

**A REVIEW OF THE GENUS *PSECTROSEMA* (DIPTERA: CECIDOMYIIDAE),
OLD WORLD PESTS OF TAMARIX (TAMARICACEAE),
AND DESCRIPTION OF THREE NEW SPECIES**

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ABSTRACT

Psectrosema is reviewed, redefined, and placed within the tribe Oligotrophini (sensu stricto). The genus is a monophyletic group of 26 known species restricted to *Tamarix* (Tamaricaceae) from the Mediterranean region through Central Asia to China. *Amblardiella* Kieffer, *Debskiana* Mamaev and Beknazarova, *Marikovskiana* Fedotova, *Mamaeviana* Fedotova, and *Harrisiana* Fedotova are reduced to synonyms of *Psectrosema*. The six poorly or incompletely known Mediterranean species of *Psectrosema* are reviewed. Three new species of *Psectrosema* from southern France are described that are candidates for biological control of tamarix or saltcedar in North America.

KEY WORDS: *Psectrosema*, new species, *Tamarix*, biological control, Cecidomyiidae, taxonomy, Mediterranean fauna.

INTRODUCTION

Tamarix or saltcedars (*Tamarix* spp.: Tamaricaceae) are deep rooted, shrubby trees. The genus is native to Europe, Africa, and Asia and comprises about 54 species (Anon., 1976; Baum, 1978). Several species were introduced as ornamentals in the early 1800s into western USA from several sources in the Old World. They have since escaped to invade many river systems and collectively (as tamarix or saltcedar) come to be considered one of the 10 worst riparian weeds. Frasier and Johnsen (1991) reviewed the classification, distribution, ecology, and control of saltcedar in the USA. They report that the taxonomy of the introduced tamarix in the USA is uncertain and that the common name refers to four species of various provenance: *Tamarix gallica* L., *T. pentandra* Pall, *T. ramosissima* Ledeb., and *T. chinensis* Lour. The habit of obtaining water at or near the water table allows tamarix to outcompete and replace native vegetation, form dense stands that can clog waterways, and reduce water deliveries of streams and rivers. Tamarix is rapidly spreading and difficult to control by mechanical or chemical means, so it is a good candidate for biological control.

Among insects known to feed on tamarix in the Old World, 23 species of gall midges placed in the genus *Psectrosema* in this paper have to date been described from shoot, stem, and bud galls of tamarix. Many of these cecidomyiids are poorly known, but all are restricted to tamarix. Some species of *Psectrosema* feed on several species of tamarix. One of the new species described here was found on several tamarix species in one locality, and two species were reared from similar galls on the same host.

The most conspicuous effect of most of these gall midges is to stunt or kill the infested branch tips (Mitjaev, 1961; Habib, 1983). Galls can also be found on racemes, which reduces seed production. The loss of energy used by the plant for the development of galls may affect plant growth and seed production (Harris, 1977). Many species are bivoltine so they affect tamarix throughout its growing season. Because of their specificity to tamarix, *Psectrosema* spp. are likely candidates for biological control of these plants in North America.

Three new species of *Psectrosema* from southern France are described here. Six previously described but poorly known species from the Mediterranean region are redescribed or reviewed; these species can probably be found again because their host plants and galls are known. We presume that many more species will be found throughout the natural range of tamarix, from the Mediterranean region to China. We redescribe the genus and list all previously described species.

By 1913 Kieffer had described three separate monotypic genera for tamarix gall midges, but two genera, *Amblardiella* and *Isosandalum*, were later synonymized under *Psectrosema* by Gerling et al. (1976) and Harris (1983). *Psectrosema* has more recently been divided into several genera and subgenera by Mamaev and Beknazarova (1983) and Fedotova (1992, 1993). We contend that the characters supporting these supraspecific taxa do not necessarily reflect natural relationships within this group and that dividing *Psectrosema* further is at least premature and probably superfluous.

METHODS

The taxonomy in this paper was done by R.J. Gagné, the field work by R. Sobhian, and some of the anatomical study by N. Isidoro. The new species are to be credited to Gagné. Most specimens used for this study were reared from galls freshly collected from *Tamarix* spp. and containing full-grown larvae or pupae. Gall samples were kept moist but aerated. Infested *Tamarix* branches kept as a bouquet in water dry out quickly, so best results were obtained by keeping infested branches in a transparent plastic bag and spraying them with water from time to time as needed. Material kept too moist favored the development of fungi that caused the death of larvae. Best collecting times in southern France were in January or February for the overwintering generation, and May for the first full generation of the year. After these times, emerging parasitoids increased in number. Other specimens for this study material were found in the collections of the US National Museum of Natural History in Washington, D.C. and The Natural History Museum in London. Fresh specimens were killed and either pinned dry or preserved in 70% ethanol. Specimens were slide mounted for identification and scientific study using the method outlined in Gagné (1989, 1994). Terminology for adult morphology follows usage in McAlpine (1981); that for larval morphology follows Gagné (1989). Abbreviations for museums are as follows: USNM = US National Museum of Natural History, Washington, D.C.; MNHN = Muséum National d'Histoire Naturelle, Paris; and BMNH = The Natural History Museum, London.

TAXONOMY

Genus *Psectrosema*

- Psectrosema* Kieffer, 1904:343, type species, *Cecidomyia tamaricis* Stefani, by monotypy.
Amblardiella Kieffer, 1912b:169, type species, *Oligotrophus tamaricum* Kieffer, by monotypy;
 Gerling et al., 1976:63 (synonym of *Psectrosema*); Fedotova, 1992:91 (genus restored),
n. stat.
Isosandalum Kieffer, 1913:40, type species, *Psectrosema provinciale* Kieffer; Gerling et al.,
 1976:63 (synonym of *Psectrosema*).
Debskiana Mamaev and Beknazarova, 1983:69, as subgenus of *Psectrosema*, type species,
Psectrosema turkmenicum Mamaev and Beknazarova, by original designation; Fedotova,
 1992:91 (as subgenus of *Amblardiella*), **n. syn.**
Marikovskiana Fedotova, 1992:91, type species, *Isosandalum dentipes* Marikovskij, by
 monotypy, **n. syn.**
Mamaeviana Fedotova, 1992:91, as subgenus of *Amblardiella*, type species, *Psectrosema*
diversicornis Mamaev and Beknazarova, by monotypy, **n. syn.**
Harrisiana Fedotova, 1992:91 (156 in trans.), type species, *Harrisiana mamaevi* Fedotova, by
 monotypy, **n. syn.**

DIAGNOSIS. Adult. Head: Eyes large, contiguous at vertex. Frons setose. Labella hemispherical, completely setulose, with or without setae. Palpus 1 to 2 segmented, setae sparse. First and second flagellomeres not connate; male flagellomeres with long neck, female flagellomeres with very short neck, apical 2 or 3 flagellomeres sometimes coalesced, clublike.

Thorax: Scutum with 2 lateral and 2 dorsocentral rows of setae. Scutellum with a group of setae on each side. Anepisternum bare. Epimeron with setae. Wing (Fig. 16) with R_5 curving posteriorly near apical third to join C near wing apex; C unbroken at juncture with R_5 . Tarsal claws with or without teeth. Empodia and pulvilli about as long as claws (Fig. 1).

Male terminalia (Fig. 2): Gonocoxite robust, longer ventrally than dorsally with gonostylus situated caudodorsally; gonostylus robust, with broad tooth, covered with setae and setulae; parameres straight or curved dorsally; hypoproct entire or bilobed; aedeagus as long as hypoproct to much longer, straight or curved.

Female postabdomen (Figs. 3–6, 29, 30): Ninth segment slightly protractile, truncate or not truncate apically; if truncate, cerci reduced in size, not projecting beyond ninth segment; cerci discrete or contiguous mesally to form a single lobe. Setal covering and length of setae various.

Pupa (Figs. 7–15, 31). Cephalothorax dark, the abdomen either dark and remaining hard and uncrinkled after ecdysis or white and becoming crinkled after ecdysis. Antennal horns short to long, simple or terminating in several points. Cervical sclerite with 2 pairs of papillae on lateral bulbous projections, one papilla of each pair with elongate seta, the other usually without seta, occasionally with short, rarely with long seta. Prothoracic spiracle cylindrical, shorter than diameter of nearest section of antennal sheath. Face with or without protuberances. Clypeus with 2 pairs of basolateral papillae, one of each pair with short seta. Abdominal terga without spines, uniformly covered dorsally with spicules except on short, smooth to wrinkled, transverse, weakly sclerotized band, situated slightly posterior to dorsal rows of papillae. Abdomen with or without triangular dorsocaudal projections.

Larva. Spatula present (Figs. 32, 33) or absent. Terminal segment (Fig. 34) with 2 pairs of setose papillae.

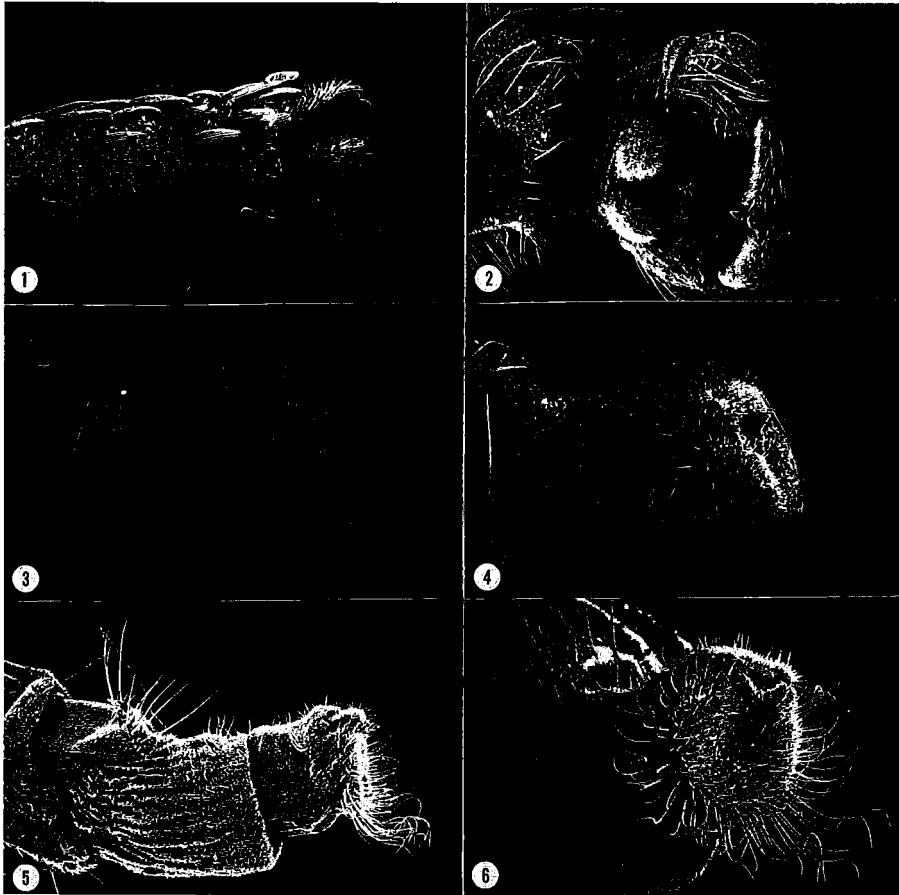


Fig. 1-6. 1-4. *Psectrosema nigrum*. 1. Fifth tarsomere showing long pulvilli laterad of tarsal claws (dorsal). 2. Male terminalia (dorsolateral). 3. Ovipositor (lateral). 4. Same, showing barely divided cerci and caudal concavity of ninth segment (caudolateral). 5, 6. *Psectrosema acuticorne*. 5. Eighth segment to tip of ovipositor (lateral). 6. Ovipositor showing barely divided cerci and caudal concavity of ninth segment (caudolateral).

REMARKS. *Psectrosema* belongs to a group of genera that includes *Oligotrophus* and *Rhopalomyia* and for which the tribal name Oligotrophini (in the strict sense, not including Dasineurini) is available. Synapomorphies of these genera are: reduction of the palpus to three or fewer segments; short, stubby parameres; larvae each in a separate cell in galls; and pupation occurring inside the larval cell. Other, probably primitive characters shared by all members of the tribe are the completely setulose male gonostylus and the always entire female eighth abdominal tergite, even when the ovipositor is elongate.

Synapomorphies of *Psectrosema* are: the separated first and second antennal flagellomeres (they are at least partially connate in *Oligotrophus* and *Rhopalomyia*); elongate pulvilli that are



Figs. 7–15. 7–11. *Psectrosema nigrum*. 7. Entire pupa with sclerotized abdomen; arrow indicating pliable, unpigmented band (lateral). 8. Pupal anterior segments (lateral). 9. Same (ventral). 10. Same, arrow indicating small sublateral frontal protuberance (ventrolateral). 11. Same, arrow indicating cervical protuberance with two setae. 12, 13. *Psectrosema album*. 12. Pupal anterior segments (ventral). 13. Same, showing small frontal protuberance at base of clypeus (lateral). 14, 15. *Psectrosema acuticorne*. 14. Pupal anterior segments (lateral). 15. Same (ventral).

about as long as the tarsal claws (the only pulvilli so modified in the family); and the unbroken costa at the juncture with the R_5 wing vein. The ovipositor, male terminalia, and pupa of some species of *Psectrosema* are variously modified. Female cerci may be separate or contiguous, large or small, projecting for their full length caudad of the ninth segment or barely protruding beyond that segment. The aedeagus is especially variable in shape and length. The pupal antennal bases and frons are variously developed and sculptured and the abdomen may be dark and hard or white and soft.

On the basis of these characteristics, Fedotova (1992, 1993) divided *Psectrosema* into four genera: *Amblardiella* (with subgenera *Amblardiella*, *Debskiana*, and *Mamaeviana*), *Harrisiana*, *Marikovskiana*, and *Psectrosema*. Pupae of *Amblardiella* and *Marikovskiana* were distinguished from the two remaining genera by whether the pupal exuviae are pigmented and the abdominal segments are banded by transverse clear stripes (Fig. 7). Actually, the head and thorax of all species of tamarix gall midges are dark, as are those of most other Oligotrophini; the difference in sclerotization lies only in the abdomen, which is either pigmented and holds its shape after ecdysis, or is white and crinkles up after ecdysis. The transverse, white area on the abdominal tergites is striking on the pigmented abdomens, but it is present although not so noticeable caudad of the transverse rows of dorsal abdominal setae in the remainder of *Psectrosema* species (Fig. 14), as well as in various Oligotrophini surveyed for this study. Further characters Fedotova used to divide pupae along generic lines are the shape of the antennal horns and cervical sclerite, the sculpturing of the frons, and whether the dorsocaudal lobes are spheroid or conical. These criteria do not effectively group similar species. For example, the only differences between two of the new species described here, *P. nigrum* Gagné and *P. album* Gagné, are that the pupa of *P. nigrum* has a pigmented abdomen and lacks a frontal horn, while that of *P. album* lacks abdominal pigmentation and has a small frontal horn. The pupa of *P. nigrum* would fit in Fedotova's *Marikovskiana*, but the pupa of *P. album* would not fit in any of the genera. That *P. nigrum* and *P. album* are otherwise so similar indicates that the character is too trivial for use in discriminating genera.

Adult characters used by Fedotova to separate genera and subgenera include: the number of antennal flagellomeres; whether the first and second flagellomeres are connate (they are separate in all the species we have seen); relative length of particular flagellomeres; number of palpal segments (1 or 2; variable even on the same specimen); whether the tarsal claws are simple or toothed; the length and shape of the aedeagus; sclerotization of the gonocoxite; and the shape and setation of the ovipositor. None of the adults of the three new species described here fits well into Fedotova's scheme, and *Psectrosema tamaricum* Kieffer, the type species of *Amblardiella*, does not fit in the subgenus *Amblardiella* as she defines it.

It appears from this study that many more species of *Psectrosema* will yet be found. More examples are likely to cast light on the relative stability of the mosaic of discriminating characters found in this genus. Because of our difficulty in placing the three new species in Fedotova's genera and subgenera, we consider those supraspecific categories to be synonyms of *Psectrosema*.

LIST OF DESCRIBED SPECIES OF *PSECTROSEMA*

The names below are listed with the original citation, combination, and country of type locality. Two are new combinations. The endings of several of the adjectival specific names are emended here to agree with the neutral gender of *Psectrosema*.

One other species, *Psectrosema gagaimo* Monzen (1955) was described in this genus, presumably in error. Adults reared from larvae living in irregular leaf folds of *Metaplexis japonica* (Thumb.) Makino (Asclepiadaceae) in Japan were described only on the basis of superficial characters and without figures. These specimens need to be restudied before their proper placement can be determined (Yukawa, 1971). Skuhrová (1986) considered *P. gagaimo* a doubtful species of Cecidomyiidae and needlessly emended the specific name to *gagaima*. Monzen (1955) evidently meant this name as a noun in apposition, so the ending is invariable.

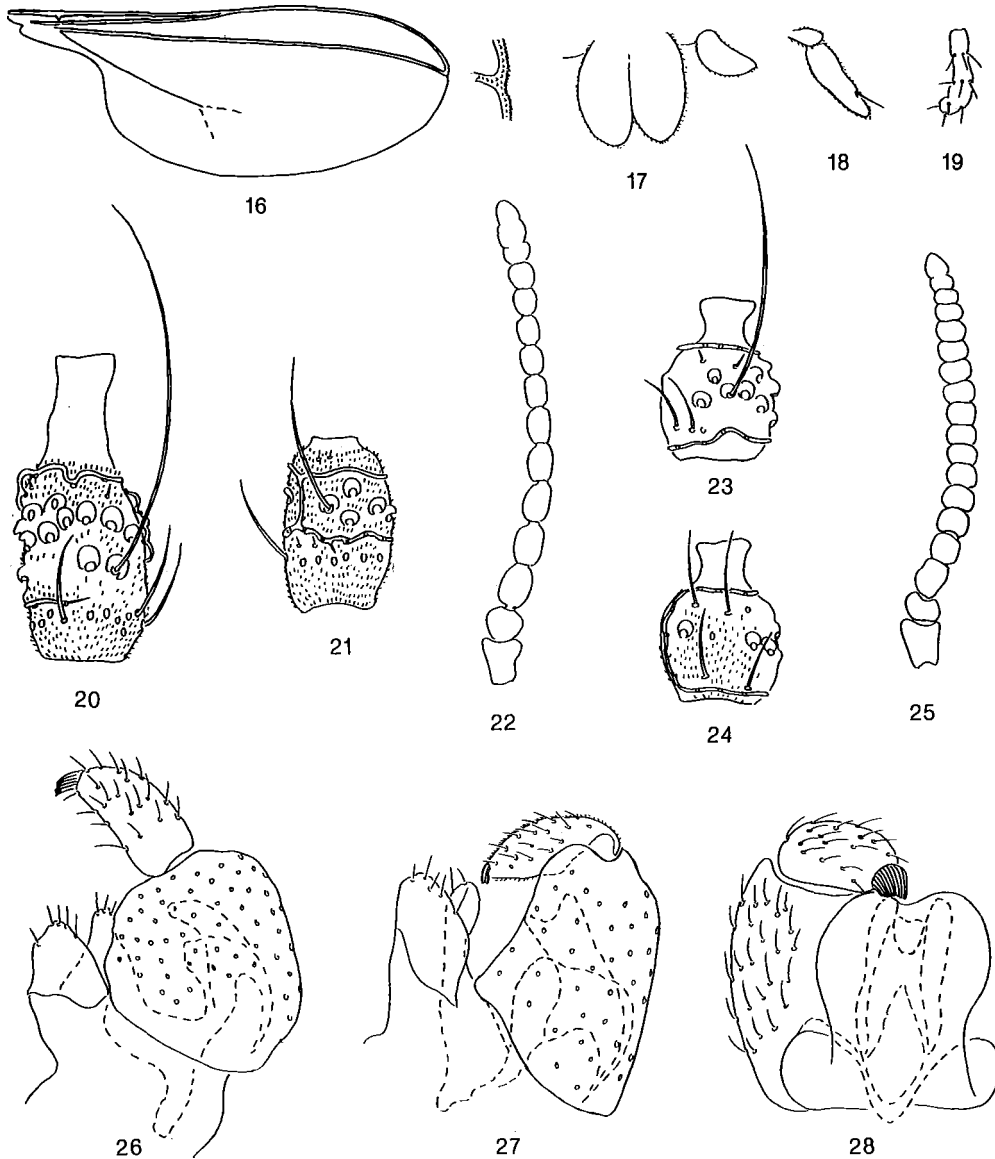
- alfierii* Debski, 1922:36, *Psectrosema*; Egypt.
barbatum Marikovskij, 1961:37, *Isosandalum*; Kazakhstan.
becknazarovae Fedotova, 1992:96, *Psectrosema*; Kazakhstan.
debskii Kieffer, 1912b:171, *Cecidomyia*; Egypt.
dentipes Marikovskij, 1961:39, *Isosandalum*; Kazakhstan, **n. comb.**
diversicorne (orig. as *diversicornis*) Mamaev and Beknazarova, 1983:68, *Psectrosema*; Turkmenistan.
grummgrzhimajloi Fedotova, 1983:35, *Isosandalum*; Kazakhstan.
iliense Marikovskij, 1961:40, *Isosandalum*; Kazakhstan.
indicum Harris, 1983:451, *Psectrosema*; Pakistan.
mamaevi Fedotova, 1993:65, *Harrisiana*; Turkmenistan, **n. comb.**
manii Harris, 1983:451, *Psectrosema* (new name for *M. tamaricis* Mani, a junior secondary homonym of *tamaricis* Stefani); India.
tamaricis Mani, 1935:432, *Misospatha*.
mitjaevi Marikovskij, 1961:38, *Isosandalum*; Kazakhstan, **n. comb.**
noxium Marikovskij, 1961:41, *Isosandalum*; Kazakhstan.
parvum Harris, 1983:454, *Psectrosema*; Pakistan.
provinciale Kieffer, 1912b:171, *Psectrosema*; France.
reticulatum Harris, 1983:452, *Psectrosema*; Pakistan.
squamosum Marikovskij, 1955:21, *Isosandalum*; Turkmenistan.
tamaricinum (orig. as *tamaricina*) Kieffer, 1909:30, *Perrisia*; Egypt, **n. comb.**
tamaricis Stefani, 1902:114, *Rhopalomyia*; Italy.
tamaricum Kieffer, 1912a:169, *Oligotrophus*; Egypt, Algeria, Tunisia.
turkmenicum (orig. as *turkmenica*) Mamaev and Beknazarova, 1983:69, *Psectrosema*; Turkmenistan.
unicorne (orig. as *unicornis*) Harris, 1983:454, *Psectrosema*; Pakistan.
xinjiangense Bu and Zheng, 1991:63, *Psectrosema*; China.

DESCRIPTION OF NEW SPECIES

Psectrosema nigrum Gagné **n. sp.**

DESCRIPTION. **Adult.** Wing length: male, 2.5–3.1 mm (n = 10); female, 2.1–2.8 mm (n = 10).

Head: Eyes about 6 facets long at vertex; facets hexagonoid, contiguous on lower 2/3 of eye and near vertex, circular near 2/3 height of eye. Frons with 28–34 setae. Labella (Fig. 19) hemispherical, completely setulose, without setae. Palpus 1 or 2 segmented (Fig. 17, 18), segments variable in shape, with 0–2 setae. Male antenna with 13–15 flagellomeres, the last two sometimes coalesced, all but the last segment with long apical neck (Fig. 20). Female antenna



Figs. 16–28. 16–18. *Psectrosema nigrum*. 16. Wing with detail of juncture of C and R_s. 17. Labella and palpus. 18. Palpus of another specimen. 19. *Psectrosema tamaricum*, palpus. 20–22. *Psectrosema nigrum*. 20. Male third flagellomere. 21. Female third flagellomere. 22. Female antenna. 23, 24. *Psectrosema acuticorne*. 23. Male third flagellomere (ventral). 24. Same (ventral). 25. *Psectrosema tamaricum*, female antenna. 26. *Psectrosema nigrum*, male terminalia (lateral). 27, 28. *Psectrosema acuticorne*. 27. Male terminalia (lateral). 28. Same (dorsal).

(Figs. 21, 22) with 12–14 flagellomeres, necks very short, the last 2 or 3 flagellomeres sometimes coalesced, clublike.

Thorax: Scutum with 2 lateral and 2 dorsocentral rows of sparse setae. Scutellum with a group of 4–7 setae on each side. Anepisternum bare. Epimeron with 15–21 setae. Tarsal claws each with small tooth.

Male abdomen: First through eighth tergites entire, rectangular, with mesally interrupted posterior setae becoming increasingly numerous from first to seventh tergites, but eighth tergite with fewer setae than seventh; each tergite additionally with several setae in transverse row laterally and pair of trichoid sensilla anteriorly. Second to eighth sternites quadrate, with row of posterior setae, preceded by bare area, then scattered setae over most of remainder of sclerite, and with anterior pair of trichoid sensilla. Terminalia (Figs. 2, 26): hypoproct deeply bilobed; aedeagus curved dorsally.

Female abdomen (Figs. 3, 4, 29): First through seventh tergites as for male. Eighth tergite narrower than seventh, lateral and posterior groups of setae almost coalesced, setae much shorter than on preceding tergites. Second to seventh sternites as for male. Eighth sternum without sclerite or setae. Eighth segment beyond tergite with scattered short setae. Ninth segment on distal half covered with short setae, truncate ventroapically in lateral view, circular and concave in posterior view. Cerci short, bulbous, almost entirely contiguous, weakly notched mesally, and not reaching beyond ninth segment, with short setae as on ninth segment and some equally short thicker setae. Hypoproct bulbous, reaching as far posteriad as cerci, with 2 setae.

Pupa (Figs. 8–11). Cephalothorax and abdomen dark, the abdomen remaining hard and uncrinkled after ecdysis. Antennal horns elongate, simple, bilaterally flattened, acute, the ventral edge flattened. Frons without prominent features except for a small bump sublaterally on each side at level of base of clypeus and clearly visible only in ventrolateral profile (Fig. 10). Abdomen with 2 triangular dorsocaudal projections.

Larva (third instar, presumably of this species). White; length 2.7–3.0 mm; integument covered with rounded spicules; spatula present, with 2 large, triangular, pointed anterior teeth with small serrations between; sternal thoracic papillae without setae; 2 widely separated, setose lateral papillae present on each side of spatula (Fig. 32); 6 dorsal and 4 pleural papillar setae equally long; pair of ventral setae of eighth tergum setose; 4 setose terminal papillae, placed laterally (Fig. 34).

MATERIAL EXAMINED. Holotype pupa, FRANCE: 15 km SE Montpellier, collected 15.v.1992 from *Tamarix parviflora* DC., R. Sobhian, deposited in USNM. Other specimens, FRANCE (collected by R. Sobhian unless otherwise noted): La Grande Motte, 14.v.1992, from *T. gallica* (3♂, 2♀); La Grande Motte, 15.v.1992, from *T. parviflora* (3 pupae, 1♀); La Grande Motte, 8.vi.1992, from tip galls on *T. gallica* (20 larvae, 24 pupae, 14♂, 12♀); La Grande Motte, 8.v.1994, from *T. gallica* and *T. parviflora* (10 pupae, 10♂, 10♀); La Grande Motte, 9.v.1994, from *Tamarix* spp. (5 larvae, 25 pupae); La Grande Motte, 8.vi.1994, from *T. gallica* (2 pupae); La Grande Motte, 22.vi.1994, from *T. ramossissima* catkin galls (10 pupae, 3♂, 6♀); La Grande Motte, 22.vi.1994, from *T. parviflora* (4 pupae); La Grande Motte, 6.vii.1994, from tip galls on *T. gallica* (1 larva, 1 pupa; associated with *P. acuticorne*); La Grande Motte, 18.viii.1994, from tip galls on *T. gallica* (1 larva, 1 pupa; associated with *P. acuticorne*); Aigues Mortes, 15.vi.1992, from *T. gallica* and *T. parviflora* (10 pupae, 5♂, 5♀); Aigues Mortes, *T. gallica* (pupa). Most specimens deposited in USNM, some will be deposited in MNHN and BMNH.

ETYMOLOGY. The name *nigrum*, meaning black, refers to the general pigmentation of the pupal abdomen.

DIAGNOSIS. *Psectrosema nigrum* is distinct from all other known congeners by the distinctive shape of the pupal antennal horns (Figs. 7–11), particularly their flattened ventral edge, and the lack of a prominent central frontal horn. It is generally similar in adult characters to *P. album*, and the two species have similar antennal horns, but the latter species does not have a pigmented pupal abdomen and has a small lobe on the lower pupal frons.

BIOLOGY. This species has been reared from slight swellings on twigs, both vegetative and propagative, of several species of *Tamarix*. Twice it was collected in association with *P. acuticorne*. Galls of the two species could not be distinguished.

DISTRIBUTION. France.

Psectrosema album Gagné n. sp.

DESCRIPTION. **Adult.** Wing length: male, 2.2–2.4 mm ($n = 2$). Female description below taken from specimens still encased in pupae.

Head: Eyes about 6 facets long at vertex; facets hexagonoid and contiguous on lower 2/3 of eye and near vertex, circular near 2/3 height of eye. Frons with 18–25 setae. Labella hemispherical, completely setulose, without setae. Palpus 2 segmented, segments of more or less same length, with 1–3 setae. Male antenna with 10–13 flagellomeres, the last two sometimes coalesced. Female antenna with 11 or 12 flagellomeres, necks very short, the last 2 or 3 flagellomeres usually coalesced, clublike.

Thorax: Scutum with 2 lateral and 2 dorsocentral rows of sparse setae. Scutellum with a group of 3 or 4 setae on each side. Anepisternum bare. Epimeron with 11 or 12 setae. Tarsal claws each with small tooth.

Male abdomen: First through eighth tergites entire, rectangular, with mesally interrupted posterior setae becoming increasingly numerous from first to seventh tergites, but eighth tergite with fewer setae than seventh; each tergite additionally with several setae in transverse row laterally and pair of trichoid sensilla anteriorly. Second to eighth sternites quadrate, with row of posterior setae, preceded by bare area, then scattered setae, and with anterior pair of trichoid sensilla. Terminalia as for *P. nigrum* (Figs. 2, 26).

Female abdomen: Similar to that of *P. nigrum* as evident on well-developed female still in pupa.

Pupa (Figs. 12, 13). Cephalothorax dark; abdomen white, becoming crinkled after ecdysis. Antennal horns elongate, simple, bilaterally flattened, acute, ventral edge flattened. Frons with small, stubby projection anterior to clypeus and 2 convex projections at far lateral angles of frons at level of base of clypeus. Abdomen with 2 triangular dorsocaudal projections.

Larva unknown.

MATERIAL EXAMINED. Holotype pupa, FRANCE: 15 km SE Montpellier, collected 20 to 26.iii.1992 from *Tamarix* sp., R. Sobhian, deposited in USNM. Remaining specimens (all in USNM), FRANCE: La Grande Motte, 10.iii.1992, from stem galls on *Tamarix* sp., R. Sobhian (larvae, 12 pupae, 4♂); La Grande Motte, 20 to 26.iii.1992, from stem galls on *Tamarix* sp. (6 pupae).

ETYMOLOGY. The name *album*, meaning white, refers to the general pigmentation of the pupal abdomen. This denotes the contrast between this species and the otherwise closely similar *P. nigrum* with a black abdomen.

DIAGNOSIS. *Psectrosema album* is distinct from all other known *Psectrosema* species by the shape of the pupal antennal horns, particularly their flattened ventral edge in combination with the presence of a small lower frontal lobe (Figs. 12, 13). It is generally similar in adult characters to *P. nigrum*, and the two species have similar pupal antennal horns; however, the pupa of *P. album* does not have a pigmented abdomen and has a small lobe on the lower frons.

BIOLOGY. This species was reared in spring from twig swellings on *Tamarix* sp.

DISTRIBUTION. France.

***Psectrosema acuticorne* Gagné n. sp.**

DESCRIPTION. Adult. Wing length: male, 1.4–1.7 mm (n = 4); female, 1.4–1.7 mm (n = 5).

Head: Eyes about 5 facets long at vertex; facets hexagonoid and contiguous on lower 2/3 of eye, circular and farther apart on upper 2/3. Frons with 5–9 setae. Labella hemispherical, completely setulose, each with 2 or 3 setae. Palpus 1 segmented, ovoid, with 0–2 setae. Male antenna with 13 flagellomeres, the last two usually coalesced, all but the last segment with short apical neck (Figs. 23, 24). Female antenna with 11 flagellomeres, necks very short, the last 2 flagellomeres coalesced, clublike.

Thorax: Scutum with 2 lateral and 2 dorsocentral rows of sparse setae. Scutellum with a group of 1–3 setae on each side. Anepisternum bare. Epimeron with 3 or 4 setae. Tarsal claws simple.

Male abdomen: First through eighth tergites entire, rectangular, with mesally interrupted posterior setae becoming increasingly numerous from first to seventh tergites, but eighth tergite with fewer setae than seventh; each tergite additionally with 0–4 setae laterally and pair of trichoid sensilla anteriorly. Second to eighth sternites quadrate, with row of sparse posterior setae, preceded by bare area, then few scattered setae laterally and with anterior pair of trichoid sensilla. Terminalia (Figs. 27, 28): hypoproct deeply bilobed; aedeagus curved dorsally, notched in lateral view.

Female abdomen (Figs. 5, 6): First through seventh tergites as for male. Eighth tergite narrower than seventh, lateral and posterior groups of setae almost coalesced, setae as long as on preceding tergites. Second to seventh sternites as for male. Eighth sternum without sclerite or setae. Eighth segment beyond tergite with scattered short setae dorsally and laterally. Ninth segment truncate ventroapically in lateral view, circular and concave in posterior view, covered on distal fourth with setae, ventral setae sinuous. Cerci dorsoventrally flattened, short, almost entirely contiguous, weakly notched mesally, and not reaching beyond ninth segment, with short setae as on ninth segment and some equally short thicker setae. Hypoproct flattened, reaching as far posteriad as cerci, with 2 setae.

Pupa (Figs. 14, 15). Cephalothorax dark, abdomen white, abdomen becoming crinkled after ecdysis. Antennal horns elongate, conical but ridged mesodorsally, acute. Frons with large, acute projection midway between antennal horns and clypeus. Abdomen with 2 conical dorso-caudal projections.

Larva (third instar, presumably of this species). White; length 1.5–2.0 mm; integument

covered with rounded spicules; spatula present, with 2 large, triangular, pointed anterior teeth; sternal thoracic papillae without setae; 2 widely separated, setose lateral papillae present on each side of spatula (Fig. 23); 6 dorsal and 4 pleural papillar setae equally long; pair of ventral setae of eighth tergum setose; 4 setose terminal papillae, placed laterally.

MATERIAL EXAMINED. Holotype pupa, FRANCE: Aigues Mortes, 30 km SE Montpellier, 3.viii.1992, from *T. gallica*, R. Sobhian, deposited in USNM. Remaining specimens, FRANCE (from *T. gallica* and collected by R. Sobhian unless otherwise noted): La Grande Motte, 8.vi.1994 (1♂; associated with *P. nigrum*); La Grande Motte, 6.vii.1994, from tip galls (5 larvae, 6 pupae; associated with *P. nigrum*); La Grande Motte, 18.viii.1994, from tip galls (6 larvae, 7 pupae; associated with *P. nigrum*); La Grande Motte, 25 to 31.viii.1994, from tip galls (2 larvae, 7 pupae, ♂, 2♀); Aigues Mortes, 3.viii.1992, from small red gall (pupa, 2♀); Aigues Mortes, 18.viii.1992, from small red gall (pupa); Aigues Mortes, mid.viii.1992 (3♀, 3♂). Most specimens deposited in USNM, some will be deposited in MNHN and BMNH.

ETYMOLOGY. The name *acuticorne* refers to the acutely pointed pupal antennal horns.

DIAGNOSIS. It is distinct from all other known *Psectrosema* species by the combination of sinuous setae on the ovipositor and simple, conical antennal horns.

BIOLOGY. This species was reared in summer from slight twig swellings on *Tamarix gallica*, twice in association with similar galls made by *P. nigrum*.

DISTRIBUTION. France.

PREVIOUSLY DESCRIBED MEDITERRANEAN SPECIES OF *PSECTROSEMA*

Six species from the Mediterranean region, listed below in alphabetical order, were described between 1902 and 1922. All are incompletely or poorly known but could be found again because their hosts and galls were recorded. One species is known only from its gall. The remaining five species, each known from one or more stages, appear to be distinct from the three new species. Available material of two of the species, *P. tamaricum* and *P. alfierii*, are described in a way comparable to the new species. The types of three of the four Kieffer species (the fourth was based only on someone else's description of the gall) are presumed lost (Gagné, 1994) and those of the Stefani species are reportedly destroyed (Horn and Kahle, 1937).

Psectrosema alfierii Debski, 1922

Debski (1922) described all stages of this species reared from twig swellings of *Tamarix arborea* (Sieb. ex Ehrenb.) Bge. found at Ghézireh (Cairo), Egypt. Two syntypes, a male and a female, are deposited in the USNM.

DESCRIPTION. Adult. Wing length: male, 3.2 mm; female, 2.8 mm.

Head: Eyes as for *P. nigrum*. Frons with 34–42 setae. Labella hemispherical, completely setulose, without setae. Palpus 1 or 2 segmented, segments variable in shape, with 0 or 1 setae. Male antenna with 16 or 17 flagellomeres, the last two partially coalesced, all but the last two segments with long apical neck. Female antenna with 13–15 flagellomeres, necks very short, the last 3 flagellomeres sometimes coalesced, clublike.

Thorax: Scutum with 2 lateral and 2 dorsocentral rows of sparse setae. Scutellum with a group of 11–14 setae on each side. Anepisternum bare. Epimeron with 9–19 setae. Tarsal claws each with 1 large tooth and with an additional small tooth on some claws.

Male abdomen: As for *P. nigrum*. Terminalia: mounted in ventrolateral view but similar to those of *P. nigrum*.

Female abdomen: As for *P. nigrum*.

DIAGNOSIS. Male and female are generally similar to those of *P. nigrum* and *P. album* except that the tarsal claws have larger teeth, which on some claws are doubled. The pupal abdomen of *P. alfieri* was described as sclerotized and pigmented, as is that of *P. nigrum*, but according to Debski (1922) the pupa of *P. alfieri* has two horns on the frons, one near each side of the clypeus.

Psectrosema debskii (Kieffer, 1912)

Kieffer (1912b) described the larva, pupa, female, and egg of this species reared from stem swellings of *Tamarix articulata* Vahl. collected at H elouan, near Cairo, Egypt. The pupa was described as being armed with five teeth, two each the long, pointed antennal horns, the three others being triangular, frontal horns, their points directed posteriorly. None of the new species has three frontal horns.

Psectrosema provinciale Kieffer, 1912

Kieffer (1912b) described the larva, pupa, male, and female of this species in a sketchy manner. They were taken from barely perceptible tip swellings on *T. gallica* from Marseille, France. The pupal antennal horns were described as each having a small, basolateral, obtuse tooth, which could conceivably fit *P. acuticorne* (Figs. 14, 15). Kieffer did not note any strong frontal horn, which is prominent on *P. acuticorne*. The only other good distinguishing character Kieffer mentioned for this species is the unpigmented pupal abdomen.

Psectrosema tamaricinum (Kieffer, 1909)

Kieffer (1909) described this species on the basis of a gall mentioned in Frauenfeld (1859). The galls were from *Tamarix africana* Poir. found in Wadi Tarfa, Egypt and resembled closed pine cones, made up of foreshortened stems and overlapping, appressed leaves. Similar galls known from Israel are figured in Gerling et al. (1976) for this species under the heading of *Dasineura tamaricina*. The gall is distinct from any of the stem and bud swellings made by the three new species.

Psectrosema tamaricis (Stefani, 1902)

This species was reared from *Tamarix* “*?tetrandra* [Pall.]” collected in the Botanical Garden in Palermo, Sicily. Stefani (1902) described all stages, although the larvae cannot belong here because they were described as gregarious. Gregarious larvae have never been reported for any other species of *Psectrosema* and larvae of all other Rhopalomyiini as well live singly in individual galls. *P. tamaricis* adults of Stefani’s 1902 description have the elongate pulvilli unique

to all other species of *Psectrosema* in our sense; therefore we suspect that Stefani observed a gall inhabited by larvae of an inquiline or successor cecidomyiid, possibly a species of *Clinodiplosis* or *Dasineura*. In this connection, one of us (R.S.) has reared adults of a *Dasineura* in the broad sense in association with one of the new species, *P. nigrum*, and Fedotova (1993) reported larvae of *Clinodiplosis* sp. in stem galls of *Tamarix* in Turkmenistan. Both of these genera have gregarious larvae. We feel secure in our contention that a species of *Psectrosema* would not have gregarious larvae.

The pupa and adult stages of *P. tamaricis* belong to *Psectrosema* on the basis of Stefani's description, i.e., one segmented palpus, clublike, coalesced last antennal flagellomeres, long pulvilli, short pupal prothoracic spiracle, and lack of spines on the pupal abdomen. According to Stefani (1902) the tarsal claws are simple and the pupa is hyaline, i.e., not pigmented. This combination of characters might agree with *P. acuticorne*, one of the new species. The sinuous setae on the ovipositor of *P. acuticorne* are so distinctive, however, that we feel they would have been noticed and described by Stefani had his specimens possessed them.

Psectrosema tamaricum (Kieffer, 1912)

Kieffer (1912a) described the pupa of this species taken from swellings on extremities of young branches. Egypt, Algeria, and Tunisia were given as localities for the gall, but the pupa came from Algeria (Kieffer, 1912b). As we know from this study, similar galls from even the same species of *Tamarix* can yield different species of *Psectrosema*, so one would want to look for a pupa referable to that described by Kieffer and not a similar gall. The pupa is presumably the same as mentioned in Houard (1902) that was collected on *Tamarix africana* Poir. at St. Denis-du-Sig (near Oran), Algeria. Kieffer described the pupa as chitinized (meaning sclerotized) and *Asphondylia*-like, as we find for that of *P. nigrum*. Details of the pupal head of *P. tamaricum*, the antennal horns two to three times as long as wide, almost touching at their bases, and curved mesally towards one another, and a frontal horn that is longer than large at its base, serve to differentiate *P. tamaricum* from *P. nigrum*.

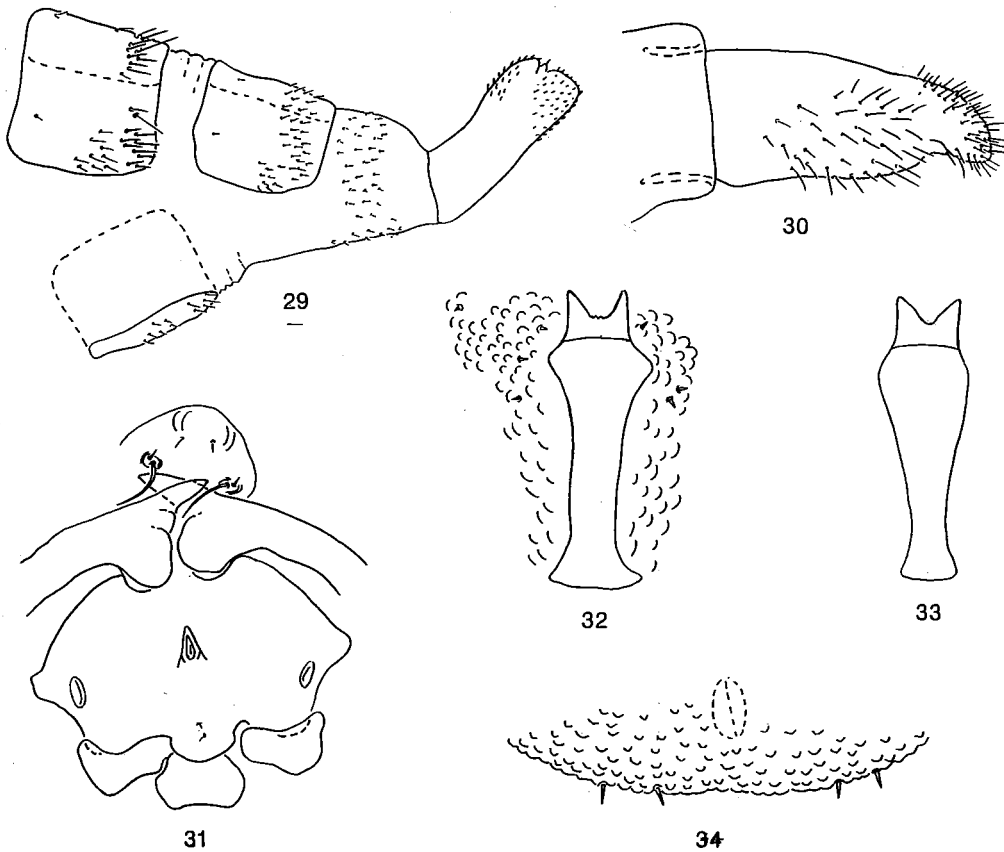
Barnes (1931) described a male and female he attributed to *P.* (as *Amblardiella*) *tamaricum*. He listed pupae also but did not redescribe this stage. Pupae and a female of this series from The Natural History Museum in London were made available for this study. They emerged 30.vi.1930 from *T. africana*, the same host as that of *P. tamaricum*, at Reghaïa, near Algiers, Algeria, and collected within 350 km of Kieffer's type locality. A description of these specimens follows:

DESCRIPTION. Adult (only one female examined). Wing length: female, 2.2 mm.

Head: Eyes as for *P. nigrum*. Frons with 16 setae. Labella hemispherical, completely setulose, with 1 seta on one labellum, none on the other. Palpus (Fig. 19) 1 segmented, but obviously a composite because unevenly lobed, with 10 or 11 setae. Female antenna (Fig. 25) with 16 flagellomeres, necks very short, the last 2 flagellomeres partially coalesced.

Thorax: Scutum with 2 lateral and 2 dorsocentral rows of sparse setae. Scutellum with a group of 1 or 2 setae on each side. Anepisternum bare. Epimeron with 9 setae. Tarsal claws each with small tooth.

Female abdomen (Fig. 30): First through eighth segments as for *P. nigrum*. Ninth segment tapering evenly to hypoproct and cerci, on distal half with short lateral and ventral setae. Cerci contiguous and forming a single lobe, situated beyond ninth segment, slightly decumbent api-



Figs. 29–34. 29. *Psectrosema nigrum*, female abdomen, segment six to end (lateral). 30, 31. *Psectrosema tamaricum*. 30. Ovipositor (lateral). 31. Head of pupal exuviae. 32. *Psectrosema nigrum*, larval spatula and associated papillae. 33. *Psectrosema acuticorne*, larval spatula. 34. *Psectrosema nigrum*, larval terminal segment (dorsal).

cally, thickly covered with setae only slightly shorter than those on ninth segment, a few thicker than remainder.

Pupa (Fig. 31). Cephalothorax and abdomen dark, the abdomen remaining hard and uncrinkled after ecdysis. Antennal horns elongate, simple, acute. Face with centrally located, prominent horn and 2 slight lobes laterally. Abdomen with 2 rounded projections.

DIAGNOSIS. The ovipositor and pupal head of this species are distinct from the three new species. Kieffer described for *P. tamaricum* an apparently rare character, which we would have found hard to credit had we not seen such a development on a few specimens of other species. This is his “double cervical setae” on each side of the cervical sclerite, with one of the setae twice as long as the other. In most specimens of *Psectrosema* available to us there is only one seta on each side of that sclerite, the remaining papilla on each convexity being setaless. Occasionally, this papilla has a very short seta, as has the pupa of *P. tamaricum* (Fig. 31). Less commonly in

this genus, this papilla has a long seta (Fig. 11). That the presence of this seta is an unusual deviation is indicated by the fact that the opposite papilla on the other side of the sclerite is usually setaless.

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