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Description of key to different species of Genera of Aphidiinae (Homoptera: Aphididae) of District DI. Khan, KPK, Pakistan

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Abstract
The present study was conducted on the basis of Aphidiins specimens collected during 2012 and 2013 form different ecological zones of District Dera Ismail Khan i.e Paharpur, Rangpur, Dhakkee, Kaich, Keri Khasoor, Biloot and Bahkhwai. Aphidiins are very small in size therefore sweeping of hand net was employed for their collection. Aphidiins were sorted out from the collection and were preserved in 70% alcohol. Specimens were then put in 97% alchohol for 24 hours before mounting on card point.

Keywords: Aphidiinae, Areas

1. Introduction
Aphidiinae is a large group of aphid parasitoids which can be recognized by the fragile habitus (body) and weakly sclerotized abdominal tergites. The antennal segments are less than twenty in most species. The suture between abdominal segments 2 and 3 is flexible which allow the abdomen to bend at this point. With the exception of two genera (*Ephedrus* and *Toxares*), the wing venation is greatly reduced. Many species have a single large median cell in the fore wing; hind wing cross vein cu-a absent. The scutellar sulcus is smooth and occipital carina is present [2].

More than 55 genera and about 400 species are known in the subfamily Aphidiinae. The genus *Praon* Haliday is one of the largest genera with more than 50 described species worldwide and many species of the genus are important biological control agents in various agro- and forest ecosystems [11].

An overall research interest in Aphidiinae has increased all over the world. Aphidiinae parasitoids were also found to be rather useful subjects for several fundamental studies. (1998) reviewed tritrophic associations for 11 genera from different parts of Pakistan [4]. listed host records for eight genera of aphidiins from different areas of Pakistan. Some work was done on the genera of Aphidiinae and host parasitism in KPK [3, 2, 1].

Dera Ismail Khan has not been studied for aphidiins. Keeping in view the importance of Aphidiinae as a biological control agent, the present study has been conducted to record the genera, provide taxonomic notes and and key to the identification of genera collected in Dera Ismail Khan area.

2. Materials and Methods
Study was based on the aphidiins specimens collected during 2012 and 2013 from different ecological zones of District Dera Ismail Khan i.e Paharpur, Rangpur, Dhakkee, Kaich, Keri Khasoor, Biloot and Bahkhwai. Aphidiins are very small in size therefore use of sweeping hand net was employed. Aphidiins were sorted out from the collection and were preserved in 70% alcohol. Specimens were then put in 97% alchohol for 24 hours before mounting on card point. Every specimen was labeled with a field label that includes (a) locality (b) collection date (c) collector's name (d) host (if any) and with identification label includes the subfamily and genus name. The Comstock Needhm System of wing vein nomenclature was followed. Wing vein and other morphological terminology was followed form [24]. Identification of the specimens was done with help of available literature [20, 6, 24, 18, 12]. Specimens were examined under an Olympus stereo-zoom microscope with magnification up to 440X. Morphometric measurements were taken using an ocular micrometer. Important diagnostic characters were drawn with free hand drawings and graphic software "Corel Draw 9". Key to the identification

Of genera of subfamily Aphidiinae has been constructed. Specimens have been deposited in Research Laboratory of the Department of Entomology, Faculty of Agricultural Gomal University, D.I khan, Pakistan.

3. Results and Discussion

The results showed that the following eight genera of Aphidiinae wasps occur in the District Dera Ismail Khan. The genera include *Aphidius, Binodoxys, Diaeretiella, Ephedrus, Monoctonus, Praon, Toxares* and *Trioxys.*

Aphidiins have often been treated as a separate family, the Aphidiidae, because of their specialization on aphids, the presence of a flexible suture between the second and third metasomal tergites and reduced wing venation (Raychaudhuri, 1990; Quicke and Van Achterberg, 1990, 1992; Tobias, 1995) but majority of the braconid specialists treated it as a subfamily of Braconidae [8, 24, 2, 1]. The following keys will separate the genera of Aphidiinae.

Key to the Genera of Aphidiinae of District Dera Ismail Khan

Venation of fore wing complete, marginal cell and three sub marginal cells present and complete……..... 2

1' Venation of fore wing incomplete, marginal cell open, without three clearly separated sub-marginal cells; antennal segments variable….....3

2 Antenna 11-12 segmented; ovipositor sheath slender ……. ***Ephedrus*** **Haliday**

2' Antenna at least 16 segmented; ovipositor sheath broad and apically trifed ….....***Toxares*** **Westwood**

3 Forewing R_S+M effacedly developed Hind wing R_S pigmented..... 4

3' Forewing R_S+M absent Hind wing R_S effaced..... 5

4 First discal cell on forewing present with R_S+M less pigmented and m-cu pigmented ……..... ***Praon*** **Haliday**

4' First discal cell on forewing absent; Radial vein on forewing perpendicular to pterostigma ovipositor sheath, ploughshare shaped, narrow at apex and distinctly curved downwardly.....***Monoctonus*** **Haliday**

5 Radial vein long and distinctly curved, hypopygium of female with prongs…….....6

5' Redial vein short and indistinctly curved, hypopygium of female without prongs……....7

6 Tergite-1 with primary tubercles only; secondary tubercles absent)…….……..***Trioxys*** **Haliday**

6' Tergite-1 with both primary and secondary tubercles…....…….…….. ***Binodoxys*** **Mackauer**

7 r-m vein absent; radial vein on forewing short, at most as long as pterostigma; propodaeum with narrow central areola ….....***Diaeretiella*** **Stary**

7` r-m vein present; areola on propodaeum very prominent, not very narrow. T-1 slightly to distinctly broader posteriorly. ……..... ***Aphidius*** **Nees** *Aphidius* Nees

Generic diagnosis: Distinguishing morphological characters include head transverse; antenna 12-21 segmented in female and 15-21 segmented in male; notaulices distinct at the ascendant part of mesoscutum; propodaeum areolated, with narrow and small central areola; forewing, pterostigma triangular, metacarpus always longer than width of pterostigma, pterostigmal cell incomplete, median abscissa-1 and intermedian vein absent, confluent radial and median cells outwardly bounded by intermedian vein-2 and downwardly by fused intermedian and median veins; ovipositor sheath comparatively short slightly curved upward, sparsely haired.

Remarks: *Aphidius* (Nees) is very specios genus in the subfamily and has an extensive and variable host range when all included species are considered [7, 13, 14, 4] described *Aphidius* with 4 and 8 species, respectively, from Pakistan [1]. Reported 12 species representing this genus in KPA.

Praon Haliday

Generic diagnosis: Members of this genus can be recognized by their oval head, little broad across eyes; antenna filiform 14- 23 segmented in female and 16-26 segmented in male; Notaulices distinct throughout; Propodaeum smooth; pterostigma triangular with distinct metacarpus; radial and median veins developed but never reach wing margin; radial cell and median cell-1 separated by median abscissa-1; interradial vein absent; Ovipositor sheath nearly straight to slightly curved upward, with pointed apex and sparsely hairy.

Remarks: The genus *Praon* Haliday is a large one in Aphidiinae with over 50 described species worldwide. The genus includes members with an extensive and variable host range. There are many taxonomic problems in the genus due to great intraspecific variability. Many species are important parasitoids of aphids in various agroecosystems. Some of them have been introduced worldwide against pest aphids [8].

Binodoxys Mackauer

Generic diagnosis: This is very common genus throughout the world, the genus can be recognized by round head across eyes; 10-11 segmented filiform antenna in female and 12-13 segmented in male; mesoscutum with notaulices at least on forefront; propodaeum with complete areola; forewing, pterostigma more or less triangular, radial vein distinct, extend just beyond the stigma, other veins are reduced; Tergite-1 with both primary and secondary tubercles, the latter sometimes poorly visible being almost fused with primary tubercles; Prongs beginning at the apex of the last sternite; Ovipositor sheath always curved downwards and last sternite of female bears long, strong, perpendicular hairs on its dorsal surface.

Remarks: Some authors like [19, 24] consider *Binodoxys* to be a subgenus of genus *Trioxys* based on the presence of prongs on female hypopygium in both genera. However authors like [31, 9, 1, 18] recognized *Binodoxys* to be a valid genus. It is very rare genus in the area studied, few specimen were recorded from District Dera Ismail Khan.

Toxares Haliday

Generic diagnosis: Important morphological characters include head somewhat round, little broad across the eyes; Antennae filiform 15-20 segmented in female and 18-23 segmented in male; Mesoscutum with notaulices, anteriorly distinct; Propodaeum completely areolated; Forewing venation complete with complete pterostigmal cell, separated radial cell-1, radial cell-2 and median cell-1; T-1 longer than its spiracular width, carinated and sometimes bearing spiracular tubercles; Ovipositor sheath curved downwards, rather broadened, deltoid and trifed at extremity.

Remarks: It is very rare genus, only few species have been identified till now [29]. Two species *Toxares macrosiphophagum* and *T. zakai* represent the genus *Toxares* in the area. These species were discovered from Dera Ismail Khan. In 2006 [1] recorded *T. macrosiphophagum* Shujauddin from Kalam (Swat). *T. zakai* is reported for the first time from Pakistan [22]. Stated that *Toxares shigai* is an oriental species, known from Japan and some parts of India and Pakistan.

Monoctonus Haliday

Generic diagnosis: Members of this genus can be recognized by round to oval head, Antennal segments of female 12-16, 15-19 segmented in male; maxillary and labial palpi with four and two segments; notaulices are distinct at the ascendant part of mesoscutum, sometimes notaulices distinct on entire mesoscutum; Propodaeum with distinct closed central areola; Forewing pterostigma triangular; vein r almost perpendicular to the triangular stigma; vein r-m of fore wing more or less angled with vein Rs; veins of first subdiscal cell of fore wing sclerotized, exceptionally (*M. cerasi*, *M. ligustri* and a form of *M. mail*) only partly pigmented; T-1 medium-sized and often sculptured; ovipositor sheath distinctly widened and membranous ventrally, ploughshare-shaped and slightly bent ventrad.

Remarks: The taxonomical status of the genera *Monoctonus*, *Falciconus* and *Harkeria* is still unresolved. On the basis of morphological characters there is no clear distinction among them. *Falciconus* and *Harkeria* share a narrow and elongate ovipositor sheath as well as 2 segmented labial palps as synapomorphies. Although, *Harkeria* species are separated from *Monoctonus* by the needle shaped ovipositor sheath, two divergent carinae at the base of propodaeum and 2 Segmented labial palps, some newly discovered *Monoctonus* species (*M. leclanti* and *M. allisoni*) also possess narrow ovipositor sheath [21, 22]. Also, *M. hispanicus* described by [17] has two divergent carinae at the base of propodaeum.

Diaeretiella Stary

Generic diagnosis: The genus can be easily identified by transverse head; antenna 13-15 segmented in female and 17-18 segmented in male, F1 as long as F2; Mesopleuron with deep and finely crenulate sternaulus anteriorly; Propodaeum distinctly areolated; Forewing, pterostigma triangular, metacarpus longer than width of pterostigma, radial vein developed but reduced in length, otherwise with effaced venation distally, recurrent vein entirely reduced; Tergite-1 variably rugose, shiny and with distinct central longitudinal carina dorsally; Ovipositor sheath short but apex narrowed.

Remarks: Genus *Diaeretiella* Stary is cosmopolitan with one described species (*Diaeretiella rapae* M'Intosh) in the world. In the present studies *Diaeretiella rapae* M'Intosh was reported to be the representative of the genus from Dera Ismail Khan. [12] In his redescription of the genus count antennal segments to be 14-17. According to our findings many specimens are with 13 segmented antennae stand with the findings of [6, 16] who described the genus with 13-18 segmented antennae.

Ephedrus Haliday

Generic diagnosis: Morphological characters include head transverse; 10-11 segmented filiform antenna in both sexes; Notaulices at least partly distinct; Forewing pterostigma highly prolong, pterostigmal cell complete; radial vein reaching wing margin; median vein and median cell complete; radial vein-2 distinct; Propodaeum areolated, disc of areolae smooth, sometime slightly rugose along carinae; T-1 squarish and rectangular, smooth or faintly to distinctly rugose; ovipositor sheath long and narrow, gradually and evenly narrowing towards apex, with scattered hairs.

Remarks: [1] reported *Ephedrus persicae* and *E. plagiater* from DI Khan in March and from Kalam (Swat). These were reared from aphid species, *Brevicoryne brassicae* and *Rhopalosiphum padi* on wheat crop. In the present study single species *E. plagiater* is reported in the genus from Dera Ismail Khan.

Trioxys Haliday

Generic diagnosis: Head round across eyes; antenna filiform, 10-11 segmented in female and more in male (13 segmented); Mesoscutum without notaulices; Forewing pterostigma more or less triangular, radial vein distinct, extends just beyond the stigma, other veins reduced; Tergite-1 longer than wide with moderately prominent primary spiracular tubercle, secondary tubercle absent; Ovipositor sheath always curved downwards and the last sternite of female bears long, strong, perpendicular hairs on its dorsal surface; Hypopygium of female with prongs.

Remarks: *Trioxys* is a less encountered genus in Dera Ismail Khan, only one species represent the genus in the area [21]. Reviewed genus *Trioxys* with 11 species found in Serbia and Montenegro, with their host range pattern. These species were placed in the genus with the following synapomorphies characters: small body size; reduced wing venation (only radial vein on forewing distinct) and paired accessory prongs on the last abdominal sternite.

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