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Fauna and Distribution of Aphid Parasites (Hym., Aphidiidae) in Iraq

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The territory of Iraq represents an area from which very little has been known about the fauna of aphid parasites. Practically, there have been only two small papers touching on this fauna (Bosch v. d. 1956, 1957; Al-Azawí 1966). On the other hand both vertical and horizontal distribution and zonation of the flora is a character which is very promising with respect to the research of aphid parasite fauna. The basic classification of the floristic zones has been also recently elaborated (Al-Rawi 1964, Guest and Al-Rawi 1966) and this facilitates better knowledge of the some obvious differences were recognized in the parasite spectra associated with separate aphid species in dependence on North-South zonation, furthermore, some parasite strains differing from those of the Mediterranean were found, and, finally, the composition of hyperparasites seems to exhibit similar features.

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A review of species

Aphidius funebris Mackauer, 1961

Hosts and localities: *Dactynotus jaceae* (L.). — 6 km Salahuddin to Shaqlawah, Arbil, 9. 7. 1968, *Centaurea solstitialis*, open oak forest (Starý). *Dactynotus sonchi* (Geoffr.). — Baghdad, 26. 4. 1968, *Sonchus oleraceus*, avenue (Starý). Baghdad, Botan. garden, 30. 4. 1968, *Sonchus oleraceus* (Starý). Baghdad, 17. 4. 1968, *Sonchus* sp., garden (Starý). Baghdad, Abu Ghraib, 27. 4. 1968, *Sonchus* sp., waste place (Starý).

Habitat: Steppe type habitats, irrigated lands, gardens, waste places.

Host range: A specialized parasite of *Dactynotus*-species.

Aphidius matricariae Haliday, 1834

Hosts and localities: *Aphis affinis* delGu. — Aqrah, Mosul, 24. 5. 1968, *Mentha* sp., mountain orchard, nr. a brook (Starý). *Aphis craccivora* Koch. — Jadidat Ish Shat, nr. Baghdad, 18. 4. 1968, *Glycyrrhiza glabra*, orchard undergrowth (Starý). *Aphis parietariae* Theo. — Aqrah, Mosul, 25. 5. 1968, *Parietaria judaica*, mountain orchard (Starý). *Myzus persicae* Sulz. — Baghdad, Botan. garden, 30. 4. 1968, *Dianthus* sp., park (Starý). Baghdad, Sulaikh, 18. 4. 1968, *Helianthus* sp., garden (Starý). Dtto, 28. 4. 1968 (Starý). Baghdad, Botan. garden, 20. 4. 1968, *Alcea rosea*, park (Starý). Baghdad, Botan. garden, 20. 4. 1968, *Citrus* sp., park (Starý). Baghdad, Sulaikh, 25. 3. 1968 (van den Bosch). Jadidat Ish Shat, nr. Baghdad, 18. 4. 1968, orchard undergrowth (Starý).

Habitat: Comparatively widely eurytopic species; in gardens, orchards, in trees and undergrowth.

Host range: A widely specialized species, its main host belonging to Aphidine and Myzine aphids.

Note: In Central Europe it is mostly distributed in steppe type habitats, penetrating to gardens and orchards.

Aphidius rosae Haliday, 1834

Hosts and localities: *Macrosiphum rosae* (L.). — Tadzhike, nr. Sar-sang, Mosul, 24. 5. 1968, *Rosa* sp., pasture meadow (Starý). Shaqlawah, Arbil, 11. 7. 1968, *Rosa* sp., riverain mountain forest (Starý). Salahuddin, nr. Shaqlawah, Arbil, 10. 7. 1968, *Rosa* sp., ornamental garden (Starý).

Habitat: Gardens, parks, riverain forests — in the mountains.

Host range: A typical parasite of *Macrosiphum rosae* (L.).

Aphidius transcaspicus Telenga, 1958

Hosts and localities: *Aphis zizyphi* Theo. — Baghdad, 18. 4. 1968, *Ziziphus nummularia*, avenue (Starý). *Hyalopterus pruni* (Geoffr.). — Baghdad, Sulaikh, 8. 5. 1968, 17. 4. 1968, 20. 4. 1968, 30. 4. 1968, 29. 4. 1968, 27. 4. 1968, *Prunus armeniaca*, gardens, orchards (Starý), Baghdad, Sulaikh, 17. 4. 1968, 20. 4. 1968, 28. 4. 1968, 30. 4. 1968, 21. 4. 1968, 18. 4.

1968, 5. 5. 1968, 4. 5. 1968, *Prunus persica*, gardens, orchards, parks (Starý). Baghdad, Zaafaranyia, 1. 5. 1968, *Prunus armeniaca*, garden (Starý). Baghdad, Abu Ghraib, 28. 4. 1968, *Phragmites communis*, marshes (Starý). Jadidat Ish Shat, nr. Baghdad, 5. 5. 1968, 18. 4. 1968, *Prunus persica*, orchard (Starý). Aqrah, Mosul, 24. 5. 1968, *Prunus persica*, mountain orchard (Starý). Dahuk, Mosul, 23. 5. 1968, *Phragmites communis*, valley of a brook, mountains (Starý). Shaqlawah, Arbil, 11. 7. 1968, *Prunus cerasifera*, mountain riverain forest (Starý). *Longiunguis donacis* (Pass.). — Aqrah, Mosul, 24. 5. 1968, *Arundo donax*, mountain orchard (Starý).

Habitat: Orchards, gardens, reeds, riverain forests; both in the mountains and lowlands.

Host range: A specialized parasite of *Hyalopterus pruni* (Geoffr.) and *Longiunguis donacis* (Pass.), to a lesser degree of some related groups (*Aphis* sp.).

Aphidius sp.

Hosts and localities: *Macrosiphum* sp. — Baghdad, Botan. garden, 30. 4. 1968, *Hordeum* sp., park (Starý). Dtto, 4. 5. 1968, *Triticum aestivum*, park (Starý).

Diaeretiella rapae M'Intosh, 1855

Hosts and localities: *Dactynotus sonchi* (Geoffr.). — Baghdad, Botan. garden, 20. 4. 1968, *Sonchus* sp., park (Starý).

Habitat: Steppe type habitats; gardens, orchards, undergrowth.

Host range: Its host ascertained in Iraq is less typical. The parasite is known to be associated namely with *Brevicoryne*, *Myzus*, etc. in Europe.

Lysiphlebus ambiguus Haliday, 1834

Hosts and localities: *Aphis craccivora* Koch. — Baghdad, Sulaikh, 29. 4. 1968, *Citrus* sp., garden (Starý). Baghdad, Abu Ghraib, 27. 4. 1968, *Delbergia cissou*, avenue (Starý). Baghdad, Botan. garden, 20. 4. 1968, *Citrus* sp., park (Starý). *Aphis fabae* Scop. — Jadidat Ish Shat, nr. Baghdad, 5. 5. 1968, *Carduus pycnocephalus*, garden (Starý). *Aphis gossypii* Glov. — Baghdad, Al Jadriyah, 17. 6. 1968, *Gossypium* sp., field (Starý). *Aphis* sp. — Baghdad, Sulaikh, 17. 4. 1968, *Chenopodium* sp., orchard undergrowth (Starý). Baghdad, Botan. garden, 30. 4. 1968, *Malva nigriflora*, park (Starý). Dtto., 4. 5. 1968 (Starý). Baghdad, Sulaikh, 29. 4. 1968, *Eucalyptus* sp., avenue (Starý).

Habitat: Mostly in forest type habitats —gardens, orchards, parks; it penetrates also to the steppe-type neighbourhood. Most probably distributed in the north as well.

Lysiphlebus fabarum Marshall, 1896

Hosts and localities: *Aphis affinis* delGu. — 6 km Salahuddin to Shaqlawah, Arbil, 9. 7. 1968, *Mentha* sp. longifolia, mountain riverain forest (Starý). *Aphis craccivora* Koch. — Baghdad, 17. 4. 1968, garden (van den Bosch). Dtto, 26. 3. 1968 (van den Bosch). Jadidat Ish Shat, nr.

Baghdad, 18. 4. 1968, *Vicia angustifolia*, orchard undergrowth (Starý).
Jadidat Ish Shat, nr. Baghdad, 18. 4. 1968, *Glycyrrhiza glabra*, orchard undergrowth (Starý). 6 km Salahuddin to Shaqlawah, Arbil, 9. 7. 1968, *Glycyrrhiza glabra*, open oak forest (Starý). Tadzhike, nr. Sarsang, Mosul, 24. 5. 1968, *Glycyrrhiza glabra*, mountain pasture meadow (Starý). Dahuk, Mosul, 23. 5. 1968, *Astragalus* sp., roadside-meadow (Starý). Dtto, 23. 5. 1968, *Onobrychis* sp. (Starý). *Aphis fabae* Scop. — Jadidat Ish Shat, nr. Baghdad, 18. 4. 1968, *Chenopodium* sp., orchard undergrowth (Starý). Dtto, 5. 5. 1968, *Carduus pycnocephalus*, garden (Starý). Sarsang, Mosul, 23. 5. 1968, *Turgenia latifolia*, roadside-mountains (Starý). *Aphis ruborum* Börn. — Baghdad, Sulaikh, 29. 4. 1968, *Rubus sanctus*, garden (Starý). *Aphis solanella* Theo. — Baghdad, Sulaikh, 20. 4. 1968, *Cestrum nocturnum*, garden (Starý). Dtto., 27. 4. 1968 (Starý). Baghdad, Sulaikh, 10. 5. 1968, orchard undergrowth (Starý). 6 km Salahuddin to Shaqlawah, Arbil, 9. 7. 1968, *Solanum nigrum*, mountain riverain forest (Starý). 6 km Salahuddin to Shaqlawah, Arbil, 9. 7. 1968, *Centaurea solstitialis*, open oak forest (Starý). *Aphis* sp. — Tadzhike, nr. Sarsang, Mosul, 24. 5. 1968, nr. a brook, mountains (Starý). Sarsang, Mosul, 23. 5. 1968, *Rumex conglomeratus*, roadside-mountains (Starý). Jadidat Ish Shat, nr. Baghdad, 18. 4. 1968, *Torilis stocksiana*, orchard undergrowth (Starý). *Brachycaudus* sp. — 6 km Salahuddin to Shaqlawah, Arbil, 9. 7. 1968, *Rumex* sp., mountain riverain forest (Starý). *Capitophorus carduinus* Walk. — nr. a village, 6 km Salahuddin to Shaqlawah, Arbil, 9. 7. 1968, *Carduus* sp., open oak forest (Starý).

Habitat: A steppe species, occurring in gardens, roadsides, pasture meadows, penetrating to orchards and edges of riverain forests; occurs both in the mountains and lowlands.

Host range: A parasite of *Aphis*-species and related groups.

Note: The Iraqi populations are deuterotokous.

***Lysiphlebus salicaphis* Fitch, 1855**

Hosts and localities: *Chaitophorus* sp. — Tadzhike, nr. Sarsang, Mosul, 24. 5. 1968, *Populus nigra*, mountain riverain forest (Starý).

Habitat: Mountain riverain forests; it was not found in the lowlands, although its occurrence is possible.

Host range: A specialized parasite of *Chaitophorus*-species.

***Lysiphlebus thelaxis* Starý, 1961**

Hosts and localities: *Thelaxes suberis* (del Gu.). — Salahuddin, nr. Shaqlawah, Arbil, 10. 7. 1968, 11. 7. 1968, *Quercus aegilops*, open oak forest (Starý). Sari Rash, nr. Salahuddin, Arbil, 10. and 11. 7. 1968, *Quercus aegilops*, open oak forest (Starý). 6 km Salahuddin to Shaqlawah, Arbil, 9. 7. 1968, *Quercus aegilops*, open oak forest (Starý).

Habitat: Oak forests-mountains.

Host range: A specialized parasite of *Thelaxes*-species.

Monoctonia pistaciaecola Starý, 1962

Hosts and localities: *Forda* sp. — Salahuddin, nr. Shaqlawah, Arbil, 11. 7. 1968, Pistacia, open oak forest (Starý).

Habitat: Oak forests — mountains; associated with Pistacia-trees.

Host range: A specialized parasite of some gall aphids (*Forda*, *Pemphigus*).

Note: Diapause cocoons were recognized in Iraq.

Praon abjectum Haliday, 1833

Hosts and localities: *Aphis craccivora* Koch. — Baghdad, Abu Graib, 27. 4. 1968, Delbergia cissoo, avenue (Starý). Baghdad, Sulaikh, 17. 4. 1968, Citrus sp., orchard (Starý). Jadidat Ish Shat, nr. Baghdad, Glycyrrhiza glabra, orchard undergrowth (Starý). Baghdad, Botan. garden, 20. 4. 1968, Melilotus sp., park (Starý). *Aphis punicae* Pass. — Baghdad, Sulaikh, 28. 4. 1968, Punica granatum, orchard (Starý). *Aphis solanella* Theo. — Baghdad, Sulaikh, 20. 4. 1968, Cestrum nocturnum, garden (Starý). *Aphis viticis* Ferrari. — Baghdad, Sulaikh, 26. 4. 1968, Vitex agnus-castus, avenue (Starý). *Aphis* sp. — Baghdad, Sulaikh, 29. 4. 1968, Eucalyptus sp., avenue (Starý).

Habitat: Associated with forest-type habitats — orchards.

Host range: A specialized parasite of various *Aphis*-species.

Praon exsoletum Nees, 1811

Hosts and localities: *Therioaphis* sp. — Jadidat Ish Shat, nr. Baghdad, 18. 4. 1968, Melilotus indica, orchard undergrowth (Starý).

Habitat: Steppe type habitats.

Host range: A specialized parasite of *Therioaphis*-species.

Praon flavinode Haliday, 1833

Hosts and localities: *Tuberculoides* sp. — Salahuddin, Arbil, 10. 7. 1968, Quercus infectoria, open oak forest (Starý).

Habitat: Oak forest association — mountains.

Host range: A parasite of some dendrophilous Callaphididae.

Note: It is known as a parasite of a number of Callaphidid aphids from C. Europe.

Praon volucre Haliday, 1833

Hosts and localities: *Hyalopterus pruni* (Geoffr.). — Shaqlawah, Arbil, 11. 7. 1968, Prunus cerasifera, mountain riverain forest (Starý). Tadzhike, nr. Sarsang, Mosul, 24. 5. 1968, Prunus sp., mountain orchard (Starý). *Longiunguis donacis* (Pass.). — Aqrah, Mosul, 24. 5. 1968, Arundo donax, mountain orchard (Starý). *Macrosiphum rosae* (L.). — Tadzhike, nr. Sarsang, Mosul, 24. 5. 1968, Rosa sp., pasture meadow (Starý). Shaqlawah, Arbil, 11. 7. 1968, Rosa sp., riverain forest (Starý).

Habitat: Forest type habitats (mountain riverain forest, orchard, etc.), penetrating also to gardens and neighbouring steppe type habitats; it occurs only in the mountains.

Host range: A parasite of a number of various aphids, mostly of Aphidine and Myzine groups.

Praon spp.

Hosts and localities: *Chaitophorus* sp. — Baghdad, Sulaikh, 4. 1968, *Populus euphratica* (van den Bosch and Starý). *Macrosiphum* sp. — Baghdad, Botan. garden, 30. 4. 1968, *Triticum aestivum* (Starý). *Myzus persicae* Sulz. — Baghdad, Sulaikh, 18. 4. 1968, *Helianthus* sp., garden (Starý).

Trioxys acalephae Marshall, 1896

Hosts and localities: *Aphis affinis* delGu. — Aqrah, Mosul, 24. 5. 1968, *Mentha* sp., mountain orchard (Starý).

Habitat: Unsatisfactorily known in Iraq.

Host range: A parasite of a number of *Aphis*-species.

Note: It is known as a species associated with steppe type habitats and penetrating to orchards.

Trioxys angelicae Haliday, 1833

Hosts and localities: *Aphis craccivora* Koch. — Baghdad, Abu Ghraib, 27. 4. 1968, *Delbergia cissoo*, avenue (Starý). *Aphis punicae* Pass. — Baghdad, Botan. garden, 20. 4. 1968, *Punica granatum*, park (Starý). Baghdad, Sulaikh, 28. 4. 1968, *Punica granatum*, garden (Starý). Aqrah, Mosul, 24. 5. 1968, *Punica granatum*, mountain orchard (Starý). *Aphis solanella* Theo. — Baghdad, Sulaikh, 27. 4. 1968, *Cestrum nocturnum*, garden (Starý). *Aphis viticis* Ferrari. — Baghdad, Sulaikh, 29. 4. 1968, *Vitex agnus-castus*, avenue (Starý). Dtto, 26. 4. 1968 (Starý). *Aphis zizyphi* Theo. — Baghdad, Sulaikh, 26. 4. 1968, *Ziziphus nummularia*, avenue (Starý).

Habitat: Forest type habitats — forests, orchards, penetrating to gardens. It occurs both in the mountains and lowlands.

Host range: A parasite of various *Aphis*-species.

Note: It is known as a parasite of a number of Aphidine, Anuraphidine and Myzine aphids in other countries.

Trioxys pallidus Haliday, 1833

Hosts and localities: *Chromaphis juglandicola* (Kalt.). — Aqrah, Mosul, 24. 5. 1968, *Juglans regia*, mountain orchard (Starý). Shaqlawah, Arbil, 11. 7. 1968, *Juglans regia*, mountain riverain forest (Starý). *Tuberculooides* sp. — Salahuddin, nr. Shaqlawah, Arbil, 10. 7. 1968, *Quercus insectoria*, open oak forest (Starý).

Habitat: Forest type habitats — mountain riverain forests and oak forests; it occurs only in the mountains.

Host range: A parasite of some dendrophilous Callaphididae.

Note: It is known to parasitize a number of various dendrophilous Callaphidid aphids in other countries.

***Trioxys quercicola* Starý, 1969**

Hosts and localities: *Thelaxes suberis* (del Gu.). — Salahuddin, nr. Shaqlawah, Arbil, 10. 7. 1968, *Quercus infectoria*, open oak forest (Starý).

Habitat: Oak forest; it occurs only in the mountains.

Host range: Probably a strictly specialized parasite of *Thelaxes suberis* (del Gu.).

***Trioxys* sp.**

Hosts and localities: *Aphis* sp. — Tadzhike, nr. Sarsang, Mosul, 24. 5. 1968, nr. a brook, mountain riverain forest (Starý). *Brachycaudus* sp. — Aqrah, Mosul, 24. 5. 1968, *Rumex conglomeratus*, mountain orchard (Starý). *Aphis parietariae* Theo. — Aqrah, Mosul, 25. 5. 1968, *Parietaria judaica*, mountain orchard (Starý).

Unidentified species

Hosts and localities: *Pterochloroides persicae* (Chol.). — Baghdad, 4. 1968, *Prunus persica*, garden (Starý).

Note: Numerous empty nummies were observed.

DISTRIBUTION

Although our knowledge of the aphid parasite fauna of Iraq is at the initial stage, the classification of species recognized in Iraq allows us to elaborate a general sketch on parasite distribution and factors influencing it in this area. The territory of Iraq of today belongs to the eastern Mediterranean. Many districts of Iraq are recognizable, the geologically youngest is the Mesopotamian lowland, which has also been cultivated from ancient times and even more intensively than in our days. We however expected that the composition of the fauna would exhibit the features related to that of other Mediterranean districts. Nevertheless, although the very general features are identical, there were very peculiar differences established which are obviously due to the climate of some parts of Iraq and are responsible for features in the parasite fauna that in many ways resemble some continental islands.

Main floristic zones of Iraq

As we have shown in our earlier studies (Starý, 1968) the aphidiid parasites are generally distributed in accordance with separate floristic zones. This dependence, to be demonstrated in the Iraqi fauna, should be explained with respect to the introductory notes on physiography, climate and vegetation of Iraq. A brilliant review of biogeographical conditions of Iraq can be found in the introductory volume of the Flora of Iraq (Guest, 1966) so that we give here only a very general idea, which is necessary for the purpose of our paper.

According to Guest (1966) six or seven categories of vegetation can be recognized in Iraq; passing from the lowlands to the highlands, successive zones of vegetation appear in the following order: A. Desert region (1. Desert zone?, 2. Sub-desert zone), B. Steppe region (3. Dry-steppe zone, 4. Moist-steppe zone), C. Mountain-forest region (5. Forest zone, 6. Thorn-cushion zone), D. Alpine region (7. Alpine zone). In addition, there is a vegetation associated with marshes, which is often transzonal as it follows the rivers. Further, there is flora associated with secondary habitats (ruderals). For the purpose of our paper a brief note should be mentioned about the forests. Three groups are distinguished: Mountain Riverain forest, Oak forest (with three zones) and Pine forest. Outside the forest zone, there lies the category of Riverain forest of the Plains, which follows the river banks and riverain islands from the mountains through steppe and desert to the Persian Gulf.

A review of faunistic complexes of parasites

According to our classification (Starý, 1968) the parasite species established in Iraq can be divided into several faunistic complexes (FC). Further representatives of the under mentioned as well as of some other complexes are expected to be found in Iraq after more detailed research is undertaken.

Forest Tundra F. C. — *Lysiphlebus salicaphis* (Fitch). This species, being Holarctic in distribution and associated mainly with Forest Tundra, a parasite of *Chaitophorus*-aphids on *Salix* and *Populus*, penetrates far to the south — usually following the mountain ranges or river valleys.

West- and East-Eurasian Coniferous Forest F. C. — Members of these complexes have not yet been established in Iraq, but they are expected to occur in the mountains of the north. Species of this complex are parasites of the Lachnidae associated with Conifers. These aphids have already been found in Iraq, especially in the mountains of the north.

European Deciduous Forest F. C. — *Aphidius rosae* Haliday, *Lysiphlebus ambiguus* (Haliday), *Lysiphlebus thelaxis* Starý, *Praon abjectum* Haliday, *Praon volucre* (Haliday), *Trioxys angelicae* (Haliday), *Trioxys pallidus* (Haliday). Of these, *Lysiphlebus thelaxis* and *Trioxys pallidus* are strictly associated with deciduous forests, while the other species — due also to their host range and occurrence of hosts — can penetrate to orchards, gardens and to ecotons. The position of *Trioxys quercicola* Starý, has been uncertain as yet, as it is known only from the highlands and further records are necessary.

Mediterranean F. C. — *Aphidius transcaspicus* Telenga, *Monoctonia pistaciaeicola* Starý. These species are associated basically with forest type habitats. *Aphidius transcaspicus* occurs also in riverain forests, orchards and reeds. The other parasite is associated with aphids living on *Pistacia* and *Populus*, and occurs in the mountains and probably also in the riverain forest associations.

Eurasian Steppes F. C. — *Aphidius funebris* Mackauer, *Aphidius matricariae* Haliday, *Diaeretiella rapae* (M'Intosh), *Lysiphlebus fabarum* (Marshall), *Praon exsoletum* (Nees), *Trioxys acalephae* (Marshall). These species occur in the steppe to semidesert and penetrate also to irrigated lands (orchards, gardens, fields). Some of them (*Aphidius matricariae*, *Trioxys acalephae* and rarely *Lysiphlebus fabarum*), owing to the occurrence of their hosts, may attack them also on trees, although they mostly occur in the undergrowth and in waste places.

Relationship and penetration of separate faunistic complexes of parasites

Similarly as with the floristic zones, the faunistic complexes of parasites are not strictly separated from each other, but a wide penetration of elements following that of the floristic zones can be recognized, while a peculiar situation occurs in irrigated lands as well as in districts changed and under cultivation.

As an example of such a penetration we can cite the oak forest association of the north of Iraq. The original virgin oak forest has a typical associated fauna of aphid parasites, which belongs to the European Deciduous Forest FC. However, owing to the forest having been cut, a number of trees were felled and at the present time most of the oak forests have an open forest character, where the steppe flora is widely distributed and practically represents undergrowth. This influence of steppe flora is semi-typical in cut forests, where only oak scrub grows around the stumps, while a complete deforestation means simultaneously full dominance of steppe flora in this area. Although there can be a wide penetration, the parasites are strictly dependent and associated with the forest elements or with the steppe. On the oaks, there exist a number of species associated with oak aphids — *Praon flavinode* (Hal.), *Trioxys pallidus* (Hal.), *Trioxys quercicola* Starý and *Lysiphlebus thelaxis* Starý. All of these can be found in old trees, while partial deforestation and existence of only oak scrub means a decrease in the number of aphids and parasites, as only some of the species can occur in such a changed habitat (*Lysiphlebus thelaxis* Starý). In the steppe, mainly *Lysiphlebus fabarum* (Marshall) occurs, together with some others. Both these groups of parasites are strictly separated and belong to the food chains associated either with oaks or steppe flora. Naturally, in completely deforested areas even lacking oak scrub, the deciduous forest parasite complex is completely lacking too.

Another situation occurs in irrigated lands, such as orchards, gardens, etc. In these habitats parasites occur belonging to the deciduous forest complex as the type of habitat is similar and suitable hosts occur here as well (*Trioxys angelicae* Haliday, *Lysiphlebus ambiguus* Haliday, etc.). Further, the elements of the Mediterranean complex occur, which is also partly associated with deciduous forest fauna (*Aphidius transcaspicus* Telenga). Finally, there are elements of the steppe complex which are primarily associated with weeds (*Aphidius funebris* Mackauer, *Aphidius matricariae* Haliday, *Lysiphlebus fabarum* Marshall, *Trioxys acalephae* Marshall, etc.), but if suitable hosts occur also on the trees, they

parasitize them as well (*Lysiphlebus fabarum* Marshall), although they belong originally to steppe fauna. The microlimatic conditions and the tendency of a part of the steppe species to concentrate near shrubs, trees, and generally shaded habitats during hot weather conditions, as well as the parasite host range and host occurrence, are the main reason (*Lysiphlebus fabarum* Marshall). On the other hand, there is a group of steppe species, which never attack aphids on trees, being strictly dependent on the steppe species which occur in the orchard undergrowth or irrigated fields (*Aphidius funebris* Mackauer, *Praon exsoletum* Nees).

The evaluation of separate parasite species is difficult when based on Iraqi records only, as the more southern the area of distribution, the less typical becomes the occurrence of some species (especially widely specialized species — *Lysiphlebus ambiguus* Haliday), while very obvious differences can be found in the northern parts of their distribution area.

If we classify the Iraqi parasite fauna on the basis of our records, there is no doubt that the general features are the same as in the Mediterranean, but certain differences occur which are due to climatic conditions in some parts of Iraq, and, or different characters of some parasite populations or strains, and which are dealt with below in more detail.

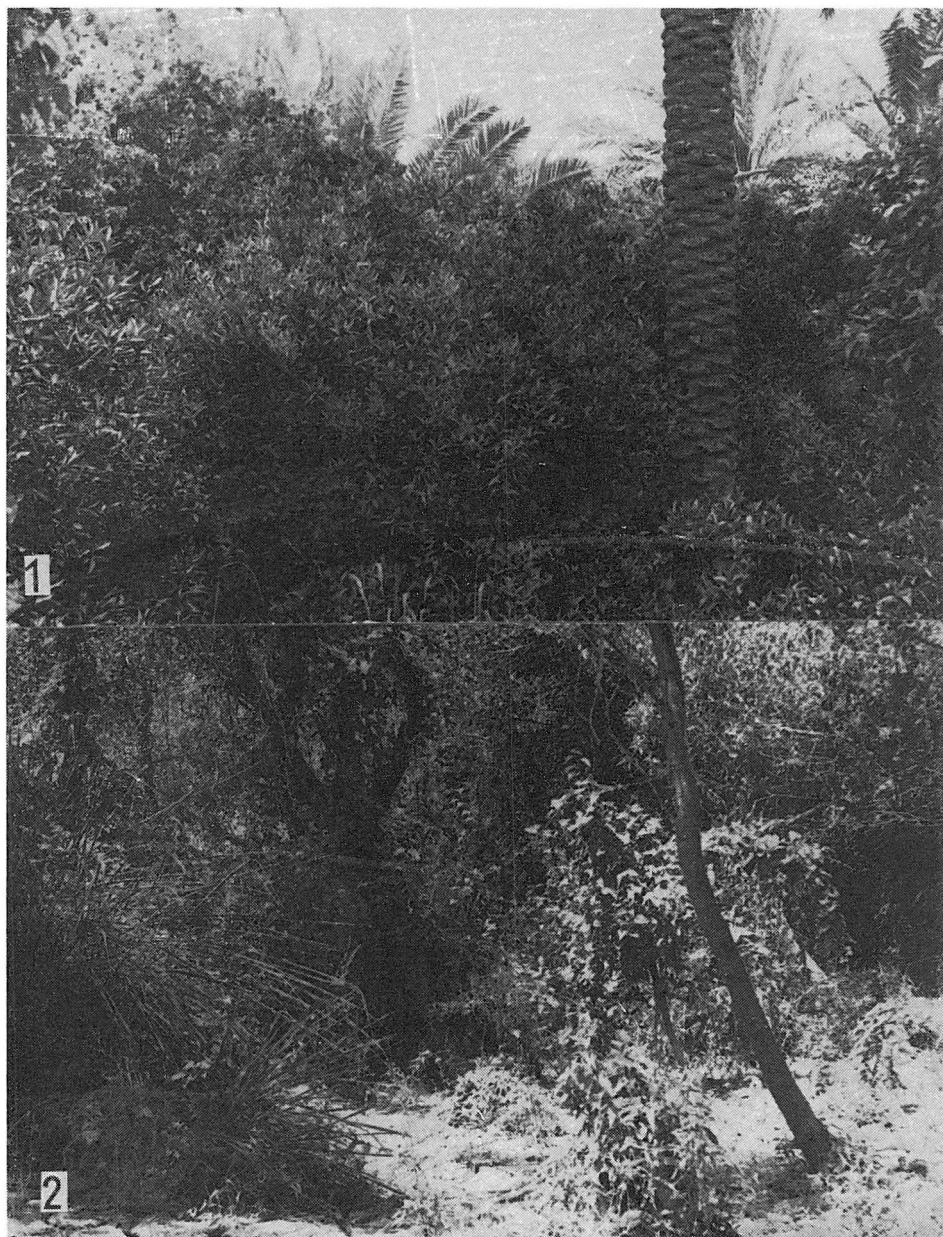
Peculiarities in parasite distribution

The peculiarities of Iraqi parasite fauna are conditioned by the geographic position of the country, by very remarkable North-South zonation, and by the occurrence of climatic extremes during the season in the southern areas.

The presence of the forests in the north and gradual change of the zone to steppe, semidesert and desert are one of the reasons, while the number of parasite species is gradually less to the south. It is well known that the greatest number of parasite species occur in the deciduous forest, forest-steppe and steppe districts. The parasite species associated with forest type habitats occur therefore mainly in the north and only some of them penetrate to the south due to the occurrence of riverain forest communities and cultivated lands (irrigated orchards, etc.). Nevertheless, even if we classify the specific composition of separate faunistic complexes of various (forest, steppe, etc.) type and compare them with the number of species known from Europe, it is obvious that the number of species in Iraq is less and this difference is more remarkable in the southern districts.

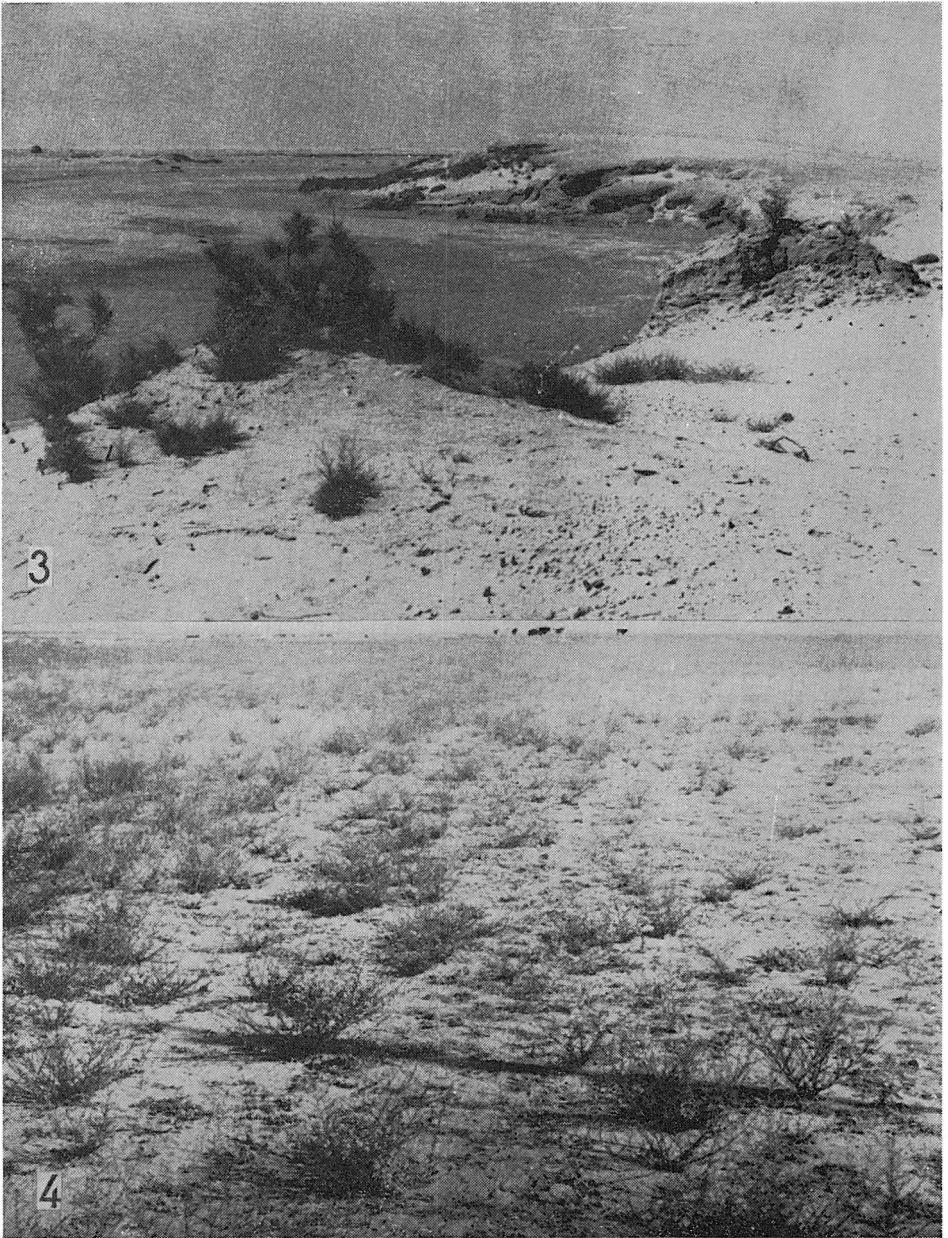
The comparison of the parasite spectra associated with an aphid species in the northern mountains and in the south (Baghdad) seems to illustrate the mentioned differences very well. Simultaneously, the differences in the conditions of the northern and southern districts allow the demonstration of the difference in host and parasite species because of the requirements of the host and associated parasites on the environment.

It seems there is a rule that none of the aphid species has a wider parasite spectrum in Lower Iraq than in the north. Two examples can be mentioned: *Hyalopterus pruni* (Geoffr.) — highlands — *Aphidius trans-*

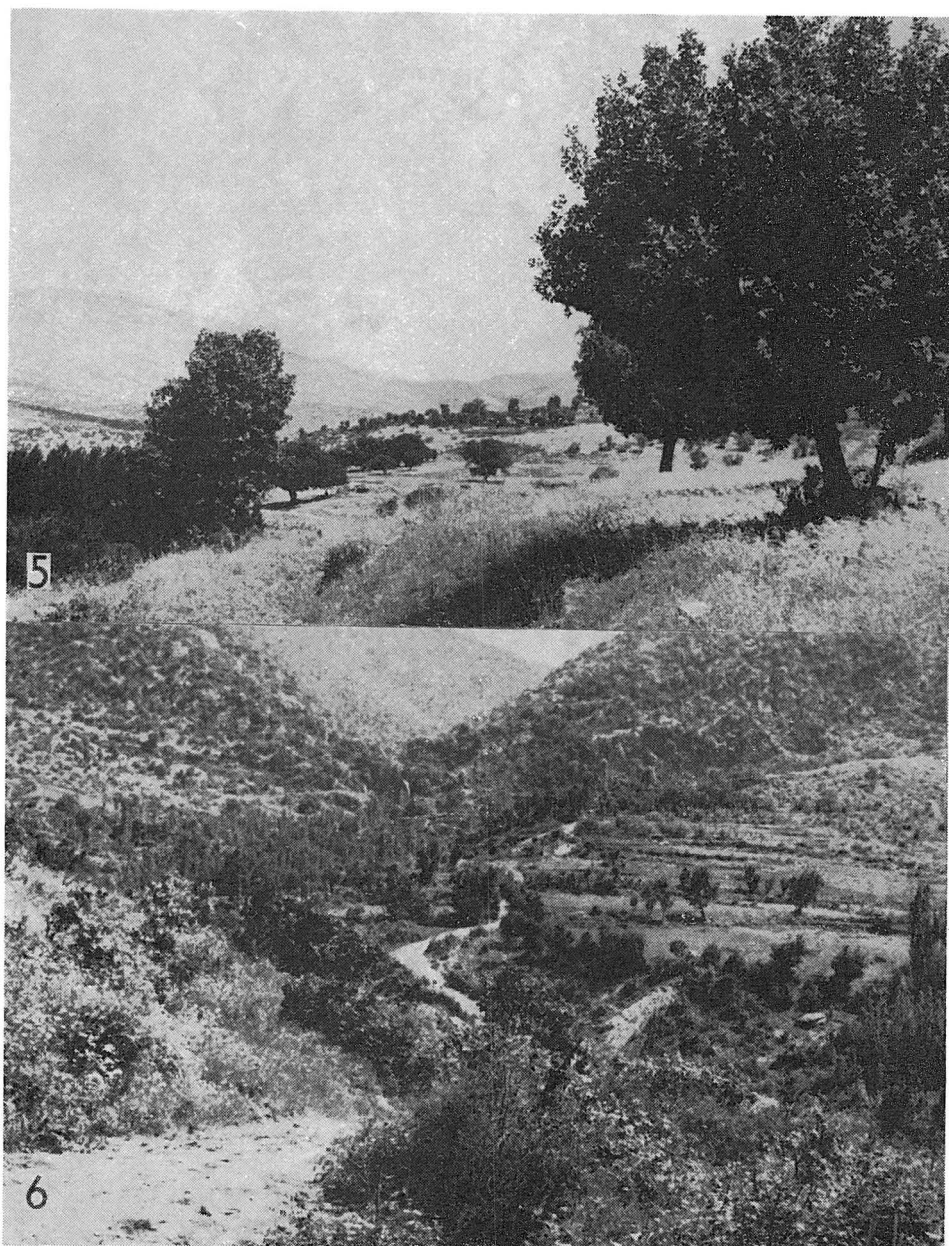


1. Irrigated orchards of the lowlands. Jadidat Ish Shat, nr. Baghdad (Citrus, apricot, palms, peaches, etc.).

2. Riverain Forest of the Plains (*Populus euphratica*). Baghdad, Al Jadriyah.



3. Wádí in a desert nr. Karbala (Tamarix and salsolaceous plants).
4. Steppe nr. Kirkuk, (Artemisia scoparia).



5. Mountain oak forest, nr. Salahuddin, Arbil (*Quercus aegilops*, *Q. infectoria*). Left — Mountain Riverain Forest (*Salix*, *Populus*, *Nerium*, etc.).

6. Mountain oak forest (*Quercus aegilops*, *Q. infectoria*) and irrigated orchards of the Mountains (in the centre). Tadzhike, nr. Sarsang, Mosul.

caspicus Telenga, *Praon volucre* (Haliday); Lower Iraq — *Aphidius transcaspicus* Telenga.

Macrosiphum rosae (L.) — highlands — *Aphidius rosae* Haliday, *Praon volucre* (Haliday); Lower Iraq — O.

We can therefore summarize that the geographic position and extreme climatic conditions in the south allow the comparison that the features of aphid parasite fauna of Iraq resemble those of a continental island, the barrier of extreme climate being equal to that of the sea in this case.

PECULIARITIES IN HOST AND PARASITE RELATIONSHIP

In this chapter we have included some features established in the host aphids and parasites in Iraq. There is no doubt that many other peculiarities will be revealed when a more detailed research is undertaken.

Narrower parasite spectrum associated with some aphid species.

We have established that several aphid species are parasitized only by some of the species which are known to attack them in northern territories (C. Europe, etc.). This can be explained by the inability of some species to survive the climatic conditions of Iraq, although favourable hosts occur here.

Dactynotus-species were found to be attacked solely by *Aphidius funebris* Mackauer in Iraq, while the following parasite species are common in Central Europe: *Aphidius funebris* Mackauer, *Ephedrus campestris* Starý, *Praon dorsale* (Haliday), *Trioxys centaureae* (Haliday).

Hyalopterus pruni (Geoffr.) was found to be parasitized solely by *Aphidius transcaspicus* Telenga in Lower Iraq and by *Aphidius transcaspicus* Telenga and *Praon volucre* (Haliday) in highlands, while the Central European spectrum includes *Ephedrus plagiator* (Nees), *E. persicae* Froggatt and *Praon volucre* (Haliday). However, *Aphidius transcaspicus* Telenga in Lower Iraq is much more effective by itself than the three species in Europe, where the percentage of parasitization is very low.

Lack of parasites in some aphid species

Some aphid species are known to be free of parasites also in other parts of their distribution area so that the lack of parasites in Iraq is not an exception. For ex.: *Lachnus*-species, *Calaphis juglandis* Goetze. In other species of aphids, parasites are known to occur in other countries but do not occur in Iraq. *Acyrtosiphon pisum* (Harris) seems to be free of parasites in Lower Iraq, although many parasites are known from other countries. This could be due to climatic conditions. For ex.: *Aphis nerii* B. d. F. Indigenous Iraqi parasites attack the aphid, but they are not capable of completing their development successfully. This indicates that the parasite populations exhibit a certain peculiarity in host range, which is different from southern European populations.

In some species, parasites are lacking in Lower Iraq, but they occur in the north. This difference in distribution is obviously due to the clima-

tic conditions of Lower Iraq which some parasite species are unable to survive. For ex.: *Macrosiphum rosae* (L.) — No parasites are known in Lower Iraq; *Aphidius rosae* Haliday and *Praon volucre* (Haliday) are known from the north, representing more or less the same parasite spectrum as is known from C. Europe.

Diapause in parasites

Aestival diapause of parasites during the hot summer months is known to occur in southern Italy and seems to be very probable in Iraq too, but this has not yet been established.

Aestival-hibernal diapause in *Monoctonia pistaciaecola* Starý was established also in Iraq. In this species the diapause is an obligatory part of its biology and represents an adaptation to the life-cycle of its gall-aphid hosts (*Forda*, *Pemphigus*). The parasite attacks the fundatrices exclusively before these are closed inside the galls. The parasite cocoons, including the prepupae, remain inside the galls until the next season when the favourable host progeny again appears.

Narrower host range in some parasite species

Judging from our recent level of knowledge it seems that many parasite species in Iraq find only a part of the aphids which belong to their host range. This is obviously due to the lack of many European aphids in Iraq, for example.

Praon flavinode (Haliday) occurs as a parasite of *Tuberculoides* — aphids, on oaks in the north, while it parasitizes a number of other dendrophilous Callaphidid aphids in C. Europe.

Trioxys pallidus (Haliday) is a parasite of the *Tuberculoides*-species on oaks and *Chromaphis juglandicola* (Kalt.) on walnuts in the north, while it attacks many other dendrophilous Callaphidids in C. Europe.

On the other hand, although the total host range is more restricted, the parasites in Iraq attack such aphid hosts which do not occur in Europe and consequently cannot be attacked. For ex.: *Lysiphlebus thelaxis* Starý. It is known as a parasite of *Thelaxes dryophila* (Schrk.) on oaks in C. Europe, while it attacks another *Thelaxes*-species on oaks in the north.

Seasonal occurrence

The seasonal occurrence of parasites in Iraq exhibits the usual differences in North-South zonation in Iraq. Owing to a cooler climate to the north, the same parasite species here occurs later in the season than in Lower Iraq. For ex.: *Aphidius transcaspicus* Telenga, *Lysiphlebus ambiguus* (Haliday), *Lysiphlebus fabarum* (Marshall), *Trioxys angelicae* (Haliday) and others.

The seasonal occurrence of parasites during the winter in Lower Iraq has not yet been studied, but there is need of such information as several aphid species occur during the mild winter and even cause considerable damage to some crops.

Another problem is the seasonal occurrence of parasites in irrigated lands, where the microclimate seems to be similar to that occurring in the riverain forest in the lowlands. The irrigated lands have a milder and for some aphids a more favourable climate than the semidesert communities, from which the aphids almost disappear very early in the warmer period of the year. *Aphis nerii* B.d.F. could be mentioned as an example. It can be observed in very abundant colonies in the first half of April on *Nerium oleander* shoots and flowers. It continues to occur here in June and even July (and probably later). The colonies become less numerous as the temperature increases, but there is not such a decrease as in the populations of most aphid species. *Aphis nerii* occurred in abundant numbers during the same period on *Cynanchum* in the undergrowth of a riverain forest, being common even on the sunny places in the ecotones; many other aphids were also found here. The significance of the oleander aphid for the survival of many natural enemies is obvious, although there is not an indigenous parasite in Iraq. *Nerium* ornamentals followed soon by aphids, are grown as one of the first ornamentals and plants in newly built districts of the cities and often represent the only source of aphids.

However, this survival of aphids in irrigated lands is not a general feature. For example, *Macrosiphum rosae* (L.), which is very abundant on *Rosa* in spring, practically disappears when hot temperatures start to prevail at the end of June, July and later.

Parasite populations and strains

At least two species of parasites exhibit some features in their biology which are different from those occurring in populations in other countries.

Lysiphlebus ambiguus (Haliday). First, the Iraqi populations are not capable of successfully parasitizing *Aphis nerii* B.d.F., although they do so in some other parts of parasite distribution area. Secondly, the Iraqi populations are deuterotokous or even arrhenotokous, while they were reported to be thelytokous in Israel.

Lysiphlebus fabarum (Marshall). The Iraqi populations are deuterotokous or arrhenotokous; the Israeli populations are thelytokous.

Hyperparasites

Three groups of hyperparasites are generally known in aphids: the Cynipids (Charipidae), the Chalcids (Pteromalidae), and the Proctotrupids (Ceraphronidae). The Cynipids are internal parasites of the larvae of primary parasites, while the other two mentioned groups are ectoparasites of the last instar larvae, prepupae, pupae and immature adults of primary parasites. It is a common thing that all three groups of hyperparasites are represented in a community. Such a situation exists, for example, in most parts of Europe. Our observations have shown that the situation is somewhat different in Iraq, resembling in principle such a situation prevailing in some islands. In almost all the samples there were

only Cynipids and Chalcids represented, while the Proctotrupids were found only in a single sample from Baghdad and in another from the north. It seems obvious that the climatic conditions of Iraq are not favourable for the Ceraphronids which are almost lacking in aphid parasite fauna, and their regulative action in the ecosystems is substituted by that of the Cynipids and Chalcids. Thus, the hot climate barrier is identical as to its action with that of the sea.

Parasites and their role in aphid limitation and control

The basic research of parasite fauna has indicated some problems of an applied character. It is our intention to stress such deduced problems and express our opinion. Many aphid species represent serious pests in Iraq and their control requires a complex point of view, the parasites as a group of natural enemies being a part of this complex.

Classification of aphids with respect to their economic significance.

1. Pest species.

Species attacked by parasites.

Parasites reach a high percentage of parasitization of aphids. Their action should be completed by the use of chemical treatment. Example: *Hyalopterus pruni* (Geoffr.) on apricots and peaches in spring is practically reduced to very low numbers by the action of *Aphidius transcaspicus* Telenga, but the high percentage occurs after the peak of aphid population. The timing of treatment by a selective insecticide could be useful.

Parasites are rare or the percentage of parasitization is low. Their action should be completed by the introduction of a more effective species and other control methods.

Species not attacked by parasites

Species not attacked by parasites at all. Such species could be e.g. *Lachnus*-species, or *Calaphis juglandis* Goetze. The role of predators should be dealt with as well as other control methods, if the species are really pests.

Species not attacked by parasites in Iraq. This case can be due to the influence of climatic factors, or by the occurrence of other parasite strains in Iraq. Example: *Macrosiphum rosae* (L.) is not attacked by parasites in Lower Iraq, while the parasites are known to occur in the north. It is obvious that the northern populations cannot survive in the south and better adapted populations from other countries should be experimentally introduced. Example: *Aphis nerii* B.d.F. The indigenous Iraqi parasites were observed to attack the aphid, but are not capable of completing their development. This is undoubtedly a case of an unadapted parasite strain. Better adapted strains of the same species (*L. ambiguus* Haliday) or other species (*L. testaceipes* Cresson) should be introduced.

2. Aphids as traps for parasites.

This is the case of *Aphis nerii* B.d.F. The aphid is very common on Nerium oleander and other ornamentals in irrigated lands as well as in natural communities (Riverain forest of the Mountains and of the Lowlands). For example, it is capable of surviving even the hot summer period, often in large numbers; according to our observations the aphid decreases generally in numbers in July in irrigated gardens, but even there numerous colonies may be found in shaded parts on the young shoots of the oleander and, moreover, a great abundance of the aphid can be observed on Cynanchum in the undergrowth of a Lowland Riverain forest. Some parasite species were observed attacking the aphids very commonly in April as well as in later months but, as we have already mentioned, the parasites are not capable of completing their development successfully. Consequently, the aphid must be classified as a trap for some parasite species as the eggs are undoubtedly deposited in those unfavourable hosts and this causes a decrease of parasite progeny, as the latter could be deposited more advantageously in other aphid species co-existent in the ecosystem (*Aphis punicae* Pass., *Aphis gossypii* Glov., *Aphis craccivora* Koch, *Aphis fabae* Scop., etc.). Such situation should be solved through the introduction of such a parasite species, which attacks both *Aphis nerii* and at least some other pest species. *Lysiphlebus testaceipes* (Cresson) is recommended for introduction from such a point of view.

3. Economically indifferent species.

Species not attacked by parasites. No control activities are necessary.

Species attacked by indifferent parasite species. Such aphids and associated parasites have no relation to the crops and are indifferent. Example: *Dactynotus*-species and associated *Aphidius funebris* Mackauer on Sonchus-weeds.

Species attacked both by indifferent parasites and parasites of pest species. This is a case of an aphid being attacked by a specialized parasite and a widely specialized parasite, the latter including a pest species in its host range.

Species attacked by parasites of pest species and representing their alternative hosts. Example: *Longiunguis donacis* (Pass.) is an alternative host of *Aphidius transcaspicus* Telenga, which is the main parasite of *Hyalopterus pruni* (Geoffr.) — pest. Such aphids can be useful for enabling parasite survival, etc.

4. Useful species.

If we classify the large production of honeydew by aphids on the oaks being useful for man, while the possible damage caused by aphids to the oaks is omitted, the *Lachnus*- and *Thelaxes*-species could be mentioned.

Species not attacked by parasites. Example: *Lachnus*-species.

Species attacked by parasites. Example: *Thelaxes*-species and associated *Lysiphlebus thelaxis* Starý on oaks. Although the parasite was observed to reach a high percentage of parasitization, parasitism cannot be classified as being useless as it means the reduction of host aphid po-

pulation equilibrium level, preventing the food source from too serious exploitation.

Natural limitation of aphids by parasites and their role in control

Parasites may not be considered either as a single factor of aphid limitation or isolately classified. They represent a part of a whole complex of natural enemies and their action is basically co-operative with the other groups of natural enemies. They are rarely capable of limiting the pest number on subeconomic levels. More often, they can reach a high percentage of parasitization, but their main action comes after the peak of pest population, when the main damage has already been made to the crop (*Hyalopterus pruni* x *Aphidius transcaspicus*). It seems that most of the parasites which fall in the group of partially effective species belong to the second group of parasites. Thus, the parasites should be classified as a factor which is capable of decreasing the pest number in a certain part of the season; its action can be higher or lower, depending on its role in the complex of natural enemies. The period of parasite action should be considered in a pest aphid control programme and other methods investigated. For example, according to our studies (Al-Rawy, Kaddou, Starý, in press) the treatment against *Hyalopterus pruni* (Geoffr.) should be undertaken by a selective insecticide and timed to such a period when there are no aphid mummies or very few, on the apricot leaves, i.e. the period of aphid increase. Later on, when a greater number of mummies can be found, the treatment is of no value and even wrong; most of the live aphids at this period are already parasitized and soon killed by the parasite larvae, and the emerged parasite adults are very sensitive to the action of even selective insecticides and die when treated.

Another positive feature of parasite biology with respect to control is that they are relatively more specialized than the predators and the population-relationships seem to be closer in consequence. Furthermore, parasite complexes are generally typical for a certain type of ecosystem, so that even a migrating aphid does not escape parasite action. In the same type of habitat, such as orchards, etc., the widely specialized parasite species can attack the same pest species on several crops (polyphagous pest species such as *Aphis gossypii* Glov., *Aphis craccivora* Koch, *Myzus persicae* Sulz., etc.), and can survive its possible absence by parasitizing other (pest) species. We can cite as an example the group of parasites and their pest aphid hosts in the orchards of Lower Iraq (*Aphis gossypii* Glov., *Aphis punicae* Pass., *Aphis craccivora* Koch, etc.).

Aphids as control objects in Iraq

Some aphid species have found the conditions of Iraq to be very congenial and become serious pests. This is due to the climate, lack or low effectiveness of natural enemies (parasites), growing of monocultures, application of non-selective insecticides against other pests, etc. For the time being the following species can be considered as pest problems (in some parts of Iraq): *Acyrtosiphon pisum* (Harris), *Aphis craccivora*

Koch, *Aphis fabae* Scop., *Aphis gossypii* Glov., *Eriosoma lanigerum* (Hausm.), *Hyalopterus pruni* (Geoffr.), *Macrosiphum rosae* (L.), *Myzus persicae* Sulz., *Pterochloroides persicae* (Chol.), and certainly there will be several others.

Parasite introduction

A typical feature of indigenous Iraqi fauna is, first, the lack of some parasite species, second, the poorer parasite spectra associated with separate pest species. Local climatic conditions and also some biological peculiarities (strains) seem to be the main factor. These considerable gaps in parasite spectra could be covered through the introduction of some parasite species from abroad. At least the following species should be experimentally dealt with, while the peculiarities of the Iraqi climate should be considered when searching for parasites and later in selecting certain species for introduction.

Aphelinus-species, a parasite of *Eriosoma lanigerum* (Hausm.). — Although it is an Aphelinid wasp, we mention it here as well, as the necessity of its introduction to Iraq is obvious.

Aphidius rosae Haliday, a parasite of *Macrosiphum rosae* L. The parasite occurs in the north of Iraq, but local populations are obviously not capable of surviving the hot climatic conditions of Lower Iraq. Consequently, better adapted populations should be searched for abroad.

Aphidius smithi Sharma and Subba Rao, a parasite of *Acyrtosiphon pisum* (Harris). The parasite, being of Indian origin, has been successfully introduced to California, Hawaii, and other countries, and its introduction to Iraq could be advantageous, at least to irrigated lands.

Lysiphlebus ambiguus (Haliday), a parasite of *Aphis nerii* B.d.F. The local Iraqi populations, although occurring in the same habitat are not capable of completing their development in the aphid successfully. Other populations should be introduced, for example, from southern Italy. The parasite also attacks a number of other aphids, including some pests.

Lysiphlebus testaceipes (Cresson), a parasite of quite a number of aphids. Populations from California, Florida or Cuba seem to be the most useful for introduction to Iraq. It attacks such pests as *Aphis craccivora* Koch, *Aphis gossypii* Glov., *Aphis fabae* Scop., *Rhopalosiphum maidis* (Fitch) as well as *Aphis nerii* B.d.F., etc. It could cover the gap in the natural enemy spectrum of *Aphis nerii* B.d.F. and could be useful in the control of other pests.

Naturally, this list of parasites recommended for introduction to Iraq is far from complete, as there are only a few examples mentioned.

Parasite exportation

The climatic conditions of Iraq to which many parasite species are adapted as well as their other biological features make some of them favourable objects for exportation to other countries. Such activities have already been undertaken by the workers of California University (*Aphidius matricariae* Haliday, *Aphidius transcaspicus* Telenga, and others).

Host and parasite catalogue

- Aphis affinis* Del Guercio, 1911: *Aphidius matricariae* Haliday, *Lysiphlebus fabarum* (Marshall), *Trioxys acalephae* (Marshall).
- Aphis craccivora* Koch, 1854: *Aphidius matricariae* Haliday, *Lysiphlebus ambiguus* (Haliday), *Lysiphlebus fabarum* (Marshall), *Praon abjectum* (Haliday), *Trioxys angelicae* (Haliday).
- Aphis fabae* Scopoli, 1763: *Lysiphlebus ambiguus* (Haliday), *Lysiphlebus fabarum* (Marshall).
- Aphis gossypii* Glover, 1854: *Lysiphlebus ambiguus* (Haliday).
- Aphis parietariae* Theobald, 1922: *Aphidius matricariae* Haliday, *Trioxys* sp.
- Aphis punicae* Passerini, 1863: *Praon abjectum* (Haliday), *Trioxys angelicae* (Haliday).
- Aphis ruborum* (Börner, 1932): *Lysiphlebus fabarum* (Marshall).
- Aphis solanella* Theobald, 1914: *Lysiphlebus fabarum* (Marshall), *Praon abjectum* (Haliday), *Trioxys angelicae* (Haliday).
- Aphis viticis* Ferrari, 1872: *Praon abjectum* (Haliday), *Trioxys angelicae* (Haliday).
- Aphis zizyphi* Theobald, 1918: *Aphidius transcaspicus* Telenga, *Trioxys angelicae* (Haliday).
- Aphis* sp.: *Lysiphlebus ambiguus* (Haliday), *Lysiphlebus fabarum* (Marshall), *Praon abjectum* (Haliday), *Trioxys* sp.
- Brachycaudus* sp.: *Lysiphlebus fabarum* (Marshall), *Trioxys* sp.
- Capitophorus carduinus* (Walker, 1850): *Lysiphlebus fabarum* (Marshall).
- Chaitophorus* sp.: *Lysiphlebus salicaphis* (Fitch), *Praon* sp.
- Chromaphis juglandicola* (Kaltenbach, 1843): *Trioxys pallidus* (Haliday).
- Dactynotus jaceae* (Linnaeus, 1758): *Aphidius funebris* Mackauer.
- Dactynotus sonchi* (Geoffroy, 1762): *Aphidius funebris* Mackauer, *Diaeretiella rapae* (M'Intosh).
- Forda* sp.: *Monoctonia pistaciaecola* Starý.
- Hyalopterus pruni* (Geoffroy, 1762): *Aphidius transcaspicus* Telenga, *Praon volucre* (Haliday).
- Longiunguis donacis* (Passerini, 1862): *Aphidius transcaspicus* Telenga, *Praon volucre* (Haliday).
- Macrosiphum rosae* (Linnaeus, 1758): *Aphidius rosae* (Haliday), *Praon volucre* (Haliday).
- Macrosiphum* sp.: *Aphidius* sp., *Praon* sp.
- Myzus persicae* (Sulzer, 1776): *Aphidius matricariae* Haliday, *Praon* sp.
- Pterochloroides persicae* (Cholodovsky, 1899): Unidentified parasite species (mummies).
- Thelaxes suberis* (Del Guercio, 1911): *Lysiphlebus thelaxis* Starý, *Trioxys quercicola* Starý.
- Therioaphis* sp.: *Praon exsoletum* (Nees).
- Tuberculoides* sp.: *Praon flavinode* (Haliday), *Trioxys pallidus* (Haliday).

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Summary

A brief review of aphidiid parasites fauna of Iraq is given, including a sketch on the representation of separate faunistic complexes. Peculiarities in the parasite distribution were recognized, being conditioned by the geographic position of the country, by the very remarkable North-South zonation, and by the occurrence of climatic extremes during the season in the southern areas. Similar general features appear also to occur in the hyperparasites. Aphids were classified with respect to their economic significance and the main control objects selected. The role of parasites in aphid limitation and control is dealt with. Parasite introduction projects were elaborated. Some parasites are recommended for exportation. Host and parasite catalogue is added.

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