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Phylogenetic Significance of Male Genitalic Characters in Indian Zygopinae (Curculionidae : Coleoptera)

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Abstract: *The present study includes detailed observations on the male genitalia of subfamily Zygopinae belonging to six tribes. Out of the six tribes studied, Isorhynchini and Coryssomerini are exceptional in lacking parameres while the remaining four tribes viz., Lobotrachelini, Mecopini, Othippiini and Sphadasmini show the presence of parameral processes. The variations relate to the shape of aedeagus, length of aedeagal and phallobasic apodeme and structure of gastral spiculum. The presence or absence of parameral processes of the phallobase also provides useful demarcative structures.*

Keywords: *Curculionidae, Genitalia , Phylogenetic , Tribe, Zygopinae*

I. Introduction

The subfamily Zygopinae is one of the largest subfamilies of `Curculionidae Phanerognathes` which includes long-snouted weevils. Its members are marked by the close approximation of the eyes on the frons. The weevils are usually dark in colour but ornamented with variously coloured scales or setae of different shape and size , forming different patterns .The number of described weevils fauna known is nearly 62,000(1). The subfamily Zygopinae has worldwide distribution under which nearly 2000 species under 197 genera(2). So far, no effort has been made to make the comparative study of male genital organ in different tribes of this subfamily and to find the taxonomic variations at different levels. However, the pioneer work on the taxonomy of Indian Zygopinae (3-9) but no mentioned of any account regarding the variations in the structure of male genital organ . Accordingly, during the present investigation an attempt has been made to highlight the significance of the genital differences in the lower taxa under different tribes of subfamily Zygopinae.

II. Material and Methods

The material for the present study represent fauna of different States and Union Territories of India. The collection surveys were made largely during the summer months i.e., between April and September. The surveyed areas include both the planes and the hilly regions. In addition to the collected material, specimens of some species have been taken on loan from the Forest Research Institute, Dehradun, British Museum (Natural History), London and Hungarian National History Museum, Budapest. The male genitalia were taken out from the freshly killed as well as from dry specimens. The genitalia extracted from such specimens were placed in 10 % Potassium hydroxide for 2-8 hours to soften the chitin and to dissolve away the mussels and other soft parts. The potashed material was washed with distilled water and the residual traces of Potassium hydroxide were removed in 1 % Glacial Acetic Acid. The material was again washed with distilled water and dehydrated in different grades of alcohol. After complete dehydration, the material was cleared in clove oil for overnight before mounting in Canada balasam.

2.1 Observations and Discussions

The male genitalia include copulatory organ and supporting parts of the eighth and ninth abdominal segments .The eighth tergite form the pygidium and ninth is completely membranous, and the ninth sternite is modified into a long gastral spiculum which is usually forked at the base. Previous workers have utilized the structure of aedeagus and the phallobase for characterizing different families of Curculionoidea and subfamilies of Curculionidae (10-15) . The study made on early Zygopinae weevil in early Miocene amber does not mentioned of any observations pertaining to external genitalia.(16) However ,a comparative account of the structure of these organs in subfamily Zygopinae has not been carried out so far. . An account of female genitalia of Curculionoidea including only four species of this subfamily was published (17). The genitalia were also studied in tribe Lobotrachelini , Isorhynchini and Mecopini (18-20).

The structure of male genitalia is studied species shows that it conforms to a basic pattern characteristic of family Curculionidae in general .The aedeagus has its dorsal wall poorly sclerotized and its ventral wall well sclerotized, as also stated by Morimoto(21) , but the degree of sclerotization shows a good deal of variation in different species. The male genitalia in this subfamily consists of the straight or somewhat curved aedeagus prolonged into a pair of apodeme .The aedeagus is comprised by the outer hardened exophallous and the invaginated flexible endophallous which is studded with a variety of sclerotized structures such as spines,

tubercles, plates and rods. The variety of endohhallic armature provides the most reliable character for the discrimination of closely related species. The phallobase is usually ring shaped encircling the base of aedeagus. It is provided with an apodeme of variable size and in few genera with a pair of strongly developed to poorly developed parameral processes. The male genitalia is also provided with another sclerotized Y- shaped or rod-shaped structure which represents total or partial transformation of the ninth abdominal sternite and is known as gastral spiculum. This supports the aedeagus from below. In addition it also helps in the protection of the same.

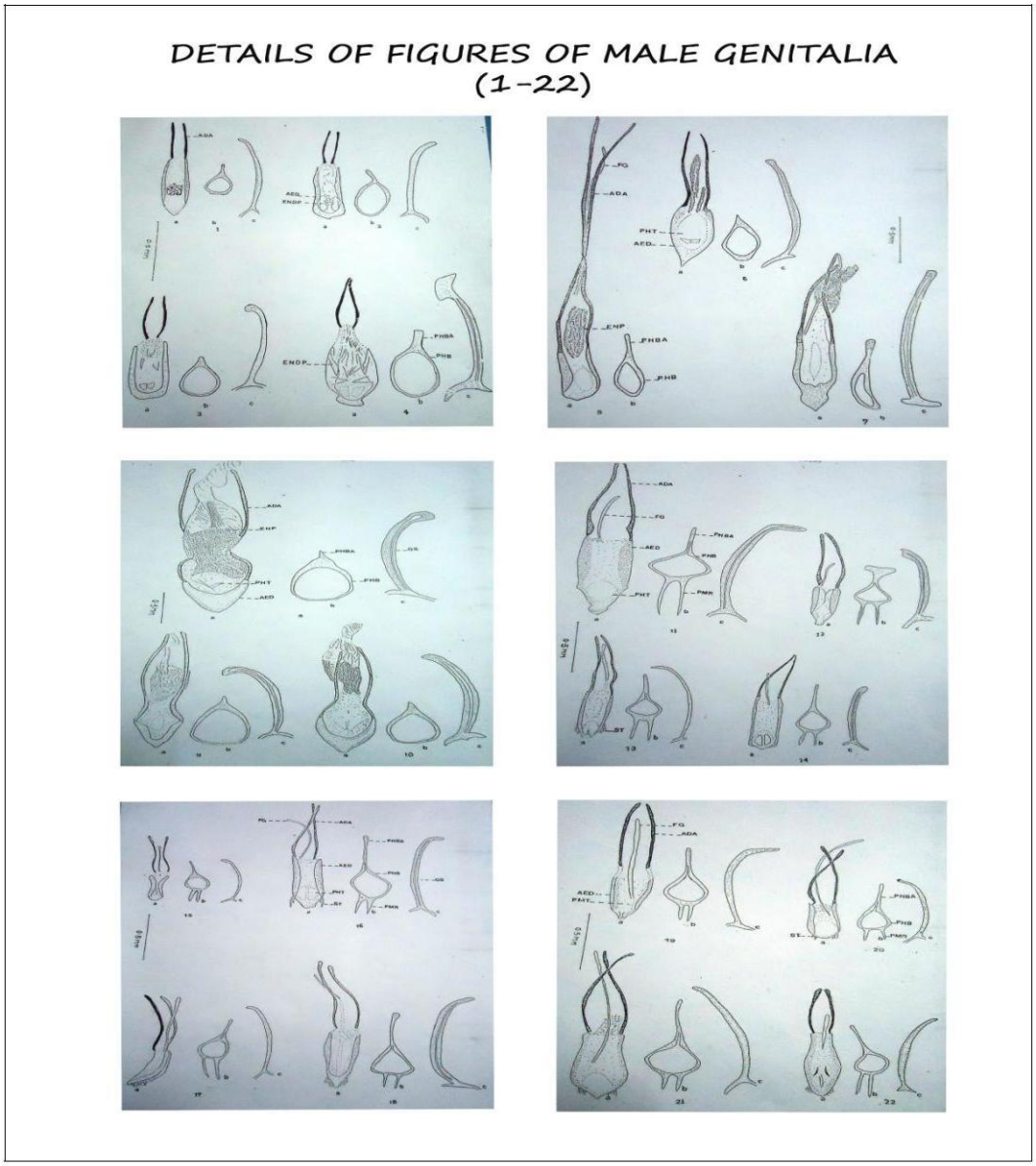
Out of the six tribes include in this work, Isorhynchini and Coryssomerini are exceptional in lacking parameres. The remaining four tribes viz., Lobotrachelini, Mecopini, Othippiini and Sphadasmini show the presence of parameral processes.

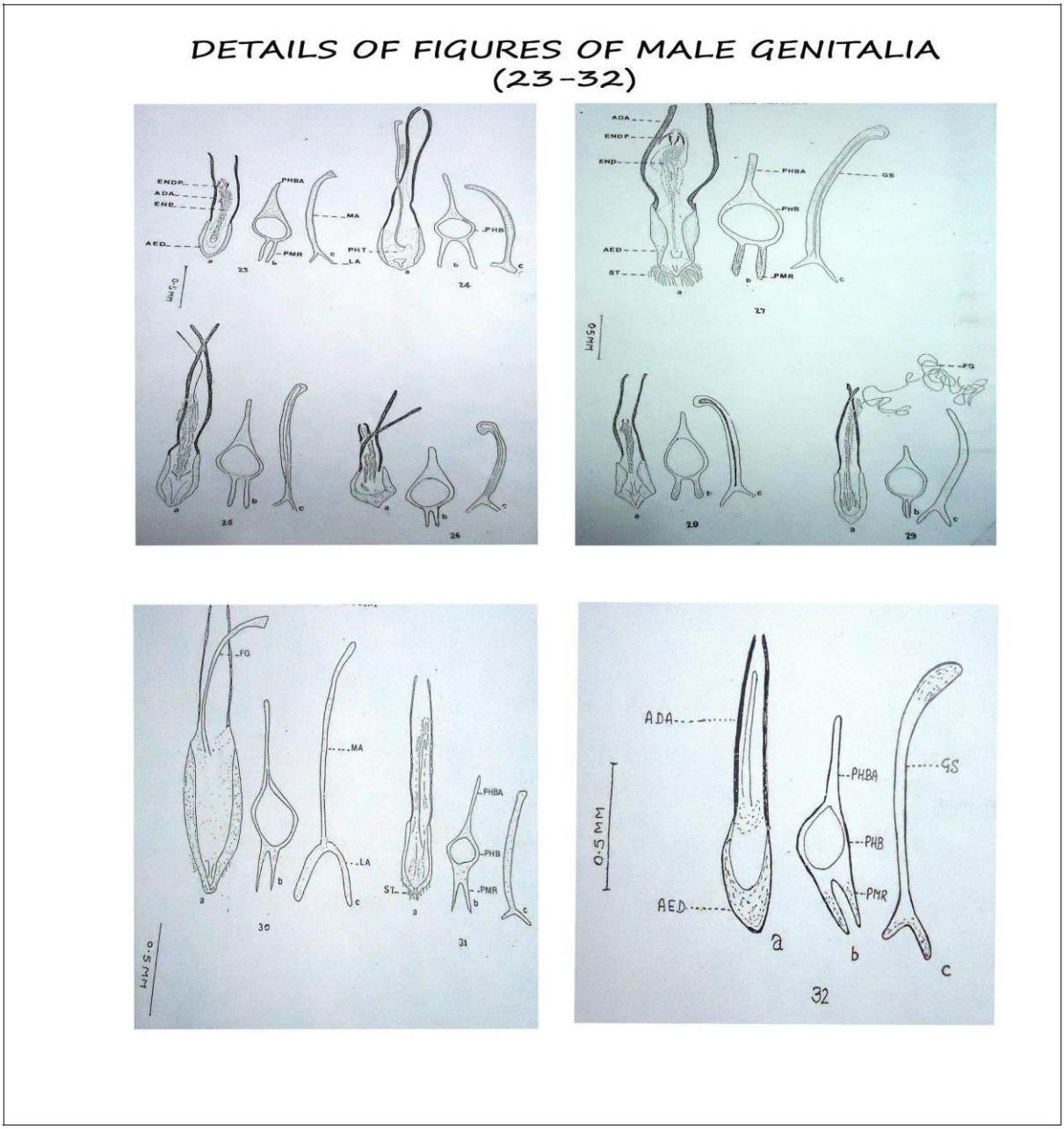
2.2 Tribe Isorhynchini (Figs. 1-4)

The Isorhynchini is characterized by short aedeagal apodemes and complex endophallic armature constituted by plates. The three genera of tribe Isorhynchini viz., *Telephae* Pascoe, *Kumuzo* Morimoto and *Hemisulcus* Kumar & Pajni be separated on the basis of the endophallic armature and the shape of the aedeagus.

2.3 Tribe Coryssomerini (Figs.5-10)

The Tribe Coryssomerini possesses long aedeagal apodemes and its two genera viz., *Osphilia* Pascoe and *Metialma* Pascoe can be separated on the basis of shape of aedeagus and the length of phallobasic apodemes. In the former, the aedeagus is usually tubular and the phallobasic apodeme well developed while in the latter, the aedeagus is usually transverse and phallobasic apodeme quite reduced.





3. 4 Tribe Lobotrachelini (Figs. 11-22).

The tribe Lobotrachelini is characterized by the presence of rod-shaped flagellum. Out of its two studied genera, *Indolobotrachelus* Kumar has the aedeagus longer than the aedeagal apodemes but the aedeagal apodemes are usually longer than the aedeagus in *Lobotrachelus* Schonherr.

2. 5 Tribe Mecopini (Figs. 23-29).

The tribe Mecopini includes six genera viz., *Mecopus* Schonherr, *Odoacis* Pascoe, *Phylaitis* Pascoe, *Chirozetes* Pascoe, *Phempherulus* Marshall and *Mecopomorphus* Hustache, of which the two last mentioned genera have approximately close parameral processes. However, the endophallic armature is complex and the flagellum is absent in *Mecopomorphus* Hustache in contrast to simple endophallic armature and coiled flagellum in *Phempherulus* Marshall. The genus *Mecopus* Schonherr is unique in having conical aedeagus beset with fine setae at its tip and broad leaf-like parameres. Genus *Odoacis* Pascoe is characteristic in having flagellum as long as the aedeagal apodemes.

2. 6 Tribe Opthippiini (Figs. 30-31)

Under tribe Othippiini, of the two studied genera, *Chelothippia* Marshall and *Podalia* Pascoe, the former has short aedeagal apodemes and free parameral process and the latter shows longer aedeagal apodemes basally fused parameres.

2.7 Tribe Sphadasmini (Fig. 32)

From the tribe Sphadasmini, one species of genus *Sphadasminus* Schonherr is characterized by closely approximated parameral processes, short aedeagus and endophallic armature consisting of spines. It thus follows from the above discussions that the structure of male genitalia is highly species –specific .However , some genera and tribes can also be distinguished from the structures of some parts of genitalia.

III. Conclusions

Detailed observations on the male genitalia of subfamily Zygopinae belonging to tribes viz., Isorhynchini, Coryssomerini, Lobotrachelini, Mecopini, Othippiini and Sphadasmini have been described. During the present investigation, effort has been made to provide general information regarding the structure of genitalia in subfamily Zygopinae as means of divergence and phylogenetic relationship within the taxa of the subfamily and its status vis - a –vis other subfamilies . The structure of these male genital organs is highly species-specific and no two species have a similar type of male genitalia .The main discriminating characters which provide reliable tool are present in the endophallic armature i.e., spines, tubercles , plates and rods.

All the discussed variations of the species, genera and higher taxa will be suitably utilized for the working of phylogenetic relationship at different levels. This will be of immense help in updating the status of economically important species and in knowing their synonyms and limits of distribution which are likely to be proved useful in establishing ecological patterns of distribution.

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Abbreviations

AED : Aedeagus; ADA : Aedeagal apodeme; ENP: Endophallus; ENDP : Endophallic plate; FG : Flagellum; GS : Gastral spiculum; LA : Lateral arm; MA : Median arm; PHB : Phallobase; PHBA : Phallobasic apodeme; PHT : Phallotreme; PMR : Paramere; ST : Setae

7.1 Details of Figures (1-32)

1 *Telephae aeneous* Pajni &Kumar*;* **2** *Telephae marshalli* Pajni &Kumar*;* **3** *Kumozo chatterjeei* (Marshall)*;***4** *Hemisulcus fuscosuturalis* (Marshall);**5** *Osphilia bombacis* Marshall*;* **6** *Osphilia vitis* Marshall*;* **7** *Osphilia gmelinae* Marshall*;* **8** *Metialma utricae* Kumar and Pajni*;* **9** *Metialma cervicornis* Kumar & Pajni*;***10** *Metialma scenica* Pascoe*;* **11** *Lobotrachelus plumbeus (*Motschulsky*);* **12** *Lobotrachelus himalayanus* Hustache*;* **13** *Lobotrachelus bidentipus* Kumar *;* **14** *Lobotrachelus albotaeniatus* Kumar *;* **15** *Lobotrachelus urenae* Marshall*;* **16** *Lobotrachelus subfasciatus* (Motschulsky) *;***17** *Lobotrachelus laporteae* Marshall*;***18** *Lobotrachelus varietus Kumar & Pajni;* **19** *Lobotrachelus brunneofasciatus* (Motschulsky)*;***20** *Lobotrachelus heterocollis* Kumar & Pajni*;* **21** *Lobotrachelus albosetosus* Kumar & Pajni*;***22** *Indolobotrachelus corvinus* Kumar *;***23** *Mecopomorphus trivitticollis* Pajni & Kumar*;***24** *Odoacis calophylli* Marshall*;***25** *Phylaitis percinomaculata* Kumar & Pajni*;***26** *Phylaitis fuscofasciatus* Kumar & Pajni*;***27** *Mecopus bispinosus* Weber*;* **28** *Chirozetes scutellaris* (Marshall *);***29** *Pempherulus affiants* (Faust *);* **30** *Chelothippia buteae* (Marshall *);***31** *Podalia trimaculata* (Motschulsky *);***32** *Sphadasmus brahminus* Pascoe

7.2 Explanations to the figures of Male Genitalia

A: Aedeagus; b: Phallobase; C: Gastral spiculum

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