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Aphid parasitoid species (hymenoptera: braconidae: Aphidiinae) and their associations in biskra province, Algeria

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Abstract

The prospections undertaken in Biskra permitted to investigate the biodiversity of parasitoids of the Aphidiinae family. Parasitoids were collected in 19 different localities on aphids associated with various host plants. All specimens were reared from the natural habitats and preserved in 70% ethanol. This study documented 14 species belonging to 6 genera: *Aphidius* genus (5species), *Binodoxys* genus (2species), *Diaeretiella* genus (1specie), *Lysiphlebus* genus (3species), *Praon* genus (2species), *Trioxys* genus (1specie). All those parasitoids were collected from 24 aphid taxa occurring on 32 plant taxa and 60 parasitoid-aphid associations are reported. Host plants belong to 14 botanical families. The Asteraceae and the Fabaceae constitute the families with the largest number of associated parasitoid species. The present survey permitted to enrich the biodiversity of the Aphidiinae family of Algeria.

Keywords: Aphid, parasitoids, Aphidiinae, habitats, Biskra, Algeria

1. Introduction

The damage caused by aphids (Homoptera: Aphidoidea) due to their feeding, honeydew production, disease transmission and plant contamination, combined with exceptional fecundity, makes them an important group of plants pests. Because pesticide regulations are now stricter and aphids have developed resistance to several insecticides [15], increasing attention has been directed towards biological control and its alternatives are increasingly investigated. Several approaches can be used to control aphids. Insect parasitoids play a major role in terrestrial food webs as they are highly diverse, abundant, exploit a wide range of niches, and are capable of influencing the population densities and dynamics of their hosts [3]. The family Aphidiinae is generally considered one of the most effective and promising groups of natural enemies of aphids. Aphidiine wasps comprise at least 400 species and 50 genera that are divided into four tribes: Aclitini, Aphidiini, Ephedrini and Praini [5]. All Aphidiine are solitary endoparasitoids and as such, only one individual completes its development inside the host. They are cosmopolitan and represent the largest fraction of aphid parasitoids. Aphidiines show different degrees of host specificity, ranging from a strict specialisation in only one aphid host species to parasitisation of more than a hundred aphid hosts in different types of habitats and geographical areas and their distribution and abundance follow rather closely that of their aphid hosts [16].

Such studies are important to understand their role and efficacy and some questions are timely and relevant to biological control [2]. There is also a growing number of studies conducted by both ecologists and biological control practitioners that devote more attention to aphid parasitoids in nature. The present study was carried out in an attempt to provide initial survey of the primary aphid parasitoids present in Biskra (Algeria) and to evaluate the geographic distribution and faunistic complexes of aphid parasitoids. The data presented here treat only primary parasitoids; hyperparasitoids were also reared, but these will be treated in a separate publication.

2. Materials and Methods

This study was carried in Biskra which is a transition region between the Northern and Southern Algeria in terms of morphological and bio-climatic, it covers a large area of over 21,671 km². The major part of the territory is desert in which the vegetation is adapted to the hot and arid climate as well as to the saline soil. Common plant species like shrubs and grasses can only be found in some valleys and on mountain tops. Climatically, extremely different

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environments of cold winters with subfreezing temperatures, relatively mild spring and hot summers are major characters of the respective areas.

From January 2009 to June 2014 parasitoids were collected in 19 different localities altitude and geographical coordinates of all localities where parasitoids were collected are included in Table (1). All the types of the main habitats in the model area were sampled, the natural habitats were gradually more preferred due to individual research targets which pertain to natural habitats. Aphid populations sampled in habitats varied in size. A subsample of aphids was preserved in 70% ethanol for later identification. Plants were identified prevalently at the spot or, less frequently, they were taken as a herbarium for later closer identification. The remaining aphid colonies were maintained in the laboratory for parasitoid emergence. Mummies, each attached to a plastic box and put inside a growth cabinet. On the lid of each box there was a circular opening covered with muslin for ventilation in order to

maintain inside the boxes conditions similar to those in the growth cabinet (22.5°C, relative humidity 65%, 16L:8D).

After emergence, the aphidiine parasitoids were placed in 70% ethanol. In order to have microscopic slides of parasitoids. The adults (females) were dissected and slide mounted in Eukkit. Identification was based on available keys [6, 9, 15, 18, 21]. Aphid parasitoid nomenclature in the key follows [6]. External morphology was illustrated using a stereo microscope and microscope with Digital cameras (Motic® Images Plus 2.0ML China).

In total, 120 samples were taken, 80 of which yielded parasitoids. Results of identification of plants, aphids and parasitoids were synthesized in a database of tritrophic associations. Basic information on aphids of Algeria was obtained from Laamari studies who also identified the aphids. The majority of the studied and identified specimens were deposited in the insect collection of the Department of Agronomy, University of Batna (Algeria).

Table 1: List of localities in Biskra, where parasitoids collected with altitude and geographical coordinates

	Altitudes(m)	Latitudes(N)	Longitudes(E)
Biskra center	103(1)	34°50.496	05°44.512
	102(2)	34°50.415	05°44.558
	102(3)	34°50.363	05°45.015
	103(4)	34°50.508	05°44.508
Ain Naga	01,3	34°40.574	06°12.597
Ain Zaatout	970, 2	35°15.090	05°49.512
Drouaa	183,2(1)	34°52.474	05°53.462
	180,4 (2)	34°52.443	05°53.457
Doucen	226,8	34°44.155	05°06.346
Djemmora	550(1)	35°05.312	05°52.176
	560, 4(2)	35°05.687	05°52.643
Fliche	85	34°49.221	05°46.138
Foughala	146	34°43.00	05°19.00
El Hadjb	149	34°47.046	05°35.235
Guadila	390,4	35°03.018	05°45.39
Guarta	66,1(1)	34°47.360	05°57.334
	57 (2)	34°46.247	05°55.142
Ghrouss	190	34°43.518	05°15.113
Khanget	65	34°42.287	06°36.096
L'outaya	179	34°55.269	05°28.563
M'ziraa	35(1)	34°43.00	06°17.085
	61(2)	34°45.007	06°24.340
	797,2(3)	34°57.377	06°24.187
	719(4)	34°57.196	06°24.233
Tolga	172	34°44.210	05°27.106
Haouch	-26,7	34°32.481	06°04.483
Sidi okba	59(1)	34°45.534	05°52.319
	31,2(2)	34°43.344	05°55.157
Sidi Khilil	93, 4	34°50.182	05°52.482

3. Results

Fourteen species belonging to six genera of Aphidiinae were reared from 24 aphid species occurring on 32 host plant species and identified. Sixty parasitoid-aphid-plant associations were recorded (Table2). Most species recorded in Biskra province were already reported by [8],[9]. Some differences in morphological characters for collected species in Biskra province were found. Below, the parasitoid species are listed, along with their aphid and host plants collecting locality, date and number of specimens (spns.)

Parasitoid-Aphid-Plant Associations

1. *Aphidius eadyi* (Stary, González & Hall 1980)

Acyrtosiphon pisum Harris on *Medicago polymorpha*, **Ain Naga** (28/II/2010), 01(♀♀) spn.

2. *Aphidius ervi* Haliday 1834

Acyrtosiphon pisum Harris on *Hydesarum carnosum*.

Drouaa (1), (21/III/2014), 02(♂♂) spns. **Guadila**, (05/V/2012), 9(♀♀) spns. **Sidi Khilil**, (21/III/2014), 02(♀♀) spns; on *Malva parviflora*. **M'ziraa** (1), (23/III/2009), 05(2♀♀, 3♂♂) spns. **Doucen**, (4/IV/2014), 01(♀♀) spn; on *Medicago laciniata*, **Djemmora**(1), (28/III/2014), 04(2♀♀, 2♂♂) spns; on *Chenopodium murale*. **Sidi Khilil**, (21/III/2014), 01(♀♀) spn.

Aphis craccivora Koch on *Medicago polymorpha*. **M'ziraa** (1), (28/II/2010), 03(♂♂) spns.

Lipaphis pseudo brassicae Davis on *Diplotaxis harra*. **Haouch**, (17/II/2012), 02 (♀♀) spns.

Myzus persicae Sulzer on *Sinapis arvensis*. **M'ziraa** (1), (28/II/2010), 09 (6♀♀, 3♂♂) spns.

Unknown aphid on *Centaurea* sp1. **Sidi okba (1)**, (28/II/2010), 01(♂♂) spn.

3. *Aphidius funebris* Mackauer 1961

Aphis fabae Scopoli on *Silybum marianum*. **Biskra center (1)**, (25/IV/2009), 01(♀♀) spn.

Uroleucon sonchi (L.) on *Sonchus oleraceus*. **Fliche, (6. IV.2009)**, 03(2♀♀, 1♂♂) spns. **Sidi okba(1)**, (23.II.2010), 05(4♀♀, 1♂♂) spns and (28.II.2010) with 15(9♀♀, 6♂♂). **M'ziraa(1)**, 28 (21♀♀, 7♂♂) spns; on *Sonchus asper*. **Guarta, (07.II.2014)**, 06(4♀♀, 2♂♂) spns. **Ghrouss (22.III.2014)**, 03(♀♀) spns. **Doucen, (4.IV.2014)**, 02(1♀♀, 1♂♂) spns.

4. *Aphidius matricariae* Haliday 1834

Acyrtosiphon gossypii Mordvilko on *Peganum harmala*. **El hadjb, (9/III/2013)**, 02(1♀♀, 1♂♂) spns.

Aphis craccivora Koch on *Hydesarum carnosum*. **Biskra center (2)**, (23/II/2010), 01(♂♂) spn; on *Medicago polymorpha*. **Biskra center (3)**, (28/II/2010), 03(2♀♀, 1♂♂) spns.

Brachycaudus helichrysi (Kaltenbach) on *Calendula aegyptica*. **Khanget, (11/IV/2014)**, 12(8♀♀, 4♂♂) spns; on *Carduus pycnocephalus*. **Doucen, (4/IV/2014)**, 44(24♀♀, 20♂♂) spns.

Brevicoryne brassicae (L.) on *Diplotaxis harra*. **Haouch, (21/II/2014)**, 1(♂♂) spns.

Capitophorus eleagni (del Guercio) on *Silybum marianum*. **Guarta (2)**, (08/II/2010) 28(17♀♀, 11♂♂) spns.

Dysaphis foeniculus (Theobald) mixed with *Cavariella aegopodii* (Scopoli) on *Daucus carotta*. **Sidi okba (2)**, (8/III/2014), 1(♂♂) spn.

Hyperomyzus lactucae (L.) on *Sonchus asper*. **Sidi Khilil, (21/II/2014)**, 01(♀♀) spn.

Lipaphis pseudo brassicae Davis on *Diplotaxis harra*. **Haouch, (17/II/2012)**, 01(♂♂) spn.

Myzus persicae Sulzer on *Cleom arabica*. **Doucen, (4/IV/2014)**, 05(2♀♀, 3♂♂) spns; on *Phalaris brachystachys*. **El hadjb, (9/III/2013)**, 01 (♀♀) spn; on *Sinapis arvensis*. **M'ziraa (1)**, (28/II/2010), 4(2♀♀, 2♂♂) spns; on *Papaver rhoeas*. **Fliach, (06/IV/2009)** 22(11♀♀, 11♂♂) spns; on *Malva parviflora*. **Ain Naga, (06/IV/2009)**, 28(16♀♀, 12♂♂) spns and (24/III/2009) with 4(♂♂) spns; on *Diplotaxis harra*. **Haouch, (21/II/2014)**, 01(♂♂) spn.

Rhopalosiphum maidis (Fitch) on *Diplotaxis harra*. **M'ziraa (1)**, (06/II/2013), 03(1♀♀, 2♂♂) spns; on *Hordeum vulgare*. **El hadjb, (9/IV/2013)**, 22(14♀♀, 8♂♂) spns.

Rhopalosiphum padi (L.) on *Malva parviflora*. **Ain Naga, (24/III/2009)**, 21(9♀♀, 12♂♂) spns; **El hadjb, (17/II/2013)**, 15(9♀♀, 6♂♂) spns; on *Melilotus infesta*. **Foughala, (17/II/2013)**, 47(34♀♀, 13♂♂) spns.

Unknown aphid on *Centaurea* sp1. **Sidi okba(1)**, (28/II/2010), 05(3♀♀, 2♂♂) spns.

Unknown aphid on *Silybum marianum*. **M'ziraa (2)**, (9/III/2012), 02 (1♀♀, 1♂♂) spns.

Unknown aphid on *Cynoglossum cheirifolium*. **Djemmora (1)**, (28/III/2014), 03 (2♀♀, 1♂♂) spns.

5. *Aphidius rhopalosiphii* De Stefani-Pérez 1902

Rhopalosiphum padi (L.) on *Malva parviflora*. **Ain Naga, (24/III/2009)**, 01(♂♂) spns.

6. *Binodoxys acalephae* (Marshall 1896)

Acyrtosiphon pisum Harris on *Medicago polymorpha*. **Biskra center (3)**, (28/II/2010), 02 (♂♂) spns.

Hyadaphis coriandri (Das) on *Coriandrum sativum*. **Guarta(2)**, (07/II/2014), 02 (♀♀) spns.

7. *Binodoxys* sp

Dysaphis foeniculus (Theobald) on *Ferula* sp. **Tolga, (24/III/2012)**, 03 (♀♀) spns.

8. *Diaeretiella rapae* (M'Intosh 1855)

Brachycaudus helichrysi (Kaltenbach) on *Calendula aegyptica*. **Khanget, (11.IV.2014)**, 2(♀♀) spns.

Brevicoryne brassicae (L.) on *Moricandia arvensis*. **Biskra center(4)**, (23/III/2009)

61(36♀♀, 25♂♂) spns, (25/IV/2009) with 3 (2♀♀, 1♂♂) spns, (10.V.2009) with 14(4♀♀, 10♂♂) spns and (28/II/2009) with 3 (2♀♀, 1♂♂). On *Diplotaxis harra*. **Haouch, (21/II/2014)**, 2 (♀♀) spns.

Myzus persicae (Sulzer) on *Malva parviflora*. **Ain Naga, (24/III/2009)**, 05(1♀♀, 4♂♂) spns. **M'ziraa (1)**, (24.III.2009), 22(11♀♀, 11♂♂) spns.

Unknown aphid on *Iberis odorata*. **El Outaya, (28/III/2014)**, 1(♂♂) spn.

9. *Lysiphlebus confusus* Tremblay and Eady 1978

Aphis craccivora Koch on *Hydesarum carnosum*. **Guadila, (05/V/2012)**, 1(♀♀) spn.

10. *Lysiphlebus fabarum* (Marshall 1896)

Aphis brunnea Ferrari mixed with *Thrioaphis alatina* on *Ononis natrix*. **M'ziraa(3)**, (14/II/2014), 1(♀♀) spn.

Aphis craccivora Koch on *Hydesarum carnosum*. **Guadila, (05/V/2012)**, 4(♀♀) spns. **M'ziraa(2)**, (14/II/2014), 45 (♀♀) spns.

Aphis fabae Scopoli on *Silybum marianum*. **M'ziraa(2)**, (14/II/2014), 50(♀♀) spns

11. *Lysiphlebus testaceipes* (Cresson)

Acyrtosiphon gossypii Mordvilko mixed with *Aphis craccivora* Koch, *Aphis fabae* Scopoli and *Brachyunguis harmalae* Das on *Peganum harmala*. **Ain Zaatout, (21/5/2012)**, 2(♀♀) spns.

Aphis brunnea Ferrari mixed with *Thrioaphis alatina* Hille Ris Lambers and van den Bosch on *Ononis natrix*. **M'ziraa(3)**, (14/II/2014), 18 (10♀♀, 8♂♂) spns.

Aphis craccivora Koch on *Hydesarum carnosum*. **M'ziraa(2)**, (14/II/2014), 2(1♀♀, 1♂♂) spns.

Aphis fabae Scopoli on *Silybum marianum*. **M'ziraa(2)**, (14/II/2014), 44(19♀♀, 25♂♂) spns.

Aphis gossypii Glover on *Marubium vulgare*. **M'ziraa(4)**, (09/III/2012), 2(♀♀) spn.

Aphis nerii Boyer de Fonscolombe on *Nerium oleander*. **Djemmora(2)**, (05/V/2012), 4 (2♀♀, 2♂♂) spns. On *Pergularia tomentosa*. **Drouaa, (21/III/2014)**, 216(103♀♀, 113♂♂) spns.

Dysaphis foeniculus (Theobald) mixed with *Cavariella aegopodi* on *Daucus carotta*. **Sidi okba (2)**, (8/III/2014), 12(10♀♀, 2♂♂) spns.

Myzus persicae (Sulzer) on *Malva parviflora*. **Ain Naga, (24/III/2009)**, 2 (♀♀) spns.

12. *Praon volucre* (Haliday 1833)

Acyrtosiphon pisum Harris on *Malva parviflora*. **Biskra center(3)**, (28/II/2010), 1(♀♀) spn.

Hyperomyzus lactucae (L.) on *Sonchus asper*. **Sidi Khilil, (21/II/2014)**, 12 (10♀♀, 2♂♂) spns.

Myzus persicae (Sulzer) on *Malva parviflora*. **M'ziraa (1)**, (23/II/2010), 2(♀♀) spns.

Uroleucon sp on *Carduus pycnocephalus*. **Guarta (1)**, (07/II/2014), 1(♀♀) spn.

Unknown aphid on *Silybum marianum*. **M'ziraa (2)**, (9 /III /2012), 02 (♀♀) spns.

13. *Praon yomenae* Takada 1968

Acyrtosiphon pisum Harris on *Medicago polymorpha*. **Biskra center (3)**, (28/II/2010), 03 (♀♀) spns. **M'ziraa (1)**, (23/II/2010), 2(1♀♀, 1♂♂) spns. On *Phoenix dactylifera*, **Djammora (2)**, (28/III/2014), 1(♀♀) spns. ***Uroleucon jaceae* (L.)** on *Centaurea* sp2, **El Outaya** (28/III/2014), 2(1♀♀, 1♂♂) spns.

14. *Trioxys* sp.

***Hyadaphis coriandri* (Das)** on *Ammi visnaga*. **Khanget**, (11/IV/2014), 19 (7♀♀, 12♂♂) spns.

4. Discussion

Faunistics : The arid areas know a weak level of follow-up. With 14 species, this survey constitutes the first and most important contribution to the knowledge on Aphid parasitoid species diversity in southeastern of Algeria. The finding of a diverse parasitoid species and its associations is in accordance with complex habitats and vegetational structure of the investigated area. The aphid fauna of Biskra has known in contrast to that of the aphid antagonists.

The history of research on the aphid fauna has been summarized in two papers by [12, 13]. The relative data of aphids known includes 42 species. Four groups of host aphids were categorized in the area based on the range of associated plants and parasitoids: aphids that are rarely sampled and without any attacks of the parasitoids (*Anoecia corni*, *Aphis balloticola*, *Aphis brotericola*, *Aphis terricola*, *Clypeoaphis suaedae*), species with a single specialized parasitoid species (*Dysaphis foeniculus*), common aphids with a complex of specialized parasitoids (*Uroleucon*, *Acyrtosiphon*), and very common aphids associated with broadly polyphagous parasitoids species (*Aphis* sp). In general, however, polyphagism is prevalent. True monophagous and oligophagous aphids are comparatively less in number.

The Aphidiinae species determined in Biskra (*Aphidius eadyi*, *A. ervi*, *A. funebris*, *A. matricariae*, *A. rhopalosiphii*, *Binodoxys aculephae*, *Binodoxys* sp, *Diaeretiella rapae*, *Lysiphlebus confusus*, *L. fabarum*, *L. testaceipes*, *Praon volucre*, *P. yomenae*, *Trioxys* sp) occur not only in southern Europe but are broadly distributed in the Mediterranean region (for eastern Mediterranean see [8, 20, 22]).

Two species *A. matricariae* and *L. testaceipes* were found in association with more than 10 aphid species on several plants in various habitats. These species represent the most important aphid parasitoids in this province. Broadly, they are oligophagous species. *Aphidius matricariae* is active early in spring. In contrast *Lysiphlebus testaceipes* is often reported to be one of the most efficient parasitoids which is dominant later in the season. The identity of the dominant primary parasitoid species differed between seasons and years. This should have large implications for biological control. Parasitoids that are active early in the year are important for maintaining aphid densities at low levels [14]. Ecological theory predicts that insect diversity will increase with increasing vegetation diversity and structural complexity [19]. In contrast to this common theory, we found less number of interactions, mainly because of a lower number of unique interaction between aphid and parasitoid species. Host use by the main parasitoid species (*A. matricariae* and *L. testaceipes*) in this province included larger proportions of present aphids.

There is an obvious paucity of species in parasitoid complexes identified in the present area of study as compared to those identified for other areas of Algeria. This phenomenon can be explained by the combination of a dry environment with the effect of human activities. On the other hand, [4] suggests that parasitoids may be able to adjust average attack rates on each aphid species to changes in aphid relative abundances, by favouring the dominant species, and keeping vulnerability of aphids constant across landscape.

Diaeretiella rapae is considered a specialist on aphids associated with crucifer [1], being reported in Biskra as the main parasitoid of *Brevicoryne brassicae*, *Brachycaudus helichrysi* and *M. persicae* Table (2). It also occurs associated with other species of aphids in different crops and it is distributed in several states in Algeria [11]. The species *L. fabarum* and *B. aculephae* were oligophagous species as well as *A. ervi*, *P. yomenae* and *P. volucre*. Such findings were already indicated in other parts of the country [10]. In addition, among aphid parasitoids, *Lysiphlebus fabarum* was found rarely and it is the first time for the presence of *Binodoxys* sp in Biskra (Algeria), parasitizing the aphid *Dysaphis foeniculus* (Theobald) on *Ferula* sp (Apiaceae = Umbelliferae). Our data indicates that *Binodoxys* sp was associated with aphids on *Ferula* sp during mainly the flowering period of the plant. Some parasitoid species were not identified to species level, they require further special taxonomic treatment.

It should be noted that the species of parasitoids identified in the present study on the aphids are in the most an important parasitoids of a number of aphid pests in several cultivated plants. In natural areas, these parasitoids may parasitize economically unimportant aphid species from where they may disperse to the neighboring crops and parasitize target aphid pests there [16, 17, 7] and the alternation of two or more host aphid species by a parasitoid may have a higher or lower effect on the intra-population composition.

Host-plants : From an analysis of The results of the present study it is clear that The Asteraceae and the Fabaceae constituted the families with the largest number of associated aphid –parasitoid species, they included 11 species of plants ; their aphids belong to the genera : *Brachycaudus*, *Uroleucon*, *Hyperomyzus*, *Capitophorus* and *Aphis*.

Most of plants species mentioned as alternative host of aphids and parasitoids in the non-cultivated habitat co-exist with crop species. This, together with the flexible phenology of most of the crop species should allow non-cultivated plant species to be effectively used as alternative host for aphids and their parasitoids. It is concluded that we accumulate knowledge regarding alternative hosts of parasitoids of pest aphids, we will be better able to incorporate agroecological strategies to optimize natural pest-control.

The biodiversity of Aphidiinae has been less studied in this region and there is no complete information on this valuable group. However, some habitats in various parts of the province have not been visited in detail till now. It is expected that more species are present in the region.

Probably with more extensive investigations, the number of species in the future checklists will increase and even new species and/or new records for Biskra province and Algeria may be added.

Table 2: List of plants families and species with associated aphid-parasitoid from Biskra province.

Host family (plant)	Host plant /aphid	Associated parasitoid species	
Asteraceae	<i>Calendula aegyptica / Brachycaudus helichrysi</i>	<i>Diaeretiella rapae</i> <i>Aphidius matricariae</i>	
	<i>Carduus pycnocephalus/ Brachycaudus helichrysi</i>	<i>Aphidius matricariae</i>	
	<i>Carduus pycnocephalus/ Uroleucon sp</i>	<i>Praon volucre</i>	
	<i>Centaurea sp2 / Uroleucon jaceae</i>	<i>Praon yomenae</i>	
	<i>Sonchus asper / Hyperomyzus lactucae</i>	<i>Aphidius matricariae</i> <i>Praon volucre</i>	
	<i>Sonchus asper / Uroleucon sonchi</i>	<i>Aphidius funebris</i>	
	<i>Sonchus oleraceus / Uroleucon sonchi</i>	<i>Aphidius funebris</i>	
	<i>Silybum marianum / Aphis fabae</i>	<i>Aphidius funebris</i>	
	<i>Silybum marianum / Aphis fabae</i>	<i>Lysiphlebus fabarum</i> <i>Lysiphlebus testaceipes</i>	
	<i>Silybum marianum / Capitophorus eleagni</i> <i>Silybum marianum / Uncknown aphid</i>	<i>Aphidius matricariae</i> <i>Praon volucre</i> <i>Praon yomenae</i>	
Fabaceae	<i>Centaurea sp1 /Uncknown aphid</i> <i>Medicago polymorpha (Fabaceae) / Acyrthosiphon pisum</i>	<i>Aphidius ervi</i> <i>Aphidius eadyi</i> <i>Binodoxys acalephae</i> <i>Lysiphlebus fabarum</i> <i>Lysiphlebus testaceipes</i> <i>Lysiphlebus confusus</i> <i>Aphidius matricariae</i> <i>Lysiphlebus fabarum</i> <i>Lysiphlebus testaceipes</i>	
	<i>Hydesarum carnasum / Aphis craccivora</i>	<i>Aphidius matricariae</i> <i>Aphidius ervi</i>	
	<i>Ononis natrix / Aphis brunnea +Thrioaphis alatina</i>	<i>Aphidius matricariae</i> <i>Lysiphlebus testaceipes</i>	
	<i>Melilotus infesta / Rhopalosiphum padi</i> <i>Hydesarum carnasum / Acyrthosiphon pisum</i> <i>Medicago laciniata/ Acyrthosiphon pisum</i> <i>Medicago polymorpha (Fabaceae) / Aphis craccivora</i> <i>Cleome Arabica (Capparidaceae) / Myzus persicae</i>	<i>Aphidius matricariae</i> <i>Aphidius ervi</i> <i>Aphidius ervi</i> <i>Aphidius ervi</i> <i>Aphidius matricariae</i>	
	Capparidaceae	<i>Iberis odorata / Uncknown aphid</i>	<i>Diaeretiella rapae</i>
		<i>Moricandia arvensis / Brevicoryne brassicae</i>	<i>Diaeretiella rapae</i>
	Brassicaceae	<i>Diplotaxis harra / Brevicoryne brassicae</i>	<i>Diaeretiella rapae</i>
		<i>Diplotaxis harra / Rhopalosiphum maidis</i>	<i>Aphidius matricariae</i>
		<i>Diplotaxis harra / Lipaphis pseudo brassicae</i>	<i>Aphidius matricariae</i>
		<i>Sinapis arvensis / Myzus persicae</i> <i>Diplotaxis harra / Myzus persicae</i>	<i>Aphidius matricariae</i> <i>Aphidius matricariae</i>
Umbelliferae	<i>Ammi visnaga / Hyadaphis coriandri</i> <i>Daucus carota / Dysaphis foeniculus +Cavariella aegopodi</i> <i>Ferula sp / Dysaphis foeniculus</i> <i>Coriandrum sativum / Hyadaphis coriandri</i>	<i>Trioxyx sp</i> <i>Lysiphlebus testaceipes</i> <i>Binodoxys sp</i> <i>Binodoxys acalephae</i>	
	Poaceae	<i>Hordeum vulgare / Rhopalosiphum maidis</i> <i>Phalaris brachystachys / Myzus persicae</i>	<i>Aphidius matricariae</i> <i>Aphidius matricariae</i>
		Apocynaceae	<i>Nerium oleander / Aphis nerii</i> <i>Pergularia tomentosa/ Aphis nerii</i>
Malvaceae	<i>Malva parviflora / Myzus persicae</i>		<i>Praon volucre</i> <i>Lysiphlebus testaceipes</i>
	<i>Malva parviflora / Rhopalosiphum padi</i>	<i>Diaeretiella rapae</i> <i>Aphidius rhopalosiphi</i> <i>Aphidius matricariae</i> <i>Aphidius ervi</i>	
	<i>Malva parviflora / Acyrthosiphon pisum</i>		
Lamiaceae	<i>Marubium vulgare / Aphis gossypii</i>	<i>Lysiphlebus testaceipes</i>	
Papaveraceae	<i>Papaver rhoeas / Myzus persicae</i>	<i>Aphidius matricariae</i>	
Chenopodiaceae	<i>Chenopodium murale/ Acyrthosiphon pisum</i>	<i>Aphidius ervi</i>	
Boraginaceae	<i>Cynoglossum cheirifolium / Uncknown aphid</i>	<i>Aphidius matricariae</i>	
Arecaceae	<i>Phoenix dactylifera / Acyrthosiphon pisum</i>	<i>Praon yomenae</i>	
Zygophyllaceae	<i>Peganum harmala / Acyrthosiphon gossypii +Aphis craccivora+Aphis fabae +Brachyunguis harmalae</i> <i>Peganum harmala / Acyrthosiphon gossypii</i>	<i>Lysiphlebus testaceipes</i> <i>Aphidius matricariae</i>	

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