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Taxonomic studies of family Pentatomidae (Hemiptera) four genera from district Faisalabad Punjab Pakistan with taxonomic keys

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Abstract

Most species belonging to family Pentatomidae are phytophagous and some species of family Pentatomidae are only crop pests. Collection of specimen was done by hand and also by aerial net. Identification of specimen related to different vegetables, fruit and crops was done by using different taxonomic keys. Four genera were identified included, *Nezara viridula* 1865, *Nezara antennata* 1874, *Halyomorpha scutellela* 1879 and *Halyomorpha picus* 1794. Taxonomic keys and high resolution photographs were also provided for further description.

Keywords: Pentatomidae, hemiptera, bugs, identification, taxonomy, Faisalabad, Punjab

Introduction

Pentatomidae family from Hemiptera order which is famous due to third largest family due to present work. Identified species of order Hemiptera from the world, are 4722 species contained by 896 genera belonging from the Pentatomidae family (Rider, 2006-2012) [9]. The insects from family Pentatomidae are commonly famous due to frequent names to the taxonomists, known to Shield bugs with suitable shield-shape body with more or less triangular scutellum. The bugs from Pentatomidae family are commonly spread all over the world, known through 73 different families by probable 39,096 species (Panizzi *et al.*, 2000) [7]. Most species belonging to family Pentatomidae are phytophagous and some species of family Pentatomidae are only crop pests (Grazia *et al.*, 2012). Stink bugs from family Pentatomidae are predaceous, occasionally omnivorous and herbivorous which are specialists or generalist in feeding behaviors and take place in a diversity of habitats variance starting from natural toward cultivated and herbaceous and grassy to arboreal (De Clerq, 2000) [4]. Stink bugs from family Pentatomidae normally experience 1 or 2 generations in a year univoltine and bivoltine in the Midwestern United States, (McPherson, 2000) [6]. Stink bugs from Pentatominae take the small labium exert among bucculae. Labium of bugs from Pentatominae is large as the thickness of antenna and adaptation of sucking sap that inject digestive juice beside within microorganisms. The Pentatominae is largest subfamily in Pentatomidae and dispersed throughout the world. Pentatominae explain the great difference in body form and coloration of antennae with five segmented well-known Pronotal angles, scutellum cover up half of abdomen (Wall, 2004) [12].

Species from the Asopinae subfamily are known as predators are adults, while the other subfamily those of Podopinae and Pentatominae as phytophagous. Species are univoltine and bivoltine in Missouri (Yonke, 1971) [13]. Stink bugs from family Pentatomidae are shield-shaped and broadly oval which ranging from 4 to 20 mm in size in length. The stink bugs have segmented like body which start from border of wings and head facilitate down uniform on the abdomen in which having leathery membranes on first pair, distally and basally (Borror *et al.* 1989) [3]. Antennae of the stink bugs are 5 segmented, frequently 4 segmented by 3 segmented tarsi. The scutellum is usually triangular-shaped. Family Pentatomidae arrange into 4 subfamilies Pentatominae, Asopinae, Podopinae and Phyllocephalinae. Subfamily Asopinae are describe 7-25 mm body, compact rostrum, the initial part of labium is clearly thicken and open which facilitate rostrum to wing onward completely creation it easier to a predator for feed. Subfamily Asopinae deviate into 300 species with 69 genera. (Rider and Zheng, 2002) [8].

The focus of this present study to construct taxonomic keys of District Faisalabad species on morphological basis to facilitate their future identification. To identify the new host plants of Pentatomidae family and provided description of different species on morphological basis.

Materials and Methods

Study site

Study was done in taxonomy lab systematics of Department of Entomology, University of Agriculture Faisalabad, during the year 2017-18.

Collection of specimen

The collection of specimen of family Pentatomidae stink bugs was done during day time. It was necessary to manage tours for collection in systematic way that contain the best collection place for the collection the sample of specimen of Pentatomidae family in District Faisalabad. The area visited was chosen for collection of specimen includes different areas of agronomic crops, public parks, vegetables, flowering plants and national rest house in Faisalabad District.

Storing and Preservation

The preservation of collected specimen of Pentatomid bugs were arranged tentatively on the origin of external morphological characteristics that contain specimen colour, labium, shape of head, antennae, ventral markings and spots on pronotum, stigmata spots, pronotum and its angles, corium, scutellum, legs, meta thoracic scent glands, connexiva. Suitable pins were used for pinning of insect specimens from Pentatomidae. The specimens were preserved within the wooden box behind pin and extend the appendages of insects i.e. antenna, wings and legs. The alteration of alcohol was done occasionally to avoid from damages.

Identification: Identification of species was done on the bases of typical morphological characters. Colored images of collected specimens and the diagram of major taxonomic characters were given. All the work was done under compound microscope and stereoscope.

Illustration and Photography

Collection of work based on morph taxonomy in any group of insects is not acceptable without collaborating manuscript with related photographs. The photography of external female and male genitalia of specimen was done with the help of image processing elements installed in DRS laboratory of Department of Agricultural Entomology University, of Agriculture Faisalabad. Line drawings being used to simplify on the structures and shapes of different morphological measurement of insects. Photography of all the components of

dead specimens of family Pentatomidae has been completed by using digital camera.

Results and Discussion

Family Pentatomidae

Pentatomidae family is one of the biggest families in the Hemiptera order. It is estimated that 36,096 species was described in which 4700 species belonging from family Pentatomidae (Panizzi *et al.*, 2000) ^[7].

Key to subfamilies of Pentatomidae

1. Having very short rostrum, not expanding beyond from anterior coxae. Basal and large component of segment 2 covered inside the bucculae.....Phyllocephalinae
Dallas More elongated rostrum, expanding coxae beyond from anterior region.....2
2. Thickened labium not covered between the bucculae..... Asopinae Not thickened labium, covered between the bucculae..... 3
3. Scutellum attaining half of the abdomen with passing immediately a little beyond it, but not reached to the head apex, with one pair of trichobothri, frena have 1/3 or large length of the scutellum, first labial segment larger or sub equal to the bucculae, Sulcation of tibiae done on upper surface, exposed the membrane.....Pentatominae
4. Long and large scutellum, which having U-shaped, mostly reached to apex of the abdomen, single trichobothria, with less and short ferna than 1/3 margin length of scutellar, first segments of labial smaller than the bucculae, tibiae not sulcate on upper face, scutellum covered the membrane.....Podopinae

Key to the genera of Pentatomidae

1. Pronotum width through the humeral angles lesser than maximum abdomen width, extended the labium up to 4th segment of abdominalHalys Fabricius
Not manufactured the humeral angles.....2
2. Labium reached beyond the mesocoxae region, pronotum from anterior margin callous and callous.....Bagrada Stal-Labium passing beyond metacoxae; anterior margin of pronotum neither elevated nor callous.....3
3. Usually partly metallic species, with red, white or orange markings; orifices of sterna gland inconspicuous.....Nezara Amoyt and Serville
Nonmetallic forms, otherwise colored; orifices of sternal gland conspicuous.....4
4. Pronotum from lateral and anterior margins not callous and elevated, labium reached to 3rd segments abdomen.....Halyomorpha Mayr

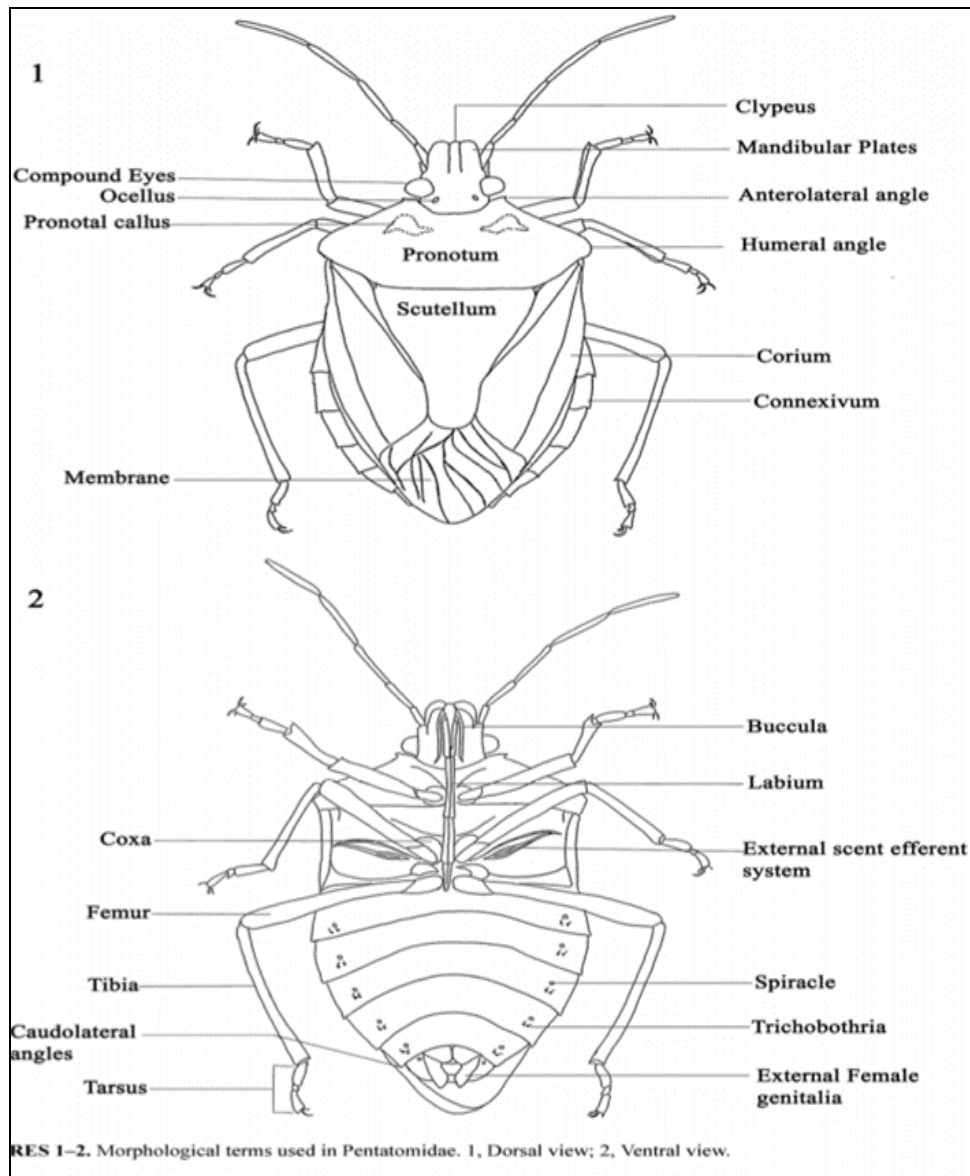


Fig 1: Common morphological characters

Genus: 1 *Nezara viridula* 1865 (Linnaeus)

Identification keys

length of body 16 mm, sub roundish head cutting paramere not rounded at apex, large area of ejaculatory reservoir, paramere straight from inner margin, elongated 9th paratergites, scarcely curved posteriorly.....*viridula* (Linnaeus)

Head: Head strongly declivent, curved at the apex, paraclypeal lobes longer than clypeal lobes, sinuous found above the eyes, parallel the inner margins, anterolateral response upwards, segments of antenna formulation the long labium, reached to the 3rd abdominal segment in anterior margin.

Thorax: Pronotum deflect down, concave the anterior margins, sub quadrate angles, tuberculate minutely, lateral margins medially sinuate, upward reflexed, sub prominent the humeral angles, with curvy apices, posterior angles marginally convex, subrugulose the scutellum, apical lobe sub triangular; Metathoracic scent gland osteolar open oblong, thickened uniformly, at apex sub rounded, reached to the metapleural margin, broad evaporatorium with well-defined posterior and anterior margins, pilosed legs without any

changes.

Abdomen

Medially convexed, temperately punctured, connexiva exposed connexiva ventrally and dorsally, pilosed the genital capsule, membrane of hemelytra passing outside the apex of abdomen, abdominal sternites having ventroanterior margin, sometime with an overturned U-shaped through the posterior angle of connexiva, arc shaped ventro posterior margin.

Measurements (mm): Body length: 15.30, length of head, 2.01, eyes width: 2.75, space of interocular 1.53, space of interocular, 0.97, distance from Preocular, 1.02, posterior head length containing eyes: 1.02, length of antennal segments, (I-V), 0.44-1.33, length of pronotum, 3.52, humeral angle width 7.52, length of scutellum: 5.30, scutellum width, 4.88.

Material Examined

Punjab: Faisalabad, 20. iv. 2017, 4 ♂; Jaranwala, 15. vii. 2017; Samundri, 19.v.12, 17; Pansera, 25-ix-17; Shahkot, 15-vii-17.



Fig 2a: Head of *Nezara viridula* in which eyes are present b. Whole body of *Nezara viridula* c. Abdomen part of *Nezara viridula*

Genus: 2. *Nezara antennata* Scott (1874)

Identification keys

Length of body 15mm, triangular head, paramere blade rounded sub acutely down at the apex, small area of ejaculatory reservoir, paramere sinuous at inner margin, 9th paratergites approximately curved at the posterior margin..... *antennata* Scott

Head: Declivent head, at apex sub rounded, par clypeal lobes larger than clypeal lobes, sinuous beyond the eyes, parallel the inner margin, reflexed upward anterolateral, segments of antenna formulate the labium long, reached the anterior margin to third segment of abdomen, length of labium.

Thorax: Pronotum deflect down, concave the anterior margins, subquadrate angles, tuberculate minutely, lateral margins marginally sinuate, upwards reflex, sub prominent the humeral angles with curved apices, well defined the posterior angle which marginally convex, subrugulose scutellum, ferna markedly pointed on the sub triangular apical lobe, scent glands from Metathoracic region osteolar open oblong, thickened uniformly, at apex sub rounded, reached to

the metapleural area, broad evaporatorium with well-defined posterior and anterior margins, pilosed legs without any changes.

Abdomen: Medially convexed, temperately punctured, connexiva exposed connexiva ventrally and dorsally, pilosed the genital capsule, membrane of hemelytra passing outside the apex of abdomen, abdominal sternites having ventroanterior margin, sometime with an overturned U-shaped through the posterior angle of connexiva, arc shaped ventro posterior margin.

Measurements (mm): Length of body: 15.0 eyes width: 2.82 space from interocular,1.11,space of interocular, 0.63, distance of Preocular, 1.17, head length containing eyes, 0.83, length of antenna,(I-V) 0.40-1.35, length of pronotum, 3.22.

Material Examined

Punjab: Faisalabad, 04.vi.17, Shahkot, 18.ix.17 Khurianwala,20.v.17,3♂,PARIS UAF,25-ix-17,5♀, Jaranwala, 14.viii17,9♀,4♂.



Fig 3a: Whole body of *Nezara antennata* b. Abdomen part of *Nezara antennata* c. Thorax part of *Nezara antennata*

Genus: 3. *Halyomorpha scutellela* Distant, 1879

Identification keys

1- Disk of pronotum uniformly black or dark brown, black colored species; crown of paramere foliaceous and provided with profuse, elongate hairs on one side; aedeagus elongated and convoluted.....*Halyomorpha scutellela* Distant

Identification character: Color variable, dorsum of head, pronotum, hemelytra except membrane, black suffused with metallic blue, sometimes light brown or dark ochraceous brown, antennae black or ochraceous, lateral margins of

pronotum leaving humeri yellowish red, scutellum medially with anchor-shaped mark bright yellow or bright red. Coloration of ventral side highly variable, whole ventral side including legs uniformly ochraceous except few black spots on thoracic sternite, apex of labium, spiracular openings, or sometimes whole ventral side except legs, labium, ventrolateral margin of head or whole ventral side of head, one large black spot each on pro sternum laterad of for coaxe, Dorsum of head, pronotum, hemelytra except membrane densely and coarsely punctuate.

Head: Shorter than width across eyes, mandibular plates nearly equal to or slightly shorter than clypeus. Antennae with proximal part of segment IV attached to remaining segments by small, short pedicel, segment ii shorter than segment iii and IV.

Labium just surpasses hindcoxae, segment is lightly longer than segment IV. Pronotum width across humeri nearly 2.5 times median length, called distinctly demarcated, moderately separated. Scutellum extending beyond middle of abdomen, apex rounded, remaining diagnostics as in generic description.

Thorax: Lateral margins of pronotum leaving humeri yellowish red, scutellum medially with anchor-shaped mark bright yellow or bright red, dark brown or black punctate laterally leaving apex and medially on disk leaving central small region, connexivum reddish or ochraceous suffused with red, with black or bluish transverse stripes, hemelytra with membrane light brown suffused with black, remaining coloration of ventral side highly variable, whole ventral side

including legs uniformly ochraceous except few black spots on thoracic sternite,

Abdomen: Black spot each medially on abdominal sternite IV-VII or only on VII, ochraceous.

Measurements (mm): Body length 15.16-27.36; length of head 2.63-3.06; width across eyes 3.32-3.60, interocular distance 1.73-1.87, lengths of antennal segments (I-V) 0.71-2.83 lengths of labial segments (I-IV) 1.24-1.53, median length of pronotum 3.44-3.91; humeral width 8.98-10.28; length of scutellum 5.79-7.05; basal width of scutellum 5.48-6.44.

Material Examined

Punjab: Faisalabad, 25.v.17, 2♀ Khurianwala, 19-vii-17, Ayub Agriculture research Institute Faisalabad, 25-ix-16: Jaranwala, 19.v.17, 16♀:Painsral.ix.16



Fig 4a: Whole body of *Halyomorpha scutellata* Pointed b. Head of *Halyomorpha scutellata* c. Abdomen Part of *Halyomorpha scutellata*

Genus: 4. *Halyomorpha picus* (Fabricius, 1794)

Identification keys

-Body size ranges from 15-22 mm; apex of mandibular plates laterally with truncate; aedeagus elongated and extensively convoluted; phallosome on ventral side with two stout, blunt thecal processes laterally near proximal end.....*Halyomorpha picus* (Fabricius)

Identification Characters

Broad head at the apex, narrowed the lateral margin sinuate and reflexed, equal length of lobes, 5 jointed antennae, first joint not reached to the head apex, large and sessile eyes, labium reached to the second and third segment of abdomen, pronotum having small tooth at every anterior angle, lateral margins somewhat reflexed and oblique, sub prominent lateral angles, scutellum narrowed with the apical, small curved at every basal angle, tibiae broadly and externally sulcate.

Head: Head slightly sub truncate at the apex, deflect moderately, paraclypeal lobes sub equal clypeal lobes, sinuous above the eyes, anterolateral somewhat reflexed, pointed at the apex, formula of antennal segments I<IV. Labium reached to 3rd segment of abdomen, formula of length of labium-I=IV<II<III

Thorax: Pronotum marginally depress anteriorly, anterior margin somewhat larger than eyes width, truncate after the eyes, form a small angle of tuberculate, obliquely straight the lateral margin, sub prominent the humeral angle, sub equal to full width of the abdomen, rugulose and long scutellum, narrowed the ferna at apical lobe, Metathoracic scent gland osteolar open extended, reached 3-4 way to margin of metapleural, broad evaporatorium, bowl-shaped medially cover 2-3rd of sternites, simple legs through tibiae.

Abdomen: Ampliate, somewhat sulcate centrally, exposed the connexiva at repose, abdominal sternites having ventroanterior margin, concave deeply, slightly upturned V-shaped, posteriorly hemelytral sub acutely produced membrane passing on the apex of abdomen.

Measurements (mm): Length of body 14.63-21.88, head length 2.55-3.63, eyes width 3.12-3.53, intraocular distance 1.65-1.96, lengths of antennal segments (I-V) 0.74-2.91, lengths of labial segments (I-IV) 1.46-1.88, median length of pronotum 2.77-3.88, humeral width 7.35-9.88, length of scutellum 4.77-6.80, basal width of scutellum 4.55-6.16.



Fig 5a: Whole body of *Halyomorpha picus* b. Head of *Halyomorpha picus* in which eyes are present c. Abdomen part of *Halyomorpha picus*

Study was done in Faisalabad Punjab Pakistan in 2017-18. Collection of specimen of bugs from family Pentatomidae done by hand picking and also done by aerial net from different areas of Faisalabad i.e. agronomic crops, national forests, public parks, flowering plants and vegetable. The identification characters of genera, family and subfamilies have been given. Keys for the identification of genera, subfamilies and species have been delivered to enable the identification in future. Whole species have also been described in detail due to differences in characters, the photography of various parts of body and important characters of taxonomy are explained. Azim and Bhat (2010) [1] reviewed Pentatomids bugs from Himalaya Kashmir which explained the analytical properties of tribes with genera. The collection of specimen of the related species belongs to two subfamilies which are Asopinae Pentatominae. Subfamily Pentatominae containing 5 species with 3 genera in tribe Halyini. Azim (2011) [2] carried out a taxonomic work on the stink bugs from family Pentatomidae originate from his individual collection and collection which was conserve in the museum of Indian Agricultural Research Institute New Delhi. Zbiorowe, (2000) [15] described keys for the species of shield bugs which cause serious damage to fruit trees, soft fruits, sugar beet, brassica and cereals in Poland. He also provided information in detail about twenty seven genera with forty six species. Zheng (1980) [16] study six species from subfamily Asopinae in China, in which 1 species is also known to *Picromerus bidens* was first time recorded from China collection of this species was done Heilongjiang and Jilin. Zaidi (1996) [14] described tribe Aeliini from family Pentatomidae from Pakistan and India subcontinent which contain 10 species with 5 genera. The article containing keys with detailed study to external genital and their geographical and morphological allocation. Thomas (2005) [11] described the faunal analysis of stink bugs from Pentatomidae of Hispaniola which included more than 800 samples refer to 55 species contain one genus and 7 species. (Swanson and Daniel, 2012) [10] Described an overview of 75 species of family Pentatomidae found in Michigan is presented, along with updated identification keys, distributional lists and relevant literature. Henry (2009) [5] described the current study of 7000 species underneath 1300 genera from Pentatomidae family are recorded all over the world.

Conclusions

Bugs from Pentatomidae family were collected from different localities of Faisalabad district i.e. shahkot, Jaranwala, Painsra, Ayub Agriculture research Institute Faisalabad, Agronomy and Horticulture Research Area UAF, Naya

Lahore during the year 2017-18. The specimen's collection were recognized into genera, subfamilies and species level. Four genera were identified included, *Nezara viridula*, *Nezara antennata*, *Halyomorpha scutellata*, and *Halyomorpha picus*.

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