

Studies on Some *Pyrgomorphinae* (*Pyrgomorphidae*: *Pyrgomorphoidea*) of Bihar

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Abstract

The subfamily *Pyrgomorphinae* belongs to the family – *Pyrgomorphidae*. Members of this subfamily have brightly colored bodies owing to which they are generally known as “gaudy grasshoppers”. It had been an expansive check for grasshoppers corresponding to diversified and rich foliage as well as different ecological conditions, downfall, moisture and temperature. Surveys were conducted in colorful seasons of important agrarian areas in different regions of Patna quarter for data collection on grasshoppers. Compliance has been ensured on their geographical distribution, diversity, host range and pest prevalence. Insects belonging to this subfamily are generally found in tropical and tropical regions. They have a short stout body with a kindly angular appearance. There are pictorial colors and patterns present on the body which include spots, stripes, and other patterns to serve as a warning to bloodsuckers. The head is broad and may be slightly conical or rounded containing well-developed conflation eyes. The face is generally vertical or slightly slanted. Antennae are short and thick, having a conjoined or slightly expanded appearance at the tips. The tummy is covered by an interior plate called the pronotum, which is stretched extending over part of a breadbasket and bears a median boat. The hind legs have strong femora and are shaped to jump while the tibia retains chins that help the insects move. The forewings, or the tegmina, are tough and contain bright colors and patterns. The hind bodies are membranous and brightly colored. The mouth corridor is shaped for smelling different shops and their corridor.

Keywords: *Pyrgomorphidae*, Patna, family, grasshoppers, distribution, diversity, colors

INTRODUCTION

The family *Acrididae* and the order *Orthoptera* include locusts and grasshoppers, both of which are set up encyclopedically. Locusts are larger members of the *Acrididae* family, while the lower species are nominated as grasshoppers. These insects frequently display two distinct phases solitary and gregarious. A nymph in the solitary phase tends to blend into its surroundings, living singly rather than in groups. In contrast, a gregarious-phase nymph is characterized by a fixed pattern of black and unheroic or orange colors and lives in large masses. Solitary-phase individualities have shorter bodies and longer legs in comparison to their gregarious counterparts. This group is divided into two sub-

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Received Date: February 01, 2025

Accepted Date: February 08, 2025

Published Date: February 21, 2025

Citation: Shams Tabrez, Md. Rashid Nayeem. Studies on Some *Pyrgomorphinae* (*Pyrgomorphidae*: *Pyrgomorphoidea*) of Bihar. Research Reviews: Journal of Life Sciences. 2025; 15(2): 26–33p.

orders *Caelifera*, which consists of short-horned grasshoppers, and *Ensifera*, which includes long-horned grasshoppers. The *Caelifera* sub-order further breaks down into four superfamilies *Acridoidea*, *Tridactyloidea*, *Tetrigoidea*, and *Eumastacoidea*. The *Acridoidea* superfamily is noted for having short antennae that are generally shorter than the body, a short ovipositor, and tarsi with three parts. These insects represent an economically significant order of Orthopteran pests that overrun colorful cultivated wild crops.

The subfamily *Pyrgomorphinae* is part of the family *Pyrgomorphidae*. These insects are

frequently appertained to as “gaudy grasshoppers” due to their bright colors. Generally, found in tropical and tropical regions, members of this subfamily retain a short and robust body with a kindly angular shape. Their bodies showcase pictorial colors and patterns similar as spots and stripes, which serve as warnings to implicit bloodsuckers. While they are spread across the globe, they thrive in tropical and tropical areas. Generally, the population of locusts and grasshoppers diminishes as one moves further from the ambit, with their figures adding near to it. They are polyphagous affluents, consuming a variety of unconnected plant species [1, 2]. Habitat differences are largely told by colorful abiotic factors, including ecosystem type, altitude, latitude, and downfall. These insects are regarded as effective pointers of hovered territories, contributing to the conservation and protection of vital areas. Grasshoppers serve as primary consumers in champagnes worldwide [3]. They are pivotal for energy transfer within trophic situations, performing as primary consumers in the food chain and as prey for other creatures, which helps maintain ecological balance. This dynamic keeps their populations in check, but their defense mechanisms produce violent competition for bloodsuckers and spongers. Lately, these insects have displayed a tendency to resettle toward natural foliage, similar as crop fields, demonstrating their eventuality as significant pests, including species like *Phlaeoba infumata*, *Atractomorpha crenulata*, and *Oxya fuscovittata*.

These insects will be watched nearly in their natural surroundings, allowing for the observation of relations between pests and shops as well as factory connections with pests. The exploration will originally cover the entire area, fastening on the Patna quarter and near agrarian zones, strands with rich soil, and pastoral regions rich in timber and foliage. This study is pivotal for taxonomists and applied entomologists, setting a standard for other interdisciplinary fields. Multitudinous economically significant grasshopper species, similar as *Hieroglyphus*, *Oxya*, *Atractomorpha*, *Pyrgomorpha*, *Spathosternum*, *Phlaeoba*, *Truxalis*, and *Acrida*, have displayed a conspicuous impact on agrarian regions being studied.

REVIEW OF LITERATURE

Originally, Belovsky (2000) [4] established the family group name *Acrididae* based on the genus *Acrida* [5]. Later on, Serville (1838) and Walker (1870) [6, 7] suggested the family names *Truxalidae* and *Oedipodidae*, independently. In the *Horae Entomologicae*, Macleay introduced *Acridina* and *Locustina* as sections within *Orthoptera*. Further, Walker (1871) [8] formally assigned the family name *Acrididae*, dividing it into three subfamilies *Acridiinae*, *Tettiginae*, and *Proscopiinae*. He also distributed the subfamily *Acridiinae* into three lines *Truxalini*, *Oedipodini*, and *Acridini*. Thomas (1880) [9] linked *Oedipodii* and *Tryxalii* as lines within *Oedipodidae*.

The researcher [10] honored several subfamilies within *Acrididae*, including *Acrydiinae*, *Eumastacinae*, *Tryxalinae*, *Pyrgomorphinae*, *Pamphaginae*, *Catantopinae*, *Pneumorinae*, and *Proscopiinae*. Brunner (1893) [11] continued this bracket. The researcher [12] arranged the family *Acrididae* into nine subfamilies *Tetriginae*, *Pneumoninae*, *Mastacinae*, *Proscopinae*, *Tryxalinae*, *Oedipodinae*, *Pyrgomorphinae*, *Pamphaginae*, and *Acridinae*. Then Lefroy (1909) [13] elevated the family *Acrididae* to the rank of sub-order *Acridoidea*, consolidating the subfamilies classified by Kirby (1914) [12] into family status as *Tetrigidae*, *Pneumoridae*, *Mastacidae*, *Proscopidae*, *Truxalidae*, *Oedipodidae*, *Pyrgomorphidae*, *Pamphagidae*, and *Acrididae*. Later, Lucas (1920) [14] designated *Acridinae*, *Oedipodinae*, *Catantopinae*, and *Pyrgomorphinae* as subfamilies of *Acrididae*, ultimately adding a fifth subfamily, *Pamphaginae*, to the family.

Thirty three locust and grasshopper species have been studied by Uvarov (1921b) [15] in Western Uttar Pradesh. The taxonomic significance of the womanish genitalia in Indian *Acridoidea* has been examined by Usmani and Khan (2010) [16]. Another researcher [17] discovered twenty six grasshopper species from the rice-growing regions of Uttar Pradesh, while Akhtar et al. (2012) [18] reported thirty four grasshopper species from the beats and paddy fields in Bihar and Jharkhand, India. The researcher [19] linked forty one grasshopper species in Jharkhand, and they also noted thirty seven species from Bihar at the same time. Then, fourteen species from beats were reported, and another twenty six species

were noted from the Aligarh Fort area of Uttar Pradesh [20]. And Usmani et al. (2012) [21] collected data on the ecological territories of grasshopper fauna in Aligarh, where Akhtar et al. (2012) [22] recorded thirty two grasshopper species. The manly genitalia were distributed by Usmani (2012) [23].

The adding population of grasshoppers has redounded in significant crop damage, as these insects are considered pests in agrarian lands, according to Usmani et al. (2012) [24]. Four grasshopper species responsible for 90% of the crop destruction were found linked [25]. The link between feeding habits and migrant traits in Mongolian locusts were further emphasized by another researcher [26]. Then, two new slant-faced grasshopper species were discovered in Central India [27], while Gupta and Chandra (2018) [28] developed the abundance and diversity of grasshoppers and their ectoparasitic communities in Dakota. The *Acrididae* family represents a different group within the *Orthoptera* order, as noted by Anderson (2019) [29]. Roughly 360 species of short horned grasshoppers have been proved [30]. *Attractomorpha*, insects belonging to this genus retain slender, elongated bodies and refocused heads [9]. Generally, their bodies are green or brown, which helps them blend into their terrain. They are generally found across Asia and Australia. *Poecillocerus* [31] bodies have the most striking colors, usually bright yellow, blue, or green, with vivid patterns. They feed on toxic plants and ingest their toxins, which give them the bright colors present on their bodies. *Chrotogonus* [31], insects of this genus have small to medium-sized bodies and short antennae. Their body color is brown or grey, allowing them to camouflage with soil or leaf litter in their surroundings.

MATERIAL AND METHODS

About 89 samples of grasshoppers were collected from various agricultural pastoral areas of Bihar and timber homes. This served as the base for the present critical study. A complete record was also maintained, indicating the reference number, position, date of collection and name of host shops etc.

Collection of Adult Grasshoppers

The authors surveyed various agricultural areas of Bihar during the period 2022–2023 for the collection of grasshoppers and locusts. They were caught by hand, by forceps, and by the ordinary upstanding nonentity net. The net was used for catching insects inclusively or by sweeping on meadows, backwoods and other vegetables. Since some acridoids live on trees, it is sometimes largely satisfying to probe the branches of trees. Attempts were made to collect the samples from their host shops as well as those attracted to light during the night. They were captured on different dates in different months from various crops. Different corridors of crops were examined. The collected samples were killed in cyanide bottles.

Preparations for Morphological Studies

Alkie mounts were also prepared for better understanding of certain characters like size, color, texture, etc. For this purpose, the samples were first relaxed, stretched and subsequently they were projected and labeled properly. Endless collections of projected samples were kept in store boxes and closed for further studies on their morphological structures.

Preparations for Genitalic Studies

For a detailed study of the various factors of genitalia, endless slides were prepared and examined under a microscope to conduct a detailed study of the genitalic structures.

RESULT

The subfamily *Pyrgomorphinae* belongs to the family – *Pyrgomorphidae*. Insects belonging to this subfamily are generally found in tropical and tropical regions. They have a short stout body with a kindly angular appearance. There are pictorial colors and patterns present on the body which include spots, stripes, and other patterns to serve as a warning to bloodsuckers. The head is broad and may be slightly conical or rounded containing well developed conflation eyes. The face is generally vertical or slightly slanted. Antennae are short and thick, having a conjoined or slightly expanded appearance at the tips. The tummy is covered by an interior plate called the pronotum, which is stretched extending

over part of the breadbasket and bears a median boat. The hind legs have strong femora and are shaped for jumping, while the tibiae retain spines that help the insects move. The forewings, or the tegmina, are tough and contain bright colors and patterns. The hind bodies are membranous and brightly colored. The mouth corridor is shaped for smelling different shops and their corridor.

Genus – *Poecilocerus*

Insects belonging to this genus are substantially found in thirsty and semi-arid regions of Asia and Africa. They have an elongated and spherical body, which is stouter and larger compared to other grasshoppers. The length of the body ranges from 40 to 80 mm. The head is large and broad, with a slightly rounded face. The eyes are large, and the antennae are filiform (thread like) with short to medium length. The pronotum covers utmost of the abdomen and extends slightly over the base of the tummy. It has crests or ship like structures (carinae) on its rearward face giving it a rugged appearance. The legs are well developed. The hind legs are strong and acclimated for jumping. They've thick and muscular femora. The tibiae bear rows of backbones. The legs and mid-legs are comparatively shorter. The bodies are completely developed. The forewings are tough and narrow, enjoying bright colors and patterns. The hind bodies are membranous, broad, and retain vibrant colors similar as blue, unheroic, or red. Their bodies have bright and bold colors with striking patterns in green, unheroic, blue, and black. This aposematic coloration helps keep down bloodsuckers and aids species recognition for mating. The mouth corridor is explosively mandibulate which helps the insects bite. The insects belonging to this genus primarily feed on poisonous shops similar as milkweed. This enables them to prize and store poisons from these shops which contribute to the bright colors on their bodies. When in trouble, some species can also release poisonous fluid from their thoracic glands which can keep down bloodsuckers.

There are five honored species within this genus, and one species was linked in our study point. The behavioral, visual, and morphological features of this species are described below.

Poecilocerus Pictus

External morphology: Body – stretched, spherical, stout, length ranging from 50 to 75 mm, color of the body is green or unheroic with striking black, blue, and orange markings (thus, these insects are also called painted grasshoppers); head – large, broad; face – slightly rounded, blunt; eyes – large, prominent; antennae – filiform, medium length, extends just beyond the head; pronotum – well-developed, covers utmost of the abdomen, extends over first many parts of the tummy, slightly convex, bears faint longitudinal crests, green or unheroic color with black markings; hind legs – well-developed and strong; femora – thick and muscular; tibiae – bears rows of backbones; legs and mid-legs – shorter; bodies – completely developed; forewings – narrow, tough, green or unheroic with black stripes of spots; hind bodies – membranous, brightly colored generally blue or unheroic, mouth corridor – mandibulate, strong. Table 1 provides the morphometric measures of insects.

Internal morphology: Digestive system – comprises of foregut, midgut, and hindgut, foregut had crop gizzard; male reproductive system – comprises of a brace of testes, vas deferens, aedeagus; female reproductive system – comprises of a brace of ovaries, oviducts, spermatheca, well developed ovipositor; respiratory system – comprises of spiracles present on the side of the body connecting to a network of tracheae; nervous system – comprises of a central brain, frontal whim-whams cord, supplemental jitters.

Behavior: Feeding – specialist critter, feeding on milkweed and other poisonous shops; locomotion – strong jumping capability using its hind legs, uses flight as a secondary means of escape over long distances; avoiding bloodsuckers – bright body color keeps down bloodsuckers, remains still under trouble, releases poisonous fluid from thoracic glands; mating – occurs during warmer months, male ones provides courting displays to attract female critters, who lay eggs in soil or within factory material, eggs door into nymphs which look like atomic grown-ups; seasonal behavior – active during warmer months, particularly during late spring and summer, dropped exertion or dormancy during colder months.

Table 1. Morphometric measurements of *Poeciloceris pictus*.

S.N.	Body Part	Male (mm)	Female (mm)
1	Body length	50–60	65–75
2	Hind femur length	25–30	30–35
3	Hind femur width	6–7	7–8
4	Hind tibia length	20–25	25–30
5	Pronotum (length/width)	8–10/4	10–12/5
6	Head length	8–9	9–10
7	Head width	7–8	8–9
8	Average diameter of head capsule	6–7	7–8
9	Maximum diameter of eye	3–4	4–5
10	Minimum diameter of eye	2–3	3–4
11	Average diameter of eye	2.5–3.5	3.5–4.5
12	Interocular space	3–4	4–5

Genus – *Chrotogonus*

Insects belonging to this genus are medium-sized and are distributed in thirsty and semi-arid regions. They can survive in dry surroundings and are agrarian pests. The bodies of these insects are kindly flattened, and their length ranges from 20 to 40 mm. They are compact and streamlined, acclimated to living on the ground. The head is slightly slanted and broad, with large prominent emulsion eyes. The antennae are short to medium in length, filiform, and extend to the length of the head. The face is slightly convex and smooth. The pronotum is stretched with a rough texture and granulated face and has side crests (carinae). Some species have a ship-like crest along the midline. The hind legs are strong and well-developed furnishing them with jumping capability. The femora are thick and muscular, and the tibiae retain small backbones. The legs and mid-legs are comparatively shorter. The bodies are completely developed. The forewings are narrow and tough and retain earthy colors to prop disguise. The hind bodies are membranous. The color of the body is generally brown, slate, or green, with mottled or freckled patterns that help this blend with their surroundings. The mouth corridor is strong and mandibulate which helps them bite plant material.

There are 19 honored species within this genus, and one species was linked to our study point. The behavioral, visual, and morphological features of these are described below.

Chrotogonus (Chrotogonus) trachypterus trachypterus (Blanchard, 1836)

External morphology: Body – spherical, compact, stout, length ranging from 25 to 45 mm, earthy colors in tones of brown, slate, or green, mottled or freckled to prop disguise; head – broad; face – slightly rounded; eyes – large, prominent; antennae – filiform, short, extending to the length of the head; pronotum – stretched, covers a large part of the abdomen, rough texture, ship running longitudinally along the midline, slightly burned side edges; hind legs – well developed; femora – thick and muscular; tibiae – slender, bears small backbones; legs and mid-legs – shorter; forewings – narrow, tough, earthy colors abetting disguise; hind bodies – membranous, brightly colored; mouth corridor – strong and mandibulate. Table 2 provides the morphometric measures of the body corridor.

Internal morphology: Digestive system – comprises of foregut, midgut and hindgut, foregut comprises of crop and gizzard; manly reproductive system – comprises of a brace of testes, vas deferens, and an aedeagus; womanish reproductive system – comprises of a brace of ovaries, oviducts, spermatheca, and ovipositor; respiratory system – spiracles along the side of the body connected to a network of tracheae; nervous system – comprises of central brain, frontal whim-whams cord, supplemental jitters.

Behavior: Feeding – meadows and other foliage generally dry and tough, uses strong bills to reuse factory material; locomotion – hind legs aid jumping, bodies help in short breakouts; avoiding

bloodsuckers – earthy colors and mottled patterns on the body permit disguise, remains still under trouble, escapes by jumping; mating – occurs during warmer months, males give courting displays to attract females, who lay eggs in soil or factory material; seasonal behaviors – active during warmer months, dropped exertion or dormancy during colder months.

Table 2. Morphometric measurements of *Chrotogonus (Chrotogonus) trachypterus trachypterus*.

S.N.	Body Part	Male (mm)	Female (mm)
1	Body length	25–35	30–45
2	Hind femur length	12–18	15–20
3	Hind femur width	4–5	5–6
4	Hind tibia length	10–15	12–18
5	Pronotum (length/width)	5–7/3	6–8/4
6	Head length	6–8	7–9
7	Head width	5–6	6–7
8	Average diameter of head capsule	4–5	5–6
9	Maximum diameter of eye	2–3	2.5–3.5
10	Minimum diameter of eye	1.5–2	2–2.5
11	Average diameter of eye	1.8–2.5	2.2–3
12	Interocular space	2–3	2.5–3.5

The subfamily *Pyrgomorphinae* comprises of six genera. The type of genus of this subfamily is *Pyrgomorpha* [30].

1. *Pyrgomorpha* [31]: Insects of this genus have a characteristic angular brightly colored body. They are extensively distributed and are frequently found in open grasslands. There are pictorial colors and patterns present on the body which include spots, stripes, and other patterns to serve as a warning to bloodsuckers. The head is broad and may be slightly conical or rounded containing well developed emulsion eyes. The face is generally perpendicular or slightly slanted. Antennae are short and thick, having a conjoined or slightly expanded appearance at the tips.
2. *Attractomorpha* [10]: Insects of this genus have slender, elongated bodies and a pointed head. The color of their bodies is generally green or brown, allowing them to disguise themselves with their surroundings. They are generally set up in Asia and Australia. Their bodies are smooth and streamlined and are generally 20 to 50 mm in length. The head is sprucely pointed and triangular. The eyes are large and prominent deposited indirectly on the head. The antennae are short and thick, generally about half the length of the body, tapering towards the end and appearing slightly conjoined. The pronotum is stretched, narrow, smooth, and contributes to the streamlined appearance of the insects. The hind legs have strong muscular femora. The legs and mid-legs are slender and help insects in movement. The bodies of the utmost species are completely developed, but some species may have reduced bodies.
3. *Chrotogonus* [32]: Insects of this genus have small to medium-sized bodies and short antennae. Their body color is brown or slate, allowing them to disguise themselves with soil or splint waste in their surroundings. The bodies of these insects are kindly flattened, and their length ranges from 20 to 40 mm. They are compact and streamlined acclimated to living on the ground. The head is slightly slanted and broad, with large prominent emulsion eyes. The antennae are short to medium in length, filiform, and extend to the length of the head. The face is slightly convex and smooth. The pronotum is stretched with a rough texture and granulated face and has side crests (carinae). Some species have a ship-like crest along the midline. The hind legs are strong and well- developed furnishing them with jumping capability.
4. *Poeciloceris* [33]: Their bodies of these insects have the most striking colors, generally bright unheroic, blue, or green, with pictorial patterns. They feed on poisonous shops and ingest their poisons, which give them the bright colors present on their bodies. They've an elongated and spherical body, which is stouter and larger compared to other grasshoppers. The length of the

body ranges from 40 to 80 mm. The head is large and broad, with a slightly rounded face. The eyes are large, and the antennae are filiform (thread-like) with short to medium length. The pronotum covers utmost of the abdomen and extends slightly over the base of the tummy. It has crests or ship-like structures (carinae) on its reward face giving it a rugged appearance. The legs are well-developed. The hind legs are strong and acclimated for jumping.

5. *Phymateus* [34]: This genus includes some of the largest and most various insects belonging to this subfamily. The insects generally retain aposematic coloration as a warning to bloodsuckers and move in large groups.
6. *Zonocerus* [34]: Insects of this genus are known as variegated grasshoppers. Their bodies are multi-colored and they are significant agrarian pests.

CONCLUSIONS

During the check, about 89 samples of grasshoppers were collected from colorful territories and colorful fields. The detailed study of species reveals that the species of grasshoppers belong to the *Pyrgomorphidae* family. Expansive check of colorful crops territories collecting grasshoppers from different agrarian areas had been conducted. An attempt has been made to collect the samples from their host place. It had been an expansive check for grasshoppers corresponding to diversified and rich foliage as well as different ecological conditions, downfall, moisture and temperature. The calculation work forms the important element of the study. Computers have been used for medication of data matrix. The result consists of tables and morphometric measurements of the *Poecilocerus pictus*, *Chrotogonus* (*Chrotogonus*) *trachypterus* species. Surveys were conducted in colorful seasons to important agrarian areas in different regions of Patna quarter for collection of grasshoppers. During the check, compliance has been made on their geographical distribution, diversity, host range and pest prevalence.

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