

**DISTRIBUTION AND NATURAL ENEMIES  
OF RUSSIAN WHEAT APHID, *DIURAPHIS  
NOXIA* (MORDVILKO)  
(HOMOPTERA:APHIDIDAE) IN THE FARS  
PROVINCE<sup>1</sup>**

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**ABSTRACT**

Field surveys were carried out from January 1988 to August 1991 to assess the distribution of Russian wheat aphid (RWA) and its natural enemies in the Fars province of Iran.

From 14 species of natural enemies of RWA, parasitization by *Pronotalia* sp., *Toxares* sp. and *Aphelinus flaviventris* Kurdjumory, and predation by *Scymnus apetzi* Mulsant have not been previously recorded in the world.

*Aphelinus varipes* Foerster and *A. flaviventris* followed by *Diaeretiella rapae* (McIntosh) were the most frequently found natural enemies of RWA in the Fars province. The first two species were active and had their greatest impact on RWA in June and July.

High levels of parasitization of the aphelinids by *Chartocerus* sp. slowed the build up of these parasitoids early in the season, reduced the number of overwintering parasitoid individuals and consequently eased attacks on aphid populations the following year.

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## تحقیقات کشاورزی ایران

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پراکنندگی و دشمنان طبیعی شته روسی گندم (*Diuraphis noxia* (Mordvilko))  
(Homoptera:Aphididae) در استان فارس

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### چکیده

بررسی های مزرعه ای به منظور مشخص کردن پراکنندگی و دشمنان طبیعی شته روسی گندم از دیماه ۱۳۶۸ تا شهریور ۱۳۷۰ در استان فارس انجام گردید. از چهارده گونه دشمنان طبیعی شته روسی گندم که در این بررسی جمع آوری شده، پارازیته شدن توسط *Toxares* sp.، *Pronotalia* sp. و *Aphelinus ?flaviventris* Kurdjumory و شکار شدن توسط *Scymnus apetzi* Mulsant تا به حال در دنیا گزارش نشده است. گونه های *Aphelinus varipes* Foerster و *A. ?flaviventris* در درجه بعدی *Diaeretiella rapae* (McIntosh) فراوانترین دشمنان طبیعی شته روسی گندم در استان فارس بودند. دو گونه اول در خرداد و تیرماه فعال بوده و بیشترین اثر را بر روی شته روسی گندم داشته اند. پارازیته شدن تعداد زیادی زنبور aphelinid توسط زنبور *Chartocerus* sp. سبب کند شدن رشد جمعیت این پارازیتوئید در اول فصل شده، تعداد زنبورهای زمستان گذران را تقلیل داده و در نهایت میزان تهاجم به شته را در سال بعد کاهش می دهد.

### INTRODUCTION

The Russian wheat aphid (RWA), *Diuraphis noxia* (Mordvilko), is a serious small grain pest in different parts of the world. It damages the host plants by withdrawing plant sap and injecting a powerful toxin into the tissues (4, 16). The most common visible damages are white, yellow or

purple longitudinal streaking of leaves and stems, leaf rolling and awn trapping. RWA is indigenous to southern Russia, countries bordering the Mediterranean sea, Afghanistan and Iran (47). Davatchi (9) and Farahbakhsh (13) reported the aphid from Varamin, Isfahan, Sirdjan and Ardekan. Remaudiere (see 17) has also found endemic level of RWA in cultivated wheat and barley in Iran. More recently, RWA has been reported from Shiraz (24) and Karadj (22). At present, the aphid occurs in several countries in Asia (6, 31), Europe (2, 15), Africa (21, 30, 46), and Central and North America (4, 23, 40).

RWA is attacked by various natural enemies. Several identified and unidentified species of *Aphelinus*, *Aphidius*, *Praon* and *Ephedrus* parasitize the aphid in its distributional areas (1, 4, 6, 17, 36).

Reports of Flanders (15), Naranjo *et al.* (33), Carl (6), Grossheim (18), Maedgen (27) and Pike and Tanigoshi (37) indicate that coccinellids, chrysopids, chamaemyiids and syrphids attack RWA.

This paper reports the distribution of RWA and identification and relative abundance of RWA natural enemies in the Fars province.

## MATERIAL AND METHODS

Specimens of RWA and its natural enemies were collected on gramineous plants in various locations in the Fars province from January 1988 to August 1991. Wheat and barley fields were surveyed in an "X" pattern during the growing season. Tillers were taken at 20 sites, 10 sites on each arm of the "X". The sample sites were approximately 6 m apart. Symptomatic tillers were checked for the presence of aphids. Between two consecutive wheat seasons, the specimens were collected on other gramineous plants. Fields were surveyed in all cereal growing areas of the

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province. When more than one field was surveyed in one area, they were at least 10 km apart.

The leaves had to be unrolled for collection of secluded RWA individuals. The RWA were transferred by means of a camel's hair brush to vials containing preserving fluid, lactic acid and alcohol (12).

The tillers bearing parasitized RWA or immature stages of predators feeding on the aphid were placed separately in small glass tubes (180 mm long, 18 mm diameter) covered with a piece of gauze and transferred to the laboratory in a cool container. Glass tubes containing mummies were placed in a container and kept under laboratory conditions. To provide necessary humidity during developmental stages of parasitoids in mummies, a small vial containing a mixture of 50 g KOH and 100 ml H<sub>2</sub>O was placed in the container (35). After emergence, adult parasitoids were allowed to die by starvation and preserved in 75% ethanol.

The hyperparasitoids that occasionally emerged from parasitized RWAs were also preserved in 75% alcohol.

Immature stages of predators were maintained in similar conditions as parasitoids and were fed daily with RWA obtained from laboratory cultures. The adults were pinned or preserved in 75% alcohol.

Leaves infested with RWA which possessed syrphid-fly eggs were detached and transferred to the laboratory for further identification.

The aphid materials were finally macerated, cleared and mounted on slides. The method followed was similar to that of Eastop and van Emden (12).

The method of Noyes (34) was used for preparation of parasitoid mounts for identification.

Keys presented by Borror *et al.* (3), Ferrier (14), Hayat (19, 20), Marsh *et al.* (28), Powell (38), Stary (42, 43, 44, 45) and Wooley (48) were

used in identification of parasitoids.

The parasitoids were also preserved in 75% ethanol, labeled and sent to Dr. P. Stary (Czechoslovak Academy of Science, Czechoslovakia) and to Dr. D. K. Reed (USDA-ARS Plant Research Laboratory, Oklahoma, USA), for confirmation and identification. The coccinellids were identified by A. Yazdani (Plant Pests and Diseases Research Institute, Rafsandjan). The key presented by Chandler (7) was used in identification of syrphids.

A large number of aphid mummies were also collected in a wheat field in Badjgah (15 km north of Shiraz) from 3 April to 30 July 1991 at 3-day intervals. The number of RWA mummies and parasitoids that emerged from them were recorded. The succession of parasitoids in the field was also studied.

## RESULTS

RWA distributional areas in the Fars province are shown in Fig. 1. A total of 1563 RWA mummies were collected in RWA infested fields. Most parasitoids which emerged from these mummies belonged to the genus *Aphelinus*, with two species of *A. varipes* and *A. ?flaviventris*. *Diaeretiella rapae* with 15.16% relative abundance ranked second. Other parasitoids (*Aphidius rhopalosiphi* De Stefani, *A. colemani*, *Praon* sp., *Toxares* sp. and *Pronotalia* sp.) collectively accounted for 4.42% (Table 1).

Four species of coccinellids (*Coccinella septempunctata* L.), *Scymnus* (*Scymnus*) *apetzi* Mulsant, *Hippodamia variegata* Goeze, *Exochomus nigrimaculatus* (Goeze), one species of syrphid (*Syrphus* sp.), and one species of chrysopid (*Chrysopa* sp.) were found feeding on RWA. A hyperparasitoid, *Chartocerus* sp. was most active on *Aphelinus* species.



Fig. 1. Distributional areas of RWA in the Fars province.

Table 1. Relative abundance (%) of RWA parasitoids in Badjgah in 1991.

Scientific name	Number of mummies collected	Relative abundance (%)
<i>Aphelinus</i> spp.	1257	80.42
<i>Diaeretiella rapae</i>	237	15.16
<i>Aphidius rhopalosiphi</i>	30	1.93
<i>Aphidius colemani</i>	20	1.28
<i>Praon</i> sp.	13	0.83
<i>Toxares</i> sp.	3	0.19
<i>Pronotalia</i> sp.	3	0.19

## DISCUSSION

RWA was frequently found with other aphid species particularly *Sitobion avenae* (F.) and *Rhopalosiphum padi* (L.). The latter two species, like RWA, are most numerous in sheltered areas in wheat and barley fields (11). No RWA was found in warmer parts of the Fars province including Larestan, Firoozabad, and Mamassani (Fig. 1). High temperature is reported to be a limiting factor for RWA longevity and reproduction (29).

Reports of Flanders (15), Gonzalez *et al.* (17), Mohyuddin and Muhammad (31), Pike and Harwood (36), and Reed (39) on *Aphelinus varipes*, *Aphidius colemani* Viereck, *A. rhopalosiphi* and *Praon* sp. and those of Aalbersberg *et al.* (1) on *Diaeretiella rapae* indicate that these wasps are more common on RWA in other parts of the world. *Aphidius colemani*, *Diaeretiella rapae*, and several species of *Praon* have been reported from Iran by Stary (44) on insects other than RWA. Parasitization of RWA by *Pronotalia* sp. and *Aphelinus ?flaviventris*, and feeding by

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*Scymnus (Scymnus) apetzi* has not been previously reported. The predators of RWA, *Coccinella septempunctata*, *Hippodamia variegata*, *Chrysopa* sp., syrphid flies, and chamaemyiids, also have worldwide distribution. In the latter family, two species, *Leucopis palumbi* Rondani from Shiraz and Kerman and *Leucopis* sp. from Sanandadj have been reported by Farahbakhsh (13) on pistachio gall aphids, *Geoica utricularia* and *Pulvinaria betulae*, respectively.

Field observations and relative abundance of RWA parasitoids revealed that the two *Aphelinus* species followed by *Diaeretiella rapae* are the most abundant natural enemies of RWA in the Fars province. The aphelinids may also puncture the body of RWA nymphs with their ovipositors, and feed on the fluid that exudes from the punctures without depositing eggs. The predatory role of these insects (8) sometimes doubles their effectiveness as natural enemies (32). In calculation of their parasitism in the field, this predatory role has not been taken into account.

Observation of a great number of chamaemyiid larvae and a relatively high level of RWA parasitized by *Diaeretiella rapae* in the field along with the reports from Jordan (37) and Pakistan (31) indicate that these two natural enemies may help alleviate depredation caused by RWA. The small size of these insects and the coccinellid, *Scymnus apetzi*, facilitates their penetration into rolled leaves and attacking secluded RWAs.

Reports of Campbell *et al.* (5) and Bodenheimer and Swirski (2) on parasitoids and predators of aphids indicate that the temperature requirements of these natural enemies are higher than those of their hosts. Thus the low temperatures that prevail in the early part of the cereal growing season are suitable for RWA development and reproduction, but would likely be less suitable for development and reproduction of its natural enemies. Hence the RWA parasitoids other than *Diaeretiella rapae*



are active and have their greatest impact on RWA in June and July. This is in accordance with the high level of parasitization of *Metopolophium dirhodum* and *Sitobion avenae* during July as reported by Dean (10) and Jones and Dean (25), respectively. *Diaeretiella rapae* is active on RWA in mid-May and late September.

The other parasitoids including *Aphidius rhopalosiphi*, *A. colemani*, *Praon* sp., *Toxares* sp. and *Pronotalia* sp. appear to be relatively ineffective on RWA. Probably they prefer other aphids as their hosts. The parasitoids have been reported on other aphids by Farahbakhsh (13), Jotwani (26), Powell (38) and Stary (44).

Syrphid, chrysopid and coccinellid predators were widely distributed, but not abundant and, except for *Scymnus apetzi*, are not generally found within the rolled leaves. However the coccinellid predation may actually increase the spread of aphid-borne viruses by dislodging the aphids due to their searching activity (41).

Among the three hyperparasitoids, *Chartocerus* sp. was the most active. This species is commonly found as a hyperparasitoid of Encyrtidae and Aphelinidae (48). High levels of parasitization of the two aphelinids were observed in the field particularly during the overwintering of the aphid on volunteer wheat in late July. Its heavy hyperparasitization slows the build up of the aphelinids early in the season, reduces the total number that overwintered, lessens the effectiveness of these primary parasitoids, and consequently eases attacks on aphid populations in the following year.

More detailed studies should be made on the biology and ecology of RWA natural enemies and their interactions and hyperparasitoids in the Fars province.

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