Contribution to the knowledge of gall-inducing insects from Biskra province, Algeria

Souad Tahar-Chaouche1*, Hadjer Guesmia1, Haroun Fadlaoui1 & Imene Tahar-Chaouche2

1 Centre for Arid Areas Scientific and Technical Research (CRSTRA), Biskra, Algeria. souadhouda@gmail.com
2 Laboratory of Natural Hazards and Spatial Planning LRNAT, University of Mustapha Benboudia, Batna 2, Algeria. imenataharchaouche@hotmail.com

ABSTRACT. On the basis of the sampling surveys in Biskra province during 2012 and 2019, fourteen distinct types of galls induced by insects were found on various host plants. They were belonging to three insect orders, four families and twelve genera. Most of the galls were induced by eight species of gall midges (Diptera: Cecidomyiidae), recently recorded from Biskra province, of which two species Houardiella salicornia Kieffer, 1912 and Gephyraulus moricandiae Sylven & Solinas, 1989 are first recorded from Algeria. The only known gall-inducing psyllid species Rhodochlanis salsolae (Lethierry, 1874) from Biskra (Algeria) as well as three gall-inducing aphid species associated with Pistacia atlantica were detected for the first time in Biskra province. These phytophagous species are associated with ten host plant species of which, the family Chenopodiaceae have the highest number of gall insects. Majority of the gallers are of Mediterranean origin, considered as economically indifferent species.

Key words: Gall-inducing, psyllid, Cecidomyiidae, Biskra, Algeria

Introduction

Galls (Latin cecidia) are structure that form as result of deviation in normal plant growth in response to insects and mites (Byers et al., 1976). Various parts of the host plants can be transformed into the gall such as roots, stems, leaves, buds, flowers and fruits (Mapes, 2008). With different characteristic gall structure, high degree of specificity to the site of gall formation (Hodkinson, 1984) and complex morphological gall inducing insects represent one of the most fascinating entomological topics (Cerasa et al., 2014). Among insects, midge species are the common gallers and represented an important source of information on the interaction between herbivore and plant (Moeinadini et al., 2017). In Algeria, the most important contributions on this subject have been conducted by several researchers (Marchal, 1897; Kieffer, 1898, 1913; Houard, 1908, 1909, 1922, 1923; Bequaert, 1914; Skuhrava, 1986; Skuhrava & Skuhravy, 1994). No survey was done on the galling insects of Algeria in the recent years. Several Cynipidae and aphid species were mentioned by spiradical papers (Chakali et al., 2002; Benia et al., 2010; Laamari et al., 2010; Pujade-Villar et
al. 2012; Pérez Hidalgo et al., 2012; Cerasa et al., 2014; Boukreris et al., 2015; Tiberi et al., 2016; Ghanema et al., 2016). Despite its specific botanic diversity, no study is devoted on the knowledge of galling-insects in Biskra province. This contribution is an attempt to establish basic information on galling species and their host plants in this province.

**Material and methods**

Located in South Eastern part of Algeria, Biskra province covers a large area of over 21,671 km². This area is characterized by an arid climate with hot summers and temperate winters. The total annual rainfall is 156 mm and the average temperature is 22.8°C. This survey was conducted in eight sites. They were chosen arbitrarily to cover the maximum of territory variability (Fig. 1). This study was based on samples of galls collected from 2012 to 2019. Sampling effort was accomplished by the authors on plant parts bearing galls. Host plants were pressed and preserved as voucher species of host records. Photographs of the galls were taken both *in situ* and from the herbrized material. Gall samples were reared in the laboratory conditions inside mesh covered semi-transparent plastic boxes until all live insects emerged. Insects were preserved in 70% alcohol for identification at later date. Identification of all galls is based on the keys of Houard (1908, 1909, 1922, 1923), the only significant resource of information about galls in Algeria and on others including Blackman & Eastop (2006), Sanchez (2016) and Moenadini et al. (2017). Nomenclature of gall midge species follows Gagné & Jaschhof (2017). Specimens and galls were deposited in the collection of Systematic and Biodiversity laboratory of Scientific and Technical Research Centre for Arid Areas CRSTRA, Biskra, (Algeria). The majority of gall midge species in the collection of Marcela Skuhravá (Prague, Czech Republic), since the time they were sent by authors in 2016 and 2019 for identification.

![Figure 1. Map of the sampling localities in Biskra province, South-East of Algeria.](image-url)
Results

Fourteen species of gall-inducing insects were found in Biskra province during investigation in years 2012–2019. The largest group of gall inducing is represented by gall midges (Cecidomyiidae) with eight species; they were not previously registered in Biskra. The species; Houardiella salicornia Kieffer, 1912 and Gephyraulus moricandiae Sylven & Solinas, 1989 were recorded for the first time from Algeria. Rhopalomyia navasi Tavares, 1904, causing galls on Artemisia herba alba, usually known to occur in north-western of Algeria, was recorded for the first time in the Biskra province.

Order: Diptera

Family Cecidomyiidae Newman, 1834

Asphondylia punica Marchal, 1897

Material examined: 30♀♀, 6♂♂, ALGREIA: Biskra province, El-Outaya, 34°57′39″ N, 05°30′28″ E, 192.5 m a.s.l., reared from galls in apical and axillary buds of Atriplex halimus (Chenopodiaceae), 14 February 2017, S. Tahar-Chaouche, leg.

General characters: These hypertrophied tissues known as rosettes galls are composed of small unilocular gall set with small and dense leaves (Fig. 2). The fresh galls with green color and they became yellowish after emergence of adult. Each gall includes many chambers. Occurrence: very common.

Remarks: In Algeria, Houard (1902) is the first who described Asphondylia punica galls on Atriplex halimus collected in Oran province situated in western region and the similar galls were found in Biskra province.

Distribution: Widespread in Mediterranean region: Greece, Algeria, Tunisia, Libya (Houard, 1902; Dorchin et al., 2014; Gagné & Jaschhof, 2017). First record for Biskra.

Figure 2. Rosette bud galls of Asphondylia punica Marchal, 1897 (Dipt. Cecidomyiidae) on buds of Atriplex halimus. Algeria: Biskra province; El-Outaya, at an altitude of 192.5 meters above sea levels.
Contarinia nasturtii (Kieffer, 1888)

**Material examined:** 20 Larvae, ALGERIA: Biskra province; El Faidh, 34°30'03.05" N, 06°31'24.19" E, -13 m a.s.l., reared from galls on flower buds of *Diplotaxis harra* (Brassicaceae), 21 May 2019, S. Tahar-Chaouche, leg.

**General Characters:** The larvae are gregarious with lemon yellow color. This species has several generations per year. At the time of sampling, most galls were empty (Fig. 3). Occurrence: scarce

**Remarks:** In Algeria, *Contarinia nasturtii* galls were reared in Oran region by (Houard, 1902, 1908, 1909) and in Algiers (Houard, 1922, 1923). First record for Biskra.

**Distribution:** Widespread in Europe, Asia, immigrant to Canada and USA (Gagné & Jaschhof, 2017).

Gephyraulus moricandiae Sylven & Solinas, 1989

**Material examined:** Larvae, ALGERIA: Biskra province; El-Outaya, 34°57'39.1" N, 05°30'28.9" E, 192, 5 m a.s.l, reared from galls on flower buds of *Moricandia arvensis* (Brassicaceae), 30 April 2017, S. Tahar-Chaouche, leg.

**General Characters:** The larvae of *Gephyraulus moricandiae* Sylven & Solinas, 1989 are white and gregarious, they cause galls on the flower buds of *Moricandia arvensis* (Brassicaceae) (Fig. 4). Occurrence: very common.

**Distribution:** Tunisia (Gagné & Jaschhof, 2017), Spain (Sanchez, 2016). Algeria (New record).

Houardiella salicorniae Kieffer, 1912

**Material examined:** Larvae, ALGERIA: Biskra province; Ourelal, 34°42'006" N, 05°33'502" E, 65 m a.s.l, reared from galls on stems of *Arthrocnemum glaucum* (Chenopodiaceae), 21 February 2019, H. Guesmia, leg.

**General Characters:** The Larvae cause conspicuous and fusiform galls by thickening of several internodes (Fig. 5). The galls measure 15-20 mm of longer and 7-8 mm of transverse diameter. Occurrence: very common.

**Distribution:** Mediterranean region. Tunisia, Libya and Sicily (Skuhravá et al., 2007). Algeria (New record).

Rhopalomyia navasi Tavares, 1904

**Material examined:** 2♀, ALGERIA: Biskra province; Ain Zaatout, 2♀, 11 June 2019, 35°11'171" N, 05°50'106" E, 1282 m a.s.l., reared from galls on stem sides of *Artemisia herba alba* (Asteraceae), 11 June 2019, S. Tahar-Chaouche, leg.

**General Characters:** The Larvae cause woolen fibers galls with 8–10 mm in diameter (Fig. 6). Several chambers occur inside each gall. Occurrence: common.

**Distribution:** Euro-Asian and Mediterranean. Spain, Romania and Egypt (Gagné & Jaschhof, 2017). In Algeria, it detected in Oran and Ain-Sefra regions (Houard, 1912). Recent records of this species in two provinces (Saida and Sidi Bel Abbes) (Tahar-chaouche & Salemkour, 2016). First record for Biskra.
Figure 3. Galls on flower buds of *Contarinia nasturtii* (Kieffer, 1888) (Dipt. Cecidomyiidae) on *Diplotaxis harra*. Algeria: Biskra province; El Faidh, at an altitude of -13.5 meters above sea levels.

Figure 4. Galls on flower buds of *Gephyraulus moricandiae* Sylven & Solinas, 1989 (Dipt. Cecidomyiidae) on *Moricandia arvensis*. Algeria: Biskra province; El-Outaya, at an altitude of 192.5 meters above sea levels. Arrow head indicating the larvae.

Figure 5. Fusiform galls of *Houardiella salicorniae* Kieffer, 1912 (Dipt. Cecidomyiidae) on *Arthrocnemum glaucum*. Algeria: Biskra, Ourelal, at an altitude of 65 meters above sea levels. Arrow head indicating the larvae.
Stefaniella atriplicis Kieffer, 1898

**Material examined:** Larvae, ALGERIA: Biskra, El-Outaya, 34°57′39″ N, 05°30′28″ E, 192.5 m a.s.l., reared from stem of *Atriplex halimus* (Chenopodiaceae), 14 February 2017, S. Tahar-Chaouche, leg.

**General Characters:** Larvae cause swelling gall (Fig. 7). Each gall includes many chambers. At sampling, most reared galls were empty. Occurrence: very scarce.

**Distribution:** Italy, former Czechoslovakia, Greece, Russia, former Yugoslavia (Gagné & Jaschhof, 2017). In Algeria it found in Oran region by (Houard, 1902). First record for Biskra.

Stefaniella trinacriae Stefani, 1900

**Material examined:** Larvae, ALGERIA, Biskra province, El-Outaya, 34°57′39″ N, 05°30′28″ E, 192.5 m a.s.l., reared from galls on stem of *Atriplex halimus* (Chenopodiaceae), 14 February 2017, S. Tahar-Chaouche, leg.

**General Characters:** Larvae cause fusiform woody galls (Fig. 8) with green or red color and nearly 20 mm of size. In each enclosed gall, we found one yellow-whitish larvae develop. Occurrence: scarce.

**Distribution:** Mediterranean (Italy - Sicily), Spain, Algeria and Tunisia (Skuhravá & Skuhravý, 1994). In Algeria, it found in Oran region by Houard (1902). First record for Biskra.

Stefaniella salsolae Tavares, 1904

**Material examined:** 26♀♀, ALGERIA: Biskra province; El-Outaya, 34°57′39″ N, 05°30′28″ E, 192.5 m a.s.l., reared from stem galls on *Salsola vermiculata* (Chenopodiaceae), 14 February 2017, S. Tahar-Chaouche, leg.
General Characters: Larvae changed buds into a fleshy rosette gall of 15-18 mm, covered with long whitish hairs (Fig. 9). Occurrence: very common.

Distribution: Mediterranean. Spain, Portugal (Gagné & Jaschhof, 2017). In Algeria, it found in Oran region by Houard (1912). First record for Biskra.

Figure 7. Swelling gall of *Stefaniella atriplicis* Kieffer, 1898 (Dipt. Cecidomyiidae) on *Atriplex halimus*. Algeria: Biskra province; El- Outaya, at an altitude of 192.5 meters above sea levels.

Figures 8-9. Galls by the Cecidomyiids on Chenopodiaceae host plants. 8. Fleshy rosette gall of *Stefaniella salsolae* Tavares, 1904 on *Salsola vermiculata*. 9. Fusiform woody gall of *Stefaniella trinacriae* Stefani, 1900 on *Atriplex halimus*; Algeria: Biskra province; El- Outaya, at an altitude of 192.5 meters above sea levels.
Order: Hemiptera
Superfamily: Psylloidea Handirsch, 1903
Family: Aphalaridae Löw, 1879
Rhodochlanis salsolae (Lethierry, 1874)
Material examined: Larvae, ALGERIA: Biskra province; Biskra city, 23 April 2019, 34°51'015" N, 05°41'280" E, 107 m a.s.l., reared from galls on young shoots of Haloxylon salicornicum (Amaranthaceae), 23 April 2019, H. Guesmia, leg.
General Characters: Larvae induce galls on young shoots of Haloxylon salicornicum and transformed them into big scales, concave in spoon. These scales envelop the between-nodes greatly hypertrophied (Fig. 10). Occurrence: common.
Remarks: The materials of this galls found in Biskra and described by Houard (1908, 1909).
Distribution: Algeria, Morocco, Tunisia, Madeira and Afghanistan (Ouvrard, 2019).

Family: Aphididae Latreille, 1802
Subfamily: Eriosomatinae Kirkaldy, 1905
Forda riccobonii (De Stefani, 1899)
Material examined: Colonies, ALGERIA: Biskra province; Besbes, 34°11'579" N, 05°01'957" E, 297 m a.s.l., reared on leaves of Pistacia atlantica (Anacardiaceae), 16 July 2017, S. Tahar-Chaouche, leg.
General Characters: Fundatrigenia of this specie induce on Pistacia atlantica leaf-edge galls (Fig. 11). Occurrence: common.
Distribution: Mediterranean and South-western of Asia regions (Blackman & Eastop, 2006). Known from Algeria (Houard, 1922, 1923; Blackman & Eastop, 2000; Laamari et al., 2010). First record for Biskra.

Figure 10. Galls and nymph of Rhodochlanis salsolae (Lethierry, 1874) (Hemi., Aphalaridae) on Haloxylon salicornicum. Algeria: Biskra province; Biskra city, at an altitude of 107 meters above sea levels.
Various leaf galls on Pistacia by the aphids. 11. Leaf-edge galls of *Forda riccobonii* (De Stefani, 1899) on *Pistacia atlantica*; 12. Spherical galls of *Geoica* sp. on *Pistacia atlantica*. 13. Spindle-shaped galls of *Smynthurodes betae* Westwood 1849 on *Pistacia atlantica*. Algeria: Biskra province; Besbes, at an altitude of 297 meters above sea levels.

**Geoica** sp.

**Material examined:** ALGERIA: Biskra province; Besbes, 34°11´579˝N, 05°01´957˝E, 297 m a.s.l., reared on leaves of *Pistacia atlantica* (Anacardiaceae), 16 July 2017, S. Tahar-Chaouche, leg.

**General Characters:** This species induces spherical galls on the abaxial side of leaflets (Fig. 12) (Nogal, 2011). At the time of sampling, most opening galls were empty.

**Distribution:** Throughout Europe, North Africa (Morocco), Middle East, Central Asia, North America and China (Blackman & Eastop, 2006). In Algeria, Louzabi et al. (2020) found the species *Geoica mimeuri* (Gaumont 1930) on *Pistacia atlantica* in Djelfa province. First record for Biskra.

*Smynthurodes betae* Westwood 1849

**Material examined:** Colonies, ALGERIA: Biskra province; Besbes, 34°11´579˝N, 05°01´957˝E, 297m a.s.l., reared on leaves of *Pistacia atlantica* (Anacardiaceae), 16 July 2017, S. Tahar-Chaouche, leg.

**General Characters:** This species produces galls on *Pistacia atlantica* which are yellow-green or red, spindle-shaped, and formed by rolling of the edge of the leaflet near its base (Fig. 13). Occurrence: Scarce.

**Distribution:** Mediterranean origin (Blackman & Eastop, 2000), Algeria (Blackman & Eastop, 2000; Laamari et al., 2010). First record for Biskra.

**Order:** Lepidoptera

**Family:** Gelechiidae Stainton, 1854

**Amblypalpis olivierella** Ragonot 1886

**Material examined:** ALGERIA: Biskra province; El Faidh, 34°30´030.5˝ N, 06°31´241.9˝ E, -13 m a.s.l., reared on the branches of *Tamarix gallica* (Tamaricaceae), 21 May 2019, H. Fadlaoui, leg.
General Characters: Upon the branches of *Tamarix* trees, larvae penetrate its center and feed upon pith. The tunnel grows in size. The fusiform galls measure about 20-30mm in length and 7-10 in width (Fig. 14). Occurrence: very common.

Distribution: North Africa (Houard, 1922, 1923), Iran and India (Lupo & Gerling, 1984). First record for Biskra.

*Oecocecis guyonianum* Guenée, 1870

Material examined: 2♀♀, ALGERIA: Biskra province; Guadila, 5 May 2012, 35°03′018″ N, 05°45′35″ E, 390.4 m a.s.l., reared on flower stams of *Limoniastrum guyonianum* (Plumbaginaceae), 5 May 2012, H. Fadlaoui, leg.

General Characters: Larvae induce ovoid galls on flower stams of *Limoniastrum guyonianum*. Found for the first time in Biskra province and described by (Guenée, 1869 in Coutin, 1995) (Fig. 15). Occurrence: very common.

Distribution: Mauritania, Cyprus, Syria, Tunisia (Houard, 1912).

Discussion

In Algeria, little attention has given to knowledge the diversity of gall inducing fauna so the current knowledge about species richness is mainly based on various oldest collections. Fourteen species of gall-inducing insects belonging to diverse orders are associated with different plant families were found. According to available information cited in the literature, the species *Rhodochlanis salsolae* and *Oecocecis guyonianum* were previously recorded in Biskra province, respectively (Houard, 1908; Coutin, 1995).
Several gall inducing insects such as Amblypalpis olivierella Ragonot 1886, Forda riccobonii (De Stefani, 1899), Geoica sp., Smynthurodes betae Westwood 1849, Rhopalomyia navasi Tavares, 1904, Contarinia nasturtii (Kieffer, 1888), Stefaniela salsolae Tavares, 1904, Stefaniella trinacriae Stefani, 1900, Stefaniella atriplicis Kieffer, 1898 and Asphondylia punica Marchal, 1897 were known in Algeria, but two gall midge species Houardiella salicorniae Kieffer, 1912 and Gephyraulus moricandiae Sylven & Solinas 1989 are newly detected in Algeria. The galls induced by Houardiella salicorniae Kieffer, 1912 are rarely collected comparing to Gephyraulus moricandiae Sylven & Solinas, 1989.

Dipterous gall makers represented by Cecidomyiidae family were the richest order with eight species followed by Hemiptera order with four species. Stefaniella (Diptera: Cecidomyiidae) is the most species rich genus, representing by three species associating with ten host plant species. Among the host plants of cecidomyiids, Chenopodiaceae family (three plant species) hosting the highest number of gall insect, followed by Brassicaceae (two plant species). Other plant families such as Asteraceae, Amaranthaceae, Plumbaginaceae and Tamaricaceae have been subjected to attack of only one species of gall-forming insect. Two host plant species Atriplex halimus (Chenopodiaceae) and Pistacia atlantica (Anacardiaceae) had more to one type of galls caused by several species. The majority of host plant species are shrubs and plant parts attacked were different and galls were found on stems, shoots, flower buds and leaves. Most gallers are Mediterranean origin and regarded as economically indifferent species. The taxonomical knowledge of the Algerian species of inducing-gall insects is still insufficient; therefore, there is a lot of potential for further discoveries in Biskra and Algeria.

Acknowledgments
We would like to thank Dr. Marcella Skuhrava (Czech Republic) for invaluable help and time in identification of gall midge samples and encouragement, and we are grateful to all people for help with collect the samples. “This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors”.

Figure 15. Ovoid galls, Oeoccocis guyonianum Guenée, 1870 (Lep. Gelechiidae) on Limoniastrum guyonianum. Algeria: Biskra province; Guadila at an altitude of 390.4 meters above sea levels.
Conflict of Interests
The authors declare that there is no conflict of interest regarding the publication of this paper.

ORCID
Souad Tahar-Chaouche: https://orcid.org/0000-0001-8223-7826
Hadjer Guesmia: https://orcid.org/0000-0002-9164-2572
Haroun Fadlaoui: https://orcid.org/0000-0002-5867-2198
Imene Tahar-Chaouche: https://orcid.org/0000-0002-0654-0839

References


Gall-inducing insects from Algeria

مطالعه حشرات گالزای استان بسكره، الجزائر

سعاد طاهر شاوش۱، هاجر قاسمیه۲، هارون فاضل‌آوی۳ و ایمان طاهر شاوش۴

۱ مرکز تحقیقات علمی و فنی مناطق خشک، بسكره، الجزائر.
۲ آزمایشگاه حشرات طبیعی و برنامه‌ریزی فضایی LRNAT دانشگاه مصطفی بن بولعيد، باتنه، الجزائر.
۳ پست الکترونیکی نویسندگه: souadhouda@gmail.com

چکیده: بررسی نمونه‌برداری در استان بسكره طی سال‌های ۲۰۱۲ تا ۲۰۱۹، جهت بررسی نوع گال ایجاد شده توسط حشرات در گیاهان میزبان مختلف یافته شد. این گال‌ها متعلق به صنف حشرات گالزای چهار خانواده و ۱۲ جنس از حشرات مختلف بود. اکثر گال‌ها توسط پشه‌های گالزای (Diptera: Cecidomyiidae) که اخیراً از استان بسكره گزارش شده‌اند، ایجاد شده بودند. به‌طور مشابه، دو گونه Rhodochlanis salsolae (Lethierry, 1874) و Gephyraulus moricandiae Sylven & Solinas, 1989 از بسکره بحرین و همچنین سه گونه شناخته شده مربوط با استان بسکره شناسایی گردیدند. این گونه‌های گیاه‌خوار باعث گسترش گیاهان میزبان در ارتباط هستند که اغلب دارای پیش‌ترین تعداد حشرات گالزای بود. اغلب حشرات گالزای مشاهده‌ای دارند و از نظر اقتصادی نیز مهم هستند.

واژگان کلیدی: گالزا، پسیل، پشه‌های گالزای بسکره، الجزائر