

# Updated host associations and distribution of *Lysiphlebus fabarum* (Marshall) (Hymenoptera: Braconidae) in Algeria

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Aphids are considered serious pests that cause damage to various crops. There are several natural enemies that regulate their populations, including the Aphidiinae who are exclusively aphid parasitoids. The importance of Aphidiinae as biocontrol agents has been reported in many articles discussing their abundance and tritrophic relationships around the world. This study aimed to determine the tritrophic relationships between aphids and the main parasitoid *Lysiphlebus fabarum* in Algeria during 2007 - 2020. Ninety-one tritrophic relationships have been established between *L. fabarum* and 40 aphid species. These aphids have been found on 50 different plant species belonging to 21 botanical families. Fourteen aphid genera have been identified, with 19 belonging to the *Aphis* genus. The most dominant interactions between this parasitoid and its host were with *Aphis craccivora*, *A. fabae* and *A. gossypii*, which accounted for half of all trophic relationships recorded in this study. The results indicate that the parasitoid *L. fabarum* is prevalent in Algeria, with a significant number of aphid hosts throughout most of the year.

**Keywords:** Algeria, aphid hosts, associations, distribution, *Lysiphlebus fabarum*

Aphids are considered to be important pests of many cultivated and natural plants. They are particularly well adapted to exploit different ecosystems (Stary 1970). They suck the sap, depriving the plant of essential nutrients for growth, and are also vectors of viruses, causing harmful physiological disorders (Van Emden and Harrington 2007). Parasitoid insects are among the auxiliary insects that make their living by killing aphids as a direct or indirect result of their action (Stary 1970).

Aphidiine adults are small, weakly sclerotised insects that usually have more or less reduced forewing veins and an average body size of 1.5 - 3.5 mm (Stary 1970). Approximately 600 species have been described worldwide, grouped into 50 genera (Van Emden and Harrington 2007). All species are solitary endoparasitoids of aphids and play an important role in reducing aphid populations due to their host specificity and rapid response to host population increases (Olmez and Ulusoy 2003; Žikić et al. 2015). Aphid parasitoids and their aphid hosts have spread throughout the world, with a predominant distribution in the northern

hemisphere (Stary 1970). Some have been recommended as excellent biological control agents (Kavallieratos et al. 2001; Le Ralec et al. 2010).

In Algeria, the first study of Aphidiines in the western region by was carried out in 1988 (Guenauoui et al. 1994) and there was a further study in 2005 (Aroun and Abdel Hussain 2006). In the eastern region, research on aphid parasitoids started in 2007, with a series of studies carried out at the University of Batna.

*Lysiphlebus fabarum* (Marshall) (Hymenoptera: Braconidae), the best-known example of these aphidiines, is native to the Palearctic (Carver and Franzmann 2001) and is a large generalist parasitoid in agroecosystems (Matin et al. 2009). This parasitoid can significantly reduce populations of *Aphis fabae* Scopoli (Hemiptera: Aphididae) and *Aphis craccivora* Koch (Hemiptera: Aphididae) and may be extremely useful for biological control of these pests (Rakhshani et al. 2013). *L. fabarum* has been well studied in recent years (Carver and Franzmann 2001; Rakhshani et al. 2013; Ilic Milosevic et al. 2014; Stary et al. 2014;

Host associations and distribution of *Lysiphlebus fabarum* (Marshall) (Hymenoptera: Braconidae) in Algeria; *H. Aggoun et al* Dennis et al, 2020); however, little data is available for Algeria. Many countries have established multiple biological control programmes for aphids, but these countries do not include Algeria. One of the reasons for this is the lack of basic information. The aim of this study was to determine the host range of this parasitoid and understand its geographical range.

## Materials and methods

### Study area

Samples were collected from 28 sites in eight Algerian provinces (Alger, Batna, Biskra, Ghardaia, Guelma, Khenchela, Ouargla and Sétif) located in four bioclimatic areas: humid, semi-arid, arid, and Saharan. The sites are in areas with different floral diversities and are at altitudes ranging from 27 - 1533 m (Figure 1).

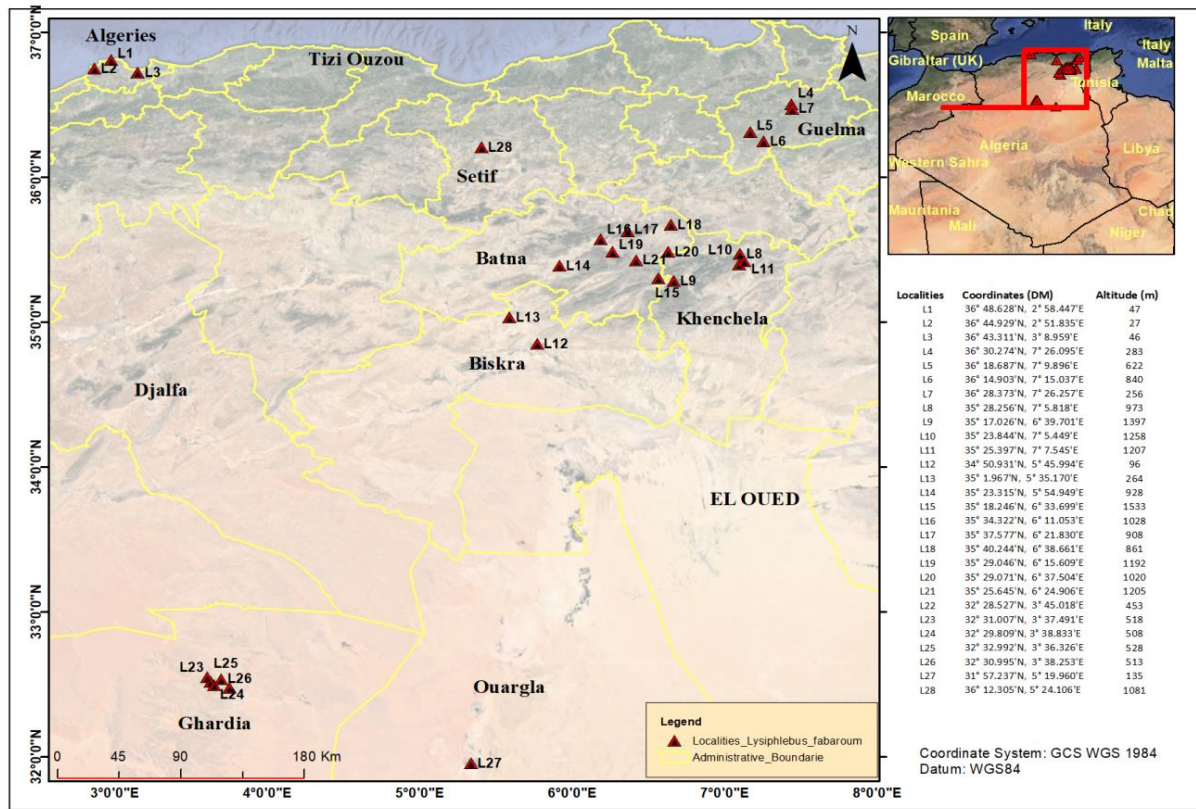


Figure 1: Sampling localities where *Lysiphlebus fabarum* was recorded.

### Sampling and data collection

Specimens were collected during 2017 - 2020 from different localities in Khenchela province. Colonies of different host aphids collected from crops and uncultivated vegetation were transferred to a laboratory where they were kept in ventilated petri dishes together with parts of the host plants. Healthy adult aphids were collected simultaneously and preserved in 75% ethanol/25% water for later

identification. The rearing dishes were kept at 25°C for 2 - 3 weeks and the emerging parasitoids were collected daily and deposited in 75% ethanol for further examination. The total number of emerged wasps was counted for each specimen. The rest of the data were extracted from the studies which refer to the taxonomy, faunal diversity, and biology of Aphidiinae parasitoids that were collected between 2007 and 2017. The literature used for different regions were: Alger (Allali 2016;

Host associations and distribution of *Lysiphlebus fabarum* (Marshall) (Hymenoptera: Braconidae) in Algeria; *H. Aggoun et al.* (Aroun 2015); Batna (Abbes 2009; Benferhat 2010; Seghir 2013); Biskra (Khenissa 2007; Tahar Chaouche 2018); Ghardaia (Chehema 2013); Guelma (Sidi Athmane 2013); Khenchela (Aggoun 2011; Aggoun 2015); Ouargla (Bellabidi 2012) and Sétif (Ghazali 2014).

## Results

### Trophic relationships of *Lysiphlebus fabarum*

As described above data were collected from 28 localities in Algeria between 2007 and 2020; 91 tri-trophic associations were established between the primary parasitoid *L. fabarum* and 40 aphids feeding on 50 different plant species from 21 botanical families (Table

1). This parasitoid was observed on a wide range of aphids (14 genera). These aphid hosts were reared on different plants: crops, non-crop plants, fruit trees, and ornamental plants growing in different types of habitats (natural, cultivated and urban). The results show that species of the genus *Aphis* were the most abundant in this study, with a large number of associations with different plants (59 associations). The highest number of trophic relationships was obtained with *Aphis craccivora*, *Aphis fabae* and *Aphis gossypii* (Hemiptera: Aphididae) with 13 associations for each of these species. The second highest number of trophic relationships was recorded for the genus *Bradycaudus* which had eight associations. The family Asteraceae hosted 12 aphids hosts species forming 12 associations.

Table 1: Tri-trophic relationships between *Lysiphlebus fabarum*, host aphids and host plants at different localities in Algeria

Host aphids	Host plants	Botanic family	Provinces (localities)
<i>Acyrtosiphon pisum</i> (Harris, 1776)	<i>Medicago sativa</i> L., 1753	Fabaceae	Khenchela (El-hamma)
<i>Acyrtosiphon</i> spp	<i>Inula viscosa</i> L.	Asteraceae	Guelma
<i>Aphis astragali</i> Ossiannilsson, 1959	<i>Astragalus armatus</i> L., 1753	Fabaceae	Batna (Ain touta)
<i>Aphis brotericola</i> (Mier Durante, 1978)	<i>Euphorbia helioscopia</i> L., 1753	Euphorbiaceae	Khenchela (Fringuel)
	<i>Euphorbia</i> spp	Euphorbiaceae	Batna (Inoughissene)
	<i>Picris echoides</i> L.	Asteraceae	Khenchela
<i>Aphis brunnea</i> Ferrari, 1872	<i>Ononis natrix</i> L.	Fabaceae	Biskra
<i>Aphis confusa</i> (Walker, 1849)	<i>carduus pycnocephalus</i> L., 1763	Asteraceae	Khenchela (Fringuel)
	<i>Scabiosa ochroleuca</i> L.	Dipsacaceae	Khenchela (El-hamma)
	<i>Scabiosa semipapposa</i> L.		Alger (Bainem)
<i>Aphis craccivora</i> (Koch, 1854)	<i>Amaranthus retroflexus</i> L., 1753	Amaranthaceae	Batna
	<i>Citrus reticulatum</i> (L.) Osbeck, 1765	Rutaceae	Alger (Staoueli)
	<i>Citrus sinensis</i> (L.) Osbeck, 1765		Alger (Staoueli)
	<i>Hedysarum carnosum</i> Desf., 1799	Fabaceae	Biskra
	Spontaneous flora	Spontaneous flora	Batna
<i>Vicia faba</i> L., 1753		Fabaceae	Ghardaia (El-Atteuf)
			Biskra
			Guelma (Oued Zenati)
			Guelma (Ain makhlouf)

Host associations and distribution of *Lysiphlebus fabarum* (Marshall) (Hymenoptera: Braconidae) in Algeria; *H. Aggoun et al.*  
 Table 1 continued...

Host aphids	Host plants	Botanic family	Provinces (localities)
	<i>Medicago sativa</i> L., 1753	Fabaceae	Biskra Ghardaia (El-Atteuf) Batna
	<i>Medicago arborea</i> L., 1753		Batna
	<i>Melilotus salcatus</i> Desf	Fabaceae	Khenchela (Fringuel)
	<i>Picris echoides</i> L.	Asteraceae	Khenchela
	<i>Robinia pseudo-acacia</i> L., 1753	Fabaceae	Batna
	<i>Vicia faba</i> L., 1753		Ghardaia (Lechbour) Ghardaia (N'tissa)
	<i>Vicia sativa</i> L.		Biskra Khenchela (Bouhmama) Khenchela
<i>Aphis fabae</i> Scopoli, 1763	<i>Amaranthus blitoides</i> S.Watson, 1877	Chenopodiaceae	Ghardaia (Daïa Ben dhahoua)
	<i>Amaranthus retroflexus</i> L., 1753	Chenopodiaceae	Guelma (Oued Zenati)
	<i>Citrus reticulatum</i> (L.) Osbeck, 1765	Rutaceae	Alger (Staoueli)
	<i>Cynara scolymus</i> (L.) Benth., 1867	Asteraceae	Alger (Staoueli)
	<i>Chenopodium album</i> L., 1753	Chenopodiaceae	Batna
	Spontaneous flora	Spontaneous flora	Batna Batna Batna (El-Madher) Batna (Ain touta)
	<i>Hedera helix</i> L., 1753	Araliaceae	Batna
<i>Aphis fabae</i> Scopoli, 1763	<i>Galactites tomentosa</i> Moench, 1794	Asteraceae	Alger (ENSA)
	<i>Rumex crispus</i> L.	Polygonaceae	Alger (Staoueli)
	<i>Silybum marianum</i> (L.) Gaertn., 1791	Asteraceae	Guelma (Heliopolis)
	<i>Solanum nigrum</i> L.	Solanaceae	Alger (Staoueli) Ghardaia (Daïa Ben dhahoua) Batna (Chemora)
	<i>Vicia faba</i> L., 1753	Fabaceae	Biskra Batna (Chemora)
	<i>Vicia sativa</i> L.		Guelma
<i>Aphis gossypii</i> Glover, 1877	<i>Capsicum annuum</i> L., 1753	Solanaceae	Sétif
	<i>Citrus sinensis</i> (L.) Osbeck, 1765	Rutaceae	Ghardaia (N'tissa)
	<i>Citrus reticulatum</i> (L.) Osbeck, 1765		Alger (Staoueli)
	<i>Cucumis sativus</i> L., 1753	Cucurbitaceae	Sétif Alger (Staoueli)
	<i>Eryngium triquetrum</i> Vahl	Apiaceae	Khenchela
	Spontaneous flora	Spontaneous flora	Batna
	<i>Lactuca sativa</i> L., 1753	Asteraceae	Alger (Staoueli)
	<i>Malva sylvestris</i> L. 1753	Malvaceae	Batna (El-Madher)
	<i>Marrubium alysson</i> L.	Lamiaceae	Khenchela

Host associations and distribution of *Lysiphlebus fabarum* (Marshall) (Hymenoptera: Braconidae) in Algeria; *H. Aggoun et al.*  
Table 1 continued...

Host aphids	Host plants	Botanic family	Provinces (localities)
<i>Aphis gossypii</i> Glover, 1877	<i>Marrubium vulgare</i> L., 1753	Labiaceae	Batna (Tazoult)
	<i>Picris echoides</i> L.	Asteraceae	Khenchela (El-hamma)
	<i>Punica granatum</i> L (1753)	punicaceae	Guelma
	<i>Vicia faba</i> L., 1753	Fabaceae	Sétif
<i>Aphis idaei</i> Van der Goot, 1912	<i>Eryngium triquetrum</i> Vahl	Apiaceae	Khenchela
	<i>Marrubium vulgare</i> L., 1753	Lamiaceae	Khenchela
<i>Aphis pomi</i> De Geer, 1773	<i>Cydonia vulgaris</i> Mill., 1768	Rosaceae	Alger (Staoueli)
<i>Aphis punicae</i> Passerini, 1863	<i>punica granatum</i> L (1753)	Punicaceae	Alger (Staoueli)
<i>Aphis pseudocardui</i> (Theobald, 1915)	<i>Cichorium spinosum</i> L., 1753	Asteraceae	Khenchela
<i>Aphis rumicis</i> Linnaeus, 1758	<i>Rumex crispus</i> L.	Polygonaceae	Alger (Staoueli)
			Batna
<i>Aphis sambuci</i> (L., 1758)	<i>Rumex crispus</i> L.	Polygonaceae	Khenchela
<i>Aphis solanella</i> Theobald, 1914	<i>Solanum nigrum</i> L.	Solanaceae	Alger (Staoueli)
<i>Aphis</i> spp	<i>Picris echoides</i> L.	Asteraceae	Khenchela
<i>Aphis spp</i> 2	<i>Amaranthus hybridus</i> L., 1753	Chenopodiaceae	Khenchela
<i>Aphis terricola</i> (Rondani, 1847)	<i>Picris echoides</i> L.	Asteraceae	Khenchela
<i>Aphis umbrella</i> (Borner, 1950)	<i>Malva sylvestris</i> L., 1753	Malvaceae	Guelma (Heliopolis)
<i>Brachycaudus cardui</i> (L., 1758)	<i>Carduus pycnocephalus</i> L., 1763	Asteraceae	Batna
			Khenchela (Fringuel)
	<i>Cynara scolymus</i> (L.) Benth., 1867	Asteraceae	Alger (Staoueli)
<i>Brachycaudus persicae</i> (Sulzer, 1776)	<i>Prunus persica</i> (L.) Batsch, 1801	Rosaceae	Khenchela (Fringuel)
			Alger (Staoueli)
<i>Brachycaudus prunicola</i> (Kaltenbach, 1843)		Rosaceae	Alger (Staoueli)
<i>Brachycaudus helichrysi</i> (Kaltenbach, 1843)	<i>Carthamus lanatus</i> L.	Asteraceae	Batna
	<i>Silybum marianum</i> (L.) Gaertn, 1791	Asteraceae	Guelma (Ain makhlof)
	<i>Silybum marianum</i> (L.) Gaertn, 1791	Asteraceae	Guelma
<i>Brevicoryne brassicae</i> (Linnaeus, 1758)	<i>Euphorbia helioscopia</i> L., 1753	Euphorbiaceae	Khenchela (Fringuel)
	<i>Medicago sativa</i> L., 1753	Fabaceae	Ouargla
	<i>Moricandia arvensis</i> (L.) Dc., 1821	Brassicaceae	Ghardaia (Bouchèn)
<i>Capitophorus elaeagni</i> (Del Gercio, 1894)	<i>Cynara cardunculus</i> L., 1753	Asteraceae	Ghardaia (El-Atteuf)
<i>Capitophorus hypophaes</i> (Walker, 1852)	<i>Cynara scolymus</i> (L.) Benth, 1867	Asteraceae	Alger (Staoueli)
<i>Dysaphis</i> spp	<i>Chaerophyllum temulum</i> L., 1753	Apiaceae	Batna (Ouled fadel)
<i>Dysaphis cynarae</i> (Theobald, F.V., 1915)	<i>Cynara scolymus</i> (L.) Benth, 1867	Asteraceae	Alger (Staoueli)

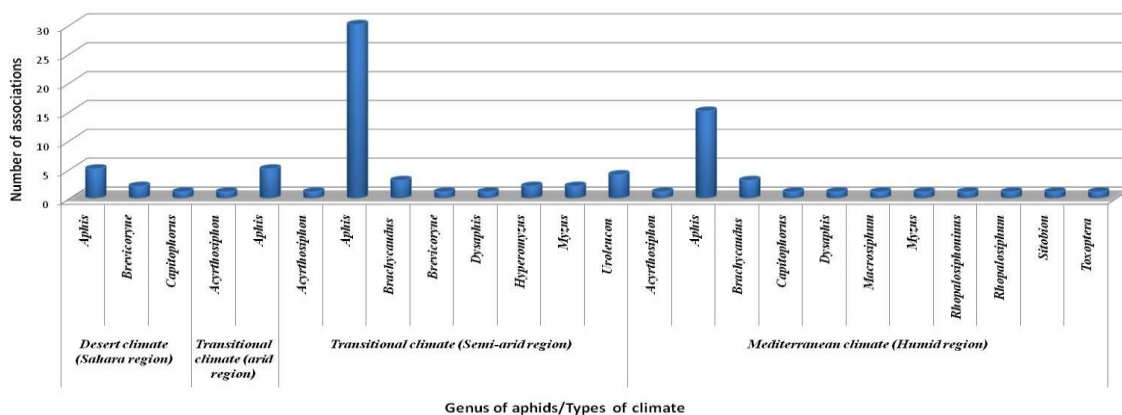
Host associations and distribution of *Lysiphlebus fabarum* (Marshall) (Hymenoptera: Braconidae) in Algeria; *H. Aggoun et al.*  
Table 1 continued...

Host aphids	Host plants	Botanic family	Provinces (localities)
<i>Hyperomyzus lactucae</i> (L., 1758)	<i>Melilotus salcatus</i> Desf	Fabaceae	Khenchela (Fringuel)
	<i>Picris echoides</i> L.	Asteraceae	Khenchela
<i>Macrosiphum euphorbiae</i> (Thomas, 1878)	<i>Pyrus communis</i> L., 1753	Rosaceae	Alger (Staoueli)
<i>Myzus persicae</i> (Sulzer, 1776)	<i>Capsicum annuum</i> L., 1753	Solanaceae	Alger (Staoueli)
	<i>Lycopersicum esculentum</i> L., 1753	Solanaceae	Sétif
	Spontaneous flora	Spontaneous flora	Alger (Staoueli) Batna
<i>Rhopalosiphoninus latysiphon</i> (Davidson, 1912)	<i>Solanum nigrum</i> L.	Solanaceae	Alger (Staoueli)
<i>Rhopalosiphum maidis</i> (Fitch, 1856)	<i>Hordeum murinum</i> L., 1753	Poaceae	Alger (Staoueli)
<i>Rhopalosiphum padi</i> (Linnaeus, 1753)	<i>Zea mays</i> L., 1753	Poaceae	Alger (Staoueli)
<i>Sitobion avenae</i> (Fabricius, 1794)		Poaceae	Alger (Staoueli)
<i>Toxoptera aurantii</i> (Boyer de Fonscolombe, 1841)	<i>Citrus sinensis</i> (L.) Osbeck, 1765	Rutaceae	Alger (Staoueli)
<i>Uroleucon compositae</i> (Theobald, 1915)	<i>Borago officinalis</i> L., 1753	Boraginaceae	Batna
	<i>Carduus pycnocephalus</i> L., 1763	Asteraceae	Khenchela (Fringuel) Batna (Oued Taga)
	<i>Sonchus asper</i> (L.) Hill	Asteraceae	Khenchela
<i>Uroleucon picridis</i> (Fabricius, 1775)	<i>Picris echoides</i> L.	Asteraceae	Khenchela

### Zonal distribution of *Lysiphlebus fabarum* associated with host aphids in Algeria

Algeria is characterised by four different bioclimatic regions: humid, semi-arid, arid, and Saharan. The present study shows that *L. fabarum* is widespread and reaches all bioclimatic areas of the eight Algerian regions

studied, with elevations ranging between 27 - 1533 m. The greatest abundance of *L. fabarum*, in terms of the number of associations and the number of aphid species attacked, is observed in humid and semi-arid regions. It is much more abundant in associations with different species of the genera *Aphis*, *Brachycaudus* and *Uroleucon* (Figure 2).

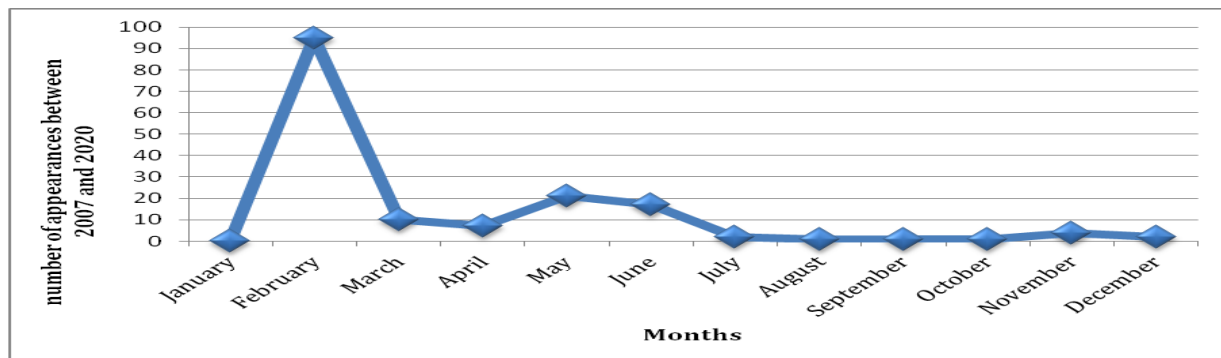


**Figure 2: Zonal distribution of *Lysiphlebus fabarum* associated with host aphids in Algeria.**

Host associations and distribution of *Lysiphlebus fabarum* (Marshall) (Hymenoptera: Braconidae) in Algeria; H. Aggoun et al. Activity period of *Lysiphlebus fabarum* in Algeria

Samples were collected from January to December from 2007 to 2020, depending on the growing season at each site. Our results showed that *L. fabarum* is present almost all

year round in Algeria, except during the cold period in the month of January. After this later period, its activity peaked in February and there was a smaller peak in May before the levels were steady and low for the rest of the year (Figure 3).



**Figure 3: Temporal variation in the activity of *Lysiphlebus fabarum* in Algeria.**

## Discussion

The primary parasitoid *L. fabarum* has been described worldwide as a polyphagous parasitoid of more than 100 species of aphids, especially of the genus *Aphis* (Stary 1970). In the field it is the most important parasitoid of *A. fabae* (Rothacher et al. 2016). Interesting hosts of *L. fabarum* are generally small aphids, such as the genus *Aphis*, including some serious pests such as *A. fabae*, *A. craccivora* and *A. gossypii* (Kavallieratos et al. 2004). In Serbia it has been shown that this parasitoid can parasitise 64 aphid species belonging to 18 genera and infest at least 148 plant species, both cultivated and wild (Ilic Milosevic et al. 2014). In Iran it is known as the most abundant and dominant parasitoid species of *A. craccivora* and has been reported on 47 host aphid species belonging to 12 genera on more than 99 host plant species (Rakhshani et al. 2013). In this study 40 aphid species were recorded as hosts of *L. fabarum*. The most infected plants were of the Asteraceae family, which is considered as one of the largest plant families in the world, including herbaceous, subshrubs or shrubs, and a few trees (Funk et al. 2009). The family contains more than 1,600

genera and more than 25,000 species (Mehrparvar 2017). Asteraceae are of economic interest because its species are used for food, medicinal purposes, grazing livestock and ornamental plants. Plant species of this family are the first choice for aphid attack in Iran (Mehrparvar 2017).

Hemidi and Laamari (2020), have demonstrated that the *L. fabarum* preferred host is an aphid that attacks plant species from four botanic families: Asteraceae, Fabaceae, Poaceae and Amaranthaceae.

*Aphis* is a largest genus of aphids with a fast process of diversification on different cultivated and non cultivated plants; it includes about 10% of the world's Aphidid fauna and the most harmful species belong to this genus (Coeur d'Acier et al. 2007).

While there have been several studies on aphids and their parasitoids in Algeria (Hemidi and Laamari 2020; Laamari et al. 2013; Aggoun et al. 2016), in many regions of the country the aphid fauna has not been thoroughly examined. The lack of comprehensive information on the various aphid species and their parasitic wasps is a significant issue in most regions. Out of the 5262 aphid species, only 168 species have

Host associations and distribution of *Lysiphlebus fabarum* (Marshall) (Hymenoptera: Braconidae) in Algeria; *H. Aggoun et al.* been identified in Algeria despite its vast size and diverse habitats (Laamari et al. 2012; Laamari et al. 2016; Ait Amar et al. 2022).

Low species richness of aphid hosts was observed in the arid and Saharan regions. However, insufficient samples were collected in these regions, since the desert region occupies more than 80% of the Algerian territory. The evidence presented clearly shows the need for further complex research on the most important group in the desert region.

Worldwide, *L. fabarum* occurs in the fauna of Andorra, Bulgaria, the Canary Islands, Corsica, Croatia, the Czech Republic, France, Germany, Great Britain, Greece, Hungary, Italy, Latvia, Lithuania, Madeira, Montenegro, Poland, Russia, Sicily, Slovakia, Slovenia, Spain, and the Netherlands (Ilic Milosevic et al. 2014). In Iran, Rakhshani et al. (2013) noted that this parasitoid was mostly restricted to areas below 475 m altitude.

According to Stary (1970) and Flinte et al. (2011), the general distribution of aphid parasitoids is mainly related to biotic (host plants, natural enemies), abiotic (rainfall, humidity, and temperature), and anthropogenic factors. Recently, researchers have become interested in how climate change affects the distribution of insect species, especially the role of temperature (Battisti et al. 2006). Climate determines the distribution and seasonal dynamics of insects (Kanturski et al. 2016). Cold affects the population dynamics of insects mainly by influencing developmental longevity, mortality, and reproduction (Stary 1970). Temperature can also affect population dynamics by affecting parasitoid-host synchrony, either by preventing parasitoid activity during a critical period or by affecting host or parasitoid development time (Langer et al. 2004). Satar et al. (2019) found that the development of immature stages, parasitism, and survival of *L. fabarum* were best within a narrow temperature range of 17 - 27°C, while 12°C and 32°C were beyond the limit for survival and reproduction of this parasitoid. In Algeria, the ecological requirements of this species are not well determined, as well as its

activity and dominance in the Sahara region are still unknown, except for the two regions of Biskra and Ghardaia, where according to Tahar Chaouche and Laamari (2015), its activity is limited between late January and early March, peaking in mid-February. In the rest of the areas, it starts its activity early in spring and it reaches its maximum density in May. In Biskra, this species occurs sporadically and mainly in the month of February, where it is usually replaced by a species of *Aphidius matricariae* (Hymenoptera: Braconidae) on the same plant and on the same host aphid (Tahar Chaouche and Laamari 2015).

*L. fabarum* also shows a defined specialisation and its change between different aphid host species during a season is very rare, a characteristic that helps to control the target aphid population (Stary 1970). In several cases it is found in complementary association with the parasitoid species *Aphidius ervi* on the same *Aphis craccivora* colony.

## Conclusion

This study identified 91 tritrophic relationships between *L. fabarum* and 40 aphids. These aphid species were found on 50 plant species from 21 plant families. Fourteen genera and 19 species of *Aphis* have been confirmed. The most significant interactions were found between *L. fabarum* and *Aphis craccivora*, *A. fabae* and *A. gossypii*, accounting for half of all recorded trophic relationships. The results showed that this parasitic wasp is widely distributed in Algeria and parasitises a large number of aphid hosts throughout the year. Currently, data on tritrophic groups (plant-aphid-parasitoids) in various bioclimatic regions of Algeria is lacking. It is hoped that future studies will expand to other areas, particularly the northwest and south (which are affected by drought and the Sahara Desert), to better understand the host range of *L. fabarum* and add to the list of Hymenoptera parasitoids found in Algeria. To improve biological control programmes against aphids, it is necessary to gather additional data on the species ecological and genetic requirements.



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