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A review of the species of *Pseudonapomyza* Hendel from Israel (Diptera: Agromyzidae)

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ABSTRACT

The genus *Pseudonapomyza* Hendel, 1920 is reviewed for Israel. Of the following ten recorded species, the last six are new records for Israel: *Pseudonapomyza asiatica* Spencer, 1961; *P. hispanica* Spencer, 1973; *P. spicata* (Malloch, 1914); *P. spinosa* Spencer, 1973; *P. atra* (Meigen, 1830); *P. atratula* Zlobin, 2003; *P. deserta* Zlobin, 2003; *P. insularis* Zlobin, 1993; *P. siciformis* Zlobin, 2003; and *P. tantai* Černý, 2005. A key to the Israeli species is given.

KEY WORDS: Diptera, Agromyzidae, *Pseudonapomyza*, Israel, faunistics, key.

INTRODUCTION

Pseudonapomyza was described by Hendel (1920) as a monotypic genus for *P. atra* Meigen, which was characterized by its wing venation, angulate first flagellomere, and erect orbital setulae. Subsequently, a number of additional species have been described and placed in this genus, primarily on the basis of the structure of the male terminalia. *Pseudonapomyza* now includes 99 species from all zoogeographic regions except Antarctica (Singh and Ipe, 1973; Spencer, 1973, 1977, 1985, 1986; Černý, 1992, 1998, 2005, 2007; Zlobin, 1993a,b, 2003, 2005; Scheirs, 1996; Sasakawa, 2004; Černý and Zlobin, 2008; Cikman and Sasakawa, 2008). Some species are actual or potential pests of crops (Spencer, 1973). The original generic characteristics of Hendel fit essentially the majority of members of the *atra* species group (except for *P. ovalis* Zlobin, 2003), which was defined by Zlobin (2003), who corrected the wing venation characteristics according to Spencer (1987) as follows: crossvein DM-Cu absent and crossvein R-M close to or in line with crossvein BM-Cu. The species belonging to the *acanthacearum*-group (Spencer, 1990; Zlobin, 2003) are characterized by the round first flagellomere and the presence of crossvein DM-Cu. All the species of the *atra*-group are very similar to each other and the differences in their external characters are slight. Conversely, the structure

of the male and female terminalia provides a sufficient number of distinguishing characters and enables a reliable identification. These structures were used successfully by Spencer (1973), who revised the status of the European species known at that time and distinguished six European and four additional species from the Palaearctic, Afrotropical and Oriental regions.

Four *Pseudonapomyza* species were recorded from Israel by Spencer (1974): *P. asiatica* Spencer, 1961; *P. hispanica* Spencer, 1973; *P. spicata* (Malloch, 1914), and *P. spinosa* Spencer, 1973. In this paper, the first records of six additional species are presented, viz., *P. atra* (Meigen, 1830); *P. atratula* Zlobin, 2003; *P. deserta* Zlobin, 2003; *P. insularis* Zlobin, 1993; *P. siciformis* Zlobin, 2003; and *P. tantai* Černý, 2005. Thus, the paper summarizes the taxonomic and faunistic knowledge on all *Pseudonapomyza* species from Israel. It is based on specimens deposited in the Israel National Collection of Insects, Zoological Museum, Tel Aviv University, Tel Aviv (TAUI).

In total 143 specimens were examined. The abdomen of most male specimens was detached and the terminalia were dissected. After examination all dissected parts were placed into a drop of medium (glycerin and gum resin) on a card and pinned below the relevant specimen. For each species a diagnosis, collection records, distribution, and drawings of the terminalia are given. Some specimens are deposited in the private collection of Miloš Černý, Halenkovice, Czech Republic (CMCH). The terminology essentially follows McAlpine (1981) and Papp and Darvas (2000). All drawings and descriptions of the phallus and other structures of the male terminalia are presented in a normal position (terminalia withdrawn).

SYSTEMATIC PART

PSEUDONAPOMYZA HENDEL, 1920

Pseudonapomyza Hendel, 1920: 115. Type species: *Phytomyza atra* Meigen, 1830, by monotypy.

Diagnosis

Small to very small species, wing length 1.1–2.2 mm. Basic coloration mostly black, frons and gena velvet black, antenna brown to black (only in *P. flavolunulata* (Sasakawa, 1963) scape yellow), ocellar triangle, fronto-orbital plate and occiput sometimes shiny to various degrees.

Head. Black; frons parallel-sided or slightly tapered anteriorly, longer than broad, 0.8–3.0 times as wide as one eye. Fronto-orbital plate broad, about 0.2–0.3 times as wide as frons, tapering towards lunule. One (rarely 2) reclinate posterior fronto-orbital seta, 3–4 inclinate anterior fronto-orbital setae, posterior seta sometimes partly reclinate. Orbital setulae short, sparse, arranged in row, reclinate or erect, but some species (e.g., *P. hindustanica* (Garg, 1971)) with partly or completely missing orbital setulae. Antennae adjacent at base. First flagellomere covered with normal short pubescence. Arista

slightly spindle-shaped, broadened near base, finely pilose. Eye oval, oblique, and bare. Parafacialia forming narrow ring ventral to eye. Gena highest posteriorly, 0.2–0.5 times as high as eye. Lunule small. Palpus and proboscis normal, short. Only several Afrotropical species with epistome (*P. grandiose* (Spencer, 1961); *P. lucentis* Spencer, 1959; *P. urundensis* (Spencer, 1959)).

Thorax. Entirely black, subshiny to dull. Scutum with (1) + 3 (only *P. gilletti* Spencer, 1985 with 0 + 2) dorsocentral setae reduced in length anteriorly, presutural seta (inserted immediately anterior to suture) and postsutural seta always shorter than middle and posterior setae, 0.3–0.8 times as long as posterior dorsocentral seta. Altogether 4 to 10 rows of acrostichal setulae present. Several species without medial postalar seta and intra-alar seta. Wing clear and hyaline, yellow to brown at base. Veins yellowish-brown to dark brown. Calypteres whitish gray, their margin and fringe white to black. Subcosta visible as fine fold along vein R_1. Thickened costa reaching end of vein R_{4+5}, or costa feebly reaching end of vein M_{1+2} (*P. courtalamensis* (Beri & Ipe, 1971) from India). Knob and stem of halter white, yellowish, brown (*P. justiciae* Spencer, 1990), or black (*P. hypoestis* Hering, 1957).

Abdomen. Black. Epandrium higher than broad, cercus small, narrow, 0.2–0.3 times as long as height of epandrium, provided with row of short setae. Distiphallus species-specific in shape. Mesophallus short, pear-shaped. Basiphallus consisting of several sclerites, these pigmented irregularly. Ejaculatory apodeme with very broad blade, or narrow at base and expanded distally. Bacilliform sclerites connected to each other, posterior projections species-specific in shape. Female with two spermathecae only slightly variable in size and shape between species.

Comments

The genus *Pseudonapomyza* was subdivided into two species groups, the *atra*-group and the *acanthacearum*-group. The principal differences between these groups were summarized by Zlobin (2003). The *atra*-group is distinctive in having the first flagellomere angulate (except for *P. ovalis* Zlobin, 2003 from Africa), 1 posterior fronto-orbital seta, rarely 2, arista short, prescutellar seta always absent, crossvein DM-Cu always missing, wing apex at tip of vein M_{1+2}, basal section of vein M_{1+2} rudimentary or absent, mid tibia without or in some species (*P. balkanensis* Spencer, 1973; *P. confusa* Zlobin, 1993; *P. insularis* Zlobin, 1993; *P. salubris* Spencer, 1977) with 1 posterodorsal seta, basiphallus consists of an unpaired sclerite, ovipositor with transverse sclerite at base, spermathecae greatly expanded apically, each larval posterior spiracle with more than 3 bulbs. This group contains most species from all geographic regions. Although host plants remain unknown for most species, those species with known biology feed on Poaceae (Spencer, 1990).

The species of the *acanthacearum*-group have the first flagellomere rounded, 2 posterior fronto-orbital setae, arista long and slender, prescutellar seta usually present, but absent in several Afrotropical species (*P. diminua* (Spencer, 1961); *P. justiciae* Spen-

cer, 1990; *P. matopi* Spencer, 1965; *P. media* (Spencer, 1961)), and Australian species (*P. memorata* Spencer, 1977)), crossvein DM-Cu present (only in *P. vernoniae* (Séguy, 1951) absent), vein M_{1+2} ending anterior to wing tip, basal section of vein M_{1+2} long, at least present as a fold, mid tibia with 1–2 posterodorsal setae (sometimes 3–5 setae in *P. atrata* (Malloch, 1914); *P. fabulosa* Spencer, 1966; *P. justiciae* Spencer, 1990; *P. memorata* Spencer, 1977), basiphallus consists of a pair of separate sclerites, ovipositor without transverse sclerite at base, spermathecae ending in a narrow projection, each larval hind spiracle with 3 bulbs. The species of this group predominantly mine leaves of Acanthaceae, although one species was found on Amaranthaceae and another on Asteraceae (cf. Spencer, 1990). They only occur in the Afrotropical, Oriental, and Australian/Oceanian regions.

KEY TO THE SPECIES OF *PSEUDONAPOMYZA* HENDEL IN ISRAEL

1 Tarsi partly yellow **2**
– Tarsi brown or black **3**
2 Frons 0.9–1.5 times as wide as eye. Second costal section 1.22 times as long as fourth costal section. Veins dark brown ..... ***atratula* Zlobin**
– Frons 0.8 times as wide as eye. Second costal section 0.8–0.9 times as long as fourth costal section. Veins yellowish ..... ***insularis* Zlobin**
3 Frons 1.7–3.0 times as wide as eye ..... ***deserta* Zlobin**
– Frons 0.9–1.5 times as wide as eye **4**
4 Veins brownish-yellow to whitish **5**
– Veins brown to black **7**
5 Distance between middle and posterior dorsocentral setae 2 times as long as distance between anterior and middle dorsocentral setae ..... ***hispanica* Spencer**
– Distance between middle and posterior dorsocentral setae 1.0–1.5 times as long as distance between anterior and middle dorsocentral setae **6**
6. Second costal section 1.5 times as long as fourth costal section. Distance between middle and posterior dorsocentral setae 1.5 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.3–0.5 times as long as middle seta ... ***tantai* Černý**
– Second costal section subequal in length to, or slightly longer than fourth costal section. Distance between middle and posterior dorsocentral setae 1.0–1.1 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.5–0.6 times as long as middle seta ..... ***siciformis* Zlobin**
7 Scutum shining black **8**
– Scutum distinctly dull, grayish black ..... ***asiatica* Spencer**
8 First flagellomere angulate, with distinct apical corner. Distance between middle and posterior dorsocentral setae 1.2–1.5 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.5–0.7 times as long as middle seta ..... ***atra* (Meigen)**
– First flagellomere with short point at apical corner. Distance between middle and posterior dorsocentral setae 2.0–2.6 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.3–0.5 times as long as middle seta **9**
9 Second costal section 1.3–1.5 times as long as fourth costal section ..... ***spicata* (Malloch)**
– Second costal section considerably shorter, slightly longer than fourth costal section ..... ***spinosa* Spencer**

***Pseudonapomyza asiatica* Spencer**
(Figs. 1–4)

Pseudonapomyza asiatica Spencer, 1961: 92.

Diagnosis

Frons not projecting beyond eye in profile, dull black, fronto-orbital plate slightly paler, more grayish. Fronto-orbital plate with 1 reclinate posterior fronto-orbital seta and 3 inclinate anterior fronto-orbital setae; orbital setulae minute, erect or reclinate. Gena expanded posteriorly to 0.2 height of eye. First flagellomere obtusely angulate at apical corner, not pointed. Scutum with 3 postsutural dorsocentral setae, distance between middle and posterior dorsocentral setae twice as long as that between anterior and middle setae. Anterior dorsocentral seta at most half as long as middle and posterior setae. Acrostichal setulae in 4 irregular rows ending at level of middle dorsocentral seta. Legs entirely blackish. Scutum distinctly dull, grayish black, slightly shiny, pleuron black. Wing length varies from 1.6 mm in male to 1.75 mm in female; ratios of 2^{nd} : 3^{rd} : 4^{th} costal sections = 15 : 16 : 7. Wing base pale, whitish, veins R_{2+3} and R_{4+5} brownish. Calypteres and fringe conspicuously silvery-white. Male terminalia (Figs. 1–2) with distiphallus black, heavily sclerotized, mesophallus small, basiphallus with long and narrow arms. Bacilliform sclerites very narrowly fused medially, posterior projections H-shaped and long, narrow, with distinct seta (Fig. 3). Both spermathecae somewhat trapezoidal, only slightly different in size (Fig. 4).

Material examined

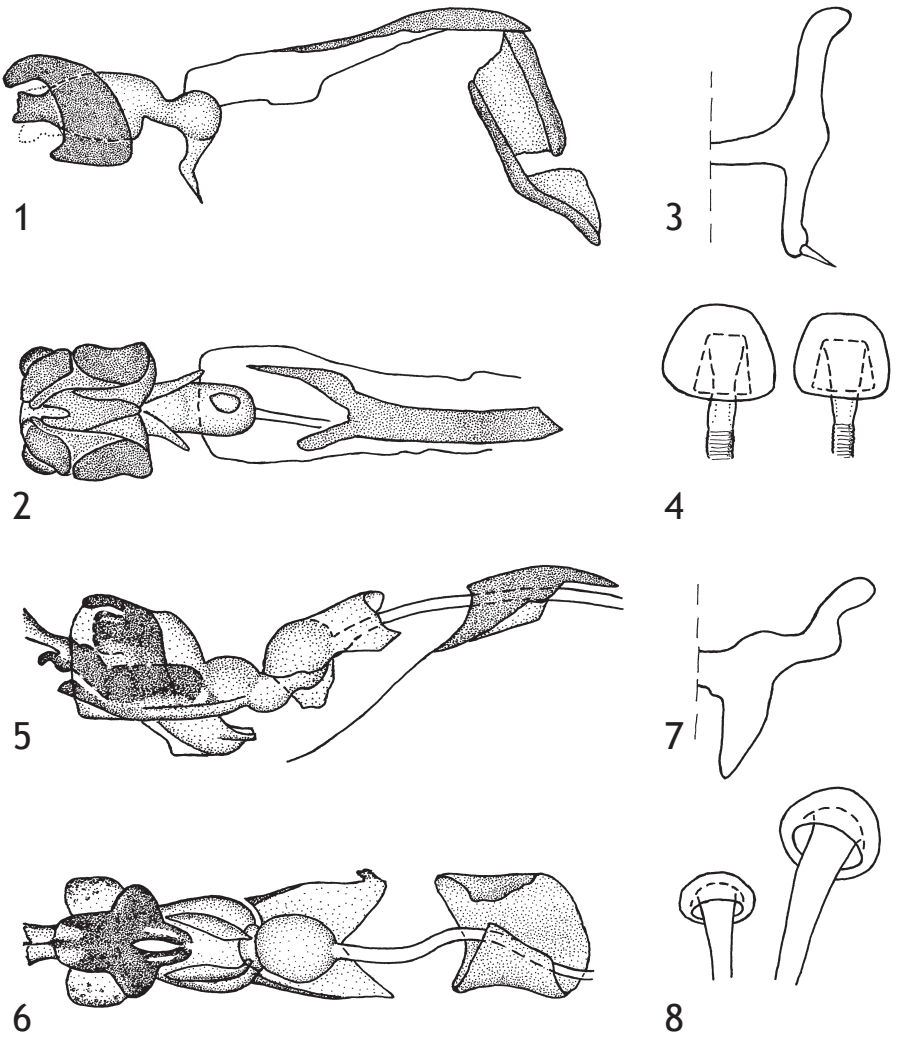
ISRAEL: ‘Akko, 9.ix.1991, A. Freidberg (1♂; TAUI); Haifa, 21.viii.1976, A. Freidberg (3♂, 1♀; TAUI and CMCH); Herzliyya Beach, 26.x.1984, A. Freidberg (1♂; TAUI); Herzliyya Beach, 25.x.1985, A. Freidberg (5♂, 2♀; TAUI and CMCH); Herzliyya, 23.ix.1975, F. Kaplan (1♂; TAUI); Herzliyya, 28.ix.1975, A. Freidberg (1♂; TAUI); ‘En Yahav, 10.xi.1984, A. Freidberg (1♂; TAUI).

Distribution

Israel, Saudi Arabia, Oman, China, Cape Verde Islands, Ethiopia, Kenya, Southern Africa, India, Sri Lanka, Taiwan, Philippines, Singapore, United States including Hawaii, Guadeloupe, Costa Rica.

Comments

This species was described from a specimen reared from a leaf mine on *Cynodon dactylon* in Singapore, and was recorded in India on *Eragrostis* sp. and rice (Spencer, 1961). The distribution range of *P. asiatica* mainly includes the Afrotropical and Oriental regions, but recently the species was also recorded from the United States and Central America (Étienne and Martinez, 2003; Boucher, 2004). The larva forms a conspicuous, whitish leaf mine at the tip of young leaves of corn (*Zea mays*) and young sugar cane seedlings and most probably also on other Poaceae. In Taiwan, this species is conventionally treated as a minor pest of rice (Liao and Shiao, 2001).



Figs. 1–4. *Pseudonapomyza asiatica*. 1. Phallus, lateral view. 2. Same, ventral view. 3. Bacilliform sclerite. 4. Spermathecae (Figs. 1, 2, 4 after Boucher, 2004; Fig. 3 original). Figs. 5–8. *Pseudonapomyza atra*. 5. Phallus, lateral view. 6. Same, ventral view. 7. Bacilliform sclerite. 8. Spermathecae (Figs. 5–8 after Černý, 1992).

***Pseudonapomyza atra* (Meigen)**

(Figs. 5–8)

Phytomyza atra Meigen, 1830: 191.

Diagnosis

Frons almost parallel-sided, 1.1–1.5 times as wide as eye. Fronto-orbital plate 0.2–0.3 times as wide as frons. Ocellar triangle swollen, large. Frons always distinctly projecting beyond eye in profile. Entirely black species, frontal stripe and gena velvety-black, ocellar triangle, fronto-orbital plate and occiput conspicuously shiny. One reclinate posterior fronto-orbital seta and 3–4 inclinate anterior fronto-orbital setae. Gena in middle about 0.2 and posteriorly almost 0.5 times as high as eye. First flagellomere angulate, with distinct apical corner. Scutum with 3 postsutural dorsocentral setae, distance between middle and posterior dorsocentral setae 1.2–1.5 times as long as that between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.5–0.7 times as long as middle seta. Acrostichal setulae in 4–6 irregular rows. Thorax entirely black and subshiny, with slight pubescence. Legs entirely blackish. Wing length 1.3–1.7 mm in male and 1.5–1.8 mm in female, ratios of 2^{nd} : 3^{rd} : 4^{th} costal sections = 12–16 : 6–7 : 10. Wing clear and transparent, brownish at base, veins dark brown, calypteres and fringe shiny white. Male terminalia (Figs. 5–6) with distiphallus strongly sclerotized, dark, consisting of several circular structures. Bacilliform sclerites narrowly fused medially, posterior projections keel-shaped (Fig. 7). Two spermathecae saucer-shaped, slightly flatter than semicircle, distinctly different in size (Fig. 8).

Material examined

ISRAEL: Majdel Shams, 20.iv.1982, M. Kaplan (1♂; TAUI); Herzliyya, hill, 32°11′N 34°49′E, 18–20.iv.2008, A. Freidberg (1♂; TAUI); Giv'at Brenner, 28.ix.1971, J. Kugler (1♂; TAUI); Nizzanim, B1, 31°42.955′N 34°35.966′E, 18.iv.2005, Malaise Trap, C. Grach (1♀; TAUI); 'Arad Junction, 5 km S Devira, 21.iii.1985, A. Freidberg (1♂; CMCH); 'Arad Junction, 21.iii.1985, F. Kaplan (1♂; TAUI); Rt. 40, Ramat Hovav, 7.iii.2007, A. Freidberg (1♂; TAUI); Rt. 224, Zomet haNegev, 7.iii.2007, A. Freidberg (1♂; TAUI); 'Avedat, 11.iv.1975, A. Freidberg (1♂; TAUI); Hazeva, Field School, 30º43′N 35º15′E, 10.xi.1997, Malaise Trap, S. Plotkin (1♀; TAUI); Shezaf Natural Reserve, Nahal Shahaq, 30°45.10′N 35°15.32′E, 13.iv.1999, Malaise Trap, I. Yarom (1♀; TAUI).

Distribution

Practically entire Europe, Turkey, Malta, Cyprus, Madeira, Canary Islands, Cape Verde Islands, Israel, Egypt, West and East Siberia, Russian Far East, Turkmenistan, Uzbekistan, Kazakhstan, Tajikistan, Kyrgyzstan, Mongolia, India, Canada, United States. First record for Israel.

Comments

P. atra is the type species of *Pseudonapomyza* Hendel and is apparently the most

widely distributed and most polyphagous species of the genus. The yellow larva mines in leaves of many Poaceae, especially *Agropyron, Apera, Avena, Hordeum, Lolium, Phalaris, Poa, Secale,* and *Triticum*, forming a short and narrow mine at the tip of the leaf.

Pseudonapomyza atratula Zlobin
(Figs. 9–12)

Pseudonapomyza atratula Zlobin, 2003: 208.

Diagnosis

Frons narrow, 0.9–1.5 times as wide as eye, slightly projecting beyond eye in profile, increasingly so towards base of antenna. Fronto-orbital plate weakly shining. First flagellomere small, straight dorsally, with distinct apical corner, covered with short, usual pubescence. One reclinate posterior fronto-orbital seta and 3–4 inclinate anterior fronto-orbital setae. Gena highest posteriorly, 0.25–0.30 times as high as eye. Scutum slightly grayish, subshiny. Three postsutural dorsocentral setae present, distance between middle and posterior dorsocentral setae 1.4 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.8 times as long as middle seta. Acrostichal setulae in 4–5 irregular rows. Tarsi partly yellowish, darker apically. Wing length 1.2–1.3 mm. Ratios of 2^{nd} : 3^{rd} : 4^{th} costal sections = 12 : 5 : 10. Wing hyaline, veins dark, calypteres and fringe shiny white. Male terminalia (Figs. 9–10) similar to those of *P. atra* but apical sclerite of distiphallus much more slender and ventral projections longer. Mesophallus without prominent ventral projection. Ejaculatory apodeme with long narrow base, pump entirely membranous. Bacilliform sclerites narrowly fused medially, posterior projections oval (Fig. 11). Two spermathecae equal in size and shape, more or less ovoid, truncate at base; duct broad at base (Fig. 12).

Material examined

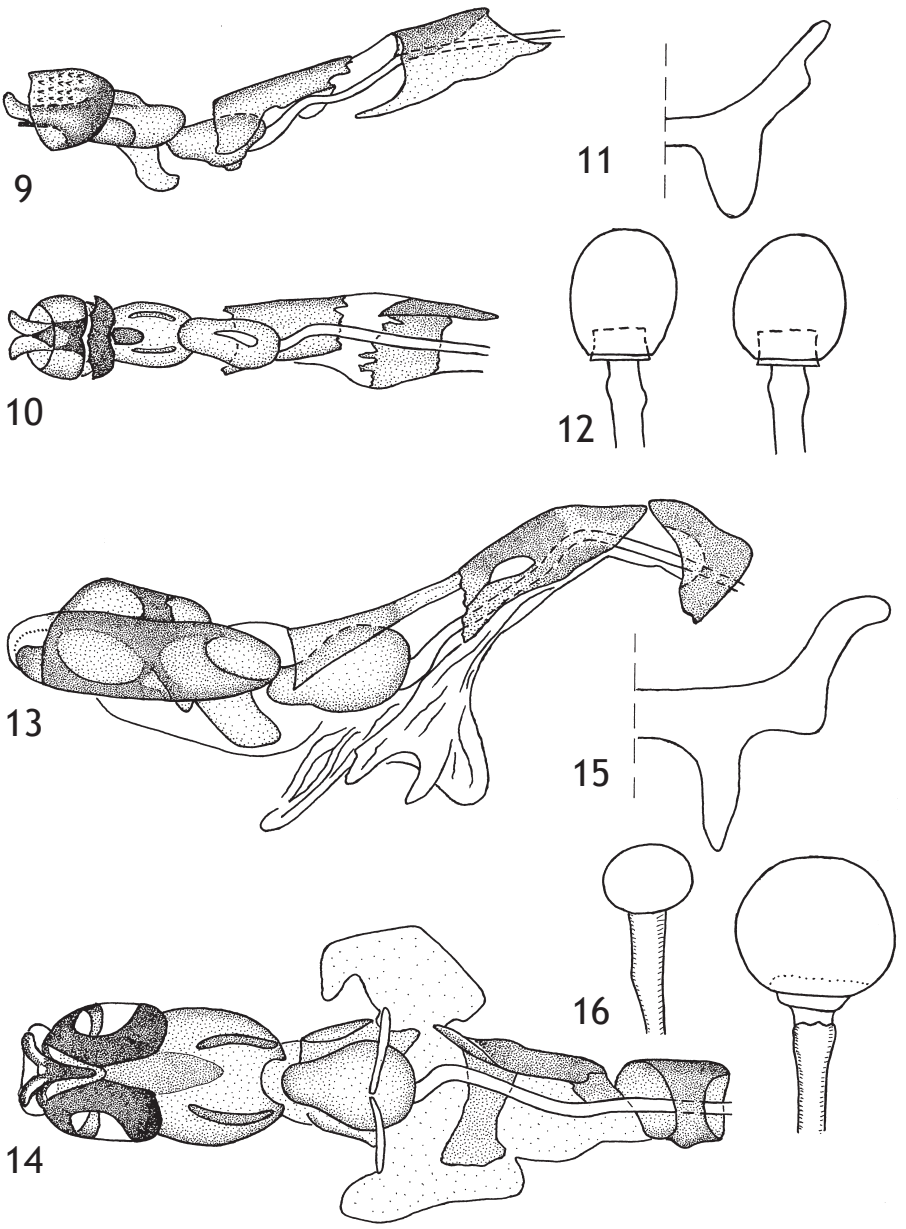
ISRAEL: Meron, 11.vi.1974, F. Nachbar (1♂; TAUI); Holon, 7.iii.1995, on tamarisk, A. Freidberg (3♂; TAUI and CMCH); Bor Mashash, 31°07′N 34°50′E, 25.iii.1987, F. Kaplan (1♂; TAUI); Sedé Boqér, 30°52′N 34°47′E, 31.iii.1975, A. Freidberg (1♂; TAUI).

Distribution

Tunisia, Israel. First record for Israel.

Comments

This species was described by Zlobin (2003) from a series of specimens from Tunisia. Based on external characters and especially the structure of the male terminalia, *P. atratula* is the most similar species to *P. atra*. The two species differ in the color of the tarsi and the structure of the male and female terminalia.



Figs. 9–12. *Pseudonapomyza atratula*. 9. Phallus, lateral view. 10. Same, ventral view. 11. Bacilliform sclerite. 12. Spermathecae (Figs. 9, 10, 12 after Zlobin, 2003; Fig. 11 original). Figs. 13–16. *Pseudonapomyza deserta*. 13. Phallus, lateral view. 14. Same, ventral view. 15. Bacilliform sclerite. 16. Spermathecae (Figs. 13–16 after Zlobin, 2003).

Pseudonapomyza deserta Zlobin
(Figs. 13–16)

Pseudonapomyza deserta Zlobin, 2003: 216.

Diagnosis

Frons very broad, 2.4–3 times as wide as eye, slightly projecting beyond eye in profile. One reclinate posterior fronto-orbital seta and 3 inclinate anterior fronto-orbital setae. Head black, fronto-orbital plate shiny. First flagellomere small, acute at apical corner, broadly rounded ventrally, covered with short, usual pubescence. Gena high, 0.4–0.5 times as high as eye. Scutum black, predominantly grayish, at most weakly shining. Three postsutural dorsocentral setae present, distance between middle and posterior dorsocentral setae 1.3 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.9 times as long as middle seta. Acrostichal setulae in 4 irregular rows. Tarsi dark brown to yellowish. Wing length 1.40–1.78 mm. Ratios of 2^{nd} : 3^{rd} : 4^{th} costal sections = 10 : 6–7 : 11–13. Wing hyaline, veins brownish-yellow to brown. Calypteres and fringe entirely white. Male terminalia (Figs. 13–14): Distiphallus with pair of stout ventral projections at base. Mesophallus without ventral projection. Ejaculatory apodeme small, pump entirely membranous. Bacilliform sclerites narrowly fused medially, posterior projections short, acute at end, widely spaced (Fig. 15). Two spermathecae spherical, distinctly differing in size (Fig. 16).

Material examined

ISRAEL: Rt. 224, Zomet haNegev, 7.iii.2007, A. Freidberg (1♂, 1♀; TAUI); Sedé Boqér, 30.iii.2004, L. Friedman (1♂, 1♀; TAUI); ‘Avedat, 31.iii.1981, A. Freidberg (3♂, 2♀; TAUI and MCMH).

Distribution

Kazakhstan, Uzbekistan, Turkmenistan, Israel. First record for Israel.

Comments

This species was described from a series of specimens from Middle Asia. It is distinguished from the other species of the *atra*-group by having the frons 2.4–3.0 times as wide as eye, gena high, first flagellomere with a distinct, acute apical corner, costal section 2 short, and the scutum dull and grayish.

Pseudonapomyza hispanica Spencer
(Figs. 17–19)

Pseudonapomyza hispanica Spencer, 1973: 270.

Diagnosis

Frons broad, 1.5 times as wide as eye. One reclinate posterior fronto-orbital seta and 3 inclinate anterior fronto-orbital setae. Frons black, fronto-orbital plate shiny.

Gena 0.3 times as high as eye. Scutum dull black, somewhat grayish in anterior view. Three postsutural dorsocentral setae present, distance between middle and posterior dorsocentral setae 2 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.5 times as long as middle seta. Acrostichal setulae in 4 regular rows. Legs entirely blackish. Wing length 1.5–1.7 mm. Ratios of 2nd : 3rd : 4th costal sections = 13 : 5 : 10. Wing veins ochreous-yellow, calypteres and fringe white. Male terminalia weakly sclerotized, with long, laterally flattened distiphallus and small mesophallus (Figs. 17–18). Bacilliform sclerites narrowly fused medially, posterior projections broad with distinct setae on medioventral surface (Fig. 19).

Material examined

ISRAEL: Mivzar Nimrod, 9.vi.1976, A. Freidberg (1♂; TAUI); Kefar Shammay, 30.ix.1975, A. Freidberg (1♂; TAUI); Gadot, 25 km N of Tiberias, 24.vi.1971, A. Kaisar (1♂; TAUI); Nahal Qana Reserve, 6.5 km SW Qarne Shomeron, 32°08′N 35°02′E, 120 m, 9.vii.2007, A. Freidberg (1♂; TAUI).

Distribution

Spain, Cyprus, Turkey, Israel, Yemen, Gambia, Sierra Leone, Kenya, Zambia. The single male paratype from Israel was recorded from Givat Brenner, on *Sorghum halepense* (Spencer, 1973).

Comments

P. hispanica is distinctive in having the frons broad and the scutum dull. In the structure of the male terminalia it is similar to *P. europaea* Spencer, 1973. *P. hispanica* was described from Spain and Israel. The male holotype is from the coastal area south of Barcelona, and two paratypes are from the mountains, one taken at 1200 m in the Sierra Nevada.

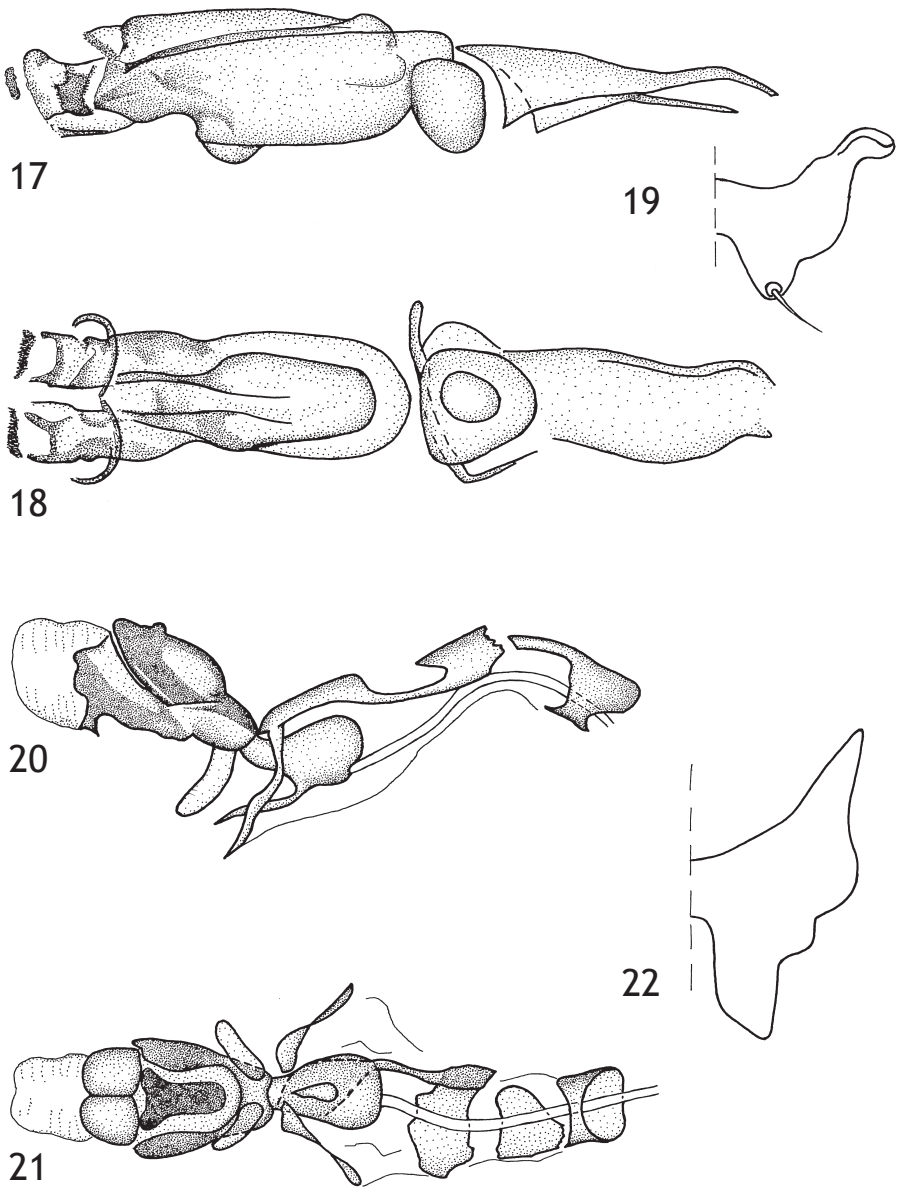
***Pseudonapomyza insularis* Zlobin**

(Figs. 20–22)

Pseudonapomyza insularis Zlobin, 1993a: 81.

Diagnosis

Frons narrow, 0.8 times as wide as eye, almost parallel sided, only slightly projecting beyond eye in profile. Fronto-orbital plate and ocellar triangle distinctly shiny. First flagellomere small, acute at apical corner, broadly rounded ventrally, covered with short, usual pubescence. Gena in middle about 0.1 and posteriorly almost 0.3 times as high as eye. Scutum mat grayish black, but with distinct subshine. Three postsutural dorsocentral setae present, distance between middle and posterior dorsocentral setae 1.2 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.8 times as long as middle seta. Acrostichal setulae in 4–5 irregular rows. Legs pale and two basal segments of tarsi yellowish. Wing length 1.4–1.5 mm. Ratios of 2nd : 3rd : 4th costal sections = 8–9 : 3 : 10. Wing hyaline, veins yellowish. Calypteres and



Figs. 17–19. *Pseudonapomyza hispanica*. 17. Phallus, lateral view. 18. Same, ventral view. 19. Bacilliform sclerite (Figs. 17–18 after Spencer, 1973; Fig. 19 original). Figs. 20–22. *Pseudonapomyza insularis*. 20. Phallus, lateral view. 21. Same, ventral view. 22. Bacilliform sclerite. (Figs. 20–21 after Zlobin, 1993a; Fig. 22 original)

fringe entirely white. Male terminalia (Figs. 20–21): Distiphallus with apical part membranous. Mesophallus with long narrow ventral projection. Ejaculatory apodeme with broad blade and with strongly sclerotized plate at base. Bacilliform sclerites narrowly fused medially, posterior projections short, wedge-shaped at end (Fig. 22).

Material examined

ISRAEL: Avenat, Rt. 90, 31°41′N 35°26′E, 22.v.2007, A. Freidberg (1♂; TAUI).

Distribution

Canary and Cape Verde Islands, Israel, Gambia, Sierra Leone, Kenya, Zambia, and Botswana. First record for Israel.

Comments

All specimens of the type series were collected on the Canary and Cape Verde Islands. They were originally discussed by Spencer (1959) and Hering (in Spencer, 1968) under the name *Pseudonapomyza spicata* (Malloch, 1914). Later, Zlobin (1993a) described the same specimens as a new species, *P. insularis*, based on the structures of the male terminalia, the characteristic pale brownish color of the legs, and the yellowish color of the two basal segments of the tarsi.

***Pseudonapomyza siciformis* Zlobin**

(Figs. 23–25)

Pseudonapomyza siciformis Zlobin, 2003: 240.

Diagnosis

Frons 1.2–1.3 times as wide as eye, slightly projecting beyond eye in profile. One reclinate posterior fronto-orbital seta and 4 inclinate anterior fronto-orbital setae. Fronto-orbital plate weakly shining. First flagellomere straight dorsally, with short projection at apical corner, rounded ventrally; covered with short sparse pubescence. Gena 0.3–0.4 times as high as eye. Scutum moderately shiny. Three postsutural dorsocentral setae present, distance between middle and posterior dorsocentral setae 1.0–1.1 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.5–0.6 times as long as middle seta. Acrostichal setulae in 4 rows. Legs entirely blackish. Wing length 1.4–1.5 mm. Ratios of 2^{nd} : 3^{rd} : 4^{th} costal sections = 10 : 5–6 : 9–10. Wing hyaline, veins brownish-yellow to whitish. Calypteres and fringe entirely white. Mesophallus without long projection. Plate ventral to mesophallus scleotized laterally. Distiphallus with pair of dagger-shaped projections at base (Figs. 23–24). Bacilliform sclerites broadly fused medially, posterior projections short and acute (Fig. 25). Ejaculatory apodeme with broad blade and with strongly sclerotized plate at base. Female unknown.

Material examined

ISRAEL: Sedé Halamish, 29.iii.1996, A. Freidberg (1♂; TAUI).

Distribution

France, Czech Republic, Israel, Mongolia. First record for Israel.

Comments

This is a small species described from Mongolia. It differs from the other species of the *atra*-group by the narrower frons, first flagellomere bearing a short projection at the apical corner, shorter 2nd costal section, veins brownish-yellow to whitish, and the scutum moderately shiny. The structure of the phallus is similar to that of *P. europaea*, but in *P. siciformis,* the distiphallus has a long central projection. Both species have the ejaculatory apodeme with a broad sclerotized blade.

***Pseudonapomyza spicata* (Malloch)**

(Figs. 26–29)

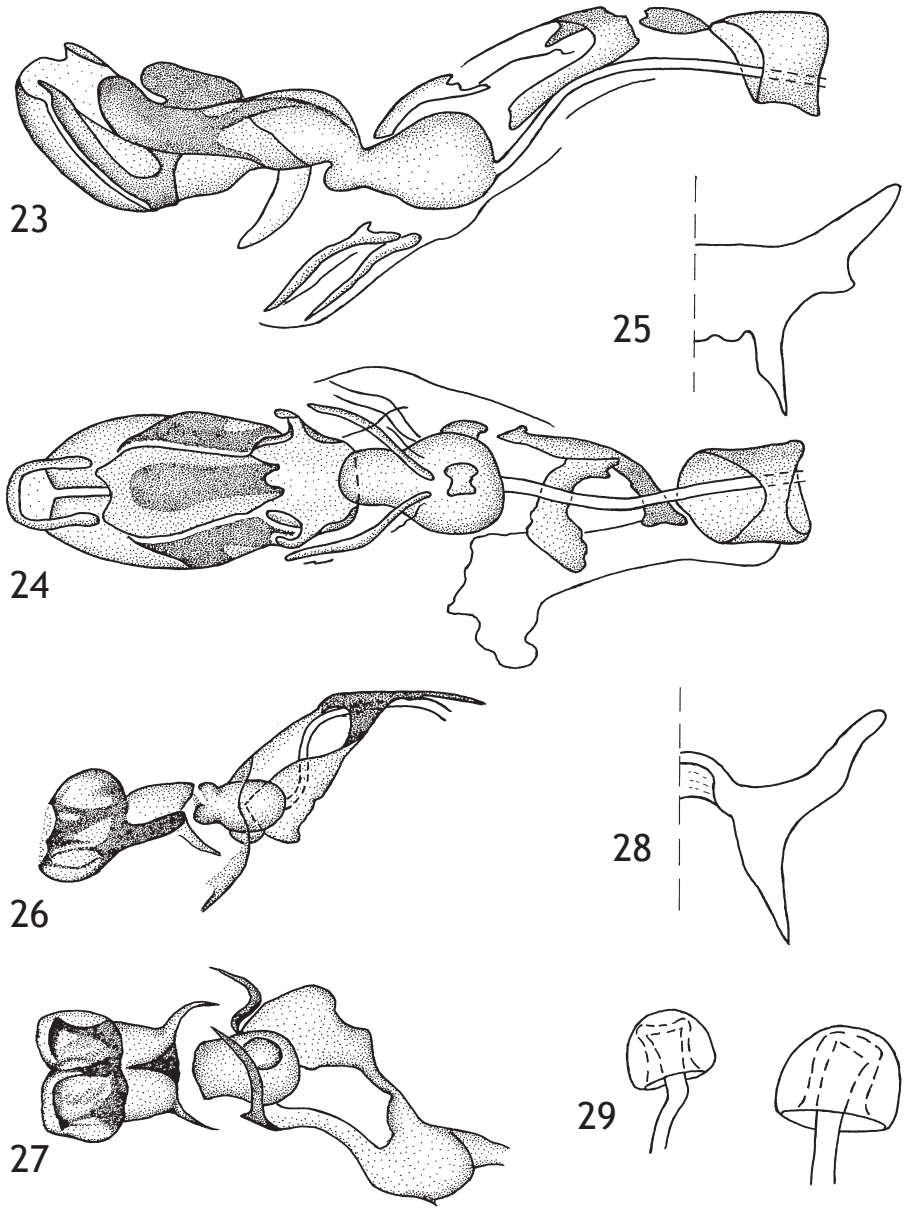
Phytomyza spicata Malloch, 1914: 334.

Diagnosis

Frons brownish to black, ocellar triangle conspicuously shiny. First flagellomere with short point at apical corner. One reclinate posterior fronto-orbital seta and 3 inclinate anterior fronto-orbital setae. Scutum black, shiny in posterior view, somewhat duller in anterior view. Three postsutural dorsocentral setae present, distance between middle and posterior dorsocentral setae 2 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.4–0.5 times as long as middle seta. Acrostichal setulae in 4 rows. Legs entirely blackish. Wing length 1.3 mm in male, 1.6 mm in female. Ratios of 2nd : 3rd : 4th costal sections = 12–13 : 5–6 : 10. Calypteres and fringe silvery white. Male terminalia with distiphallus small and pale, distinctly divided into separate sections (Figs. 26–27). Bacilliform sclerites narrowly fused medially, posterior projections narrow and long, tapered into a narrow tip (Fig. 28). Two spermathecae semispherical, slightly higher than semicircle, distinctly differing in size (Fig. 29).

Material examined

ISRAEL: Kefar Shammay, 6.x.1974, A. Freidberg (1♀; TAUI); ,Akko, 6.x.1974, A. Freidberg (1♀; TAUI); Sede Eliyahu, 1.ix.1986, I. Susman (1♀; TAUI); Hadera, 24.v.1980, A. Freidberg (1♀; TAUI), 26.ix.2004, I. Zonstein (1♂; TAUI); Berekhat Ya'ar, 13.viii.2007, A. Freidberg (1♂, 1♀; TAUI); Herzliyya, 20.vii.1981, A. Freidberg (1♂; TAUI); Herzliyya, 20.vi.1981, Malaise Trap, A. Freidberg (1♀; TAUI); Herzliyya, 14.viii.1981, Malaise Trap, A. Freidberg (1♂; TAUI); Herzliyya, 26.vii.1984, on cotton, A. Freidberg (3♂, 1♀; TAUI and CMCH); Herzliyya Beach, 12.x.1986, on dead fish, A. Freidberg (1♀; TAUI); Herzliyya hill, 32°11′N 34°49′E, 13.vii.2007, A. Freidberg (1♂, 1♀; TAUI), 4.viii.2007, A. Freidberg (4♂, 2♀; TAUI and CMCH), 10.viii.2007, A. Freidberg (2♂, 3♀; TAUI and CMCH), 18.viii.2007, A. Freidberg (3♂, 1♀; TAUI and CMCH), 22.viii.2007, A. Freidberg (3♂, 1♀; TAUI and CMCH); Yavne, 19.ix.1982 (1♀, TAUI), 23.ix.1982, ex corn (2♂, 1♀; TAUI and CMCH); Yavne, 24.ix.1982, ex sorghum



Figs. 23–25. *Pseudonapomyza siciformis*. 23. Phallus, lateral view. 24. Same, ventral view. 25. Bacilliform sclerite (Figs. 23–25 after Zlobin, 2003). Figs. 26–29. *Pseudonapomyza spicata*. 26. Phallus, lateral view. 27. Same, ventral view. 28. Bacilliform sclerite. 29. Spermathecae (Figs. 26–27 after Spencer, 1990; Figs. 28–29 original).

(1♀; TAUI); ‘En Hemed, 3.x.1974, A. Freidberg (1♂, 1♀; TAUI); Yerushalayim, Har haZofim, 28.viii.1935, O. Theodor (1♂, 1♀; TAUI); Nahal Qumeran, Rt. 90, 31°44.2′N 35°27.6′E, –370 m, 28.iii.2007, A. Freidberg (1♂; TAUI); Rosh Zuqim, 20.iii.1986, I. Susman (1♀; TAUI); Hazeva, Field School, 30°43′N 35°15′E, 30.viii.1997, Malaise Trap, S. Plotkin (2♂; TAUI and CMCH); Hazeva, Field School, 4.x.1997, Malaise Trap, S. Plotkin (1♀; TAUI); Hazeva, Field School, 6.x.1997, Malaise Trap, S. Plotkin (1♀; TAUI).

Distribution

Canary Islands, Egypt, Sudan, Turkey, Israel, Iraq, Saudi Arabia, Yemen, Oman, China, India, Thailand, Taiwan, Micronesia, Solomon Islands, Vanuatu, Loyalty Islands, New Caledonia, Polynesia, Hawaiian Islands.

Comments

The species was described as a *Phytomyza* by Malloch (1914) from Takao (Formosa). Hennig (1941) transferred it to *Pseudonapomyza*. *P. spicata* is very similar to *P. spinosa*, differing readily by the longer 2nd costal section and the structure of the male terminalia. It was recorded as a leaf miner on *Triticum, Panicum, Sacharum*, *Zea mays*, and other Poaceae.

***Pseudonapomyza spinosa* Spencer**

(Figs. 30–33)

Pseudonapomyza spinosa Spencer, 1973: 275; Spencer, 1974: 151.

Diagnosis

Frons distinctly brown, ocellar triangle shiny black, fronto-orbital plate weakly shiny. One reclinate posterior fronto-orbital seta and 3–4 inclinate anterior fronto-orbital setae. First flagellomere with short point at apical corner. Scutum shiny black, but slightly grayish in anterior view. Three postsutural dorsocentral setae present, distance between middle and posterior dorsocentral setae 2.0–2.6 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.3–0.4 times as long as middle seta. Acrostichal setulae in 4 rows. Legs entirely blackish. Wing length 1.3–1.6 mm. Costal section 2 subequal in length to, or slightly longer than, costal section 4. Ratios of 2nd : 3rd : 4th costal sections = 10 : 5–6 : 10. Calypteres and fringe silvery-white. Distiphallus uniformly heavily sclerotized, with small projection at anteroventral corner (Figs. 30–31). Bacilliform sclerites narrowly fused medially, posterior projections basally broad, tapered into sharp tip (Fig. 32). Both spermathecae semispherical, slightly higher than semicircle, of equal size (Fig. 33).

Material examined

ISRAEL: ‘Akko (swamp), 25.ix.1986, A. Freidberg (1♂; TAUI); Meron, 11.vi.1974, F. Nachbar (2♀; TAUI); Kefar Shammay, 30.ix.1975, A. Freidberg (1♂; TAUI); ‘Ami‘ad,

6.x.1974, A. Freidberg (1♂; TAUI); Bet Shean Valley, Nahal Bezeq, 22.x.1981, A. Freidberg (1♀; TAUI); Herzliyya, 20.vi.1981, Malaise Trap, A. Freidberg (1♂, 1♀; TAUI); Herzliyya, 24.vii.1982, Malaise Trap, A. Freidberg (2♂, 2♀; TAUI and CMCH); Herzliyya hill, 32°11′N 34°49′E, 13.vii.2007, A. Freidberg (1♂; TAUI), 4.viii.2007, A. Freidberg (4♂, 1♀; TAUI and CMCH), 18.viii.2007, A. Freidberg (2♂; TAUI), 22.viii.2007, A. Freidberg (1♂; TAUI); Holon, 15.iv.1994, A. Freidberg & F. Kaplan (3♂; TAUI and CMCH); Rosh ha'Ayin, 17.vii.1978, A. Freidberg (1♀; TAUI); Yavne, 23.ix.1982, ex corn (1♂; TAUI); Yerushalayim, Har haZofim, 29.viii.1935, O. Theodor (1♂; TAUI), 9.ix.1935, O. Theodor (2♂; TAUI); Nahal Qumeran, 9.iv.1986, G. Eldar (1♀; TAUI); Sedom, 29.iv.1974, A. Freidberg (1♂; TAUI); Rt. 90 near 'En Admon, 11.iv.1994, A. Freidberg & F. Kaplan (2♂, 1♀; TAUI and CMCH); Bor Mashash, 16.vi.1986, F. Kaplan (1♂; TAUI); Nahal Ramon, 30.x.1984, A. Freidberg (1♂; TAUI); 'Arava Valley, 0.2 km N Hazeva, Field School, small wadi, el. –116 m, 30°46.77′N 35°14.158′E, Sharkey Malaise Trap, 19.iii.1995, M.E. Irwin (1♀; TAUI); Hazeva, Field School, 30°43′N 35°15′E, 30.ix.1997, Malaise Trap, A. Maklakov (1♀; TAUI); 'Arava Valley, 'En Yahav Makhteshim Res., 'En Shahaq, 2.5 km W of hwy. 90 at km 150, Sharkey malaise over spring, 60 m, 30°42.85′N 35°11.12′E, 21.iii.1995, M.E. Irwin (1♂; TAUI); 'Arava Valley, small wadi, 2.5 km W of hwy. 90 at km 149, 60 m, 30°42.90′N 35°11.15′E, hand netted, 1.iv.1995, M.E. Irwin (1♂; TAUI); Timna', 3.iv.1997, A. Freidberg (1♂; TAUI); Timna', 3.iv.1997, Y. Malihi (1♀; TAUI); Elot, 26.iv.1974, A. Freidberg (1♂; TAUI), 6.ix.1974, A. Freidberg (1♂; TAUI); Elat, 4.v.1986, F. Kaplan (1♂; TAUI).

Distribution

Canary Islands, Greece, Turkey, Cyprus, Egypt, Israel, Oman, Saudi Arabia, Yemen. Nigeria, Kenya, Tanzania, Mauritius, South Africa, Lesotho, India, Australia, New Caledonia, Loyalty Islands, Fiji.

Comments

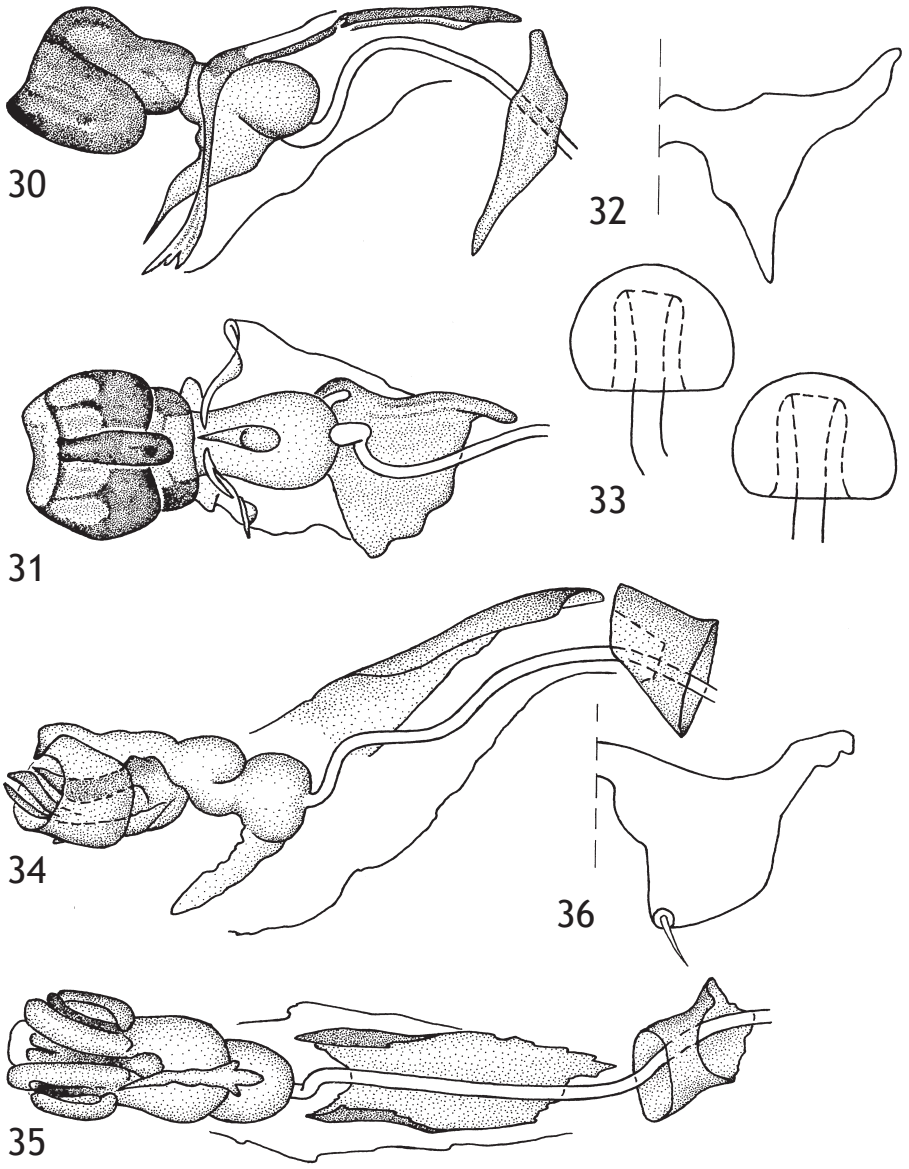
This species was described from Egypt, Nigeria, South Africa, India, Australia, and the Pacific islands. *Hordeum vulgare*, *Triticum aestivum*, and *Eleusine indica* were given as host plants. *P. spinosa* shares with *P. spicata* the short point of the first flagellomere and the shiny black scutum, but it differs from this species by the shorter 2nd costal section.

***Pseudonapomyza tantai* Černý**
(Figs. 34–36)

Pseudonapomyza tantai Černý, 2005: 95.

Diagnosis

Small, predominantly dark species, only front and notopleural triangle ochreous-brown. Frons narrower than long, 1.1–1.2 times as wide as eye. One reclinate and partly eclinate posterior fronto-orbital seta and 3 inclinate weaker and short anterior fronto-



Figs. 30–33. *Pseudonapomyza spinosa*. 30. Phallus, lateral view. 31. Same, ventral view. 32. Bacilliform sclerite. 33. Spermathecae (Figs. 30–33 after Zlobin, 1993a). Figs. 34–36. *Pseudonapomyza tantai*. 34. Phallus, lateral view. 35. Same, ventral view. 36. Bacilliform sclerite (Figs. 34–36 after Černý, 2005).

orbital setae. Posterior part of gena 0.3 times as high as eye. First flagellomere short, prolonged apically but with blunt tip. Scutum with 3 postsutural dorsocentral setae, distance between middle and posterior dorsocentral setae 1.5 times as long as distance between anterior and middle dorsocentral setae. Anterior dorsocentral seta 0.3–0.5 times as long as middle seta. Acrostichal setulae arranged in 4 regular rows. Legs dark black. Wing length 1.4–1.6 mm. Ratios of 2^{nd} : 3^{rd} : 4^{th} costal sections = 15 : 5–6 : 10. Wing base yellowish-white, veins ochreous-yellow, paler towards wing base. Calypteres and fringe white. Phallus symmetrical (Figs. 34–35), distiphallus consisting of some tube-like structures covered by sclerite dorsally and laterally. Mesophallus spherical, with long, proclinate and weakly pigmented projection. Basiphallus developed as broad and long sclerite. Ejaculatory apodeme intensively pigmented, with short stem broadened into blade, bifid basally, but arms unequal. Bacilliform sclerites narrowly fused medially, posterior projections very broad with distinct setae on medioventral surface (Fig. 36). Female unknown.

Material examined

ISRAEL: 'Ami'ad, 6.x.1974, A. Freidberg (1♂; TAUI).

Distribution

Egypt, Israel. First record for Israel.

Comments

This species was recently described from a single male from the Nile delta, Egypt (Černý, 2005). Externally, it resembles other species of the *atra*-group. The unique characters are in the terminalia: the phallus complex has a conspicuous ventral projection on the mesophallus, and the bacilliform sclerite is large, with a broad ventral arm. The biology of this species is unknown.

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