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Aphid Parasitoids in a Dry Lowland Area of Khuzestan, Iran (Hymenoptera, Braconidae, Aphidiinae)

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ABSTRACT

Parasitoid-aphid-plant associations were examined in searching for potentially promissive biocontrol agents as well as faunal composition in approximately 400 samples collected in Khuzestan during 1976-1978 and in 2008. Altogether, 14 parasitoids species were recorded, among which 2 and 5 species were new records for Iran and Khuzestan fauna, respectively. Low parasitoid species richness was observed in the area studied. Aphid host species were found to be associated with the parasitoids in all environments studied. Some plants and habitats represent refugia in which parasitoid-aphid associations may survive unfavourable periods including those where poorly selective pesticides have been applied. Patterns of individual aphid and parasitoid species and combinations of aphid-parasitoid species identified, were similar for the two sampling periods 1976-8 and 2008.

Key words: Faunal composition, biocontrol agents, Khuzestan, Iran

INTRODUCTION

A central Asian framework for the target research, presented by Starý (1979) was followed by a review of research work on aphid parasitoids in Iran (Starý *et al.*, 2001). Iran is known as a cross-roads for different faunas hence the importance of research also into the aphid-parasitoid fauna of this region.

Research on aphid parasitoids has intensified recently with key interest to the biosystematics of parasitoids, parasitoid complexes on different pest aphid species, refugia, zonation in distribution and crops affected (namely cereals): (Rakhshani *et al.*, 2006, 2007a, b, 2008a, b; Starý *et al.*, 2005; Talebi *et al.*, 2009). Last but not least, the territory of Iran has been explored for the presence of aphid parasitoids that can be exploited as biological control agents in other parts of the world. Some such agents have been exported already by Starý *et al.* (2001).

Evidence for the presence of aphid parasitoids in Khuzestan has been presented by Baroon *et al.* (2008), Khajehzadeh *et al.* (2006), Modi and Mossadegh (2006), Mossadegh (1991), Mossadegh and Kocheili (2003) and Rezaei *et al.* (2006).

In the present study, we concentrate on the faunal characteristics distinctive features of Khuzestan. Faunal interactions between crops and non-crops were derived and related to environmental management and pest aphid control methods. Furthermore, the potential of parasitoid species isolated was assessed for use as biocontrol agents.

MATERIALS AND METHODS

The Khuzestan Province of Iran includes forrested mountainous and dry lowland areas. In the present study it was selected as a model for studying species composition and parasitoid-aphid-plant interactions in a dry lowland environment. The habitats studied involved urban agroecosystems, gardens, sites, orchards and field stands.

Samples were collected during 1976-1978 and in 2008 to allow for changes in faunal composition with time to be monitored following some earlier pioneer studies such as that of Mossadegh (1991).

Aphid colonies were collected, together with a part of the plant on which they were situated, by gently cutting the plant with scissors and transferring into transparent containers 13×9.5×5 to 36×23×10 cm to obtain aphid parasitoids. Four 2 cm holes in diameter covered with fine mesh gauze were provided on lead of containers for ventilation. These samples were maintained at room temperature for about two weeks to allow for emergence of parasitoids. The plant species was identified *in situ* or a sample was taken for later identification in an herbarium (Mozaffarian, 1999; Sabeti, 1994). A representative sample of aphids, also, was collected and transferred into 70% ethanol for laboratory identification. Any parasitoids that emerged were collected similarly in 70% ethanol for later identification. Samples on iso specific plant species were repeated centering the gradual completeness of the parasitoid spectra (guilds, assemblages) as well as the seasonal occurrence of the individual species members on individual plant associations.

Basic information on aphids of Iran was obtained from Hodjat (1993) and Eastop and Hodjat (1978). Aphids were identified by Hodjat (1993) based on nomenclature of Remaudiere and Remaudiere (1997). Parasitoid identification was made by P. Stary following the nomenclature of Starý *et al.* (2001).

The collected material is deposited in the insect collection of Plant Protection Department, College of Agriculture, Shahid Chamran University, Ahwaz, Iran, with some representative specimens being preserved, also, in the collection of P. Stary (Èeské Budìjovice).

RESULTS AND DISCUSSION

In these studies, altogether 14 parasitoid species were recorded and identified , among which 2 and 5 species were new records for Iran and Khuzestan respectively. Parasitoid species and their associations are listed in Table 1.

Taxonomy: Some parasitoid species were not identified to species level. *Lysiphlebus* sp. A is characterized by manifesting metacarpus length equal to pterostigma length, irregularly distributed setae on the lateral forewing margin, which are longer than the surface setae; adpressed setae on hind leg femora and tibiae. *Lysiphlebus* sp., B manifests metacarpus length equal to pterostigma length, forewing lateral margin with regular setae which are longer than the surface setae, adpressed setae on hind femur and tibia. *Aphidius* sp., closely resembling *transcaspicus* Tel. is another unclear species. The aforementioned parasitoid species are of broader distribution, at least in Asia Minor and they require further, special taxonomic treatment.

Fauna: From an analysis it is clear that the number of species represented in the aphid parasitoid fauna reflects the semi-arid nature and geographical position of the area. In comparison to other regions of Iran, numbers of aphid species recorded were also low, as were those of their respective

Table 1: Parasitoid species and their host associations

Parasitoid	Hosts: Aphids	Hosts: Plants
Aphidius colemani Viereck	*Aphis* sp.	*Aster* sp., *Chrysanthemum* sp.
	Myzus persicae Sulzer	*Chrysanthemum* sp., *Convolvulus arvensis*
Aphidius hieraciorum Starý	*Nasonovia* sp.	*Lactuca sativa*
Aphidius matricariae Haliday	*Aphis craccivora* Koch.	*Centura* sp., *Medicago polymorpha, Melilotus officinalis*
	Aphis euphorbiae Kalt.	*Euphorbia cyparrisias*
	Aphis fabae Scop.	*Ammi majus*
	Aphis gossypii Glov.	*Tecoma stans, Cestrum nocturnum*
	Aphis. sp.	*A. majus, Anagallis arvensis, Aster* sp., *Callendula officinalis, Centura* sp., *Chrysanthemum* sp., *Duranta plumieri, Hibiscus esculentus, Lamium* sp., *Malva* sp, *Mentha pulegium, Rumex acetosa, Silybum marianum, Tagetes* sp., *Urtica dioica*
	Brachycaudus helichrysi (Kalt.)	*Chrysanthemum* sp.
	Dysaphis plantaginea (Pass.)	*Malus* sp.
	Hyperomyzus lactucae (L.)	*Antirrhinum majus, Coropsis delphinifolia, Silybum marianum*
	Lipaphis sp.	*Raphanus sativus*
	Lipaphis erysimi (Kalt.)	*Brassica kaber, Brassica oleracea*
	Lipaphis lepidii (Nevsky)	*B. kaber, C. arvensis, Lepidium draba*
	M. persicae	*Amaranthus* sp., *Antirrhinum majus Beta maritima, B. kaber, C. officinalis, Caucalis* sp., *Centura* sp. *Chrysanthemum* sp., *Convolvulus* sp.,*C. arvensis, Dodona viscosa, Eruca* sp., *Euphorbia helioscopia, Euphorbia* sp., *Helianthus annus, Lamium* sp., *Lepidium draba, Malva* sp., *Nicotiana tabacum, Papaver dubium, S. marianum, Tagetes* sp.
	Rhopalosiphum padi (L.)	*Bromus* sp., *Hordeum murinum*
	Sitobion avenae (F.)	*Triticum aestivum*
	Aphids-	*Chrysanthemum* sp., *Galium* sp., *Petroselinum sativum, Spinacia oleracea*
Aphidius persicus Rakhshani et Starý	*Uroleucon sonchi* (L.)	*Lactuca serriola, Sonchus asper*
Aphidius rhopalosiphi DeStefani-Perez	*S. avenae*	*Avena fatua, T. aestivum*
Aphidius rosae Haliday	*Macrosiphum rosae* (L.)	*Rosa* sp.
Aphidius transcaspicus Telenga	*Hyalopterus amygdali* (Blanch.)	*Phragmites* sp., *Prunus amygdalus, P. armeniaca*
Aphidius sp.near *transcaspicus* Telenga	*A. fabae*	*A. majus*
	M. persicae	*A. majus*
Binodoxys acalephae *(Marshall)*	Aphis sp.	*Vicia villosa*
	Aphids	*Cicer arietinum*
Binodoxys angelicae (Haliday)	*Aphis affinis del* Guercio	*Mentha piperita*
	Aphis craccivora Koch.	*Medicago polymorpha, Medicago sativa, M. officinalis, Solanum nigrum, Vicia faba*
	A. fabae	*Carduus* sp., *Carduus getulus, Chrysanthemum pyrethrum., S. nigrum, V. faba*
	A. gossypii	*Althaea rosea, C. nocturnum, C. pyrethrum, Dahlia excelsa, Duranta plumieri, Gossypium herbaceum, Hibiscus rosa-sinensis, Malva parviflora, M. piperita, Prosopis juliflora, S. nigrum, T. stans*

Table 1: Continued

Parasitoid	Hosts	
	Aphids	Plants
	Aphis polygonata Nevs.	*Polygonum aviculare*
	Aphis umbrella (Börner)	*Malva parviflora*
	Aphis sp.	*A. rosea, Capsella bursa pastoris, Cosmos* sp., *D. plumieri, H. rosa-sinensis, Lamium* sp., *Lantana camera, Malva* sp., *M. piperita, M. pulegium, Rumex acetosa, Scrophularia* sp., *Tagetes* sp.
	Brachycaudus helichrysi	*D. plumieri*
	Hyperomyzus sp.	*S. marianum*
	M. persicae	*Beta vulgaris, C. officinalis, C. pyrethrum, Emex spinosus, M. parviflora, Papaver dubium,S. marianum, Tagetes* sp.
	Myzus sp.	*Papaver rhoeas*
Diaeretiella rapae (M´Intosh)	*A. gossypii*	*H. rosa-sinensis, P. juliflora*
	Aphis sp.	*A. majus*
	Brevicoryne brassicae (L.)	*Brassica gongiloides, B. oleracea,*
	Lipaphis erysimi (Kalt.)	*B. kaber,Brassica napus, Brassica rapa, Eruca* sp. *Brassica chinensis, B. gongiloides, B. oleracea, B. oleracea, B. rapa, Lipaphis* sp., *Raphanus sativus*
	Lipaphis lepidii (Nevsky)	*Lepidium draba*
	M. persicae	*Dianthus* sp., *A. majus, B. oleracea, C. arvensis, Eruca* sp., *L. draba, R. sativus, S. marianum,*
	Rhopalosiphum padi (L.)	*Triticum aestivum*
	S. avenae	*T. aestivum*
Ephedrus persicae Froggatt	*Aphis* sp.	*Beta maritima*
	Rhopalosiphum maydis (Fitch)	*Hordeum vulgare*
Lysiphlebus fabarum (Marshall)	*A. gossypii*	*Pyrus communis*
	A. craccivora	*Phaseolus vulgaris*
	A. gossypii	*Solanum melongena*
Lysiphlebus sp. A	*A. craccivora*	*Medicago polymorpha, Medicago sativa, Melilotus officinalis, Portulaca oleracea, V.faba, Vicia sativa Vicia villosa, Xanthium stramarium,*
	A. fabae	*C. getulus, V. faba*
	Aphis frangulae Kalt.	*Viola tricolor A.rosea, Anchosa strigosa, C. nocturnum Gossypium herbaceum, Hibiscus esculentus, M. parviflora, P. juliflora, Zinnia elegans*
	A. gossypii	*A. rosea*
	Aphis umbrella	*Malva nigriflora, Malva* sp.
	Aphis polygonata (Nevsky)	*Polygonom aviculare*
	Aphis sp.	*Atriplex* sp.,*Carthamus oxyacanthus, Carthamus tinctorius, Centura* sp.,*Citrus* sp.,*Dahlia excelsa, H. rosa-sinensis, Malva* sp., *M. piperita, R. acetosa, S. marianum, S. nigrum*
	Brachyunguis harmalae Das.	*Peganum harmala*
	Lipaphis lepidii (Nevsky)	*L. draba*
	M. persicae	*Atriplex* sp., *B. maritima, C. officinalis, S. marianum Solanum tuberosum*
	Aphids	*Glycyrrhiza glabra, Lycium* sp., *Trifolium* sp. *Urtica dioica.*

Table 1: Continued

Parasitoid	Hosts	
	Aphids	Plants
Lysiphlebus sp. B	*A. craccivora*	*V. fabae*
	A. fabae	*V. fabae*
	A. gossypii	*D. excelsa*
	M. persicae	*A. majus, R. sativus*
Praon necans Mackauer	*A. gossypii*	*P. juliflora*
	Aphis nerii B.d.F.	*Nerium oleander*
	Aphis sp.	*Anagallis arvensis, Scrophularia* sp., *Spergullaria* sp.
	M. persicae	*Euphorbia helioscopia*
	Rhopalosiphom padi (L.)	*Hordeum vulgare*
	S. avenae	*T. aestivum*
	Aphids-	*Rosa* sp.

parasitoid complexes (Starý *et al*., 2001). *Aphidius matricariae*, *B. angelicae*, *D. rapae* and *Lysiphlebus* sp. A are clearly dominant, they are broadly oligophagous and this phenomenon seems to contribute positively to their occurrence in an extreme dryland environment. *L. fabarum* and *Lysiphlebus* sp. B are less common, being more widely distributed in Central Asia than in Khuzestan. *Aphidius rhopalosiphi* was found to be a widely distributed parasitoid of cereal aphids while *A. rosae* was a broadly distributed parasitoid of the rose aphid in gardens. *A. hieraciorum* is an associate with *Nasonovia* in a broader area in the west Palearctic. *A. colemani* is an endemic of Central Asia manifesting but broader natural distribution and similar characteristics is that of *A. transcaspicus*. *A. persicus* is an endemic of central Asia and it was detected also in Khuzestan. *P. necans* is newly detected in Iran, with some interesting new host associations since it is generally known as an associate of *Rhopalosiphum nymphaeae* on aquatic plants. In some cases, species known to occur in forest habitats in the mild zone of Europe (*A. hieraciorum, B. angelicae, P. necans*), were found to occur also in the dryland area, though in this instance in the environs of sites that were being irrigated.

Parasitoid complexes: There is an obvious paucity of species in the parasitoid complexes (=guilds, assemblages) identified in the present area of study as compared to those identified for other areas of Iran (Starý *et al*., 2001). This phenomenon can be explained by the combination of a dry lowland environment with the effect of human activities.

Refugia: A broad oligophagy of the key aphid species is connected with their occurrence on a number of host plants such as crops, ornamentals and weeds. Seasonal changes and plant conditioning are associated with the host alternation. Similar situation occurs also in the parasitoids in which, however, the host range of prevailingly oligophagous species allows more or less different community interactions compared with their aphid hosts (Starý, 1972, 1978). Irrigated areas tend to represent preferable refugia than the non-irrigated areas.

Parasitoid complexes comprise, usually, several species which interact in different sites and habitats, so that the overall pressure is represented at least by one parasitoid species, but often mixtures per a sample (size dependence) occur (Starý and Rejmánek, 1981). Parasitoids thus attack their aphid hosts at all the environments during the course of a season. This association is important also for the eventual re-covery of the parasitoids in case of crop treatment by less-selective insecticides. Parasitoid species and their associations are listed in Table 1.

Biological control: Populations of some parasitoid species adapted in the plane dryland area of Khuzestan might become potentially useful biocontrol agents for exportation. This parasitoid species set includes the dominant species (see above) and *A. colemani* and *A. transcaspicus* because of several aphid pest biocontrol projects in the world (e.g., *Diuraphis noxia* Kurdj., *Hyalopterus pruni* Geoffr.) (Starý *et al.*, 2001).

Outlines: The presented evidence manifests clearly the need for further complex research on the target group in other regions of the Khuzestan province supplementing an over-all faunal research of Iran.

CONCLUSION

Patterns of individual aphid and parasitoid species and combinations of aphid-parasitoid species identified, were similar for the two sampling periods 1976-8 and 2008.

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