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Fruit Fly *Tephritis zernyi* Hendel, A Member of Genus *Tephritis* Latreille in Family Tephritidae within Order Diptera.

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ABSTRACT

Globally, fruit flies (Diptera: Tephritidae) are among the most important pests of fruits and vegetables. In addition to the polyphagous nature of some fruit fly species, several are considered highly invasive, aided by globalization of trade and poor quarantine infrastructure in the certain countries. Fruit fly pests attack to host species causing direct damage, and in addition to the direct losses, indirect losses are also attributed due to quarantine restrictions imposed enormously. The present studies based on specimens collected from Murree region of Pakistan recognized a fruit fly of genus *Tephritis* Latreille, which is being newly reported for the local insect fauna. The fruit fly was described as *Tephritis zernyi* Hendel and may subsequently be found in across other localities to have a wide geographic and ecologic ranges in the country. Morphometry using various body parts was used to separate *T. zernyi* population from other closely related *Bactrocera* species. At the initial part of this study, identification key, description and photos of the studied species especially figures of wing pattern and Oviscape are prepared. At the subsequent part of this study, the locality, host plants, distribution of the studied species and references are prepared. The morphology of structures of species belonging to different genera of Tephritidae can be made by a combination of features using optical and scanning electron microscopes as investigated and given.

INTRODUCTION

Tephritidae (true fruit flies) is a large family of the order Diptera with more than 4400 described species over the world. Considering their damage on fruit plantations, they are important insects from the agricultural point of view as well as Forest Entomology ^[1]. Most species of Tephritids are phytophagous and the majority of their larvae develop in fruit or within the flower heads of Asteraceus plants. A few tephritids are leaf miners, some species are stem borers and some others live in roots ^[2]. Fruit flies attack a range of hosts and are primarily attracted to ripened fruits and vegetables, and can cause a significant amount of damage and make infected hosts unmarketable. Fruit flies lay their eggs near the surface of host fruits and vegetables or other food materials. Upon emerging, the tiny larvae continue to feed near the surface of the hosts. Females normally deposit eggs under the skin of fruit that is just beginning to ripe or often in an area where some break in the skin has already occurred. Several females may use the same deposition hole of a host. The larvae burrow into interior of the fruit to feed on the pulp for 3-4 weeks. Owing to larvae burrowing into the pulp of developing fruit, young fruits become distorted and usually drop, mature attacked fruits may develop a water soaked appearance, larvae leave fruit through large exit hole, and larval damage provides entry points for bacteria and fungi that cause the fruit to rot. On the other hand,

they also have the potential to contaminate food with bacteria and other disease producing organisms. In addition to the polyphagous nature of some species, several larvae may also feed on stems and buds of host plants, and may also attack young seedlings and succulent tap roots of hosts. Larvae exit from the fruit to pupate in the soil. Adults may live over a year and breeding is continuous with several generations per year [3,4,5].

According to the latest systematic database, the Tephritidae has 3 subfamilies, 471 genera and 4257 species [6]. There is much information about the adult taxonomy of fruit flies. This family is recognized by the following characters: medium or small sized flies; vertical plate usually does not reach midpoint of frons and carries one or more orbital bristles; antennae with glabrous or plumose arista; wings usually with a pattern consisting of brown strips and spots, costal vein with two interruptions, one before humeral vein and one at place of ending of subcostal vein; abdomen in males with five and in females with six segments visible externally. This family differs from other Tephritoidea by the following character: costal vein with two interruptions, one before humeral vein and the other at place of ending of subcostal vein [7]. The *Tephritis* Latreille 1804, is a genus of fruit flies that contains around 170 described species, making it the sixth largest genus in the family Tephritidae. The *Tephritis* occurs throughout much of the world, but most are Palearctic [8]. They can be found in a wide range of climate types, from hot semidesert to tundra [9]. Most species inhabit the inflorescence of plants from several tribes in the family Asteraceae and a few species cause galls formation [10]. Many more undescribed *Tephritis* species are known from various specimen collections [11]. The *Tephritis* can be distinguished from other fruit flies of the Tephritinae by the arrangement of setae on their bodies and among other characters [12].

The genus *Tephritis* includes near 170 species occurring predominantly in the Holarctics and to the lesser degree in the Oriental, Afrotropical and Australasian regions. As far as known, the larvae of *Tephritis* feed in flower heads of a wide range of Asteraceous plants of the tribes Cichorieae, Cardueae, Astereae, Senecioneae and Anthemideae, and occasionally inducing soft galls in flower heads, shoots and rosettes. They inhabit in almost all the climatic zones and altitudes, from dry and hot semi-deserts to the circumpolar tundra and subnival belt in the mountains [13,14]. In this study, different species of various genera were collected in Murree region of Pakistan. Of them, *Tephritis zernyi* Hendel is being newly record for insect fauna of the country. In addition, this species is recorded for the first time from this region. But the complete fauna of *Tephritis* in this region still has not been properly studied; however, *T. zernyi* is being newly reported for the insect fauna of the state.

MATERIALS AND METHODS

For these investigations several fruit flies species materials were collected by sweeping net on flowers heads of plants in various localities which situated through the working area of Murree region of Pakistan. Murree is situated at 50 kilometers northeast of Islamabad at an altitude of 2286 meters in the Himalayan foothills at 33° 54' 30" north latitude and 73° 26' east longitude. This type of area has cold, snowy winter, relatively cool summer with drastically escalated rain, in relation with lower altitudes, and frequent fog. Precipitation is received year round, with two maxima, first one during winter and second one at summer, July-August. The total mean precipitation annually is 1,789 mm. The alive fly samples were killed in a killing jar containing potassium cyanide. The fruit flies specimens were also surveyed by assembling the infested fruit hosts and then taken to Laboratory University of Agriculture, Faisalabad, Punjab, Pakistan.

Specimen preparation

The adults fruit flies emerged from hosts were killed in boiling water for 2 minutes and preserved in 70% ethanol. For optical study, adults were treated overnight in 10% KOH for clearing of specimens. Then dehydrated in graded acetone series and dried at room temperature. For microscopy, the samples were examined by means of an optical microscope and photographs were made.

RESULTS AND DISCUSSION

Genus *Tephritis* Latreille

1804 *Tephritis* Latreille, Nouv. Dictionn. Hist, Nat., 24 (3): 196.

Type: *Musca arnicae* Linnaeus

Key to the species of *Tephritis* Latreille from Pakistan

- 1. Cell r1 in wing with 2 hyaline spots2
 - Cell r1 with 3 hyaline spots, the apical one smaller.....4
- 2. Wing apex with 2 isolated dark spots at tips of veins R4+5 and M1+2....*T. zernyi* Hendel
 - Wing apex with a forked spot, which is connected to the remaining pattern3
- 3. Small species; no hyaline spot in cell r2+3 before r-m cross vein.....*T. praecox* (Loew)
 - Larger species; with a hyaline spot before r-m cross vein.....*T. cardualis* Hardy
- 4. Cross vein r-m surrounded by 4 hyaline spots; thorax (1.77 mm) equal to preabdomen (1.77 mm)..... *T. crepidis* Hendel - Cross vein r-m surrounded only with 2 hyaline spots on upper margin thorax (1.77 mm) longer than preabdomen (1.47 mm).....*T. frauenfeldi* Hendel

***Tephritis zernyi* Hendel**

1927 *Tephritis zernyi* Hendel, In Lind. Die FN. Pala. Reg., Stuttgart, 5 (2). 212.

FEMALE DESCRIPTION

The single adult female species collected and analyzed is summarized below:-

Body length

Body length, 5.42 mm. Body coloration brownish-yellow.

Head

Length, 0.59 mm. Width 2.70 times greater than length; frons 1.84 times wider than eye, yellow, with thick pollinosity; frontal stripe yellow, with a few pale yellow hair; ocellar triangle and bristles black, acuminate; 2 pairs of inferior and 2 pairs of superior frontal orbital bristles; inferior pairs, lower superior pair and inner vertical bristle pairs acuminate, brown to black; upper superior pair, postocellar, postvertical and outer vertical bristle pairs lanceolate, pale yellow; postorbital bristles mixed, acuminate which are brown to black and lanceolate which are pale yellow; face 1.19 times longer than antenna, yellow, without any spot or band; epistome projecting forward, yellow; gena 1.36 times wider than 3rd antennal segment, yellow, with 1 brown to black bristle pair; subocular spot absent; mouthparts capitate; antennal segments yellow except apex and outer surface of 3rd fulvous, 2nd with short black hair, 3rd pointed at apex and 1.5 times longer than wide, arista with short pubescence, black with fulvous base; occiput yellow except upper middle half fuscous.



Figure 1: *Tephritis zernyi* Wing (Female)

Thorax

Length, 1.94 mm. Longer than preabdomen (1.59 mm), 1.44 times longer than wide; black in

ground color, with brownish appearance, sparsely pollinose, with pale yellow hair; post pronotal lobe, some notopleural area, small area below post pronotal lobe and apical two-thirds of anatergite and katatergite yellow; scutellum triangular, black in ground colour except sides with yellow colouration; subscutellum yellow; postnotum and mediotergite black; haltere yellow; scapular setae absent.

Setae

Setae, *Hm.* 2, *a.npl.* 2, *p.npl.* 2, *mpl.* 2, *pt.* 2, *st.* 2, *prsu.* 2, *psu.* 2 (situated very close to suture), *a.npl.* 2, *p.npl.* 2, *la.* 2, *prsc.* 2, *sc.* 4 (basal pair 2 times longer than apical), all acuminate and brown to black except posterior notopleural seta lanceolate and pale yellow.

Legs

Entirely yellow, fore femur with yellow to brown bristles dorso-ventrally, mid tibia with 1 black apical spur.

Wings

Length, 4.41 mm. Shorter than body (5.42 mm), yellowish-brown; costal spine stout; basal costal and costal cells hyaline; subcostal cell brown; cell r1 typically with 2 large hyaline spots, apically brown; cell r 2+3 with a brown subbasal spot, a hyaline area leading to a brown area at apex, which has a very small subapical hyaline spot; hyaline spot before continuation of r-m cross vein absent, which is not surrounded by hyaline spots; wing apex with only 2 isolated small dark spots at tips of veins R 4+5 and M 1+2; basal radial cell with more than basal half hyaline, remaining apical part brown having few hyaline spots; basal part of cell r 4+5 faint brown, with some hyaline spots, dark brown medially, apex faint, with brown and hyaline spots; basal medial cell hyaline; discal cell with very faint brown spots, largely hyaline; cells m and 1st anterior cubital with a similar pattern as in cell r 4+5; posterior cubital cell hyaline, with short extension; vein R 4+5 bare, with many setulae at its node; veins R 4+5 and M ending almost parallel at apex, the latter ending posterior to wing apex; supernumerary lobe not developed (Fig. 1).

Abdomen

Length, 1.59 mm. Sparsely poilinose, with pale yellow hair and bristles, terga I-III yellow, the latter without pecten, IV yellow with basal part reddish, V-VI yellow, with basal parts black, last one with brown to black bristles on posterior and lateral margins; oviscape long (1.29 mm) (Fig. 2), but shorter than preabdomen (1.59 mm), ochraceous, black apically, with pale yellow hair, eversible membrane and aculeus not visible.

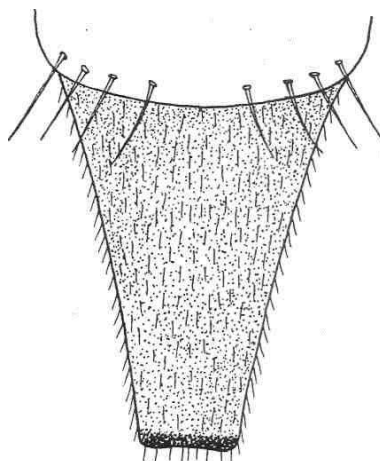


Figure 2: *Tephritis zernyi* Oviscape (Female)

MALE

Male not known from the locality.

Measurements (mm) - a single adult female collected.

Female body parts	Mean
B.L.	5.42
H.L.	0.59
H.H.	1.06
H.W.	1.59
FR.W.	0.77
E.W.	0.42
A.L.	0.48
A.S ₃ .L.	0.21
A.S ₃ .W.	0.14
F.L.	0.57
G.W.	0.19
T.L.	1.94
T.W.	1.35
W.L.	4.41
P.A.L.	1.59
O.S.L.	1.29
H.W./ H.H.	1.50
H.W./ H.L	2.70
H.H./ H.L.	1.80
FR.W./ E.W.	1.84
F.L./ A.L.	1.19
A.S ₃ .L./ A.S ₃ .W.	1.50
G.W./ A.S ₃ .W.	1.36
T.L./ T.W.	1.44

Material examined

A single adult female was reared from a pupa found in the flower head of the thistle (*Cnicus wallichii*).

Habitat

Adult female collected from Murree on 19- 04- 1996.

New record

It has been recorded for the first time in Pakistan.

DISCUSSION

Some previous workers misidentified *Tephritis zernyi* as *Tephritis bardanae*, because both these species are very closely related and have a similar wing pattern. However, *T. zernyi* has an ochraceous body color and the ovipositor is slightly longer than *T. bardanae*.

There are many characters that allow the identification of Tephritid samples. Probably many of these characters of the larval phenotype are adaptative and they are a consequence of natural selection [15,16]. A rapid larvae identification of species belonging to the genera *Anastrepha*, *Bactrocera*, *Ceratitis*, *Rhagoletis* and *Toxotrypana* is possible using optical microscopy. The species of these genera can be identified by a combination of features, principally: shape of cephalic segment, shape of antennomaxillary complex, shape of ventral and dorsal cornua of cephalopharyngeal skeleton, neck of mandible, preoral teeth, oral teeth, caudal segment area, anal lobes, hairs of posterior spiracles, and spinules surrounding the anal lobes [17].

The *Bactrocera* and *Ceratitis*, of the tribe Dacini, have a cephalopharyngeal skeleton very similar in morphology, specially the dorsal and ventral cornua, the neck of the mandible and also an evident dorsal bridge of the ventral cornua. However, *Anastrepha* and *Toxotrypana*, despite both belonging to the tribe Toxotrypanini [14], are very different in the morphology of the cephalopharyngeal skeleton, specially the mandible morphology and the dorsal and ventral cornua morphology. Considering the cuticular projection of *Bactrocera* species, it is important to increase our knowledge of morphology of all the larva instars in other species and genera to aid in their identification, and understanding of classification and phylogenetics relationships.

REFERENCES

1. Merz B. Faunistics of the Tephritidae (Diptera) of the Iberian Peninsula and the Balears. Bulletin de la Societe Entomologique Suisse. 2001; 74: 91-98.
2. White IM. Tephritid flies: Handbooks for the identification of British insects. Vol. 10, part 5A. London: Royal Entomological Society of London. 1988: 134 p.
3. Sarwar M, M Hamed, B Rasool, M Yousaf, M Hussain. Host Preference and Performance of Fruit Flies *Bactrocera zonata* (Saunders) and *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae) For Various Fruits and Vegetables. International Journal of Scientific Research in Environmental Sciences. 2013; 1 (8): 188-194.
4. Sarwar M, M Hamed, M Yousaf, M Hussain. Monitoring of Population Dynamics and Fruits Infestation of Tephritid Fruit Flies (Diptera: Tephritidae) in Guava (*Psidium guajava* L.) Orchard. Journal of Agriculture and Allied Sciences. 2014; 3 (2): 36-40.
5. Shah SMM, N Ahmad, M Sarwar, M Tofique. Rearing of *Bactrocera zonata* (Diptera: Tephritidae) for parasitoids production and managing techniques for fruit flies in mango orchards. International Journal of Tropical Insect Science. 2014: 1-6.
6. Norrbom AL, LE Carroll, A Freidberg. Status of knowledge: 9-47. In: Fruits Fly Expert Identification-From Basic to Applied Knowledge. System and Systematic Information Database (F.C. Thompson Ed.). Backhuys Publishers. 1998: 524 p.
7. Richter VA. Family Tephritidae (Trypetidae)- fruit flies. In: Bei- Bienko, G. Ya., ed. Keys to the insects of the European part of the USSR. Vol. V. Diptera, Siphonaptera. Part 2, Leiden, New York. 1989: 212-276.
8. Kutuk M. A new species of *Tephritis* Latreille (Diptera: Tephritidae) from Turkey. Belgian Journal of Zoology. 2008; 138 (2): 132-134.
9. Khaghaninia S, E Zarghani, SM Namin, VA Korneyev. A new species of *Tephritis* Latreille (Diptera: Tephritidae) with an unusual wing pattern from Iran and its taxonomic implications. Zootaxa. 2011; 3047: 54-62.
10. White IM. Tephritid Flies (Diptera: Tephritidae). Handbooks for the Identification of British Insects. 10 pt 5a. Royal Entomological Society of London. 1984: 134 p.
11. Korneyev SV. Revision of species of the genus *Tephritis* Latreille 1804 (Diptera: Tephritidae) with entire apical spot. Zootaxa. 2013; 3620 (1): 67-88.
12. Zarghani E, S Khaghaninia, RF Pour Abad, B Gharali. Synopsis of the genus *Tephritis* Latreille (Diptera: Tephritidae) in Iran. Munis Entomology & Zoology. 2010; 5: 1176-1181.
13. Merz B. Order Diptera, family Tephritidae // Arthropod fauna of the UAE / Ed. A. Van Harten- Dar Al Ummah Printing Publishing, Distribution & Advertising, Abu Dhabi. 2008; 1: 643-661.
14. Norrbom AL, LE Carroll, FC Thompson, IM White, A Freidberg, FC Thompson. Systematic database of names. Fruit Fly Expert Identification System and Systematic Information Database. Myia. 1999; 9: 65-251.
15. Andreeva RV. Biogeography of palearctic horse flies (Diptera: Tabanidae) and morphoecological studies on their larvae: 271-303. In: Contributions to the knowledge of Diptera. Edited by John F. Burger. 1999: 648 p.

16. Frias D, D Selivon, V Hernandez-Ortiz. Taxonomy of immature stages: new morphological characters for Tephritidae larvae identification. Fruit Flies of Economic Importance: From Basic to Applied Knowledge. Proceedings of the 7th International Symposium on Fruit Flies of Economic Importance 10-15 September 2006, Salvador, Brazil. 2006: 29-44.
17. Frias D. Importance of larval morphology and heterochromatic variation in the identification and evolution of sibling species in the genus *Rhagoletis* (Diptera: Tephritidae) in Chile: 267-276. In: Proceedings of the 6th International Symposium on Fruit Flies of Economic Importance. Edited by Brian Barnes. Stellenbosch, South Africa, 6-10 May, 2002. Isteg Scientific Publication, South Africa. 2004: 35-43.