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Studies on the female genital musculature of *Acrida exaltata* (Walk.) (Orthoptera: Acrididae)

Robina Naseer, * Mohammad Amir

Department of Zoology, A.M.U., Aligarh, Uttar Pradesh, India

Abstract
The female genital musculature of grasshopper *Acrida exaltata* (Walk.) (Orthoptera: Acrididae) is described with its origin and insertion. The female genital musculature consists of mainly twenty four muscles with different origin and insertion in eighth, ninth, tenth and eleventh abdominal segments. These muscles includes median internal dorsal muscle (242), lateral internal dorsal muscle (243), median external dorsal muscle (245), median internal ventral muscle (247), lateral ventral muscle (248), internal lateral muscle (250), first external lateral muscle (251), second external lateral muscle (252), short protractor of ovipositor (256), internal dorsal muscle (260), long protractor of ovipositor (262), retractor of ovipositor (263), levator of dorsal or third valvula (271), depressor of ventral or first valvula (272), adductor of ventral or first valvula (273), adductor of dorsal or third valvula (274), muscle of intermediate or second valvula (275), depressor of cercus (287), median levator of cercus (288), lateral levator of cercus (289), ventral muscle of paraproct (291), transverse muscle (292), adductor of cercus (293) and adductor of paraproct (294).

Keywords: grasshopper, *acrida exaltata*, genital musculature, female, abdomen

Introduction
Locusts and grasshoppers have long been regarded as one of the most important group of agricultural pests belonging to the order Orthoptera. The order Orthoptera is a large order, with over 10,000 described species. The Orthoptera includes not only such familiar forms as grasshoppers, locusts and crickets but also the mole crickets and grouse locusts. They are almost terrestrial and though usually capable of jumping actively, relatively few strong fliers are known, all belonging to the family Acrididae.

Chesler [1] found that each species of *Acrida* appeared to have a particular type of habitat and that certain species were found in close association. *Acrida* genus is found in areas where grass grows thickly about two to three feet high. The wings of *Acrida* produce a noise when grasshoppers are in flight. Literature show that very scanty work has been done regarding genital musculature of grasshoppers and include works of Snodgrass [2] on *Dissosteira carolina*, Anwar [3] on *Poecilocerus pictus* and Singh and Chauhan [4] on *Chrotogonus trachypterus*. In the female, VIII and following segments contain special powerful muscles of the ovipositor. Present study deals with functional morphology of the muscles of the ovipositor of *Acrida exaltata* to fill lacunae in the literature.

Material and methods
Adult grasshoppers were collected from the field of Aligarh Muslim University campus during rainy season. They were kept and reared in insect breeding cages in the laboratory at 32±1ºC and 65% RH. Fresh bundles of grass (*Cynodon dactylon*) were supplied daily in the morning as food to grasshopper. The bundles of grass were kept in a small beaker with little water to prevent it from drying.

For the study of genitalic musculature, the apical part of female live insect was cut off and dissected under a binocular microscope in 70% alcohol by giving lateral cuts. The muscles were traced with fine forceps and needles. After that, muscles were stained with borax carmine (alcoholic) for 2 minutes. The diagrams of various muscles of the genitalia were drawn using binocular microscope.

Result and Discussion (Figs. 1, 2, 3, 4 & 5)
The genital musculature of female *A. exaltata* includes muscles associated with eighth, ninth, tenth and eleventh abdominal segments.

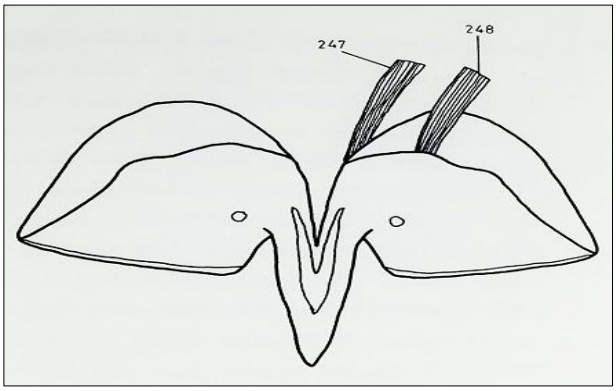

Fig 1: Sub-genital plate of *A. exaltata* and its muscles

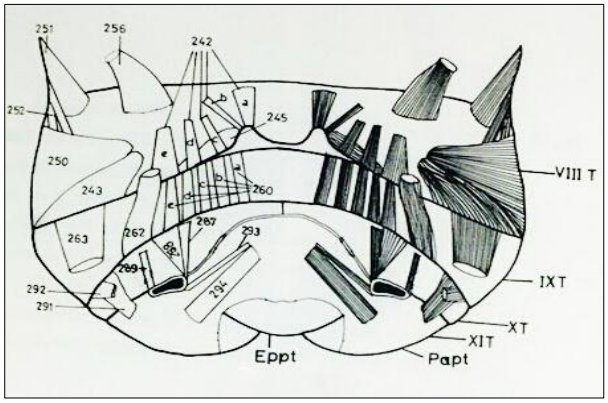

Fig 2: Supra-anal plate of *A. exaltata* and its muscles

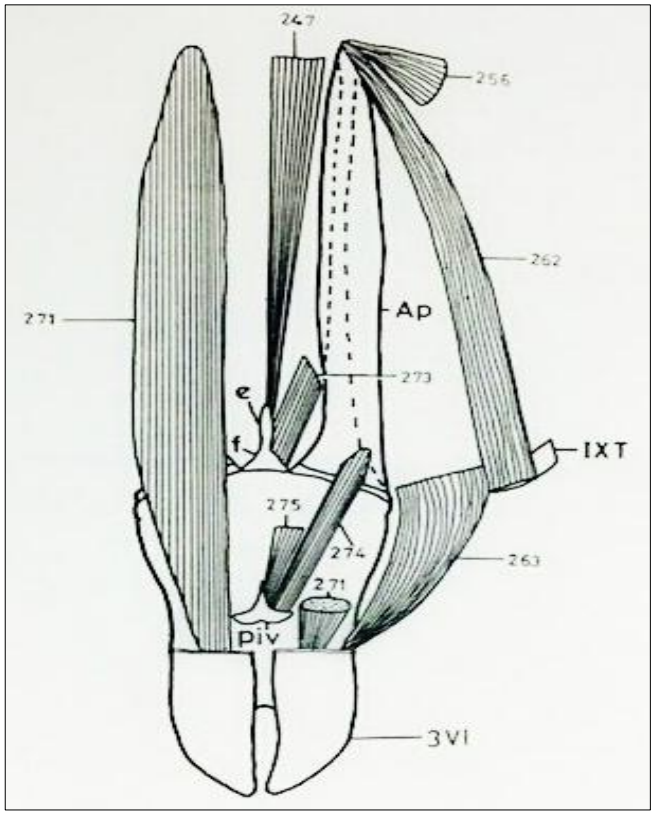

Fig 3: Ovipositor of *A. exaltata* and its muscles

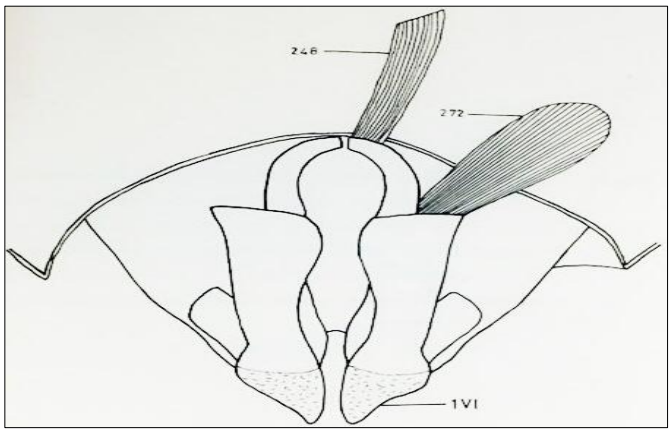

Fig 4: Ovipositor of *A. exaltata* and its muscles

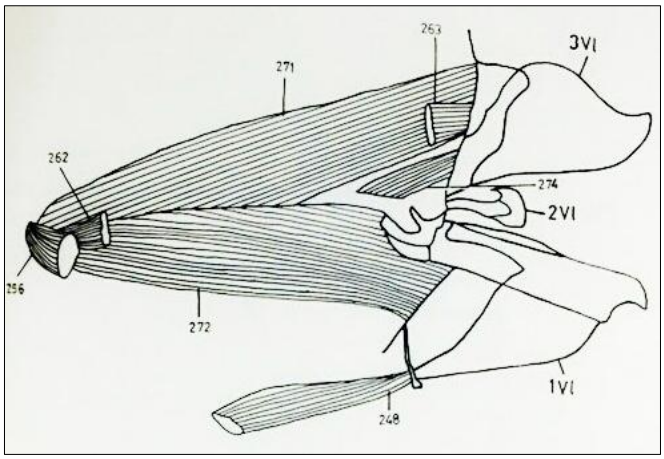

Fig 5: Ovipositor of *A. exaltata* and its muscles

Genital musculature of eighth abdominal segment

Median internal dorsal muscle (No. 242)

This muscle consist of five longitudinal fibres (a,b,c,d&e) arranged side by side in *A. exaltata*. These muscle fibres arise from eighth tergum (VIIIT) and first two branches (a&b) are inserted on apodeme of ninth tergum, while other three (c,d&e) on ninth tergum (IXT). Similar observation has been made by Snodgrass [2] and Anwar [3] in *D. carolina* and *P. pictus*. However Singh and Chauhan [4] reported its absence in *C. trachypterus*.

Lateral internal dorsal muscle (No. 243)

This muscle is comparatively much thicker than median internal dorsal muscle (242) and spread into a larger area before its insertion. It arises from eighth tergum (VIIIT) and inserted on ninth tergum (IXT). Snodgrass [2] recorded similar observation in *D. carolina*.

Median external dorsal muscle (No. 245)

This muscle is paired, thick and broad band of fibres and originates from posterior margin of eighth tergum (VIIIT) and inserted on the apodeme of ninth tergum (IXT). These findings are in agreement with those of Snodgrass [2] and Anwar [3] in *D. carolina* and *P. pictus*. However, Singh and Chauhan [4] named this muscle as second median external dorsal muscle (164) in *C. trachypterus* with similar origin and insertion like that of present study.

Median internal ventral muscle (No. 247)

These muscles are paired, long and slender and arise antero-laterally on eighth sternum (VIII) with insertion on apodeme sclerites of anterior intervalvula of ovipositor (e). However Snodgrass [2] and Anwar [3] recorded that this muscle is subdivided into two branches in *D. carolina* and *P. pictus*.

Lateral ventral muscle (No. 248)

These muscles are paired, slender and elongated which arise from the base of apodeme of eighth sternum and inserted posteriorly on anterior basal scelrite of ventral or first valvula of ovipositor. Present findings are in agreement with those of Snodgrass [2] in *D. carolina*, Anwar [3] in *P. pictus* and Singh and Chauhan [4] in *C. trachypterus* with little variation in the length of muscles.

Internal lateral muscles (No. 250)

This muscle is paired, broad and triangular arising from eighth tergum (VIIIT) and its fibres spreading ventrally before its insertion along the lateral margin of eighth sternum (VIIIS). These findings are similar to those of Snodgrass [2] in *D. carolina*. However, Anwar [3] in *P. pictus* and Singh and Chauhan [4] in *C. trachypterus* subdivided this muscle into first and second internal lateral muscle and numbered them as 247 and 248 in *P. pictus* and 167 and 168 in *C. trachypterus* with origin and insertion similar to those of present study.

First external lateral muscle (No. 251)

These muscles are paired, flat, broad and thick in *A. exaltata* and arise from anterior side of eighth tergum (VIIIT) and inserted anteriorly on apodeme of eighth sternum (VIIIS). Snodgrass [2], Anwar [3] and Singh and Chauhan [4] made similar observations in *D. carolina*, *P. pictus* and *C. trachypterus* with similar origin and insertion.

Second external lateral muscle (No. 252)
This muscle is very small, thin and paired in *A. exaltata* but comparatively longer than first external lateral muscle (251) which originates on the eighth tergum (VIIIT) and inserted on the base of apodeme of eighth sternum. Similar observation was made by Snodgrass [2] in *D. carolina*, Anwar [3] in *P. pictus* and Singh and Chauhan [4] in *C. trachypterus* having similar origin and insertion but with some difference in the length of the muscles.

Short Protractor of the ovipositor (No. 256)
This muscle is paired, short, flat and fan shaped which originates from the side of the eighth tergum (VIIIT) anterior to internal lateral muscle (250) and inserted on the anterior end of apodeme of ovipositor (Ap). These findings are in agreement with those of Snodgrass [2] in *D. carolina* and Anwar [3] in *P. pictus* with similar origin and insertion to that of present study. However, Singh and Chauhan [4] recorded that this muscle (174) arises from ventral anterior margin of the eighth tergum in between lateral ventral muscle (166) and first external lateral muscle (169), runs anteriorly before its insertion on the anterior end of ovipositor apodeme in *C. trachypterus*.

Genital musculature of ninth abdominal segment
Internal dorsal muscle (No. 260)
This muscle is subdivided into five small bands of longitudinal fibres (260 a, b, c, d & e) on each side. It arises from ninth tergum (IXT) and inserted on the tenth tergum (XT). Two branches (260 d&e) are below the long protractor of ovipositor (262). These findings are in conformity with those of Snodgrass [2], Anwar [3] and Singh and Chauhan [4] in *D. carolina*, *P. pictus* and *C. trachypterus*.

Long protractor of ovipositor (No. 262)
This muscle is paired, long and flat which widen at base and narrow posteriorly, arising on the posterior ventral margin of the ninth tergum (IXT) runs anteriorly before its insertion on the anterior end of apodeme of ovipositor (Ap). Similar findings were reported by Snodgrass [2] in *D. carolina*, Anwar [3] in *P. pictus* and Singh and Chauhan [4] in *C. trachypterus* having similar origin and insertion with some variation in the size of muscle.

Retractor of the ovipositor (No. 263)
This muscle is paired, small, flat and broad in *A. exaltata* and arises from anterior ventral margin of ninth tergum (IXT) ventrad of long protractor of ovipositor (262) extends posteriorly before its insertion laterally to the base of third valvulae (3Vl) of ovipositor. These findings are similar to those of Snodgrass [2] in *D. carolina*, Anwar [3] in *P. pictus* and Singh and Chauhan [4] in *C. trachypterus*.

Levator of dorsal or third valvula (No. 271)
This muscle is paired, long, broad and very thick, lying on the dorsal surface of the apodeme of ovipositor (Ap). It is attached anteriorly to anterior end of ovipositor apodeme and posteriorly on the dorsal margin of the base of third valvula (3Vl). These findings are in agreement with those of Snodgrass [2], Anwar [3] and Singh and Chauhan [4] in *D. carolina*, *P. pictus* and *C. trachypterus* respectively, with some difference in the length and thickness of muscle.

Depressor of the ventral or first valvulae (No. 272)
These muscles are paired, thick, long and broad. It arises from ventral surface of the apodeme of ovipositor (Ap) and gets inserted on the basal plates of first valvula. Snodgrass [2] recorded that this massive bundle of fibres in *D. carolina* with similar origin and insertion as observed in present study. He concluded that this muscle possibly corresponds with the intersternal protractor or external ventrals of pregenital segment. Anwar [3] also made similar observation as to that of present study in *P. pictus*. However, Singh and Chauhan [4] reported that this muscle (182) consists of two bundles (182 i&ii) in *C. trachypterus*.

Adductors of ventral or first valvulae (No. 273)
This muscle is paired, long and slender in *A. exaltata* which arises from the proximal parts of posterior inner margin of the apodeme of ovipositor (Ap) and inserted on the median apodemal sclerites of anterior intervalvula (f). Snodgrass [2] in *D. carolina*, Anwar [3] in *P. pictus* and Singh and Chauhan [4] in *C. trachypterus* described these muscles as flat and thick, with similar origin and insertion as recorded in present study.

Adductors of dorsal or third valvulae (No. 274)
This muscle is paired, short and thin in *A. exaltata*. It originates from the proximal part of dorsal surface of apodeme of ovipositor (Ap) and inserted on posterior intervalvula (piv) of the third valvula (3Vl). This muscle is short in *D. carolina* [2], long and thin in *P. pictus* [3] but flat in *C. trachypterus* [4], with similar origin and insertion corresponding to present study.

Muscle of intermediate or second valvulae (No. 275)
This muscle is paired, small and placed below the adductor of the third valvula (274) and originate laterally on the dorsal surface of anterior intervalvula and get inserted posteriorly on the distal end of small valvulae. These findings are in conformity with those of *D. carolina* [2], *P. pictus* [3] and *C. trachypterus* [4] having similar origin and insertion as found out in the present study.

Genital musculature of tenth abdominal segment
The muscles of tenth segment have no evident relation to the muscles of preceding segments. It includes muscles to cerci, epiprocts and paraprocts and a transverse intersegmental muscle.

Depressor of cercus (No. 287)
This muscle is paired, small and longitudinally arranged in *A. exaltata*, arising anteriorly from tenth tergum (XT) and get inserted posteriorly on posterior margin of basal lobe of cercus. Snodgrass [2] and Singh and Chauhan [4] reported similar observations in *D. carolina* and *C. trachypterus* having similar origin and insertion. However, Anwar [3] described this muscle as very small in *P. pictus* with similar origin to that of present study but insertion on outer wall of the cercus.

Median levator of the cercus (No. 288)
This muscle is paired, small and slightly fan shaped arising anteriorly from the tenth tergum (XT) lateral to the depressor of cercus (287) and inserted posteriorly on small sclerites between tenth tergum and basal lobe of cercus. Snodgrass [2] reported that median levator of the cercus is broad in *D.*

carolina, with similar origin and insertion with that of present study. However, in some cases, a number of fibres are shown to be inserted on basal angle of epiproct (Eppt). Present findings are broadly in agreement with those of Anwar [3] in *P. pictus* and Singh and Chauhan [4] in *C. trachypterus*, with similar origin and insertion, except in *P. pictus* where this muscle has insertion on the outer wall of cercus.

Lateral levator of the cercus (No. 289)
This muscle is paired, small, narrow and slender lying near the lateral dilator of the rectum in *A. exaltata*. This muscle originates from the tenth tergum (XT) and inserted posteriorly on the membrane behind the tenth tergum close to outer angle at the base of cercus. Snodgrass [2] in *D. carolina*, Anwar [3] in *P. pictus* and Singh and Chauhan [4] in *C. trachypterus* reported that the lateral levator of cercus is small and slender muscle, with similar origin and insertion to those of present study.

Ventral muscle of the paraproct (No. 291)
This muscle is paired and wedge shaped with wide base and narrow tip and makes its origin from tenth tergum (XT) and insertion on paraproct (Papt) on its ventral side. These findings are similar to those of Snodgrass [2], Anwar [3] and Singh and Chauhan [4] in *D. carolina*, *P. pictus* and *C. trachypterus* respectively, having similar origin and insertion, but with some difference in the thickness of muscle.

Transverse muscle (No. 292)
This muscle is small and strap like, lies dorsally to the base of ovipositor and attached laterally on the ends of tenth tergum (XT). Present findings are similar to those of Snodgrass [2], Anwar [3] and Singh and Chauhan [4] in *D. carolina*, *P. pictus* and *C. trachypterus* respectively.

Genital musculature of eleventh abdominal segment
The genital musculature of eleventh abdominal segment includes muscles from epiproct to cerci and paraproct and muscles from epiproct and paraproct to circumanal membrane.

Adductor of cercus (No. 293)
These muscles are paired, thin and long, arising from anterior part of epiproct (Eppt) and inserted on basal lobe of cercus. These findings are in agreement with those of Snodgrass [2] in *D. carolina*, Anwar [3] in *P. pictus* and Singh and Chauhan [4] in *C. trachypterus* with similar origin and insertion but with some difference in the length and thickness of muscle. In *D. carolina* and *P. pictus*, these muscles are long and slender but short and thin in *C. trachypterus*.

Adductor of paraproct (No. 294)
This muscle is paired, broad and rectangular in shape but slightly longer than the preceding (293). They arise medially from epiproct (Eppt) just behind adductor of cercus (293) and get inserted in upper part of paraproct (Papt) behind the base of cercus. Present findings are in conformity with those of Snodgrass [2], Anwar [3] and Singh and Chauhan [4] in *D. carolina*, *P. pictus* and *C. trachypterus* with similar origin and insertion.

References

1. Chesler J. Observations on the biology of some South African Acrididae (Orthoptera). Ecological Entomology. 1938; 87(14):313-351.
2. Snodgrass RE. The abdominal mechanism of a grasshopper. Smithsonian Miscellaneous Collection. 1935; 94(6):89.
3. Anwar M. Muscular system of *Poecilocerus pictus* F. (Acrididae, Orthoptera). Pakistan Journal of Science. 1965; 17:3-26.
4. Singh AP, Chauhan RS. Studies on the somatic musculature of *Chrotogonus trachypterus* Blanchard, part-IV. The Abdomen. Agra University Journal of Research (Science). 1975; 14(II):57-68.