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APHIDIID WASPS (HYMENOPTERA, APHIDIIDAE) PARASITIZING APHIDS ON HERBACEOUS LEGUMES (FABACEAE) IN THE CENTRAL WOOD-AND-STEPPE ZONE OF UKRAINE

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Aphidiid Wasps (Hymenoptera, Aphidiidae) Parasitizing Aphids on Herbaceous Legumes (Fabaceae) in the Central Wood-and-Steppe Zone of Ukraine. Kaliuzhna M. O., Zubenko O. G. — Species composition and host associations of the aphidiid wasps infesting aphids in Kyiv, Cherkasy, Poltava and Kirovohrad Regions of the Central Wood-and-Steppe Zone of Ukraine were studied during 2010–2011, mainly on meadows. Nine species of aphids were found on 36 plant species, of them 7 species were infested by aphidiids. Six species of parasites were reared: *Lysiphlebus fabarum* (Marshall), *L. confusus* Tremblay et Eady, *L. fritzmuelleri* Mackauer, *Lipolexis gracilis* Förster, *Binodoxys acalephae* (Marshall), *B. angelicae* (Haliday). The most widespread species were *L. fabarum* and *L. confusus*. The rate of aphids colony infestation according to weather conditions and association with host plants are discussed. An illustrated key to the found species is given.

Key words: aphidiids, aphid parasites, Aphidoidea, Aphidiidae, Fabaceae, Ukraine, Wood-and-Steppe.

Афидииды (Hymenoptera, Aphidiidae) — паразиты тлей на травянистых бобовых растениях (Fabaceae) Центральной Лесостепи Украины. Калужная М. А., Зубенко О. Г. — Установлены видовой состав и трофические связи афидиид (паразитов тлей) на травянистых бобовых растениях в Центральной Лесостепи Украины на территории Киевской, Черкасской, Полтавской и Кировоградской областей. Материал собран в 2010–2011 гг. в основном на луговой растительности. На 36 видах растений было выявлено 9 видов тлей, 7 из которых были заражены афидидами. Всего было выведено 6 видов паразитов: *Lysiphlebus fabarum* (Marshall), *L. confusus* Tremblay et Eady, *L. fritzmuelleri* Mackauer, *Lipolexis gracilis* Förster, *Binodoxys acalephae* (Marshall), *B. angelicae* (Haliday). Наиболее массовыми видами оказались *L. fabarum* и *L. confusus*. Обсуждается доля зараженности колоний тлей в зависимости от погодных условий и приуроченности к кормовым растениям. Приведена таблица для определения видов выявленных афидиид.

Ключевые слова: афидииды, паразиты тлей, Aphidoidea, Aphidiidae, Fabaceae, Украина, Лесостепь.

Introduction

Herbaceous legumes (Fabaceae) occur in many biocoenoses such as forests, meadows and steppe plant associations in the Wood-and-Steppe Zone of Ukraine. Large areas are used for planting legumes such as peas, vetch, lupine, and perennial legumes as clover, sweet clover, alfalfa, and sainfoin. The main pests of the legume crops and wild plants species are the aphids: *Acyrtosiphon pisum* (Harris), *Aphis craccivora* Koch, *Aphis fabae* Scopoli, *Megoura viciae* Buckton, *Therioaphis trifolii* (Monell). These species of aphids can cause serious damage to the shoots, shrinkage and reduction of the crop yield (Mamontova, 1987; Petrukha et al., 1989; Gorbach et al., 1989).

Parasitic wasps of the family Aphidiidae are among the natural enemies of aphids. Aphidiidae is the family of specialized aphid endoparasites effectively regulating aphid population in natural ecosystems and in agricultural landscapes; they are biocontrol agents of many pest species (Starý, 1970; Shyiko et al., 1991; Kavallieratos et al., 2010). Starý (1965), Adashkevich (1972), Kierych (1975), Tobias, Chiriach (1986), Kavallieratos et al. (2004), Starý (2006), Starý, Lukáš (2009) provided the data on Aphidiidae parasitizing aphids found on herbaceous legumes in different parts of Europe. There is no detailed information available for Ukraine (Kaliuzhna, 2010). Some papers (Telenga, 1950; Starý, 1965; Tobias, Chiriach, 1986) contain fragmentary or very common data on the host-parasite relationships for aphidiids with the species of aphids.

Material and methods

The material of parasites used in this paper, unless otherwise indicated, was collected by O. G. Zubenko, and identified by M. O. Kaliuzhna. Parasites were reared from the infested aphids collected in the field in 2010–2011 in Kyiv, Cherkasy, Poltava, and Kirovohrad Regions. Samples were taken mostly from plants collected in upland and steppified meadows, and occasionally on the vegetation of lowland and floodplain meadows, forest edges and clearings. Altogether, 86 samples of parasitized aphid colonies were taken from 36 species of herbaceous legumes. Each sample, which includes the mummified aphids and parts of the host plants, was placed in a ventilated container with photoelecting for emerging of parasites. Samples of aphid hosts and their host plants were taken also for further identification. Percentage of infestation by aphidiids was calculated for each colony. The number of samples, host plants species and aphidiid species emerged from each host aphids species are given in table 1. Morphological features were examined on temporary slides, and pictures were taken under Olympus CX41 microscope with mounted camera Olympus C3040. The morphological terminology for parasitoids follows U. Gärdenfors (1986). The material is deposited in the collection of Schmalhausen Institute of Zoology, National Academy of Science, Kyiv, Ukraine (SIZK).

Results

Six species of aphidiids were reared: *Lysiphlebus confusus* Tremblay et Eady, 1978; *L. fabarum* (Marshall, 1896); *L. fritzmulleri* Mackauer, 1960; *Binodoxys acalephae* (Marshall, 1896); *B. angelicae* (Haliday, 1833); *Lipolexis gracilis* Förster, 1862. They infested seven of the nine aphids species found in the Region of studies (table 1).

Reared species of aphidiids

Material is sorted according to host aphids, and then to aphids host plants, and geographic location. Such structure corresponds with table 2. Abbreviations of habitat types: UM — upland meadows, SM — steppified meadows, LM — lowland meadows, and FM — floodplain meadows, FE — forest edge, FEC — forest edges and clearings.

Lysiphlebus confusus Tremblay et Eady, 1978

Material. **From *Aphis craccae***: on *Lathyrus palustris*: Cherkasy Region: Kaniv Distr.: Mezhyrich, UM, 6.09.2011, 2 ♀, 3 ♂; on *Lathyrus pratensis*: Mezhyrich, UM, 29.06.2010, 5 ♂; Kaniv, UM, 6.09.2011, 2 ♀, 2 ♂; on *Vicia cracca*: Chyhyryn Distr.: Melnyky, UM, 03.07.2010, 9 ♂; Melnyky, UM, 15.07.2011, 4 ♀, 1 ♂; on *Vicia sepium*: Melnyky, UM, 16.07.2011, 1 ♀, 2 ♂; on *Vicia sylvatica*: Horodyshe Distr.: Buda-Orlovetska, 4.08.2011, 1 ♂; on *Vicia villosa*: Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 1 ♂. **From *Aphis craccivora***: on *Anthyllis alpestris*: Kirovohrad Region: Oleksandrivka Distr.: Pidlisne, 5.07.2010, 17 ♂; on *Astragalus arenarius*: Cherkasy

Table 1. Aphids parasitisation by aphidiids in the Central Wood-and-Steppe Zone of Ukraine

Таблица 1. Зараженность тлей афидидами на травянистых бобовых растениях Центральной Лесостепи Украины

Aphids	Ns	Np	Aphid parasites						Total
			LF	LC	BAC	BAN	LG	LFR	
<i>Aphis craccae</i>	14	7	+	+	+	+	+	+	6
<i>A. craccivora</i>	44	20	+	+	+	+	+	–	5
<i>A. fabae</i>	20	14	+	+	+	+	+	–	5
<i>Aphis</i> sp.	3	3	+	–	–	–	–	–	1
<i>Acyrtosiphon pisum</i>	1	1	+	–	–	–	–	–	1
<i>Acyrtosiphon</i> sp.	1	1	+	–	–	–	–	–	1
<i>Macrosiphum albifrons</i>	1	1	+	–	–	–	–	–	1
<i>Aphis confusa</i>	1	1	–	–	–	–	–	–	0
<i>Brachycaudus</i> sp.	1	1	–	–	–	–	–	–	0
Total	86	36	7	3	3	3	3	1	

Note. Ns — number of samples, Np — number of host plant species, LF — *Lysiphlebus fabarum*, LC — *L. confusus*, BAC — *Binodoxys acalephae*, BAN — *B. angelicae*, LG — *Lipolexis gracilis*, LFR — *Lysiphlebus fritzmulleri*.

Region: Chornobai Distr.: Krutky, SM, 25.06.2010, 3 ♂; Zolotonosha Distr.: Chapaievka, 25.05.2011, 2 ♂; Cherkasy Distr.: Yasnoziryia, FE, 2.08.2011, 1 ♀, 1 ♂; on *Astragalus glycyphyllos*: near Cherkasy, pine forest, FEC, 18.06.2010, 4 ♂; Katerynopil Distr.: Kyselivka, UM, 9.07.2011, 1 ♀, 1 ♂; on *Astragalus onobrychis*: near Cherkasy, pine forest, FEC, 18.06.2010, 4 ♂; Drabiv Distr.: Boikivschyna, UM, 12.08.2011, 2 ♀, 1 ♂; on *Coronilla varia*: Chyhyryn Distr.: Subotiv, UM, 30.06.2010, 3 ♂; Melnyky, UM, 26.06.2011, 8 ♀, 12 ♂; Korsun-Shevchenkivskiy Distr.: Drabivka, UM, 2.08.2011, 1 ♂; on *Genista tinctoria*: Zolotonosha Distr.: Korobivka, SM, 22.06.2011, 1 ♂; on *Lotus corniculatus*: Kyiv Region: Kyiv, Teremky, FEC, 15.07.2010, 1 ♂ (M. Kaliuzhna); on *Lotus ucrainicus*: Kirovograd Region: Oleksandrivka Distr.: Pantaivka, motley grasses, 15.07.2010, 9 ♀, 36 ♂; Cherkasy Region: Chyhyryn Distr.: Melnyky, UM, 16.07.2011, 2 ♀, 10 ♂; on *Medicago lupulina*: Melnyky, UM, 26.06.2011, 9 ♂; on *Medicago falcata*: Melnyky, UM, 7.07.2010, 12 ♂; Melnyky, UM, 26.06.2011, 1 ♀, 9 ♂; Melnyky, UM, 20.06.2011, 3 ♀, 13 ♂; on *Medicago sativa*: Melnyky, UM, 18.08.2010, 10 ♂; Melnyky, UM, 20.06.2011, 2 ♂; Zolotonosha Distr.: Pishchane, ecotone between floodplain and UM, 5.08.2011, 5 ♂; on *Melilotus albus*: Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 2 ♀, 1 ♂; Melnyky, motley grasses, 20.09.2010, 13 ♀, 34 ♂; on *Melilotus officinalis*: Melnyky, UM, 2.07.2010, 2 ♂; on *Onobrychis viciifolia*: Kirovograd Region: Svitlovodsk Distr.: Pavlivka, small flat-bottom valleys, 15.07.2010, 5 ♀, 42 ♂; Poltava Region: Myrhorod Distr.: Zubivka, UM, 2.07.2010, 4 ♂; Pyriatyn Distr.: Oleksiivka, UM, 9.07.2010, 2 ♂; Cherkasy Region: Chyhyryn Distr.: Melnyky, UM, 11.07.2011, 10 ♂; on *Trifolium alpestre*: Holovkivka, UM, 8.07.2010, 4 ♂; Melnyky, UM, 30.06.2011, 2 ♀, 2 ♂; on *Trifolium arvense*: Kirovograd Region: Svitlovodsk Distr.: Velyka Andrusivka, 10.07.2010, 5 ♀, 23 ♂; Poltava Region: Pyriatyn Distr.: Oleksiivka, UM, 9.07.2010, 5 ♂; Cherkasy Region: Chyhyryn Distr.: Melnyky, UM, 30.06.2011, 3 ♀, 6 ♂; on *Trifolium rubens*: Holovkivka, UM, 8.07.2010, 3 ♂; Smila Distr.: Nosachiv, UM, 6.07.2011, 1 ♀, 2 ♂; Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 1 ♂. **From *Aphis fabae***: on *Coronilla varia*: Cherkasy Region: Korsun-Shevchenkivskiy Distr.: Drabivka, UM, 28.06.2010, 2 ♂; Zvenyhorod Distr.: Tarasivka, UM, 11.07.2011, 2 ♂; on *Genista tinctoria*: Zolotonosha Distr.: Korobivka, SM, 22.06.2011, 3 ♂; Cherkasy Distr.: Moshny, FE, 3.08.2011, 2 ♂; on *Lathyrus pratensis*: Kaniv Distr.: Mezhyrich, UM, 29.06.2010, 4 ♂; on *Lathyrus tuberosus*: near Cherkasy (Dakhnivka), 19.06.2010, 2 ♂; Talne Distr.: Maidanetske, UM, 17.08.2011, 2 ♀; on *Lathyrus vernus*: Sokolivochka, UM, 17.08.2011, 1 ♂; on *Lupinus polyphyllus*: Zolotonosha Distr.: Korobivka, SM, 22.06.2011, 2 ♂; on *Medicago romanica*: Chyhyryn Distr.: Melnyky, UM, 20.06.2011, 17 ♂; on *Medicago sativa*: Zolotonosha Distr.: Pishchane, ecotone between floodplain and UM, 1.07.2010, 2 ♂; Pishchane, UM, 5.08.2011, 2 ♂; on *Trifolium arvense*: Kamianskyi Distr.: Mykhailivka, UM, 1.07.2010, 3 ♂; Smila Distr.: Sunky, UM, 6.07.2011, 1 ♂; on *Trifolium medium*: Chyhyryn Distr.: Melnyky, UM, 8.07.2010, 7 ♂; Melnyky, UM, 10.07.2011, 5 ♂; on *Trifolium montanum*: Kamianskyi Distr.: Kosari, SM, 3.07.2011, 2 ♀, 3 ♂; on *Trifolium spadiceum*: Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 1 ♀, 5 ♂; on *Vicia hirsuta*: Kaniv Distr.: Yablunivka, UM, 23.08.2011, 2 ♀; on *Vicia villosa*: Korsun-Shevchenkivskiy Distr.: Vyhraiv, UM, 2.08.2011, 1 ♂.

Specialization. Wide oligophagous¹.

Hosts. Mostly aphid species of the genera *Aphis*, and also *Brachycaudus*, *Brachyunguis*, *Cryptosiphum*, *Hydaphias*, *Macrosiphoniella*, *Melanaphis*, *Phorodon*, *Toxoptera*, and *Uroleucon* (Tobias, Chiriach, 1986; Davidyan, 2007).

Habitat. Forest, wood-and-steppe, steppe. Found in all studied localities.

Distribution. Ukraine (throughout). — Europe; Turkey, Iran, Lebanon, Israel; China, India.

Results of rearing. The second abundant species; specimens (mostly males) of *L. confusus* emerged from 65 (75.6 %) samples, from three aphid species; commonly occurring together with *L. fabarum*.

Lysiphlebus fabarum (Marshall, 1896)

Material. From *Acyrtosiphon pisum*: on *Medicago sativa*: Cherkasy Region: Chyhyryn Distr.: Melnyky, motley grasses, 6.07.2011, 5 ♀. From *Acyrtosiphon* sp.: on *Onobrychis viciifolia*: Melnyky, motley grasses, 13.07.2011, 3 ♀. From *Aphis cracciae*: on *Lathyrus palustris*: Kaniv Distr.: Mezhyrich, UM, 29.06.2010, 7 ♀; Mezhyrich, UM, 6.09.2011, 4 ♀; on *Lathyrus pratensis*: Kaniv, UM, 6.09.2011, 10 ♀; Mezhyrich, UM, 29.06.2010, 11 ♀; on *Vicia cracca*: Kyiv Region: Kyiv, isl. Muromets, park "Druzhby narodiv", 22.06.2011, 9 ♀ (M. Kaliuzhna); Cherkasy Region: Chyhyryn Distr.: Melnyky, UM, 03.07.2010, 6 ♀; Melnyky, UM, 15.07.2011, 2 ♀; Medvedivka, FM, 4.08.2011, 3 ♀; on *Vicia sepium*: Melnyky, UM, 16.07.2011, 2 ♀; on *Vicia sylvatica*: Horodyshche Distr.: Buda-Orlovetska, 4.08.2011, 3 ♀; Chyhyryn Distr.: Melnyky, UM, 20.07.2011, 2 ♀; on *Vicia tetrasperma*: Kamianskyi Distr.: Mykhailivka, UM, 6.07.2011, 1 ♀; on *Vicia villosa*: Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 3 ♀. **From *Aphis craccivora***: on *Anthyllis alpestris*: Kirovohrad Region: Oleksandrivka Distr.: Pidlisne, 5.07.2010, 23 ♀; on *Anthyllis macrocephala*: Cherkasy Region: Chornobai Distr.: Krasenivka, UM, 12.08.2011, 2 ♀; on *Astragalus arenarius*: Krutky, SM, 25.06.2010, 7 ♀; Zolotonosha Distr.: Chapaievka, 25.05.2011, 4 ♀; Cherkasy Distr.: Yasnoziryia, FE, 2.08.2011, 3 ♀; on *Astragalus onobrychis*: near Cherkasy, pine forest, FEC, 18.06.2010, 1 ♀; Drabiv Distr.: Boikivschyna, UM, 12.08.2011, 3 ♀; on *Coronilla varia*: Chyhyryn Distr.: Subotiv,

¹ Classification into oligophagous, monophagous and polyphagous according to Davidyan (2009).

UM, 30.06.2010, 10 ♀; Korsun-Shevchenkivskiy Distr.: Drabivka, UM, 2.08.2011, 5 ♀; Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 12 ♀; on *Lotus ucrainicus*: Kirovograd Region: Oleksandrivka Distr.: Pantaivka, motley grasses, 15.07.2010, 45 ♀; Cherkasy Region: Chyhyryn Distr.: Melnyky, UM, 16.07.2011, 11 ♀; on *Medicago falcata*: Melnyky, UM, 7.07.2010, 7 ♀; Melnyky, UM, 26.06.2011, 1 ♀; on *Medicago lupulina*: Korsun-Shevchenkivskiy Distr.: Kirove, UM, 2.08.2011, 4 ♀; Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 2 ♀; on *Medicago sativa*: Melnyky, UM, 18.08.2010, 4 ♀; Melnyky, UM, 20.06.2011, 3 ♀; Zolotonosha Distr.: Pishchane, ecotone between floodplain and UM, 5.08.2011, 3 ♀; on *Melilotus albus*: Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 4 ♀; Melnyky, motley grasses, 20.09.2010, 24 ♀; on *Melilotus officinalis*: Melnyky, UM, 2.07.2010, 5 ♀; Melnyky, UM, 30.06.2011, 2 ♀; on *Onobrychis vicifolia*: Melnyky, UM, 11.07.2011, 17 ♀; Kirovograd Region: Svitlovodsk Distr.: Pavlivka, small flat-bottom valleys, 15.07.2010, 45 ♀; Poltava Region: Myrhorod Distr.: Zubivka, UM, 2.07.2010, 31 ♀; Pyriatyn Distr.: Oleksiivka, UM, 9.07.2010, 11 ♀; on *Trifolium alpestre*: Cherkasy Region: Chyhyryn Distr.: Holovkivka, UM, 8.07.2010, 5 ♀; Melnyky, UM, 30.06.2011, 6 ♀; on *Trifolium arvense*: Kirovograd Region: Svitlovodsk Distr.: Velyka Andrusivka, 10.07.2010, 24 ♀; Poltava Region: Pyriatyn Distr.: Oleksiivka, UM, 9.07.2010, 18 ♀; Cherkasy Region: Chyhyryn Distr.: Melnyky, UM, 30.06.2011, 1 ♀; on *Trifolium aureum*: Kamianskyi Distr.: Kosari, SM, 3.07.2011, 5 ♀; on *Trifolium repens*: Drabiv Distr.: Mekhedivka, LM, 12.08.2011, 2 ♀; Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 1 ♀; on *Trifolium rubens*: Holovkivka, UM, 8.07.2010, 2 ♀; Melnyky, UM, 26.06.2011, 2 ♀; Smila Distr.: Nosachiv, UM, 6.07.2011, 1 ♀. **From *Aphis fabae***: on *Coronilla varia*: Korsun-Shevchenkivskiy Distr.: Drabivka, UM, 28.06.2010, 5 ♀; Zvenyhorod Distr.: Tarasivka, UM, 11.07.2011, 2 ♀; on *Genista tinctoria*: Zolotonosha Distr.: Korobivka, SM, 22.06.2011, 1 ♀; Cherkasy Distr.: Moshny, FE, 3.08.2011, 4 ♀; on *Lathyrus pratensis*: Kaniv Distr.: Mezhyrich, UM, 29.06.2010, 10 ♀; on *Lathyrus tuberosus*: near Cherkasy (Dakhnivka), 19.06.2010, 5 ♀; Talne Distr.: Maidanetske, UM, 17.08.2011, 3 ♀; on *Lathyrus vernus*: Sokolivochka, UM, 17.08.2011, 3 ♀; on *Lupinus polyphyllus*: Zolotonosha Distr.: Korobivka, SM, 22.06.2011, 3 ♀; on *Medicago romanica*: Chyhyryn Distr.: Melnyky, UM, 20.06.2011, 6 ♀; on *Medicago sativa*: Zolotonosha Distr.: Pishchane, ecotone between floodplain and UM, 1.07.2010, 6 ♀; Pishchane, UM, 5.08.2011, 5 ♀; on *Trifolium arvense*: Kamianskyi Distr.: Mykhailivka, UM, 1.07.2010, 3 ♀; Smila Distr.: Sunky, UM, 6.07.2011, 3 ♀; on *Trifolium medium*: Chyhyryn Distr.: Melnyky, UM, 8.07.2010, 3 ♀; Melnyky, UM, 10.07.2011, 2 ♀; on *Trifolium montanum*: Kamianskyi Distr.: Kosari, SM, 3.07.2011, 2 ♀; on *Trifolium spadicum*: Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 6 ♀; on *Vicia hirsuta*: Kaniv Distr.: Yablunivka, UM, 23.08.2011, 2 ♀; on *Vicia villosa*: Korsun-Shevchenkivskiy Distr.: Vyhraiv, UM, 2.08.2011, 2 ♀. **From *Aphis* sp.**: on *Trifolium medium*: Chyhyryn Distr.: Melnyky, UM, 13.07.2011, 19 ♀; on *Trifolium pratense*: Kirivihrad Region: Oleksandrivka Distr.: Birky, FM, 2.07.2010, 7 ♀; on *Vicia sepium*: Cherkasy Region: Chyhyryn Distr.: Subotiv, UM, 7.07.2010, 2 ♀. **From *Macrosiphum albifrons***: on *Lupinus polyphyllus*: Kyiv Region: Pereyaslav-Khmelnitskyi Distr.: near Pereyaslav, UM, 28.07.2010, 3 ♀.

Specialization. Polyphagous.

Hosts. Many species of the genera *Aphis*, *Brachycaudus*, *Brachyunguis*, *Cavariella*, *Chaitophorus*, *Chromaphis*, *Dysaphis*, *Eriosoma*, *Hyalopterus*, *Hyperomyzus*, *Macchiatella*, *Melanaphis*, *Myzus*, *Pemphigus*, *Rhopalosiphum*, *Semiaphis*, *Sitobion*, *Tinocallis* (Tobias, Chiriac, 1986; Davidyan, 2007).

Habitat. Occurs in forest, wood-and-steppe, and steppe zones; recorded in all studied biotopes.

Distribution. Ukraine (throughout). — Palaearctics; India, Australia, introduced to North America.

Results of rearing. The most abundant species, reared from 77 (89.5 %) samples. *L. fabarum* has the widest range of studied hosts (7 species).

Lysiphlebus fritzmuelleri Mackauer, 1960

Material. **From *Aphis craccae***: on *Vicia cracca*: Cherkasy Region: Chyhyryn Distr.: Melnyky, UM, 15.07.2011, 1 ♂; Medvedivka, FM, 4.08.2011, 1 ♂.

Specialization. Monophagous.

Hosts. *Aphis craccae* on *Vicia cracca* (Tobias, Chiriac, 1986; our data), on *Vicia sepium* (Starý, Lukáš, 2009).

Habitat. Steppes and meadows (Starý, 1965). Found on floodplain meadows.

Distribution. Ukraine (Wood-and-Steppe Zone). — Europe; West Siberia; Kazakhstan.

Results of rearing. *L. fritzmuelleri* was recorded only 2 (2.3 %) samples and only on 1 host. Not numerous species reared from infested colonies together with *L. fabarum* and *L. confusus*.

Lipolexis gracilis Förster, 1862

Material. **From *Aphis craccae***: on *Vicia sylvatica*: Cherkasy Region: Horodyshe Distr.: Buda-Orlovetska, 4.08.2011, 1 ♂. **From *Aphis craccivora***: on *Medicago falcata*: Kamianskyi Distr.: Hrushkivka, SM, 3.07.2011, 1 ♀; on *Trifolium aureum*: Kosari, SM, 3.07.2011, 1 ♂. **From *Aphis fabae***: on *Genista tinctoria*: Cherkasy Distr.: Moshny, FE, 3.08.2011, 1 ♀.

Specialization. Polyphagous.

Hosts. Aphids of the genera *Aphis*, *Brachycaudus*, *Liosomaphis*, *Lipaphis*, *Myzus*, *Rhopalosiphum*, *Therioaphis*, *Toxoptera* (Davidyan, 2007).

Habitat. Steppes and meadows, rarely forest edges and gardens (Starý, 1965). Recorded by authors on the floodplain and edge of the forest.

Distribution. Ukraine (Wood-and-Steppe Zone). — Europe, Northern Africa, Near East, Middle Asia, Far East, Pakistan, India.

Results of rearing. *L. gracilis* reared from 4 (4.7 %) samples and three species of aphids. *L. gracilis* infested singular specimens of *A. craccae*, *A. craccivora*, and *A. fabae*. Usually occurs together with *L. fabarum*, *L. confusus* and with species of the genus *Binodoxys* (often with *B. acalephae*).

Binodoxys acalephae (Marshall, 1896)

Material. **From *Aphis craccae***: on *Vicia cracca*: Cherkasy Region: Chyhyryn Distr.: Medvedivka, FM, 4.08.2011, 1 ♀; on *Vicia sylvatica*: Melnyky, UM, 20.07.2011, 1 ♀, 1 ♂; on *Vicia tetrasperma*: Kyiv Region: Kyiv, Teremky, 15.07.2011, 1 ♀ (M. Kaliuzhna). **From *Aphis craccivora***: on *Medicago lupulina*: Cherkasy Region: Korsun-Shevchenkivskyi Distr.: Kirove, UM, 2.08.2011, 1 ♂; on *Medicago falcata*: Kamianskyi Distr.: Hrushkivka, SM, 3.07.2011, 1 ♂; on *Trifolium aureum*: Kosari, SM, 3.07.2011, 1 ♀; on *Trifolium repens*: Drabiv Distr.: Mekhedivka, LM, 12.08.2011, 1 ♀. **From *Aphis fabae***: on *Medicago romanica*: Chyhyryn Distr.: Melnyky, UM, 20.06.2011, 1 ♀, 1 ♂; on *Trifolium arvense*: Smila Distr.: Sunky, UM, 6.07.2011, 1 ♂; on *Vicia villosa*: Korsun-Shevchenkivskyi Distr.: Vyhraiv, UM, 2.08.2011: 1 ♂.

Specialization. Narrow oligophagous.

Hosts. Mainly aphid of genus *Aphis* (Tobias, Chiriac, 1986; Davidyan, 2007).

Habitat. Occurs everywhere, but mostly in the steppes and wood-and-steppes (Starý, 1965). In this study recorded from all types of meadows (upland, steppified, lowland, and floodplain).

Distribution. Ukraine (Wood-and-Steppe Zone); Russia, Georgia, Kazakhstan, Uzbekistan; Tajikistan; Turkey, Iran, Iraq; Mongolia, China; India; Canada.

Results of rearing. *B. acalephae* reared from 10 (11.6 %) samples, together with *L. fabarum*, *L. confusus*, and often with *L. gracilis* and *B. angelicae*.

Binodoxys angelicae (Haliday, 1833)

Material. **From *Aphis craccae***: on *Lathyrus palustris*: Cherkasy Region: Kaniv Distr.: Mezhyrich, UM, 6.09.2011, 2 ♀. **From *Aphis craccivora***: on *Medicago lupulina*: Chyhyryn Distr.: Melnyky, UM, 26.06.2011, 1 ♀; on *Trifolium repens*: Drabiv Distr.: Mekhedivka, LM, 12.08.2011, 1 ♀. **From *Aphis fabae***: on *Lathyrus tuberosus*: Talne Distr.: Maidanetske, UM, 17.08.2011, 1 ♂.

Specialization. Wide oligophagous.

Hosts. Species of the genera *Aphis*, *Ceruraphis*, *Dactynotus*, *Dysaphis*, *Myzodes*, *Myzus*, *Brachycaudus*, *Acyrtosiphon*, *Amphorophora*, *Cavariella*, *Uroleucon*, *Toxoptera* (Tobias, Chiriac, 1986; Davidyan, 2007).

Habitat. Forests, wood-and-steppes, garden and park edges (Starý, 1965). Species recorded for upland and lowland meadows.

Distribution. Ukraine (Wood-and-Steppe Zone). — Europe; Russia, Kazakhstan, Uzbekistan, Tajikistan; Near East; Pakistan, India, China; North Africa.

Results of rearing. *B. angelicae* reared from 4 (4.7 %) of samples. It occurs only with other species of Aphidiidae.

Table 2. Trophic associations of aphidiid wasps (Aphidiidae) parasitizing aphids on herbaceous legumes in the Central Wood-and-Steppe Zone of Ukraine

Таблица 2. Трофические связи афидиид — паразитов тлей на травянистых бобовых растениях Центральной Лесостепи Украины

Aphidiid species	Aphid species	Plant species
<i>Lysiphlebus confusus</i>	<i>Aphis craccae</i>	<i>Lathyrus palustris</i> <i>L. pratensis</i> <i>Vicia cracca</i> <i>V. sepium</i> <i>V. sylvatica</i> <i>V. villosa</i>
	<i>A. craccivora</i>	<i>Anthyllis alpestris</i> <i>Astragalus arenarius</i> <i>A. glycyphyllos</i> <i>A. onobrychis</i> <i>Coronilla varia</i> <i>Genista tinctoria</i> <i>Lotus corniculatus</i> <i>L. ucrainicus</i> <i>Medicago lupulina</i> <i>M. falcata</i> <i>M. sativa</i> <i>Melilotus albus</i> <i>M. officinalis</i> <i>Onobrychis viciifolia</i> <i>Trifolium alpestre</i> <i>T. arvense</i> <i>T. rubens</i>
	<i>A. fabae</i>	<i>Coronilla varia</i> <i>Genista tinctoria</i> <i>Lathyrus pratensis</i> <i>L. tuberosus</i> <i>L. vernus</i> <i>Lupinus polyphyllus</i> <i>Medicago romanica</i> <i>M. sativa</i> <i>Trifolium arvense</i> <i>T. medium</i> <i>T. montanum</i> <i>T. spadiceum</i> <i>Vicia hirsuta</i> <i>V. villosa</i>
<i>L. fabarum</i>	<i>Acyrtosiphon pisum</i>	<i>Medicago sativa</i>
	<i>Acyrtosiphon</i> sp.	<i>Onobrychis viciifolia</i>
	<i>Aphis craccae</i>	<i>Lathyrus palustris</i> <i>L. pratensis</i> <i>Vicia cracca</i> <i>V. sepium</i> <i>V. sylvatica</i> <i>V. tetrasperma</i> <i>V. villosa</i>
<i>A. craccivora</i>	<i>Anthyllis alpestris</i> <i>A. macrocephala</i> <i>Astragalus arenarius</i> <i>A. onobrychis</i> <i>Coronilla varia</i> <i>Lotus ucrainicus</i> <i>Medicago falcata</i> <i>M. lupulina</i> <i>M. sativa</i> <i>Melilotus albus</i> <i>M. officinalis</i> <i>Onobrychis viciifolia</i> <i>Trifolium alpestre</i> <i>T. arvense</i> <i>T. aureum</i> <i>T. repens</i> <i>T. rubens</i> <i>Coronilla varia</i> <i>Genista tinctoria</i> <i>Lathyrus pratensis</i> <i>L. tuberosus</i> <i>L. vernus</i> <i>Lupinus polyphyllus</i>	

Aphidiid species	Aphid species	Plant species
	<i>A. craccivora</i>	<i>Medicago romanica</i> <i>M. sativa</i> <i>T. arvense</i> <i>T. medium</i> <i>T. montanum</i> <i>T. spadicum</i> <i>Vicia hirsuta</i> <i>V. villosa</i>
	<i>Aphis</i> sp.	<i>Trifolium medium</i> <i>T. pratense</i> <i>Vicia sepium</i>
	<i>Macrosiphum albifrons</i>	<i>Lupinus polyphyllus</i>
<i>L. fritzmuelleri</i>	<i>Aphis craccae</i>	<i>Vicia cracca</i>
<i>Lipolexis gracilis</i>	<i>A. craccae</i> <i>A. craccivora</i>	<i>Vicia sylvatica</i> <i>Medicago falcata</i> <i>Trifolium aureum</i> <i>Genista tinctoria</i>
	<i>A. fabae</i>	
<i>Binodoxys acalephae</i>	<i>A. craccae</i>	<i>Vicia cracca</i> <i>V. sylvatica</i> <i>V. tetrasperma</i> <i>Medicago lupulina</i> <i>M. falcata</i> <i>Trifolium aureum</i> <i>T. repens</i> <i>Medicago romanica</i> <i>Trifolium arvense</i> <i>Vicia villosa</i>
	<i>A. craccivora</i>	
	<i>A. fabae</i>	
<i>B. angelicae</i>	<i>A. craccae</i> <i>A. craccivora</i>	<i>Lathyrus palustris</i> <i>Medicago lupulina</i> <i>Trifolium repens</i> <i>Lathyrus tuberosus</i>
	<i>A. fabae</i>	

Key to Species of Aphidiids Parasitizing Aphids on Herbaceous Legumes in the Central Wood-and-Steppe Zone of Ukraine

Таблица для определения видов афидиид — паразитов тлей на травянистых бобовых растениях Центральной Лесостепи Украины

1. Fore wing venation partly incomplete: discal and both submarginal cells are fused, m-cu vein absent, r-m vein developed, M vein almost all absent except under r-m vein (fig. 1, 1, 2). Propodeum without central areola, sometimes with small carinae divergent from apex (fig. 2, 1). Petiole widening to its apex, without central longitudinal carina, with mediobasal tubercle (fig. 3, 1). Ovipositor sheath short and wide (fig. 4, 1). 2.
- Venation of fore wings more reduced: r-m and M veins entirely absent (fig. 1, 3, 4). Propodeum with central areola (fig. 2, 2–4). Petiole with or without central longitudinal carina, without medial tubercle at base; slightly expanding, sometimes parallel-sided or slightly narrowing to its apex (fig. 3, 2–4). Ovipositor sheath relatively long and narrow (fig. 4, 2–4). 4.
2. Vein R1 shorter than stigma (fig. 1, 1). External margin of wing with long setae. *Lysiphlebus fritzmuelleri* Mackauer
- Vein R1 longer than stigma (fig. 1, 2). External margin of wing with long or short setae. 3.
3. External margin of wing with long setae, longer than setae on wing membrane *Lysiphlebus confusus* Tremblay et Eady
- External margin of wing with short, hardly visible setae, as long as setae on wing membrane (fig. 1, 2). *Lysiphlebus fabarum* (Marshall)
4. Last abdominal sternite with two appendages (prongs) (fig. 4, 3, 4). Ovipositor sheath with depression on ventral margin, which separates wide basal part from narrow apical, sheath apex rounded (fig. 4, 3, 4). Petiole with pair of spiracular tubercles and additional pair of tubercles; slightly expanding to the apex or parallel-sided (fig. 3, 2, 3). SR vein short, not reaching the wing apex (fig. 1, 3). 5.
- Last abdominal sternite without prongs. Ovipositor sheath evenly narrowing from base to apex, with light subapical constriction; apex of ovipositor sheath with straight margin (fig. 4, 2). Petiole without additional tubercles, parallel-sided or slightly narrowing to apex (fig. 3, 4). SR vein long, almost reaching the wing apex (fig. 1, 4). *Lipolexis gracilis* Förster
5. Basal part of ovipositor sheath tetragonal, clearly delimited from narrow apical part (fig. 4, 4). Distance between spiracle tubercles and additional tubercles of petiole as long as distance between spiracles or even longer (fig. 3, 2). *Binodoxys angelicae* (Haliday)
- Basal part of ovipositor sheath evenly transiting into narrow apical part (fig. 4, 3). Distance between spiracle tubercles and additional tubercles of petiole less than distance between spiracles (fig. 3, 3). *Binodoxys acalephae* (Marshall)

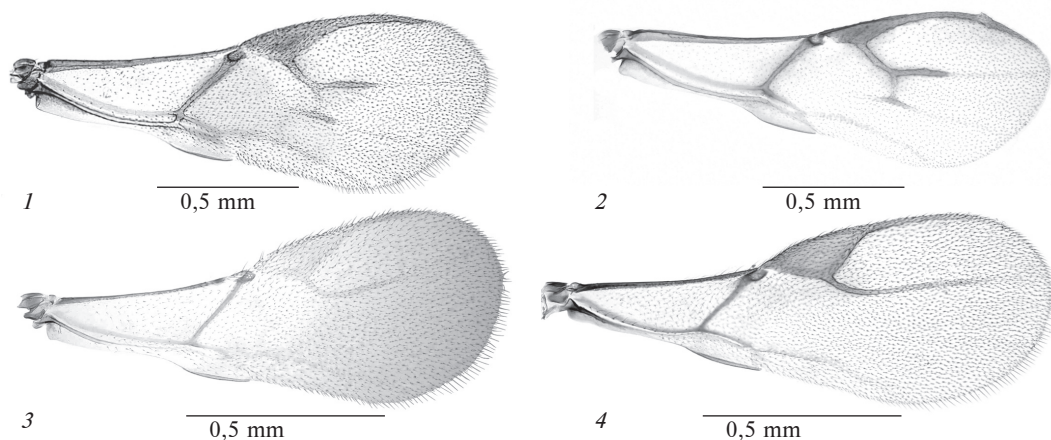


Fig. 1. Fore wings: 1 — *L. fritzmuelleri*; 2 — *L. fabarum*; 3 — *B. acalephae*; 4 — *L. gracilis*.

Рис. 1. Передние крылья: 1 — *L. fritzmuelleri*; 2 — *L. fabarum*; 3 — *B. acalephae*; 4 — *L. gracilis*.

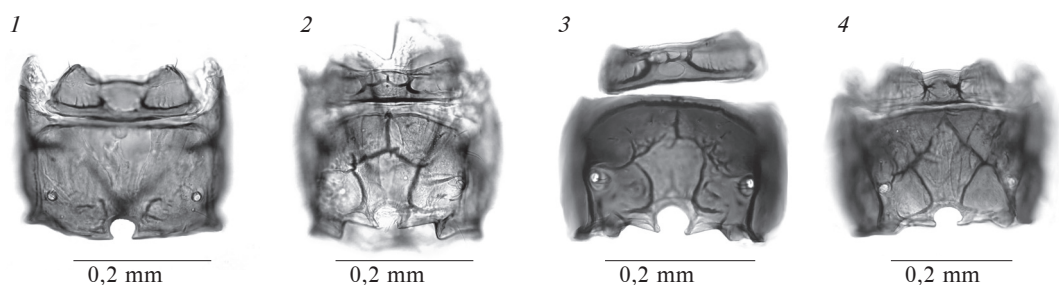


Fig. 2. Propodeum and metanotum: 1 — *L. confuseus*; 2 — *B. angelicae*; 3 — *B. acalephae*; 4 — *L. gracilis*.

Рис. 2. Промежуточный сегмент и заднеспинка: 1 — *L. confuseus*; 2 — *B. angelicae*; 3 — *B. acalephae*; 4 — *L. gracilis*.

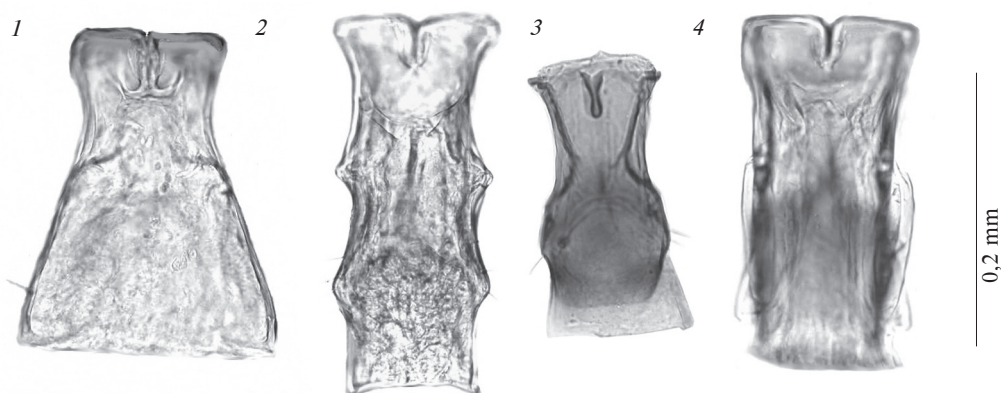


Fig. 3. Petiole: 1 — *L. confuseus*; 2 — *B. angelicae*; 3 — *B. acalephae*; 4 — *L. gracilis*.

Рис. 3. Стебелек: 1 — *L. confuseus*; 2 — *B. angelicae*; 3 — *B. acalephae*; 4 — *L. gracilis*.

Colony infestation percentage was different in 2010 and 2011 for certain species of aphids on same host plants. Figures 5 and 6 show comparison of the two-year data for *A. craccivora* and *A. fabae*, respectively.

Depending on the aphid host plants, infestation by aphidiids was the highest for *A. craccivora* on *O. viciifolia* — 92.5 % (2010) and 64 % (2011); high infestation was also recorded on *L. ucrainicus* — 68.6 % (2010), *M. albus* — 64 % (2010) and *M. officinalis* — 60.5 % (2010), *M. sativa* — 58.2 % (2010); the lowest infestation was recorded on *A. glycyphyllos* — 8.3 % (2011), *M. albus* — 10 % (2011), *M. officinalis* — 11.3 % (2011). The highest infestation of the colonies of *A. fabae* were on *L. pratensis* — 54.6 %

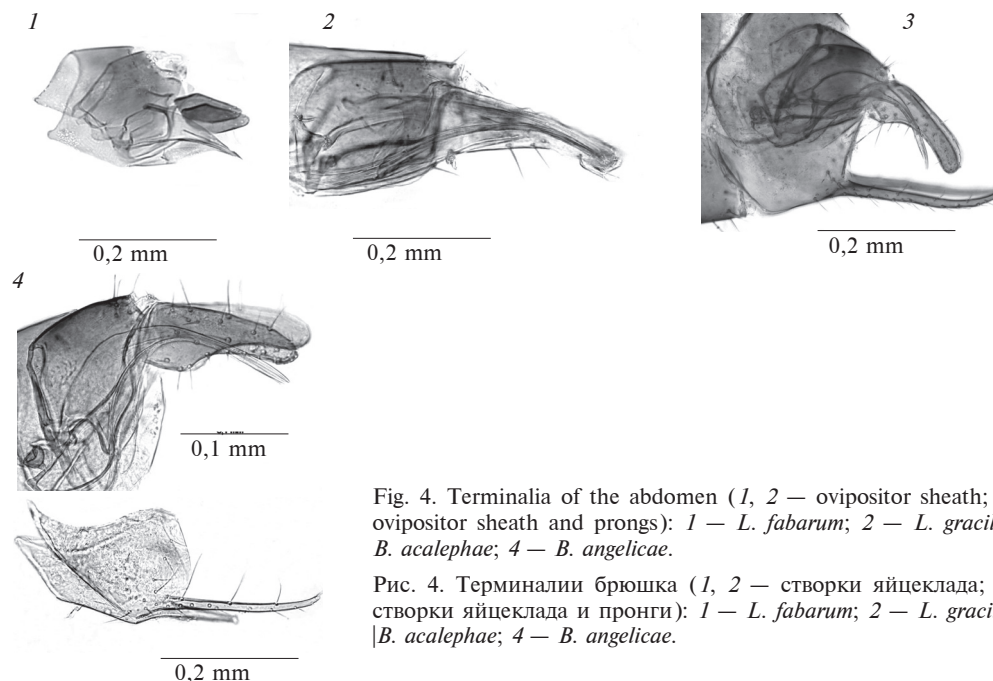


Fig. 4. Terminalia of the abdomen (1, 2 — ovipositor sheath; 3, 4 — ovipositor sheath and prongs): 1 — *L. fabarum*; 2 — *L. gracilis*; 3 — *B. acalephae*; 4 — *B. angelicae*.

Рис. 4. Терминалии брюшка (1, 2 — створки яйцеклада; 3, 4 — створки яйцеклада и пронги): 1 — *L. fabarum*; 2 — *L. gracilis*; 3 — *B. acalephae*; 4 — *B. angelicae*.

(2010), *M. sativa* — 51.5 % (2010), and the lowest was on *T. spadicum* — 2.2 % (2011), *T. montanum* — 2.5 % (2011), *T. arvense* — 4 % (2011), *T. medium* — 7.1 % (2011). Infestation ratio in other aphid colonies was less than 50 %.

Discussion

The species of aphidiids found in this study are known from different parts of Europe as usual parasites of aphids on herbaceous legumes (Starý, 1965; Adashkevich, 1972; Kierych, 1975; Tobias, Chiriach, 1986; Gruppe, Roemer, 1988; Kavallieratos et al., 2004; Starý, 2006; Starý, Lukáš, 2009). In addition to them, in these papers some species of the genera *Aphidius*, *Diaeretiella*, *Ephedrus*, *Praon*, and *Trioxys* were recorded (table 3). Most of them are known to be present in the fauna of Ukraine, but have not been found in this study. Species not recorded in this study are the parasites of *A. pisum*, which was found only in one sample. Also these species are parasites of *Megoura viciae* Buckton, *Therioaphis trifolii* (Monell) and *Brachycaudus helichrysi warei* (Theobald), but they have not been recorded in our samples.

A. pisum and *M. albifrons* are recorded for the first time as hosts for *L. fabarum*. However, these host-parasite associations, in our opinion, require further verification. *L. fabarum* is considered to be a polyphagous species, but there is a lot of data (Tobias, Chiriach, 1986; Davidyan, 2007; Sanders, Veen van, 2012; Starý P., personal communication) that aphids of the genus *Acyrtosiphon* do not belong in the range of its hosts, although according to other sources (Mackauer, Starý, 1967) it is possible. *M. albifrons* is a species of North American origin, first found in 1981 in Western Europe (Gruppe, Roemer, 1988); in 1994 V. Chumak (2000) found this species in the fauna of Ukraine. North American and European aphidiids parasitizing *M. albifrons* belong to the genera *Aphidius* and *Praon* (Gruppe, Roemer 1988; Starý, 2006) (table 3). Further rearing of *L. fabarum* should be provided to clarify this host-parasite association. Unfortunately, the mummies of *A. pisum* and *M. albifrons* are lacking.

Most reared aphidiids belong to *L. fabarum* and *L. confusus*. These are common species occurring in samples everywhere and often together, dominatively infesting the

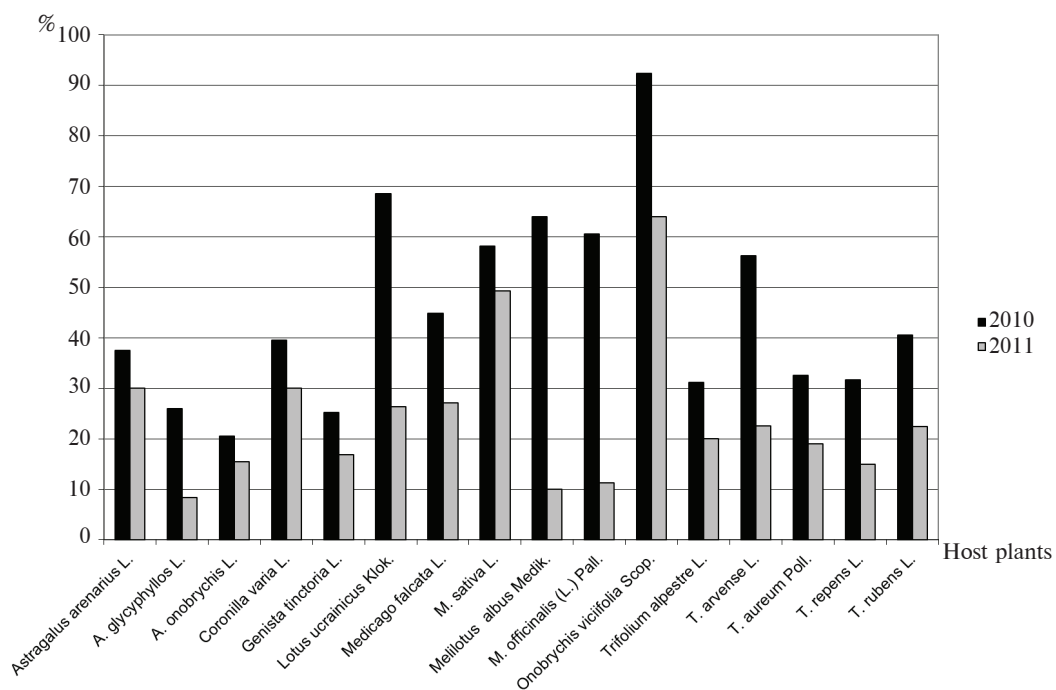


Fig. 5. Mean percentage of aphids infested by aphidiids in *A. craccivora* colonies in 2010 and 2011 on different host plants.

Рис. 5. Средний процент зараженности афидидами колоний *A. craccivora* в 2010 и 2011 гг. на разных кормовых растениях.

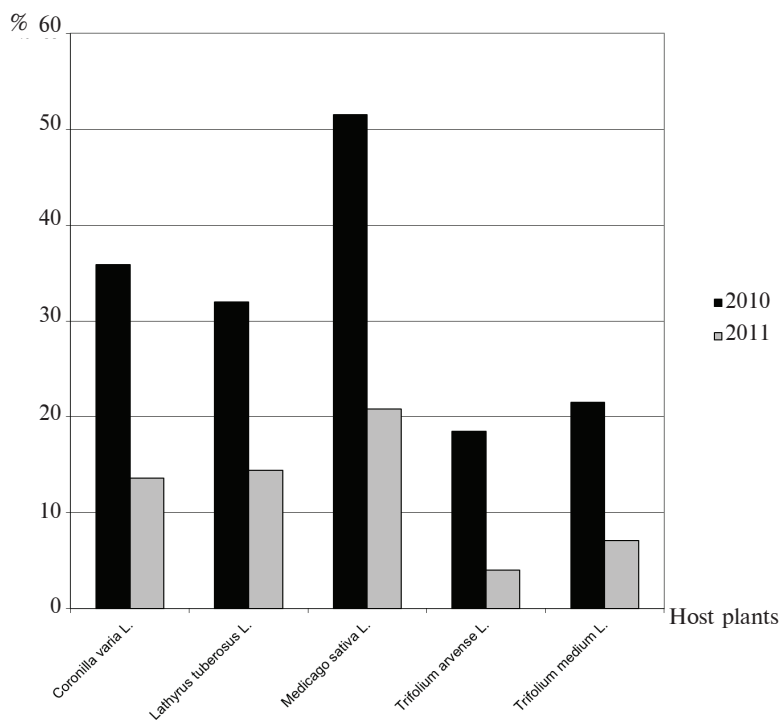


Fig. 6. Mean percentage of aphids infested by aphidiids in *A. fabae* colonies in 2010 and 2011 on different host plants.

Рис. 6. Процент зараженности афидидами колоний *A. fabae* в 2010 и 2011 гг. на разных кормовых растениях.

same colony. Other species were less common, and reared in smaller amount from mixed colonies infested by *L. fabarum* and/or *L. confusus*. The colonies infested by two species of the genus *Binodoxys*, and the combination of species *Binodoxys* spp. and *L. gracilis* occurred.

Most of the reared species occur everywhere, more often in the steppes, grasslands and at the forest edges. An exception is *B. angelicae*, which was found in this study on the plants of upland and lowland meadows, but according the literature data this species is more common in forested habitats on trees and shrubs, such as *Robinia pseudoacacia* L. and *Caragana arborescens* Lam. (Stary, 1965; 2006). According to Stary (2006), *L. confusus* also recorded mostly on trees and shrubs, but in this study, it was a common species in the meadows and steppes. Stary (2006) suggests that it is a group of cryptic species rather than one species.

Trophic specialization of recorded aphidiids is also different. Most of these species are polyphagous and wide oligophagous.

The infestation ratio for aphid colonies of different species depends on various conditions. For example, the role of the entomophages in reducing of *A. craccivora* population is increasing under deficiency of moisture for host plants, which inhibits the development of aphids (Mamontova, 1987). Also higher infestation ratio in aphid colonies was observed in dry and hot summer of 2010 in comparison with 2011.

Table 3. Aphidiids — parasitoids of aphids on herbaceous legumes in Europe

Таблица 3. Афиидиды — паразиты тлей на травянистых бобовых растениях в Европе

Aphidiid species	Aphids species							Total number	
	<i>Acyrthosiphon pisum</i>	<i>Macrosiphum albifrons</i>	<i>Megoura viciae</i>	<i>Therioaphis trifolii</i>	<i>Brachycaudus helichrysi warei</i>	<i>Aphis cracciae</i>	<i>Aphis craccivora</i>		<i>Aphis fabae</i>
<i>Aphidius avenae</i> Haliday, 1834	+								1
<i>Aphidius colemani</i> Viereck, 1912							+	+	2
<i>Aphidius eadyi</i> Stary, Gonzalez et Hall, 1980	+								1
<i>Aphidius ervi</i> Haliday, 1834	+	+							2
<i>Aphidius matricariae</i> Haliday, 1834							+		1
<i>Aphidius megourae</i> Stary, 1965			+						1
<i>Aphidius smithi</i> Sharma et Subba Rao, 1959	+								1
<i>Aphidius urticae</i> Haliday, 1834	+								1
<i>Binodoxys acalephae</i> (Marshall, 1896)						+	+	+	3
<i>Binodoxys angelicae</i> (Haliday, 1833)						+	+	+	3
<i>Diaeretiella rapae</i> (M'Intosh, 1855)					+				1
<i>Ephedrus niger</i> Gautier, Bonnamour & Gaumont, 1929			+						1
<i>Ephedrus lacertosus</i> (Haliday, 1833)	+								1
<i>Ephedrus plagiator</i> (Nees, 1811)	+					+	+	+	4
<i>Lipolexis gracilis</i> Forster, 1862							+	+	2
<i>Lysiphlebus cardui</i> (Marshall, 1896)								+	1
<i>Lysiphlebus confusus</i> Tremblay et Eady, 1978							+	+	2
<i>Lysiphlebus fabarum</i> (Marshall, 1896)							+	+	2
<i>Lysiphlebus fritzmuelleri</i> Mackauer, 1960						+			1
<i>Lysiphlebus testaceipes</i> (Cresson, 1880)							+	+	2
<i>Praon abjectum</i> (Haliday, 1833)						+	+	+	3
<i>Praon barbatum</i> Mackauer, 1967	+								1
<i>Praon dorsale</i> (Haliday, 1833)	+								1
<i>Praon exsoletum</i> (Nees, 1811)				+					1
<i>Praon longicorne</i> Marshall, 1896	+								1
<i>Praon megoura</i> Stary, 1971			+						1
<i>Praon volucre</i> (Haliday, 1833)	+	+			+		+	+	5
<i>Trioxys complanatus</i> Quilis Perez, 1931				+					1
Total number	11	2	3	2	2	5	11	11	

Conclusions

Six species of three genera are found in the Central Wood-and-Steppe Zone of Ukraine on the herbaceous legumes: *Lysiphlebus fabarum*, *L. confusus*, *L. fritzmuellerei*, *Lipolexis gracilis*, *Binodoxys acalephae*, *B. angelicae*. *Lysiphlebus fabarum* and *L. confusus* are recorded as dominant species. This species were found in 89.5 % and 75.6 % of the samples, respectively.

Infestation percentage of aphids was higher in 2010, due to unfavorable climatic conditions for aphids (hot and dry summer).

The highest infestation percentage was observed in colonies of *Aphis craccivora*. In colonies of *A. fabae* infestation percentage was medium (about a half of specimens). Infestation of other aphid species was low. The highest infestation of *A. craccivora* was recorded on *Onobrychis viciifolia*; *A. fabae* was highly infested on *Lathyrus pratensis*. Both species of aphids were insignificantly infested on various species of clover (*Trifolium* spp.).

A. pisum and *M. albifrons* are recorded for the first time as hosts for *L. fabarum*, but these host-parasite associations require, in our opinion, further verification.

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