REVIEW PAPER
BIOLOGICAL CONTROL OF APHIDS IN WHEAT FIELDS

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INTRODUCTION

1. Economic importance

Wheat is the most important cereal crop in Egypt. It is constrained by a vareity of insect pests, vertebrates and diseases. Aphids are the serious insect pests attacking wheat plants in Egypt, their losses to the crop were estimated by 7-23% in middle and upper Egypt, where highest infestation mostly occurs (Enayat et al., 1984; Tantawi 1985b; El-Heneidy et al., 1991). Aphids are one of the insect groups whose economic importance increases with the development of agriculture. The extensive monoculture and agrotechnical practices result in much better conditions for population increase than the aphids find in natural environments. Pesticide treatments against various pests have been followed by the occurrence of secondary pests and the aphids are agreed as belonging mainly to this group. The intensification of pesticide treatment has shown that the aphids cannot be eradicated but, on the contrary, resistant populations have appeared which exhibit even more vitality than the original sensitive strains. Besides, the routine pesticide treatments have adversely influenced the natural enemies population.

2. Aphids Damage

Aphids cause direct damage to plants by sucking plant fluid and also cause indirect damage as vectors of economically important virusus. The cereal aphids are efficient vectors of different strains (types) of Barley Yellow Dwarf Virus (BYDV), which has recently been identified as economically serious in some parts of Egypt (Abou El-Ata et al., 1995).

3. Aphids Species on wheat

El-Hariry, 1979, Tantawi, 1985 a,b and El-Heneidy and Attia, 1988 recorded

Rhopalosiphum padi L., *R.maiadis F., schazaphis graminum* R.and *Sitibion avanae* F. as major aphid species on wheat plants in Egypt. Attia and El-Kady, 1988 added the Russian aphid species *Duraphis noxia* Mordivolko to the aphid fauna in wheat fields. *R.padi* has proved to be the most common and important species in Egypt, for its abundance and long season, particularly in upper and middle Egypt. Grain losses due to *R.padi* in upper Egypt have been documented as 30% (International center for Agricultural Reseach in the Dry Areas (ICARDA) annual report of the Nile valley project, 1995). Infestation and losses are still less in the Delta, although they have obviously increased and dispersed in several Governorates during the last decade.

3. Control Programs against Aphids

Up till now, the only control tactic against aphids in wheat fields available to farmers in Egypt is total dependence on insecticides. The crop receives mostly 2-3 insecticidal applications during the growing season. Controlling aphids with insecticides has many risks; including destruction of the role of natural enemies, accelerated development of insecticide resistance in wheat aphid species and upsets of secondary pests (Ward and Tan, 1977).

5. Biological control of wheat Aphids

Studies done on the potential of natural enemies of aphids in wheat fields in Egypt are still few and they have mainly concerned with their survey and seasonal abundance (Ghanim and El-Adl, 1983a, b; El-Heneidy and Attia, 1988; El-Heneidy, 1991; El-Heneidy et al., 1991; El-Heneidy, 1994; El-Heneidy and Fayad, 1995; Ibrahim et al., 1994., 1995, and 1996).

6. Achievements of the Biological Control Component in the Nile Valley project throughout the period 1989-1996.

6.1. Aphid species incidence and Abundance, Fig.1.

El-Heneidy and Attia, 1988 and El-Heneidy, 1991 and 1994 recorded initial occurrence of aphid species in wheat fields by early January at Sohag (upper Egypt) and by late January in the Delta. Infestation started always with *R.padi* followed by *S.graminum* and/or *R.maiadis* during tillering growth stage. *S.avenae* was always a late season species, it started during boating growth stage (around March). Relative abundance of different aphid species varied not only from one region to another, but also from one season to another, at the same area.

6.2. Rate of Aphid Infestation

Highest infestation rates of aphids were estimated during boating and heading growth stages of the wheat plant (late February - late March in upper and middle Egypt), and a few weeks later in delta. Relatively high rates of infestation continued also during ripening stage (mostly April), Fig.2, El-Heneidy, 1994).

6.3. Potential of Natural Enemies on wheat Aphids

El-Heneidy and Attia, 1988, El-Heneidy, 1991, El-Heneidy et al., 1991, El-Heneidy, 1994, El-Heneidy and Fayad, 1995, Ibrahim et al., 1994, 1995, and 1996 studied the potential of natural enemies on wheat aphids in several Governorates of upper and middle Egypt as well as in delta. They stated that no insect pathogens were recorded on the aphids in wheat fields throughout the working period. They also recorded six groups of predators associated with aphids on the wheat plants, these were; the coccinellids, *Coccinella undicumpunctata* L., and *Scymnus interruptus* L., the chrysopid *chrysoperla carnea* Steph., the staphylinid *Paederus alfierii* (Koch), the anthocorids *Orius spp.*, the syrphids *Syrphus* spp., and the true spiders. Numbers of predators increased steadily towards the end of the season to reach their peaks during the ripening growth stage (almost during April), Fig.3. *C.undicumpunctate* and true spiders were the most abundant species of predators counted associated with aphids on wheat plants in all Governorates. Concerning the parasitoids, four hymenopterous braconid species; *Diaeretiella rapae* M., *Aphidius matricariae*, *Trioxys sp., and Praon sp.* were recorded as native parasitoids on wheat aphids in Egypt. Highest percentages of parasitism were estimated mostly during the boating and heading growth stages of the wheat plant (late February - mid-April) to coincide more or less with the highest population of aphids.

6.4. Influence of Insecticidal Applications on Aphids and their Natural Enemies

El-Heneidy et al., 1991, El-Heneidy and Fayad, 1995, and Ibrahim et al., 1994 and 1995 studied the influence of chemical control on predators number and percentage parasitism in wheat fields. They reported that: (a) some fields which received three sprays during the season showed rapid resurgence of aphid population, infestation lasted longer and continued relatively with high population throughout the season compared with that sprayed only once in the proper timing, (b) fields that received single spray in the infested spots early in the season, maintained relatively with low population throughout the season and on the other hand, with relatively high

population of natural enemies, and (c) insecticidal applications were always followed by a sharp decline in the number of predators as well as percentage parasitism estimated with 71 and 66% reduction, respectively.

DISCUSSION

Controlling aphids primarily with insecticides results not only in a short-term environmental disaster from outbreaks of induced pests, but also in a long-term adverse impact on destruction of native natural enemies, insect resistance, wildlife losses and soil and water contamination. Small grain fields are important sources of native natural enemies in agro-ecosystems, contributing to the control of primary and secondary pests in small grains and adjacent crops (Lopez and Teetes, 1976).

Establishment of effective natural enemies will: (a) reduce pesticide load in the environment, (b) promote development of a cereal IPM program that is economically, environmentally, and socially acceptable, and (c) increase the availability and effectiveness of natural pest controls as pesticide use is reduced (Gonzalez et al., 1995).

Although four indigenous parasitoid species beside six groups of predators were recorded attacking aphid species in wheat fields in Egypt, the extant aphid natural enemy species do not effectively control the pest. This is mainly due to the misuse of insecticides in the wheat fields. Regarding biological control of wheat aphids, substantial work has not been completed in connection with this project. Indigenous parasitoids and predators associated with wheat aphids were identified (personal contact) and their relative population dynamics throughout the season in different agro-ecosystems, e.g. upper Egypt (Sohag and Assuit), middle Egypt (Beni-Suef and Fayoum), and the delta (Sharkia) were determined. However, there are several studies substantiating a basis for pest management programs for small grains have not been done yet such as Economic Threshold levels, mainly because of financial and adminstrative prospects.

The long-term goal is to select resistant cultivars that will produce optional yield and most effectively reduce aphids infestation in combination with naturally occurring parasitoids and predators.

CONCLUSION

The rapid resurgence of aphid population may be attributed to the result of developing resistance in aphids mostly because of receiving sub-lethel doses of the in-

secticide due to ineffective applications and/or depending on a single recommended insecticide (e.g. Malathion 57%) for several years.

It was observed that high rates of aphid infestation in wheat fields (mostly during March) coincide with highest rates of parasitism, while the high infestation was earlier than the active period of the aphidophagous predators (mostly during April).

Diversity and population of parasitoids and predators in wheat fields in Egypt seem to be strongly suppressed to play a significant role for aphid control management. Additional efforts should be done to make the agro-ecosystems much favourable to attract and activate natural enemies.

However, an integrated pest control program against aphids in wheat fields depending on biological control is needed to reduce dependence on currently used programs of chemical insecticides.

FUTURE DIRECTION

A balanced and sustainable integrated pest control program depends on biological control is essentially needed and it will minimize environmental hazards and maximize crop production. Successful implementation of a wheat crop control program will provide greater profits for farmers, lower economic costs, and reduced environmental pollution.

Figures Legends:

Fig.1. Seasonal incidence of aphid species throughout different growth stages of the wheat plant in upper and middle Egypt.

Fig.2. Mean number of aphids / wheat plant in different growth stages at upper Egypt, Middle Egypt and Delta during the successive seasons 1988/89-1995/96.

Fig.3. Mean number of aphid predators/100 wheat plants in different growth stages at Upper Egypt, Middle Egypt and Delta during the successive seasons 1988/89-1995/96.

Fig. 4. Mean percentages of parasitism on wheat aphids in different growth stages at upper Egypt, Middle Egypt and Delta during the successive seasons 1988/89-1995/96.5

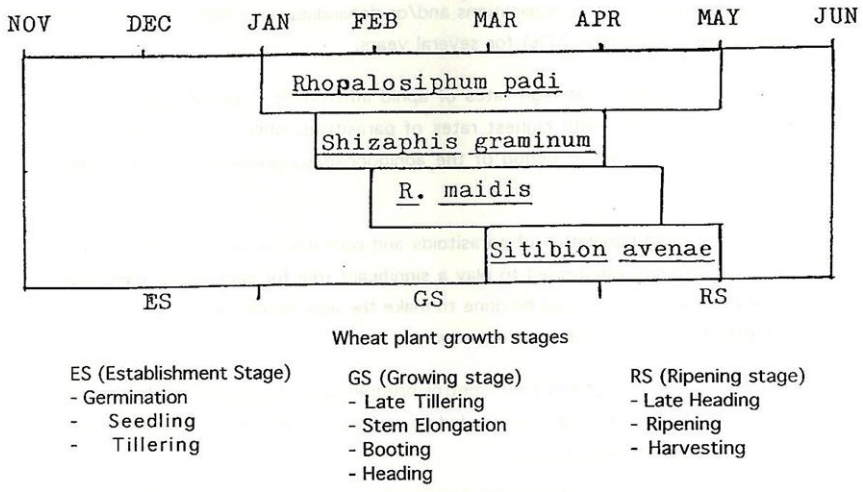

Fig. 1. Seasonal incidence of aphid species throughout different growth stages of the wheat plant in Egypt.

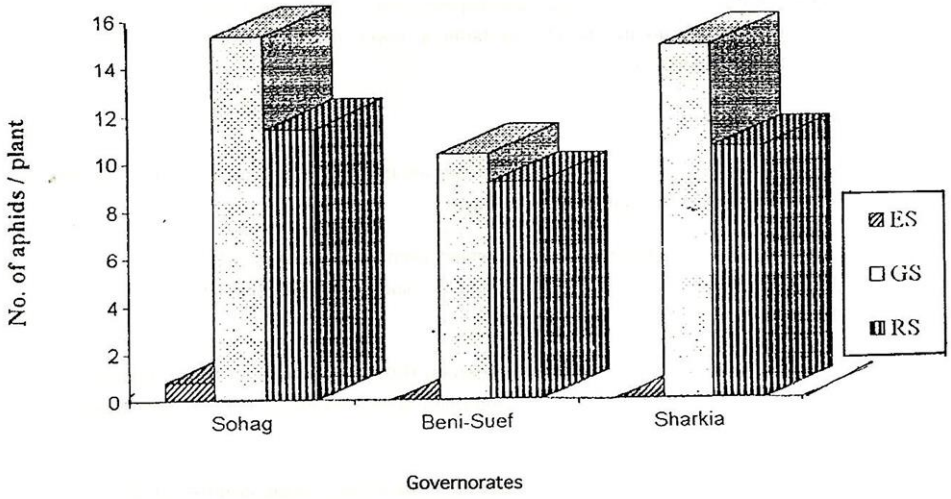

Fig. 2. Mean number of aphids / wheat plant in different growth stages at Upper Egypt, Middle Egypt, and Delta during the successive seasons 1988/89-1995/96.

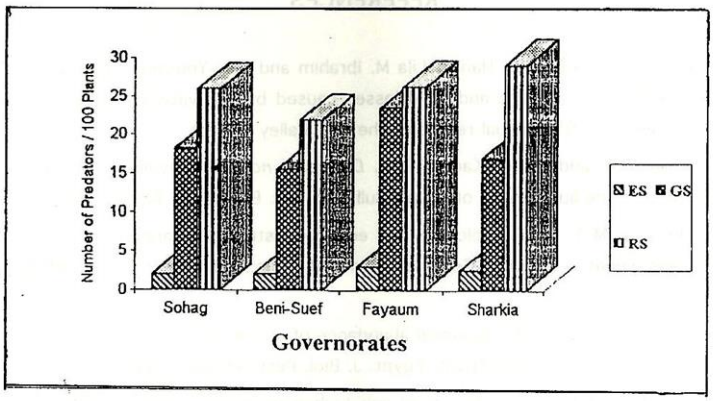

Fig. 3. Mean number of aphid predators/100 wheat plants in different growth stages at Upper Egypt, Middle Egypt and Delta during the successive seasons 1988/89-1995/96.

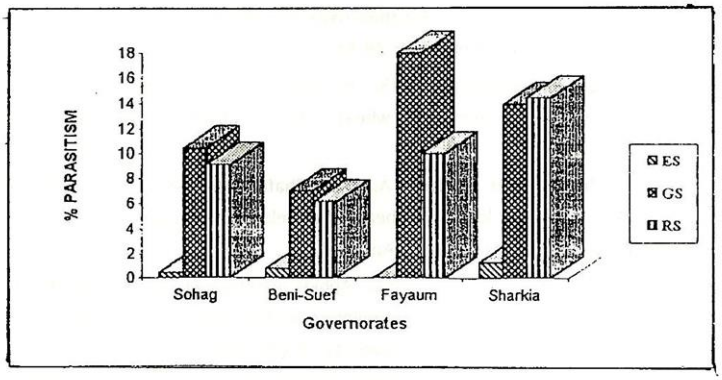

Fig. 4. Mean percentages of parasitism on wheat aphids in different growth stages of wheat plant at Upper Egypt, Middle Egypt, and Delta during the successive seasons 1988/89-1995/96.

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