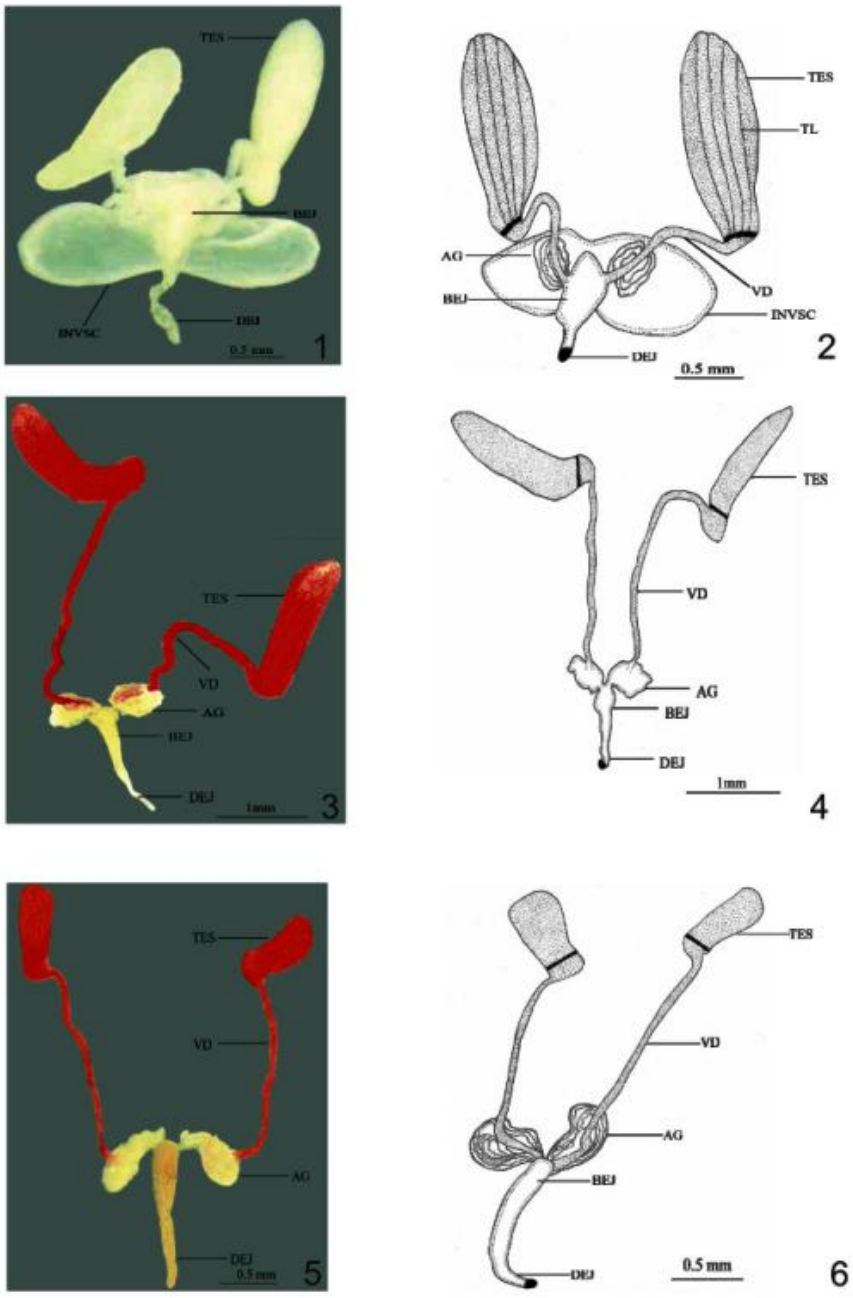


Figure legends

Pentatomidae (Figure 1-6)

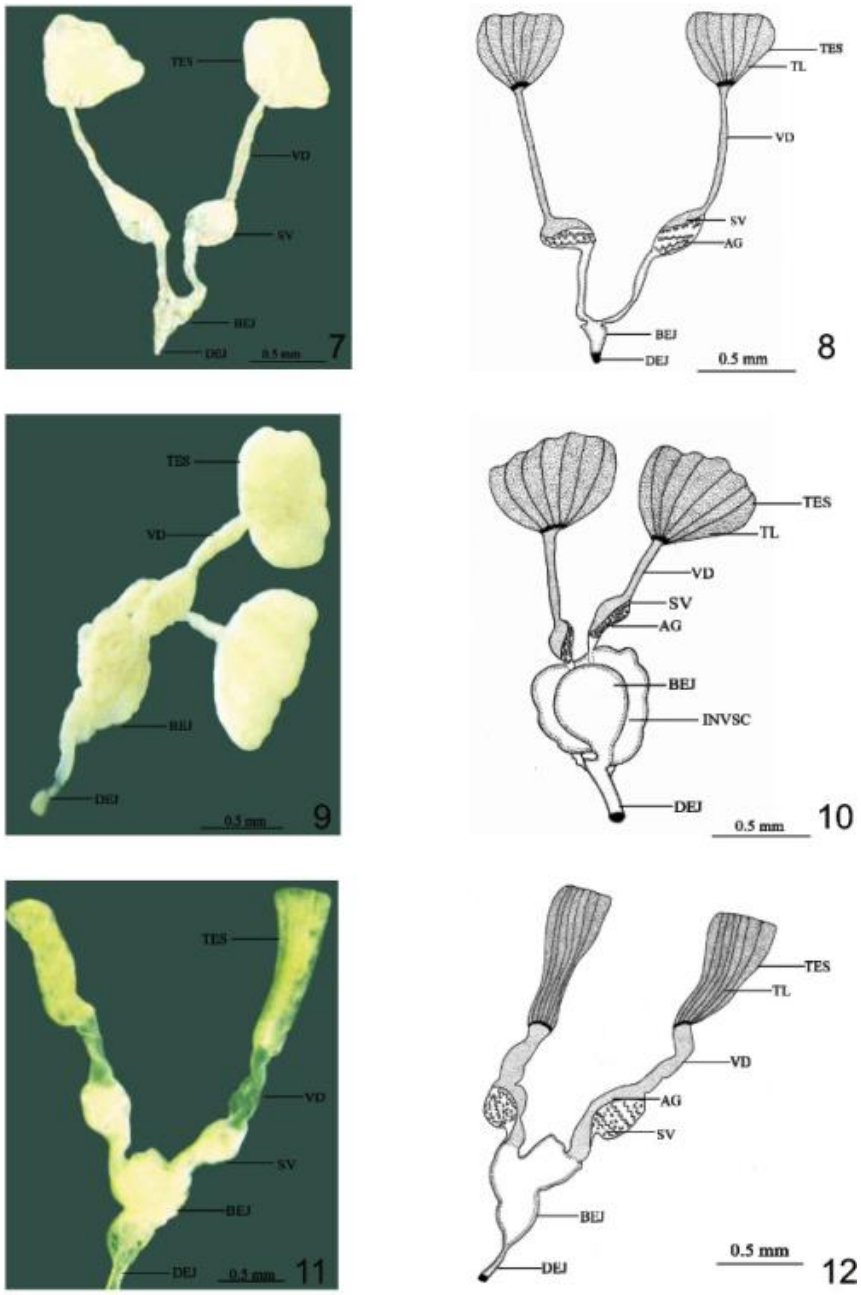
Figure 1-2. *Carbula scutellata*, 1- Microphotograph of internal male reproductive organs (red colour of testes faded in preservative); 2- Camera lucida diagram of internal male reproductive organs.

Figure 3-4. *Erthesina fullo*, 3- Microphotograph of internal male reproductive organs; 4- Camera lucida diagram of internal male reproductive organs.

Figure 5-6. *Tropicoris punctipes*, 5- Microphotograph of internal male reproductive organs; 6- Camera lucida diagram of internal male reproductive organs.

Abbreviations

AG - Accessory glands, BEJ - Bulbus ejaculatorius, DEJ - Ductus ejaculatorius, INVSC Investing sac, SV - Seminal vesicle, TES - Testis, TL - Testicular lobes, VD - Vas deferens.



Coreidae (**Figure 7-12**)

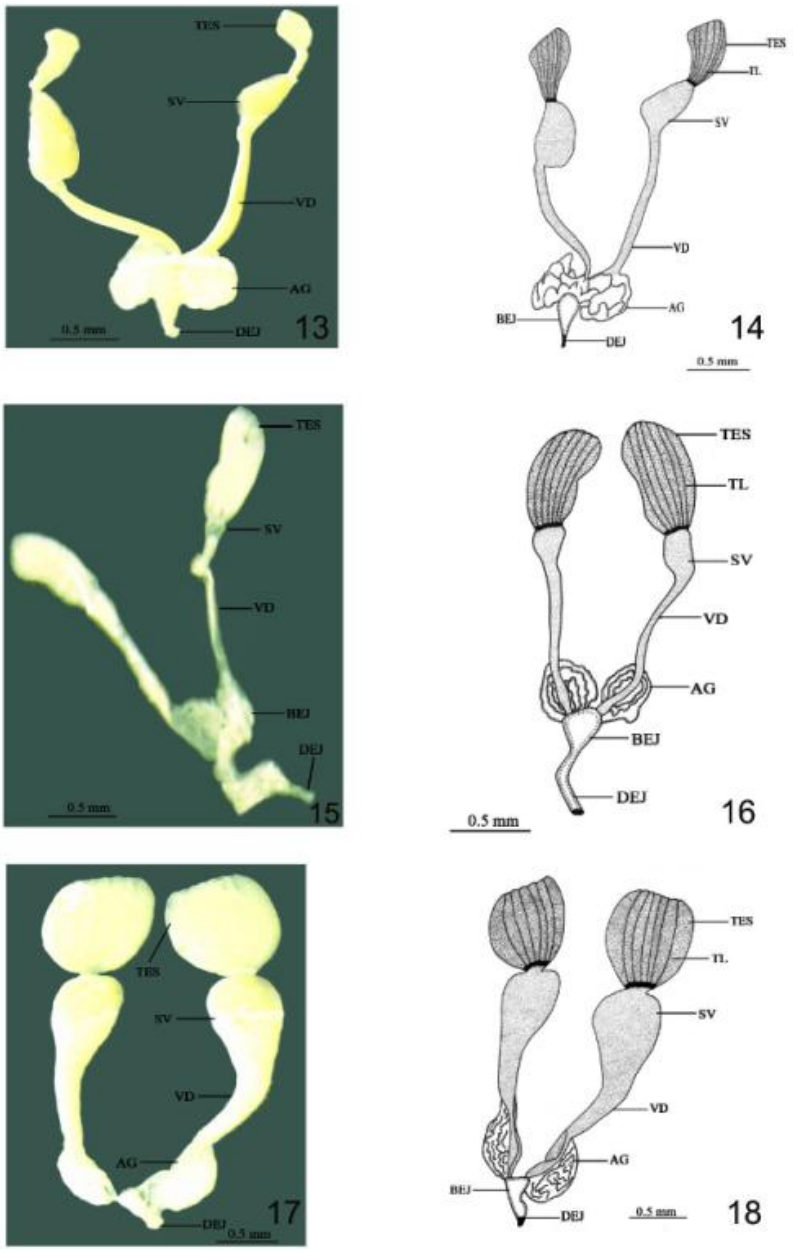
Figure 7-8. *Cletus pallescens*, 7- Microphotograph of internal male reproductive organs (orange colour of testes faded in preservative); 8- Camera lucida diagram of internal male reproductive organs.

Figure 9-10. *Cletus punctulatus*, 9- Microphotograph of internal male reproductive organs; 10- Camera lucida diagram of internal male reproductive organs.

Figure 11-12. *Brachytes bicolor*. 11- Microphotograph of internal male reproductive organs; 12- Camera lucida diagram of internal male reproductive organs.

Abbreviations

AG - Accessory glands, BEJ - Bulbus ejaculatorius, DEJ - Ductus ejaculatorius, INVSC Investing sac, SV - Seminal vesicle, TES - Testis, TL - Testicular lobes, VD - Vas deferens.



Pyyrhocoridae (Figure 13-16)

Figure 13-14. *Dysdercus evanescens*. 13- Microphotograph of internal male reproductive organs (Yellow colour faded in the preservative); 14- Camera lucida diagram of internal male reproductive organs.

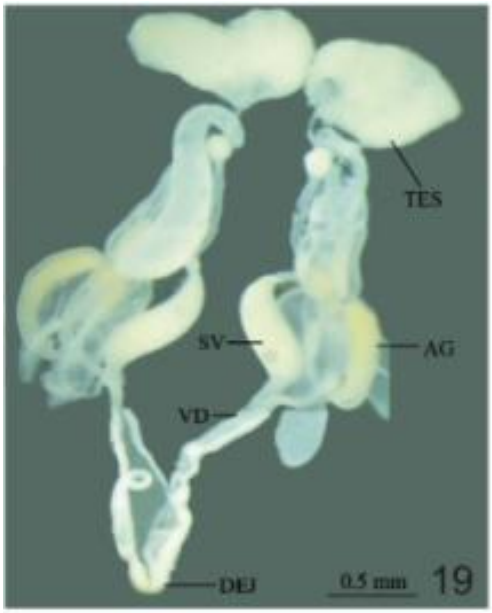
Figure 15-16. *Ectatops gelanor*, 15- Microphotograph of internal male reproductive organs; 16- Camera lucida diagram of internal male reproductive organs.

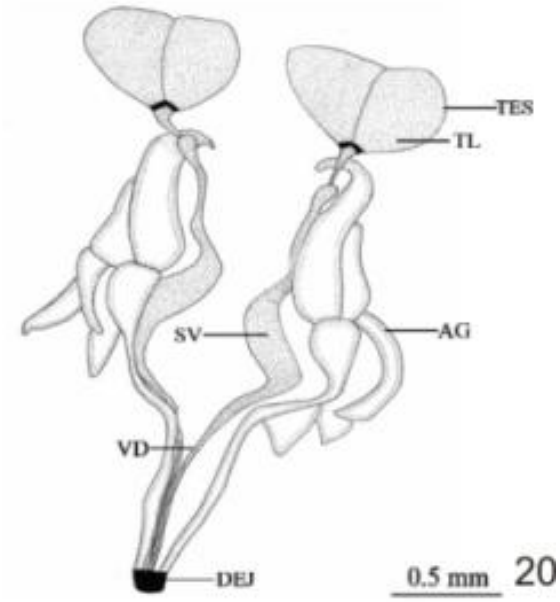
Largidae (Figure 17-18)

Figure17-18 *Physopelta gutta*. 17- Microphotograph of internal male reproductive organs; 18- Camera lucida diagram of internal male reproductive organs.

Abbreviations

AG - Accessory glands, BEJ - Bulbus ejaculatorius, DEJ - Ductus ejaculatorius, INVSC Investing sac, SV - Seminal vesicle, TES - Testis, TL - Testicular lobes, VD - Vas deferens.





Reduviidae (Figure 19-20)

Figure 19- 20 *Repipta taurus*. 19- Microphotograph of internal male reproductive organs; 20- Camera lucida diagram of internal male reproductive organs.

Abbreviations

AG - Accessory glands, BEJ - Bulbus ejaculatorius, DEJ - Ductus ejaculatorius, INVSC Investing sac, SV - Seminal vesicle, TES - Testis, TL - Testicular lobes, VD - Vas deferens.

creamy-white in *Ectatops gelanor*. There are seven testicular lobes in the testes of both the species. In Pyrrhocoridae, all the taxa studied so far, are observed to have seven testicular lobes. (Weber, 1930; Pendergrast, 1957; Kumar, 1968; Abbasi, 1973; Grozeva & Kuznetsova, 1992). In *Dysdercus evanescens* and *Ectatops gelanor*, vasa deferentia are very long. Seminal vesicles are apically placed in both the species. Bulbus ejaculatorius is more or less pear-shaped. Investing sac is absent. However, a sac like investment on dorsal surface of the bulbus ejaculatorius has been observed in *Dysdercus fasciatus* (Pendergrast, 1957) and *Dysdercus koenigii* (Abbasi, 1973) while in *Dindymus* sp., the investing sac has been seen to cover the middle and central layers of the bulbus ejaculatorius (Kumar, 1968).

Tubular accessory glands cover the vas deferens posteriorly and its junction with the bulbus ejaculatorius. A similar condition has been observed in *Pyrrhocoris apterus* (Pendergrast, 1957) and *Dindymus* sp. (Kumar, 1968)

Largidae (Figure 17-18)

Rosette-shaped testis of *Physopelta gutta* (Figs 17-18) is composed of seven testicular lobes as is observed in some coreids (Pendergrast, 1957; Kumar, 1965b; Abbasi, 1973) and in all pyrrhocorids (Weber, 1930; Pendergrast, 1957; Kumar, 1968; Abbasi, 1973; Grozeva & Kuznetsova, 1992). Seminal vesicles are apically placed as is observed in Pyrrhocorids. Accessory gland wraps each vas deferens in the distal region before its junction with ejaculatory bulb.

Reduviidae (Figure 19-20)

In *Repipta Taurus* (Figs 19-20), testes are anteriorly bipartite structures enclosed in red sheath. Two lobes are distinctly observed from outside. However, in *Sinea diadema* (Pendergrast, 1957) and *Cosmoclopius nigroannulatus* (Jahnke *et al.*, 2006), there are seven testicular lobes. Vas deferens arises from the base of each testis, shows a distinct but small swelling after a short distance, runs for a distance, then again shows

an elongated swollen region and finally runs backward to open into the ductus ejaculatorius. Morphologically, it is not clear which part is the seminal vesicle, the anterior small swelling or the posterior elongated swelling. In *Cosmoclopius nigroannulatus,* duct from each testicular tubule is highly convoluted to form epididymis while seminal vesicle is reported to be absent (Jahnke *et al*., 2006).

Bulbus ejaculatorius is not apparently distinct in *Repipta taurus* which shows similarity to the findings of Pendergrast (1957) and Jahnke *et al.* (2006) in *Sinea diadema* and *Cosmoclopius nigroannulatus* respectively.

Each of the paired accessory glands consists of five lobes which open into a duct that runs alongside the vas deferens and opens into the ductus ejaculatorius. In *Cosmoclopius nigroannulatus*, however, each gland consists of four lobes.

The present study reveals that internal male reproductive system in Pentatomidae is in its simplest form with testicular tubules enclosed in a sheath and a simple vas deferens without a well demarcated seminal vesicle. Seminal vesicle is apically placed in Pyrrhocoridae and Largidae, and distally or centrally placed in Coreidae. Descended, somewhat distal position of seminal vesicle is considered to be a specialized feature derived from primitive apical position (Kumar, 1962; Ahmad & Abbasi, 1971). Morphological studies indicate close proximity between Pyrrhocoridae and Largidae. Accessory glands cover the vasa deferentia distally in Pentatomidae, Pyrrhocoridae and Largidae while in Coreidae, they laterally wrap almost three fourth portion of the seminal vesicle. With respect to investing sac, family-specific conditions are not evident. In Reduviidae, accessory glands alongwith their ducts constitute an independent system opening directly into the bulbus ejaculatorius.

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