

Significance of Hyperparasitization of Primary Cereal Aphid Parasitoids in Egypt "Hymenoptera, Parasitica"

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ABSTRACT

Cereal aphids are the major insect pests infesting wheat plants in Egypt. A survey of the most abundant parasitoid species; primary and/or secondary, associated with cereal aphid species in wheat fields, in four agro-ecosystems in Egypt, was carried out for four seasons 1997/98 - 2000/2001 to evaluate the significance of hyperparasitization on primary cereal aphid parasitoids. Seven species from each of primary and secondary parasitoids were found. Mean percentage of the parasitism by the primary parasitoids did not exceed 36% in the four seasons. *Aphidius* spp. (*matricariae* and *colemani*) and *Diaeretiella rapae* were the most abundant primary parasitoid species (35.9 and 34.3%, respectively). Total percentage of hyperparasitism ranged between 19.1 and 24.6% and averaged 21.2%. Highest percentage (51.5%) of hyperparasitism was recorded in the New Valley, whereas the lowest (2.8%) was found in middle of the Delta. Cynipids were the most abundant secondary parasitoid species (76.2%).

Key Words: Cereal aphids, Parasitization, Hyperparasitism, Wheat, Egypt

INTRODUCTION

Aphids are the key insect pests infesting wheat plants in Egypt. Wheat yield loss due to aphid infestation was estimated by 7-23% in Middle and Upper Egypt (El-Heneidy, 1994). In Egypt, *Rhopalosiphum padi* L., *R. maidis* Fitch, *Schizaphis graminum* Rond. and *Sitobion avenae* Fab. were recorded as main aphid species on wheat plants (El-Hariry 1979). The Russian wheat aphid, *Diuraphis noxia* (Kurdj.) was recently added (Attia and El-Kady 1988). *R. padi* was recorded as the most abundant cereal aphid species in Egypt (El-Heneidy 1994).

Aphidiids form the major part of the parasitoid spectrum of aphids. In addition, the aphelinids form another small group of the primary parasitoids of aphids. The relative abundance of aphidiid species is derived from the percentage of occurrence of the different "members" of the parasitoid complex per aphid species. In general, the relative abundance seems to be the most constant and usable parameter if it is determined from a large number of samples taken in the course of several years in a defined geographical area (Stary, 1970).

Aphid hyperparasitoids are mostly obligate because they are restricted to being secondary parasitoids whose progeny can develop only in or on primary parasitoids. Hyperparasitoids have an ecological impact on both the primary parasitoids and host aphid population dynamics. For instance, hyperparasitism has practical ecological implications in any biological control program because of the negative effect on the beneficial primary parasitoids.

Parasitoid species; primary and/or secondary, on cereal aphids in Egyptian wheat fields were recorded by several authors in particular regions; in Upper Egypt, by Aly and Morsy (1983) and Abdel-Rahman *et al.* (2000), in Upper and Middle Egypt, by El-Heneidy (1994 and 1998), Ibrahim (1990a, b and c), Ibrahim and Afifi (1991) and in all wheat growing regions, by El-Heneidy *et al.* (2001).

The present study focuses on estimating the significant role of hyper parasitization on the primary cereal aphid parasitoids in different wheat regions in Egypt.

MATERIALS AND METHODS

Samples of wheat plants infested with aphids were collected regularly from four major regions representing different wheat agro-ecosystems in Egypt. Samples were collected weekly from 10 Egyptian Governorates; Sohag and Assuit (Upper Egypt), Beni-Suef, Fayoum and Giza (Middle Egypt), Menoufia, Gharbia, Bihaara, Dakhalia and Sharkia (Lower Egypt, the Delta), and monthly from the eleventh Governorate, the New Valley (located in the western desert). Sampling was carried out annually from mid-January to the end of April for the four wheat growing seasons 1997/98-2000/2001.

Samples were kept in transparent plastic jars under laboratory conditions (22-25°C and 60% R.H.) until emergence of parasitoid adults. Emerged adults were collected daily and preserved in 70% alcohol for identification. P. Stary, Institute of Entomology, Academy of Science of the Czech Republic identified parasitoid specimens. Seasonal occurrence and numbers of different species, in wheat growing regions were recorded.

Percentage of hyperparasitism was calculated as follows:

$$\% \text{ Hyperparasitism} = \frac{A}{B} \times 100$$

Where: A = No. of secondary parasitoid individuals;
B = Total no. of parasitoid individuals

RESULTS AND DISCUSSION

Aphid Species Incidence

Wheat plants were susceptible to damaging infesta-

tions mainly by three cereal aphid species, *R. padi*, *R. maidis*, and *S. graminum*. Seasonal infestation periods of different species were recorded as follows; from early January to the end of April for *R. padi*, from late January to mid-April for *S. graminum*, and from early February to mid-April for *R. maidis*. The fourth species, *S. avenae* which occurs late in the season was found in very low numbers during the course of this study and only in one region, (the Delta).

Survey of Cereal Aphid Parasitoids

Out of 612 samples collected from wheat plants infested with aphids in the four wheat regions in Egypt during 1997/98-2000/2001 seasons, a total of 6453 parasitoid adults emerged from cereal aphids. 5085 (78.8%) and 1368 (21.2%) individuals were primary and secondary parasitoid species, respectively.

The following is a list of hymenopterous primary and secondary parasitoid species that emerged from the key cereal aphids in wheat fields in Egypt during the study:

Primary Parasitoids

Aphidiidae: *Aphidius matricariae* Haliday, *A. colemani* Viereck, *Diaeretiella rapae* M'Intosh, *Praon necans* Mackauer, *Ephedrus persicae* Froggatt and *Trioxys* spp.

Aphelinidae: *Aphelinus* spp.

Secondary Parasitoids

Cynipidae: *Alloxysta* (= *Charips*) spp. and other cynipids.

Chalcididae: chalcids and pteromalids (*Asaphes* and *Pachyneuron*).

Encyrtidae: *Aphidencyrus* spp.

Megaspilidae: *Dendrocerus* (formerly *Lygocerus*) spp.

Figs. (1 and 2) show the percentages of each primary and secondary parasitoid species, respectively among all parasitoids counted throughout the study. Among the recorded primary parasitoid, the aphidiids and the aphelinids represented 96.7 and 3.3%, respectively. *Aphidius* parasitoids (*A. matricariae* and *A. colemani*) were the most abundant (35.5%) followed by *Diaeretiella* (34.4%). *D. rapae* was the most abundant species (34.4%), followed by *P. necans* (25%), *A. matricariae* (22.1%) and *A. colemani* (13.4%) (Fig. 1). The cynipids were the most abundant secondary parasitoid species (76.2%), followed by the chalcids (9.9%) (Fig. 2).

As shown in Fig. (3), the highest numbers of both primary and secondary parasitoids were collected from Lower Egypt (the Delta) while the lowest were collected from the New Valley Governorate. Medium numbers were collected from both Middle and Upper Egypt (Fig. 3). These results may be attributed to the different number of samples collected from each region where a total of 300, 162, 138 and 12 samples were collected from Lower, Middle, Upper Egypt and the New Valley, respectively. In an earlier report, distribution and abundance of cereal aphids and their natural enemies in wheat field regions were ranked from most to least abundant as follows; Up-

per, Lower, Middle Egypt and the New Valley (El-Heneidy *et al.*, 2001).

Generally, the highest numbers of parasitoids were counted during February and March, in all sampling localities (El-Heneidy *et al.*, 2001). These were synchronized with the peak numbers of cereal aphids on wheat plants (El-Heneidy and Abdel Samad, 2001). Peaks were recorded during February, in Upper, Middle Egypt and in the New Valley and a few weeks later during March in Lower Egypt (the Delta). Peaks of secondary parasitoid numbers followed the peaks of the primary parasitoids by 2-3 weeks in most of the sampling sites.

It was found that the overall mean percentage of hyperparasitization from all the study sites reached 21.2%. Means were 20.8, 19.8, 19.1 and 24.6% in the Delta, Middle, Upper Egypt and the New Valley, respectively (Fig. 4). Weekly percentage of hyperparasitism was estimated per Governorate per season. Data per region per season are summarized in Fig. (5). As shown in the figure, the highest percentage of hyperparasitism (51.5%) was recorded in the New Valley during 1997/98 season, whereas the lowest (13.5%) was recorded in the Delta during 2000/2001 season. The lowest percentage of hyperparasitism (2.8%) was recorded in Menoufia Governorate during 1997/98 season.

Generally, few studies have been carried out on hyperparasitism of aphids' primary parasitoids in Egypt. However, the present results agree with those recorded by Ibrahim, 1990a, b and c and Ibrahim and Afifi, 1991 who recorded (24-36.4%) hyperparasitism on cereal aphid parasitoids at Giza Governorate in the 1988 and 1989 wheat seasons. They also reported *Alloxysta* sp. (Cynipidae) as the most common and abundant species (47- 75%) among the secondary parasitoid species collected.

In conclusion, the diversity of species and number of the parasitoids and their potential to control cereal aphids in wheat fields in Egypt has been adversely influenced by: 1) Regular pesticide treatments. A sharp decline (66%) in the number of parasitoids in wheat fields following pesticide applications was recorded (El-Heneidy *et al.*, 1991). 2) The significant role of hyperparasitoid species (13.5-51.5%) in suppressing the primary parasitoids. Maximum percentage of naturally occurring parasitism recorded on the cereal aphids was 36% in Upper Egypt (El-Heneidy and Abdel Samad, 2001).

Hyperparasitism has traditionally been viewed in the context of applied ecology as being harmful and so it is believed to have usually a negative impact on beneficial primary parasitoids. There is a contrary speculation as to hyperparasitoids' possible positive role in maintaining a proper balance between the primary parasitoids and their hosts by preventing an excessive build up of parasitoid numbers (Stary, 1970, May, 1973 and Van den Bosch *et al.*, 1979).

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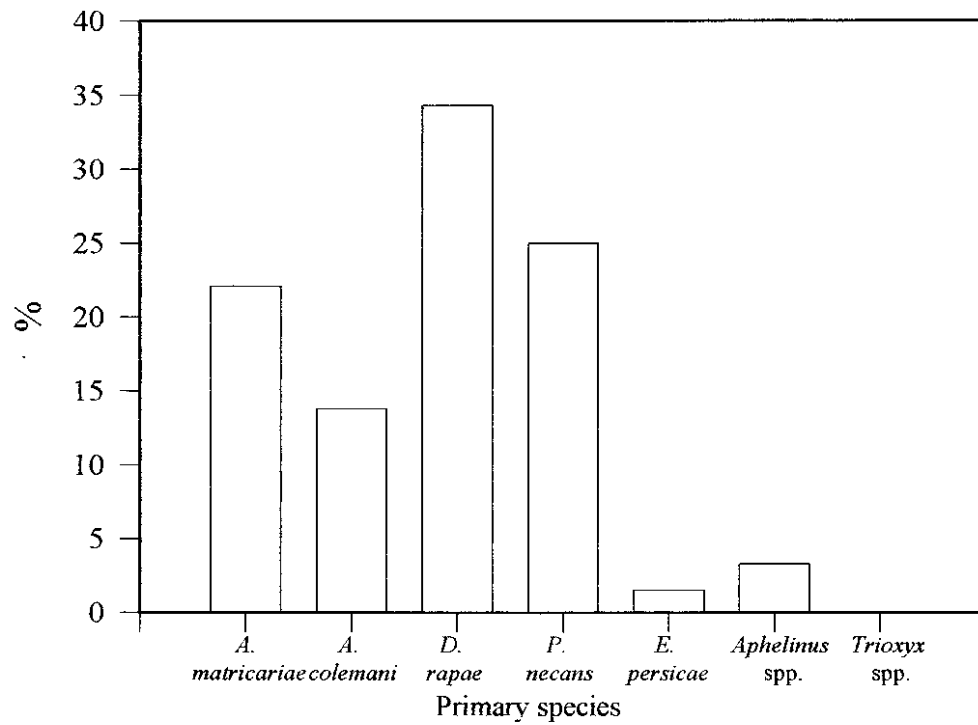


Fig. (1): Mean percentage of total primary parasitoid species collected from cereal aphids in Egyptian wheat fields 1997/98 - 2000/2001

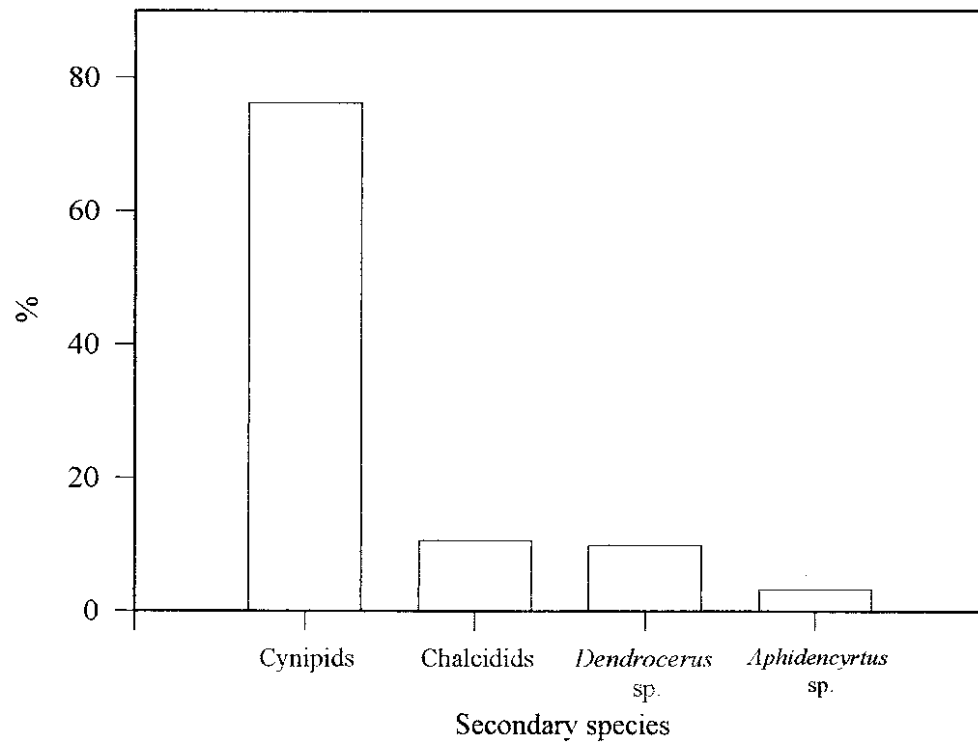


Fig. (2): Mean percentage of total secondary parasitoid species of primary cereal aphid parasitoids in Egyptian wheat fields 1997/98 - 2000/2001

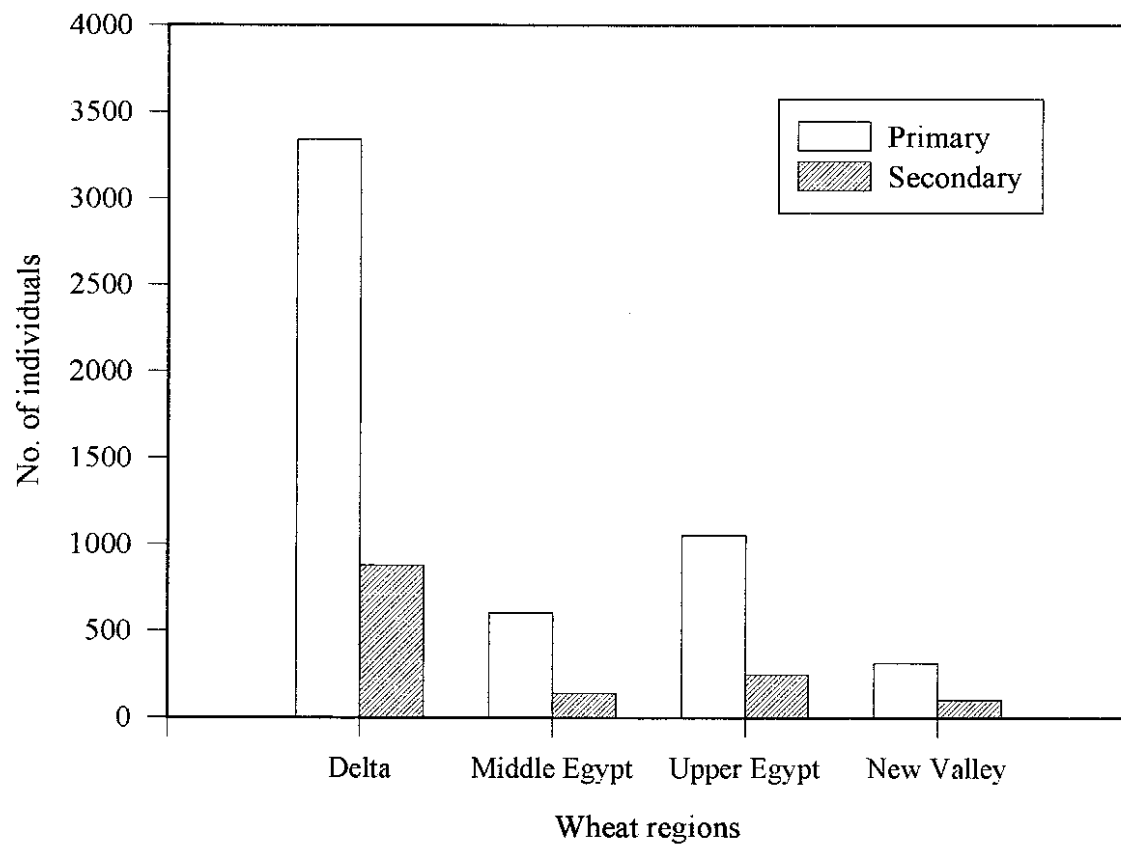


Fig. (3): Total numbers of primary and secondary parasitoid species of cereal aphids collected from different wheat regions in Egypt 1997/98 - 2000/2001

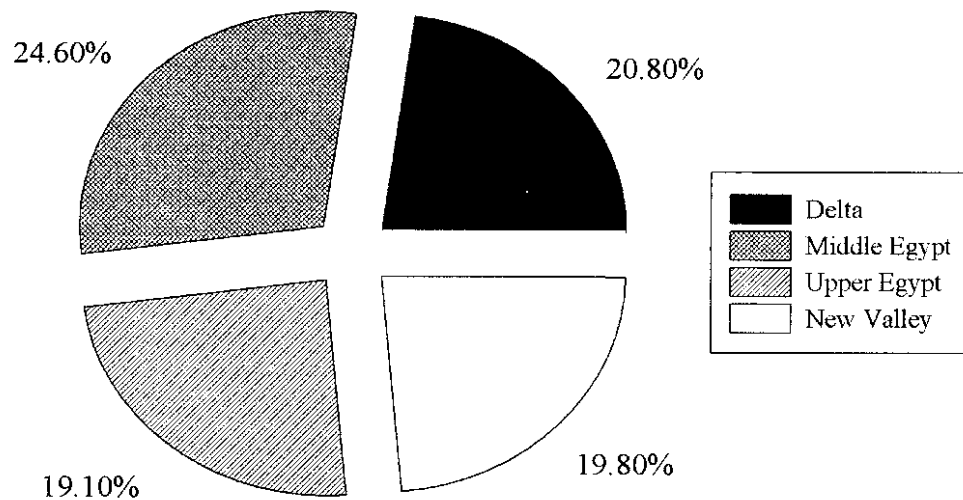


Fig. (4): Total percentage of hyperparasitism on primary parasitoids of cereal aphids in different wheat regions in Egypt 1997/98 - 2000/2001

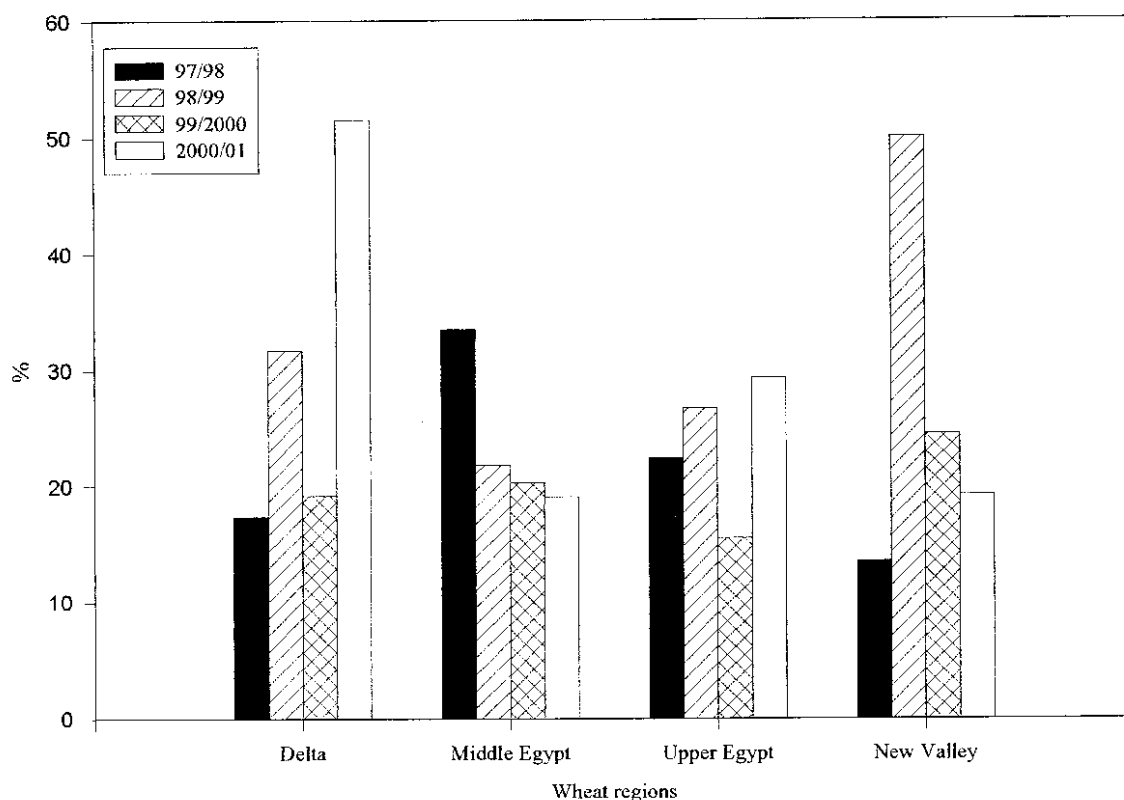


Fig. (5): Total seasonal percentage of hyperparasitism on primary parasitoids of cereal aphids in different wheat regions in Egypt 1997/98 - 2000/2001

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