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Checklist of Hemipteran Insects Collected on Cucurbitaceous Crops of Punjab, India

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ABSTRACT: Cucurbits are warm-season crops that constitute the most widely cultivated category of summer vegetables. The family Cucurbitaceae comprises 120 genera and 800 species, including 31 genera and 94 species found in India. India is the second-largest global producer of vegetables, accounting for approximately 15% of the world's overall output. The current survey-cum-collection study illustrates the current status and taxonomic characteristics of hemipteran species visiting cucurbitaceous vegetables in the state of Punjab, India, and provides a checklist of these insects. In total, 14 insect species in the order Hemiptera were observed in eight families and 11 genera, including Aleyrodidae and Coreidae (1 genus, 1 species), Geocoridae and Lygaeidae (3 genera and 3 species), Pentatomidae, Pseudococcidae (1 genus, 1 species), Pyrrhocoridae, and Reduviidae (2 genera and 2 species). This checklist provides basic information about the current status of regional biodiversity in Punjab's agricultural systems, which in turn will help formulate innovative integrated pest management (IPM) approaches. Species-wise morphometric observations, key diagnostic features, distribution, and host records in India are provided based on literature searches and field observations.

Keywords: Cucurbits, Diversity, Hemiptera, Punjab, India.

1. INTRODUCTION

Punjab, also known as the "Granary of India," is a state located in north-western India that ranks third in total foodgrain production after the Uttar Pradesh and Madhya Pradesh states in the country (Ministry of Finance, 2026), and is known to be a major contributor to the production of food grains in India (Singh, 2020). Some economically valuable cucurbitaceous crops cultivated in all regions of the state are cucumber (*Cucumis sativus* L.), bottle gourds (*Lagenaria siceraria* (Molina) Standl.), bitter gourd (*Momordica charantia* L.), watermelon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai), and muskmelon (*Cucumis melo* L.) (Dhaliwal, 2017; Mercy & Nmom, 2017 and Ingle & Shyamrao, 2020). Various insect pests infest cucurbitaceous crops, and hemipteran insects constitute an important part of the total pest complex (Atwal & Dhaliwal, 2018).

All hemipteran insect species associated with cucurbitaceous crops are either pest species that directly damage the crop through feeding or beneficial predatory species that contribute to natural pest control (Omkar & Kumar, 2013 and Cuthbertson, 2020). Basic knowledge of species composition and distribution is critical for developing effective integrated pest management (IPM) and sustainable agricultural management practices (Gyawali et al., 2024; Tartanus & Malus, 2024).

Earlier studies on the hemipteran fauna of Punjab have

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been scattered and mostly focused on specific pest species (Distant, 1902, 1904). Comprehensive checklists documenting the diversity of hemipteran insects in cucurbitaceous crops in the Punjab region are scarce (Kaur et al., 2012). The purpose of this study was to revise the list of hemipteran species collected from various cucurbitaceous crops in five agro-climatic regions of Punjab, to provide a checklist of their diagnostic characteristics, and to document their distribution in India.

2. MATERIALS AND METHODS

2.1. Study Area

Hemiptera bug collections were conducted from April 2022 to October 2022 in five agro-climatic regions in Punjab, India (sub-mountain, undulating region, undulating plain region, central plain region, western plain region, and western region) (Table 1, Figure 1).

The state of Punjab in India has five distinct agro-climatic regions, with the cooler, rain-fed Shivalik foothills in the northeast and the arid southwest plains. Differences determine various environmental and social realities. First, the Sub-Mountain Undulating Region (Zone I or Kandi region) is a transitional, semi-arid tract along the northeastern border of Punjab, situated at the base of the Shiwalik hills and, to the north, bordering Himachal Pradesh state. Second, the Undulating Plain Region (Zone II) directly borders and lies south of the Shiwalik foothills of Himachal Pradesh. These regions are mainly undulating with hilly topography and is prone to serious soil erosion due to higher rainfall. These regions mainly support the rural population, which depends on mixed farming and rain-fed crops. As one move inwards the regions undulating plains region is a transitional region of a moderately irrigated region with some undulating topography that quickly flattens out to the hyper-fertile Central Plain Region (Zone III), which is the rich agricultural region regarded as the breadbasket of India, following an intensive wheat rice rotation producing a rich farming community (Kaur et al., 2024; Singh, 2013). However, extensive and sophisticated network of tubewells have resulted in severe groundwater depletion. Finally, Western Plain Region (Zone IV) and Western Region (Zone V) bordering north-western Rajasthan state has sandy soils, low rainfall and high summer temperature. The local

Table 1. Survey locations in five agro-climatic regions of Punjab during the study

Agro-climatic region	Location of collection	GPS coordinates
Sub-Mountain Undulating region (Z1)	Khanpur, Mukerian	31°54'42.1"N 75°37'31.8"E
Undulating Plain region (Z2)	Kolar, SBS Nagar	31°04'28.0"N 76°23'20.5"E
Central Plain region (Z3)	Malerkotla	30°32'20.7"N 75°51'21.8"E
Western Plain region (Z4)	Lehra Bega, Bathinda	30°14'13.8"N 75°06'44.3"E
Western region (Z5)	PAU RRS, Abohar	30°10'15.0"N 74°12'22.7"E
	Nihalkhera, Abohar	30°13'42.7"N 74°08'02.1"E

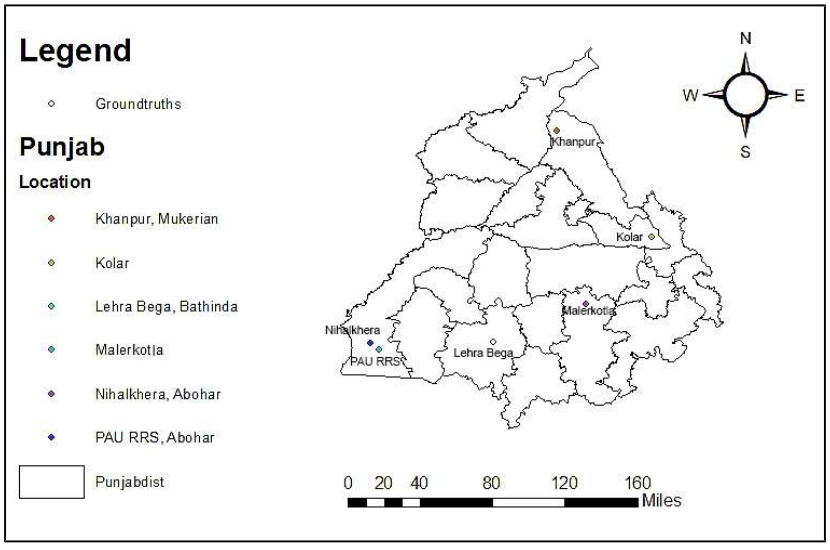


Figure 1. Collection sites of hemipteran bugs in Punjab

population depends on canal irrigation for growing cotton and citrus crop. Soil salinity and waterlogging are important environmental challenges in these regions (Singh, 2013 and Bandumula et al., 2018).

2.2. Collection, Identification, and Morphometry

2.2.1. Field surveys and sampling

Multiple field surveys were conducted in cucurbit-growing areas in Punjab to collect data on cucumbers, bottle gourds, bitter gourds, watermelons, and muskmelons. Insect samplings were performed in farmers' fields and on research plots at PAU Ludhiana campus, Ludhiana, Regional Research Station (RRS), Bathinda, and Dr. J C Bakshi RRS, Abohar during the 2021-22 cropping season (Table 1).

Various standard entomological techniques were employed for specimen collection, including visual searches, light traps, sweep nets, and direct host collection. The collected specimens were curated and identified using standard taxonomic keys and morphological characteristics (Triplehorn & Johnson, 2005). Taxonomic identification was performed based on taxonomic articles and relevant taxonomic data (Distant, 1902, 1904; Chandra et al., 2018). Experts were consulted to reconfirm the species or genus.

2.2.2. Morphometry

The adult insect specimens were identified using Nikon SMZ25 Motorized Stereo Zoom Microscope (Nikon Corp., Japan) housed in the Insect Taxonomy Lab of the Department of Entomology, PAU, Ludhiana. The dorsal habitus of each pinned specimen was photographed with the mounted Nikon D5300 camera body on the aforementioned microscope. The morphometric observations of the head, thorax, and abdomen for each specimen were measured using the ocular micrometer (Nikon Corp., Japan) available within the eyepiece of the same microscope. The measurements were expressed in millimetres (Table 2). The existing literature has been utilised to compile Indian distributional data for the fauna of the region, taxonomic records, and habitat surveys (Distant, 1902, 1904; Gupta & Singh, 2013; Chandra & Boaz, 2018; and Chandra et al., 2018).

3. RESULTS AND DISCUSSION

3.1. Systematic Account

The dorsal habitus of all 14 hemipteran species or genera recorded during the survey is shown in Figure 2, with each specimen labelled by its scientific name, its authority, and scale. Figure 2 provides a visual reference for easy diagnosis of hemipteran insects found on various cucurbits cultivated in Punjab, in which each family, genus, and species is described along with its key morphological characters, host records, and their extended distribution within India.

3.2. Order HEMIPTERA Linnaeus, 1758

3.2.1. Family ALEYRODIDAE Westwood, 1840

Genus *Bemisia* Quaintance & Baker, 1914

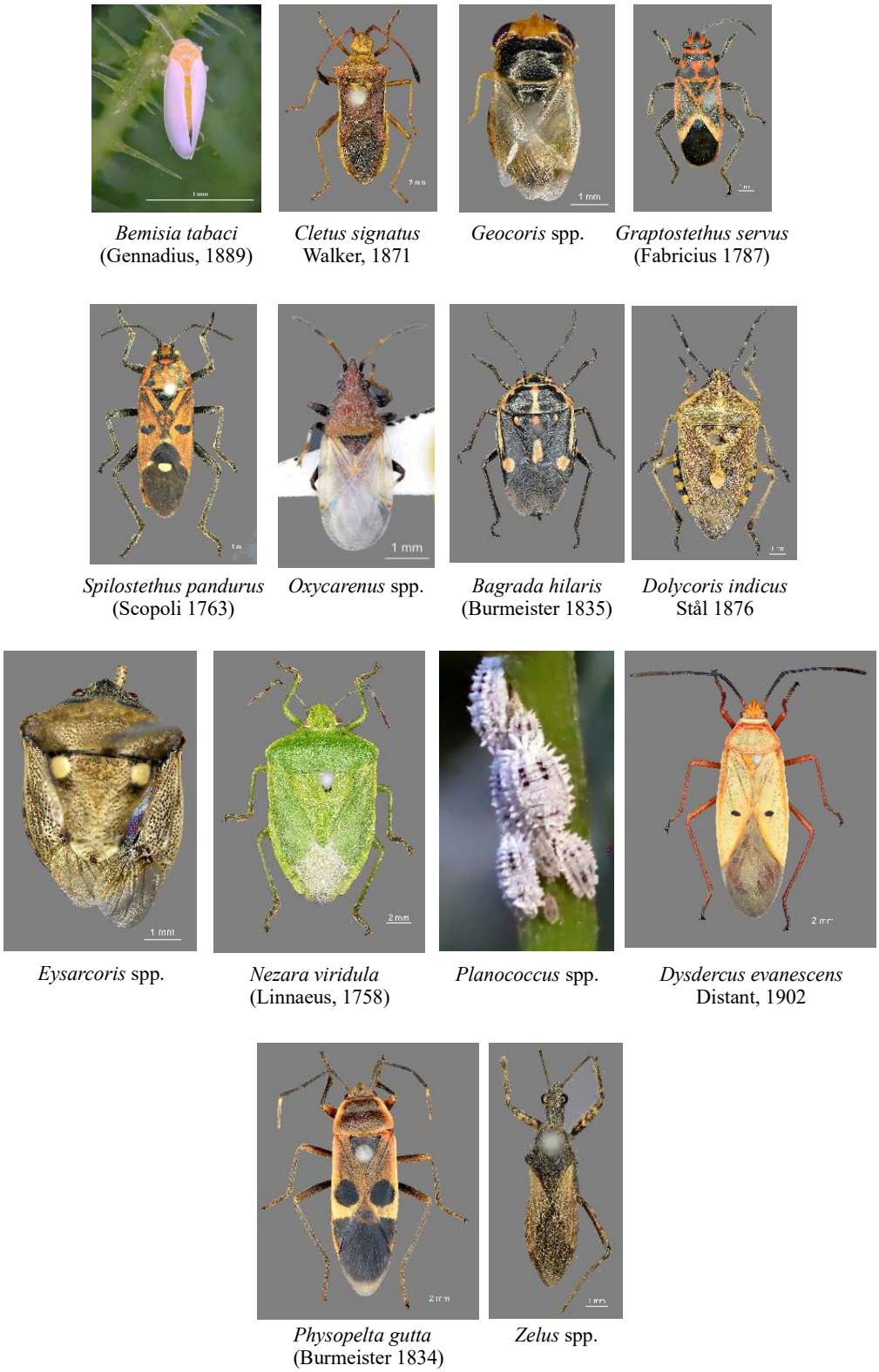
***Bemisia tabaci* (Gennadius, 1889)**

Common name: Silverleaf whitefly, Cotton whitefly

Diagnostic characters: Adult insects were smaller than 2

Table 2. Morphometric observations of genera and species of hemipteran fauna collected from Punjab, India

Genus/Species	Family	Head (mm)	Thorax (mm)	Abdomen (mm)
Bemisia tabaci (Gennadius, 1889)	Aleyrodidae	0.09	0.11	0.23
Cletus signatus Walker, 1871	Coreidae	1.20	3.87	4.09
Geocoris spp.	Geocoridae	0.49	1.01	2.8
Graptostethus servus (Fabricius, 1787)	Lygaeidae	1.16	1.95	5.34
Spilostethus pandurus (Scopoli, 1763)	Lygaeidae	0.73	2.45	7.95
Oxycarenus spp.	Lygaidae	0.82	1.47	2.37
Bagrada hilaris (Burmeister, 1835)	Pentatomidae	0.99	1.24	3.13
Dolycoris indicus Stål, 1876	Pentatomidae	2.07	6.17	3.49
Eysarcoris spp.	Pentatomidae	0.56	4.55	1.2
Nezara viridula (Linnaeus, 1758)	Pentatomidae	1.87	7.72	3.82
Planococcus spp.	Pseudococcidae	0.25	0.54	1.78
Dysdercus evanescens Distant, 1902	Pyrrhocoridae	1.87	5.21	10.33
Physopelta gutta (Burmeister, 1834)	Pyrrochoridae	1.42	5.23	8.03
Zelus spp.	Reduviidae	2.47	3.18	4.79



Bemisia tabaci (Gennadius, 1889) | *Cletus signatus* Walker, 1871 | *Geocoris* spp. | *Graptostethus servus* (Fabricius 1787)

Spilostethus pandurus (Scopoli 1763) | *Oxycarenus* spp. | *Bagrada hilaris* (Burmeister 1835) | *Dolycoris indicus* Stål 1876

Eysarcoris spp. | *Nezara viridula* (Linnaeus, 1758) | *Planococcus* spp. | *Dysdercus evanescens* Distant, 1902

Physopelta gutta (Burmeister 1834) | *Zelus* spp.

Figure 2. Dorsal habitus of various hemipteran insects collected from cucurbitaceous crops grown in Punjab, India, during 2022. Each specimen is labelled with its scientific name and authority; scale bars are shown on the individual photographs

mm, and their wings were covered with a whitish waxy powder coating. The wings were opaque, whitish, and powdery. The fore and hind wings were somewhat equal in size to the hind wings. The pupal case was colourless to brown. Caudal setae were invariably strong and usually as long as the vasiform orifice. The orifice, situated slightly within the edge of the pupal case, was shorter than that of the caudal furrow. The sides of the orifices were nearly straight. These observations coincided with those reported by Martin (1987), Hodges and Evans (2005) and Chaubey et al. (2015).

Host plants: Polyphagous in many plant families, such as Cucurbitaceae, Solanaceae, Malvaceae, and Leguminosae (Martin, 1987 and Hodges & Evans, 2005). This insect was found feeding on pumpkins in Punjab.

Distribution in India: Throughout India - Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal (Martin, 1987 and EPPO, 2025).

Remarks: The major pests of cucurbitaceous crops cause direct feeding damage and are known to transmit plant viruses.

3.2.2. Family COREIDAE Leach, 1815

Genus *Cletus* Stål, 1859

***Cletus signatus* Walker, 1871**

Common name: Squash bug, Leaf-footed bug

Diagnostic characters: Medium-sized bugs with body lengths ranging between 12 and 15 mm. The adult body was moderately elongated and dark in colour. A leaf-like expansion was observed in the hind tibia. The humeral spine was not acute. The outer angle of the 7th abdominal sternite was acute. The spermathecal bulb was of uniform length, and the outer angle of the abdominal sternite 7 was sharp. Well-developed scent glands were observed between the middle and hind coxae. These characteristics are consistent with those reported by Triplehorn and Johnson (2005) and Gupta and Singh (2013).

Host plants: Several cucurbitaceous crops, such as squash, pumpkin, gourds, etc. (Schaefer & Panizzi, 2000 and Gupta & Singh, 2013). This insect feeds on pumpkin and bottle gourds in Punjab.

Distribution in India: Widely distributed in several states, including Assam, Bihar, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal (Gupta & Singh, 2013).

Remarks: Inflict damage due to sucking plant juices, especially in developing fruits.

3.2.3. Family GEOCORIDAE Baerensprung, 1860

Genus *Geocoris* Fallén, 1814

***Geocoris* spp.**

Common name: Big-eyed bugs

Diagnostic characters: Small-bodied bugs, measuring 3.5-4.0 mm in length. Adults are characterized by the presence of large reniform compound eyes protruding from the head. The body was dark, whereas the head and rostrum were yellow-brown. The compound eyes were reddish-brown in colour. The antennae were black, and the first and apical joints were light brown and yellowish, respectively. A yellowish-brown coloration was present on the lateral margins of the thoracic pronotum and the corium of the forewing, whereas the scutellum and pronotum were black. The 3rd and the 4th abdominal segments had spiracles on their dorsal side. Similar characteristics have been reported by Henry (2009); Kóbor (2018, 2020) and Triplehorn and Johnson (2005).

Host(s): These are generalist predators thatprey on several small insects on cucurbitaceous crops (Sweet, 2000; Mead, 2011 and Varshney, 2023). An adult of this insect was collected from a half-opened bitter gourd flower in Khanpur, Punjab.

Distribution in India: Throughout India, including all major states, such as the North Indian foothills, Punjab, Haryana, Uttar Pradesh, Bihar, Odisha, West Bengal, Assam, Tamil Nadu, Karnataka, Maharashtra, Gujarat, Arunachal Pradesh, and Rajasthan (Distant, 1910, 1918; Kóbor, 2018 and Varshney, 2023).

Remarks: Beneficial predatory bugs that feed on sedentary pests such as aphids, whiteflies, thrips, scales, and other small insect pests.

3.2.4. Family LYGAEIDAE Schilling, 1829

Genus *Graptostethus* Stål, 1868

***Graptostethus servus* (Fabricius, 1787)**

Common name: Seed-eating bug

Diagnostic characters: Medium-sized bugs, approximately 8-9 mm long. The body was reddish-brown with fine hair. The triangular head and its width were nearly equal to its length. The antennae were 4-segmented, and the 2nd segment was the longest. The compound eyes were large, round, and black. The rostrum was elongated and extended into the hind coxae. The thorax had a distinct shape, with a quadrangular pronotum that was wide at the base and gradually tapered towards the front. The scutellum was black, whereas the clavus and corium displayed a combination of red and black, all adorned with subtle greyish pubescence.

In contrast, the abdominal sternum was pale gray. All

abdominal spiracles were positioned dorsally. the wing membrane had deep brown, featuring straight longitudinal veins. Our findings corroborate those by Distant (1904), Triplehorn and Johnson (2005) and Chandra et al. (2018), and are similar to these studies.

Host plants: Adults and nymphs feed on the seeds of several plant species, including cucurbits (Distant, 1904; Schuh & Slater, 1995 and Chandra et al., 2018). This insect was collected from bitter gourds, pumpkins, and bottle gourds in Punjab.

Distribution in India: Extensively distributed in Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal (Distant, 1904 and Chandra et al., 2018).

Remarks: Feeds mainly on seeds but can damage the growing fruits

Genus *Spilostethus* Stål, 1868

***Spilostethus pandurus* (Scopoli, 1763)**

Common name: Seed bugs

Diagnostic characters: The bugs were large, ranging in size from 13 to 16 mm. The body was red, with black markings on the head apex, inner edges of the compound eyes, and two longitudinal patches on the pronotum, antennae, rostrum, scutellum, and legs. The wing membrane was reddish-brown in colour, with a prominent white spot. The femora had spines underneath them. The rostrum extended to the mid-coxae. Our findings extend those reported by Distant (1904) and Chandra et al. (2018).

Host plants: Adult and nymphal stages of this insect feed on the seeds of various cucurbitaceous vegetable crops (Schuh & Slater, 1995 and Chandra et al., 2018). This insect was collected from pumpkin, bitter gourd, and bottle gourd in Punjab.

Distribution in India: Across India, from Kashmir to Tamil Nadu, including Punjab, Haryana, Maharashtra, North Bihar, West Bengal, and Odisha, Andhra Pradesh, Karnataka, Gujarat, and Rajasthan (Chandra et al., 2018).

Remarks: It is mainly a seed feeder; however, it can damage developing fruits.

Genus *Oxycarenus* Fieber, 1837

***Oxycarenus* spp.**

Common name: Dusky cotton bug

Diagnostic characters: Oblong-bodied small-to-medium-sized bugs. The head was triangular and projected in front of the antenniferous tubercles. The rostrum was thin and long. The pronotum was trapezoidal with a midline constriction. The scutellum was triangular and barely wider than it was long. The hemelytra with straight lateral margins completely covered the abdomen. The moderately thickened femora were finely spined. These observations are consistent with those of Distant (1902) and Schuh and Slater (1995).

Host plants: Cotton, cucurbits, etc. (Distant, 1902 and Ahmad & Kamaluddin, 1985). This insect was collected from bottle gourds and sponge gourds in Punjab.

Distribution in India: Found throughout India, especially in cotton-growing tracts such as Punjab, Haryana, Rajasthan, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Karnataka, and Tamil Nadu (Distant, 1902).

Remarks: Primarily a pest of cotton, but may also occur on cucurbitaceous crops.

3.2.5. Family PENTATOMIDAE Leach, 1815

Genus *Bagrada* Stål, 1862

***Bagrada hilaris* (Burmeister, 1835)**

Common name: Painted bug, Bagrada bug

Diagnostic characters: Medium-sized bugs with subovate, shield-shaped bodies. It had a black and shiny head. The lateral sides of the head, edges of the eyes, lateral and anterior margins of the pronotum, and pronotum had a median longitudinal stripe that extended to the scutellum, and the sides of the corium were pale off-white in colour (Rider, 2017 and Chandra et al., 2018). The antennae and tarsi were five- and three-segmented, respectively, which is consistent with those reported by Triplehorn and Johnson (2005), Rider (2017), and Chandra et al. (2018).

Host plants: Cruciferous crops and cucurbits (Palumbo et al., 2016; Rider, 2017 and Chandra et al., 2018). This insect was collected from pumpkin, bitter gourds, and bottle gourds in Punjab.

Distribution in India: North India - Punjab, Haryana, Rajasthan, Gujarat, Himachal Pradesh, Jammu & Kashmir, and some parts of Uttar Pradesh (Chandra et al., 2018).

Remarks: Mainly a cruciferous crop pest, but sometimes a pest of cucurbitaceous crops.

Genus *Dolycoris* Mulsant & Rey, 1866

***Dolycoris indicus* Stål, 1876**

Common name: Indian shield bug

Diagnostic characters: The medium-to-large-bodied and oval-shaped adult bugs were brownish-ochraceous in colour, with thick punctures covering the body. The five-segmented antennae were black, with the basal joint and bases of the other joints being luteous (orange-yellow or greenish-yellow) coloured. Small black spots were observed near the coxae. Tarsi three-segmented. The thoracic sternum did not have a longitudinal median keel. The scutellum was large and covered a large portion of the abdomen. The lateral

areas of the prosternum and abdomen had sparse black punctures, and the connexivum was spotted black at the incisures. The membrane was greyish, with slightly darker veins; similar observations were recorded by Distant (1902), Triplehorn and Johnson (2005), and Rider (2017).

Host plants: Many crops, including cucurbits, legumes, and vegetables (Distant 1902, Rider 2017). This insect was collected from bitter gourds and bottle gourds in Punjab.

Distribution in India: This insect was collected from sponge gourds, bitter gourds, pumpkin, and bottle gourds in Punjab. Throughout India, from most Indian states, including Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, Odisha, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Maharashtra, Gujarat, and Rajasthan (Distant, 1902).

Remarks: Polyphagous pest found damaging through sucking plant sap.

Genus *Eysarcoris* Hahn, 1834

***Eysarcoris* spp.**

Common name: Shield bugs

Diagnostic characters: Small- to medium-sized pentatomid bugs with a typical shield-shaped body. The body was obovate in shape, moderately broad, and somewhat strongly convex beneath it. The head was deflected, with a rounded apex, and the central lobe was as long as or slightly longer than the lateral lobes. The five-segmented antennae had a basal joint that did not reach or nearly reached the apex of the head. The tarsi were three-segmented. Body shape varied from rounded to oval. The pronotum was deflected forward, while the scutellum was approximately the same length as its width at the base or slightly longer. The scutellum was triangular and did not cross the apex of the abdomen. These observations are consistent with the findings of Distant (1902), Triplehorn and Johnson (2005), Salini (2006, 2015) and Rider (2017).

Host plants: Different types of crops, such as cucurbits and vegetables (Distant, 1902, 1904 and Rider, 2017). This insect species was collected from bottle gourds and bitter gourds in Punjab.

Distribution in India: Widely distributed pan-India in Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, Odisha, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Gujarat, Rajasthan, and Himachal Pradesh (Distant, 1902, 1904).

Remarks: Minor pest of various crops, including cucurbitaceous plants.

Genus *Nezara* Amyot & Serville, 1843

***Nezara viridula* (Linnaeus, 1758)**

Common name: Southern green stink bug

Diagnostic characters: Large pentatomid bugs, 12-17 mm in length. Colourful insects with a bright green colour may vary depending on the season. Five-segmented antenna. Three-segmented tarsi. Shield-shaped body characteristics of the family. Although the scutellum was large, it did not reach the apex of the abdomen. These diagnostic characteristics are in accordance with those reported by Triplehorn and Johnson (2005) and Rider (2017).

Host plants: Highly polyphagous and feed on many crops, including cucurbits, legumes, cereals, and vegetables (Ahmad & Kamaluddin, 1985; Jones, 1988 and Rider, 2017). This insect pest was collected from pumpkin, bottle gourds, and bitter gourds in Punjab.

Distribution in India: Throughout India - this is one of the most widespread pentatomids and is distributed in all the major states, as far as Punjab and Haryana southwards to Uttar Pradesh and Bihar, westwards to West Bengal, Odisha, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, and Maharashtra, and eastwards to Gujarat, and Rajasthan (Distant, 1902, 1904 and Ahmad & Kamaluddin, 1985).

Remarks: This pentatomid bug is an important polyphagous insect pest that is known to cause economic losses in many field crops.

3.2.6. Family PSEUDOCOCCIDAE Cockerell, 1905

Genus *Planococcus* Ferris, 1950

***Planococcus* spp.**

Common name: Mealybugs

Diagnostic characters: These mealy bugs are soft-bodied and produce a powdery white wax that covers their bodies. Adult females are wingless. Their bodies are broadly oval-shaped and appear convex dorsally and relatively flat ventrally. Dorsally, adult females show yellowish, brownish, or greyish-yellow colouration while yellowish ventrally. In female mealybugs, the colouration on the dorsal surface is mostly hidden due to the presence of a dense layer of white powdery substance. Similar observations have also been reported by Williams and Granara de Willink (1992), Miller et al. (2000) and Joshi et al. (2021).

Host plants: Polyphagous on many crops, including cucurbits, citrus, and ornamentals (Williams & Granara de Willink, 1992 and Miller et al., 2000). Adult female insect were collected from bottle gourds in Punjab.

Distribution in India: All over India, collected from all major agricultural states, namely, Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, Odisha, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Maharashtra, Gujarat, and Rajasthan (Williams & Granara de Willink, 1992).

Remarks: It is an agriculturally important insect pest that is

known to cause direct damage to crops and transmit plant viruses.

3.2.7. Family PYRRHOCORIDAE Amyot & Serville, 1843

Genus *Dysdercus* Guérin-Méneville, 1831

***Dysdercus evanescens* Distant, 1902**

Common name: Red cotton bug

Diagnostic characters: Adult bugs were medium to large in size, measuring 10- 14 mm. The body was brilliantly red and black. All abdominal spiracles were located dorsally. In general, the head was narrower than the pronotum. The antennae were four-segmented. The pronotal collar was either white or the same colour as the rest of the body. The adults were concolourous, with the pronotal disc, anterior angles, and posterior margin ranging from a light grayish-ochraceous colour to a deep red shade. The corium exhibited a small transverse spot that was centrally located and relatively smaller than the size of the insect. These observations are consistent with those of Distant (1902), Kapur and Vazirani (1956) and Ahmad and Kamaluddin (1985).

Host plants: Cotton, cucurbits, and other crops (Distant, 1902 and Ahmad & Kamaluddin, 1985).

Distribution in India: Found throughout India - most prominently in the cotton-growing areas of Punjab, Haryana, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu (Distant, 1902 and Ahmad & Kamaluddin, 1985). This insect pest was collected from pumpkin, bottle gourds, and bitter gourds in Punjab.

Remarks: Primarily, a cotton pest. However, it is occasionally found in cucurbitaceous crops.

Genus *Physopelta* Amyot & Serville, 1843

***Physopelta gutta* (Burmeister, 1834)**

Common name: Red bug

Diagnostic characters: Medium-sized bugs with distinctive red and black colourations. The elongated body was dull reddish-yellow in colour with a pilose texture. Four-segmented antennae. The base of the apical joint of the antennae was yellow. The apical angles of the corium and membrane were black, and the center of the corium was characterized by a black round mark on each side. The rostrum, legs, sternum, abdominal incisures, and three sublateral spots exhibited a dark brownish-gray coloration. The lateral margins of the prosternum, base of the first joint of the antennae, basal angle of the membrane, coxae, trochanters, and femora beneath exhibited a dull reddish-yellow coloration. All abdominal spiracles were dorsally present, which is typical of familial characteristics. These observations are congruous with those of Distant (1902), Schuh and Slater (1995), Stehlík (2013) and Chandra and Boaz (2018).

Host plants: Several plants, such as cucurbits and other crops (Distant, 1902, 1904 and Schuh & Slater, 1995). Adults were collected from bottle gourds and bitter gourds in Punjab.

Distribution in India: Widely distributed in Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, Odisha, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Gujarat, Rajasthan, and the northeastern states (Distant, 1902, 1904).

Remarks: Attacks a wide range of plants, including cucurbitaceous crops.

3.2.8. Family REDUVIIDAE Latreille, 1807

Genus *Zelus* Fabricius, 1803

***Zelus* spp.**

Common name: Assassin bugs

Diagnostic characters: Medium-to large-bodied, elongated predatory bugs. Typically, they were slender. The colour ranged from yellowish-brown to black, with a generally consistent hue. The head was narrowed behind the compound eyes, forming a distinct neck. The ocellus was raised. The three-segmented rostrum was short and curved. The antennae were four-segmented. The front legs wee often developed to catch prey. The scape and basiflagellomere were long and subequal, whereas the pedicel and distiflagellomeres were short. The scape was at its maximum thickness. The legs were elongated and slender, with nearly equal femoral diameters. The lengths of the pro- and metafemora were greater than that of those mesofemur. The hemelytron extended beyond the end of the abdomen. The abdomen typically had subparallel lateral margins, with a ventral outline that was usually straight or concave. Wings were well-developed when present. Similar observations have been reported by Ambrose (2003), Triplehorn and Johnson (2005) and Zhang et al. (2016).

Hosts: Prey on several insects that feed on cucurbitaceous and other crops (Ambrose, 2003 and Weirauch & Munro, 2009). Only one adult was collected from a bitter gourd field in Punjab.

Distribution in India: Common throughout India, including all major states, namely Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, Odisha, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Maharashtra, Gujarat, and Rajasthan (Distant, 1902, 1904 and Ambrose, 2003).

Remarks: Beneficial predatory species that consume various pest insects in cucurbits.The morphometric

observations (in mm) of all the species or genera described in this study are provided in Table 2.

In the current study, eight families, five genera, and nine species were collected from cucurbitaceous crops in Punjab, India, during the April 2022 to October 2022 growing season and taxonomically identified using available keys. Among the eight Hemipteran families, Pentatomidae was the most predominant, represented by three species and one genus. In the family Lygaeidae, two species were successfully identified, while in the family Pyrrochoridae, one genus and two species were successfully identified. However, in five families (eg. Aleyrodidae, Coreidae, Geocoridae, Pseudococcidae, and Reduviidae) one species each was identified. Morphometric measurements of the head, thorax and abdomen were recorded from the dorsal side of all 14 adult insects and expressed in mm. Thus, multiple insect pest species and a few beneficial predators inhabiting cucurbitaceous crops form intricate ecological associations. This biodiversity is necessary in sustainable agricultural environments.

3.3. Insect Pest Species

The nine insect species described and depicted in this checklist are key cucurbitaceous crop pests and predators of insects on cucurbits. For instance, *Bemisia tabaci* is one of the most damaging insect pests, known for its direct feeding injuries to crops. Additionally, B. tabaci is a known insect vector of a few plant viruses (Martin, 1987). *N. viridula* is a highly polyphagous insect that causes economic damage to various agricultural crops (Ahmad & Kamaluddin, 1985 and Jones, 1988). Vegetable crops, such as brinjal and okra, are attacked by *N. viridula*. They cause damage through sap-sucking, thereby negatively affecting plant growth and reducing fruit development (Bhosale & Kamble, 2022). Recent studies by Prabhakar et al. (2023) have identified *N. viridula* as an emerging insect pest of maize crops in India. The peak activity of *N. viridula* during the critical growth period of the crop results in significant crop yield losses. *C. signatus* appears to be injurious because it sucks the sap of developing fruits (Gupta & Singh, 2013). Owing to the damage to developing seeds and fruits, several seed bugs (e.g., *G. servus, S. pandurus*) cause both direct and indirect damage to the seeds and fruits (Chandra et al., 2018).

3.4. Beneficial Species

The two families represented in this checklist contain beneficial predatory species. Common predators of aphids, thrips, and other small insect pests are *Geocoris* spp. (Family: Geocoridae) (Sweet, 2000; Mead, 2011 and Varshney, 2023). *Zelus* spp. (Family: Reduviidae) have been reported as generalist predators that feed on various insects (Ambrose, 2003; Weirauch & Munro, 2009).

3.5. Biogeographical Significance

The species presented have broad distributions in India, as the majority of the reported species are found across many states (Distant, 1902, 1904; Chandra et al., 2018). This indicates the agricultural significance of cucurbitaceous crops in India, as well as the adaptability of cucurbitaceous crops in different climates in which hemipteran species can survive.

4. CONCLUSION

In this study, nine species of hemipteran insects, belonging to eight families and 11 genera, were collected and identified from various cucurbitaceous crops cultivated in Punjab, India. Among all families, Pentatomidae was the most abundant family, representing four species. In this study, it was observed that the insect community represented both pest species (e.g., silver leaf whitefly (*B. tabaci*), southern green stink bug (*N. viridula*), and beneficial species (e.g., *Geocoris* spp. or *Zelus* spp.). The coexistence of insect pests and beneficial predators suggests the need for an integrated pest management (IPM) program that includes the conservation of biocontrol agents and the management of harmful insect species. Many of the species presented in this study hadhigh distribution values throughout India; therefore, the results of this study have implications for agricultural systems throughout India.

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CRediT authorship contribution statement

Abu Bakar Farooq Babu: Insect Collection and Insect Curation, Writing - Draft Preparation. **Prasad S. Burange:** Conceptualization, Methodology, Insect Collection, Supervision, Writing-Reviewing and Editing.

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Conflict of interest

The authors declare that is there is no conflict of interest.

Declaration of generative AI and AI-assisted technologies in the writing process

The authors declare that no AI tool was used in the preparation of this manuscript.

Data availability

The data and insect specimens are available from Prasad S. Burange.

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