

**ABUNDANCE OF APHIDS AND ASSOCIATED PARASITOIDS
IN WHEAT FIELDS AND ITS RELATION TO YIELD AT
KAFR EL-SHEIKH**

By

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ABSTRACT

Field experiments were conducted at Sakha Agric. Res. Station, Kafr El- Sheikh A. R. Egypt during 1997/98, 1998/99 and 1999/2000 seasons to study population abundance of aphid species and associated parasitoids on two wheat varieties; Sakha 69 and Sakha 61 and its relation to the grain yield. Results indicated that, the numbers of aphids on the two tested varieties were significantly higher in the first season than the second one. The lowest numbers of aphids were observed in the third season. Sakha 69 seemed to be more susceptible to aphid infestations than Sakha 61.

The percentages of parasitism were significantly higher during the first season than that recorded during the second and third season without significant difference between them. The high percentage of parasitism was noticed in Feb. and March, and it was in harmony with the highest period of aphid infestation prevailing during the three seasons. Three species of aphid parasitoids were found and identified as: *Aphidius matricariae* Hal.; which was the most dominant , *Aphidius colemani* and *Praon* sp.

It can be deduced that, aphid number- grain yield loss relationship was not clear, since the highest grain yield loss was recorded in case of Sakha 61 in spite of receiving the lowest number of aphids in the two assayed seasons (1997 / 98 and 1998 / 99). There was insignificant difference between the loss for the same variety in the two seasons. Thus, Sakha 69 approved to be more tolerant to aphid infestation

Key words : aphids , abundance , parasitoids , wheat .

INTRODUCTION

Aphids are the most important insect pests attacking wheat plants causing considerable reduction in the yield and the grain quality (Tantawi 1985 and El-Heneidy et al., 1990). The damage of aphids to wheat is a result of sucking the plant sap , producing honeydew on

which the sooty moulds grow and the availability of transmission plant virus diseases (Jones and Jones, 1974).

Aphid population densities and the corresponding injury for wheat plants fluctuate greatly in different seasons and within the same season depending on the abundance of the associated natural enemies and / or prevailing weather conditions (Ibrahim , 1990 and Salem & Khalafallah, 1998). The relationship between yield losses, aphid population densities and weather conditions is incomplete unless these variables are controlled throughout the entire growing season (McPherson and Brann, 1983).

Therefore, the present study was initiated during three successive wheat growing seasons to study the relationship between the changes in the population abundance of aphid species and associated parasitoids on two wheat varieties and the corresponding grain yield.

MATERIALS AND METHODS

The present investigation was carried out at Sakha Agric. Res. Station, Kafr El-Sheikh during three successive wheat growing seasons 1997/98, 1998/99 and 1999/2000 to evaluate the changes in population abundance of aphid species and related parasitoids on two wheat varieties namely Sakha 69 and Sakha 61 and its relation to the grain yield. The experimental area was divided into plots of 1/100 fed. Every variety was replicated four times. The seeds were sown during the last week of November in the three studied seasons and the normal agricultural practices were adopted without any insecticidal applications.

To assess aphid population density, weekly sample of 20 wheat tillers was randomly selected from each plot and the number of aphids was directly counted in the field. Sampling started from late December to late April.

Samples of infested wheat plants were collected weekly and transferred to the laboratory for parasitism determination (El-Heneidy 1991). The emerged parasitoid adults were identified in the Department of Biological Control Research at the Plant Protection Research Institute. Monthly mean numbers of aphids and percentage of parasitism throughout the whole season were calculated.

To estimate the grain yield loss due to aphid infestation, Malathion 57 % EC was applied at 10 days intervals before appearance any aphid infestation in a half of each replicate to avoid aphid damage. At maturity, the grain yield /m² was determined in each plot and the percentages of grain yield loss were only calculated for 1997 / 98 and 1998 / 99 seasons.

The daily records of temperature and relative humidity during the experimental period were obtained from the Meteorological Department at Sakha Agricultural Research Station, Kafr El-Sheikh. Statistical analysis of the obtained data were performed by using least significant difference (L.S.D.) method according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

I-Seasonal abundance of aphids on wheat plants and its relations to weather conditions :

During the course of study, the bird cherry-oat aphid, *Rhopalosiphum padi* (L.) was the most dominant aphid species on wheat plants but , the study involved the aphid complex. Data presented in Tables (1, 2 and 3) illustrate the fluctuations in the population density of aphids on two wheat varieties and the percentages of parasitism under the prevailing weather conditions through the three successive wheat growing seasons of 1997/98, 1998/99, 1999/2000.

For the first season as shown in Table (1), aphids started to appear in the second week of Jan., 1998 at which the average temperature and relative humidity reached 11.8 C⁰ and 66.5 %, respectively, with mean numbers of 12 and 13 aphids /20 tillers on Sakha 69 and Sakha 61, respectively. Then, the population increased gradually recording its peak of 417 aphids /20 tillers on Sakha 69 in the first week of March, where the means of temperature and relative humidity were 12.6 C⁰ and 65.8%, respectively.

As for Sakha 61, the aphids recorded a maximum number of 111 aphids /20 wheat tillers in the second week of March (at 13.7 C⁰ and 60.9% RH). After that, a sharp decrease in population was observed on the two varieties till the plants became free of infestation by the third week of April at mean temperature of 17.9C⁰ and 62.5% RH. It was apparent that, the high population of aphids was recorded through Feb. and march, where the monthly means of temperature and relative humidity were 12.4 C⁰ & 61.7 % and 13.3C⁰ & 61.8 % during both months, respectively.

In the second season, data recorded in Table (2) indicate that, aphids infestation was observed during the first week of Jan., 1999 (at 15.3C⁰ and 59.6% RH) with means of 19 and 13 aphids / 20 wheat tillers of Sakha 69 and Sakha 61 , respectively . Then, a sharp increase of aphid population occurred on Sakha 69 forming

Table (1): Mean numbers of aphids, percentages of parasitism, and prevailing temperature and relative humidity on two wheat varieties; Sakha 69 and Sakha 61, Sakha Agricultural Res. Station, Kafr El-Sheikh during 1997/98 wheat growing season.

Date		Mean no. of aphids/ 20 tillers		Parasitism %	Mean temperature C ^o	Mean relative humidity %
Month	Week	Sakha 69	Sakha 61			
Dec., 1997	4 th	0	0	0	12.3	59.9
Jan., 1998	1 st	0	0	0	11.8	63.7
	2 nd	12	13	0	11.8	66.5
	3 rd	27	56	8	12.2	73.2
	4 th	29	64	12	11.7	68.8
	Mean + SD*	17.00 + 13.63	33.25 + 31.51	5.00 + 6.00	11.9 + 0.2	68.1 + 4.0
Feb., 1998	1 st	111	80	15	14.7	60.4
	2 nd	163	83	12	12.4	62.8
	3 rd	214	83	7	11.1	60.3
	4 th	262	99	12	11.2	63.2
	Mean + SD*	187.50 + 65.08	86.25 + 8.62	11.50 + 3.32	12.4 + 1.7	61.7 + 1.5
Mar., 1998	1 st	417	104	12	12.6	65.8
	2 nd	360	111	28	13.7	60.9
	3 rd	47	21	54	12.7	57.2
	4 th	33	20	24	14.1	63.2
	Mean + SD*	214.25 + 202.63	64.00 + 50.31	29.50 + 17.69	13.3 + 0.7	61.8 + 3.7
Apr., 1998	1 st	12	8	0	15.4	66.0
	2 nd	9	5	0	21.5	59.6
	3 rd	0	0	0	17.9	62.5
	4 th	0	0	0	17.9	62.5
	Mean + SD*	7.00 + 6.24	4.33 + 4.04	0.00 + 0.00	18.2 + 3.0	62.7 + 3.2
General mean + SD*		136 + 137.18	46.69 + 42.09	11.5 + 14.31	13.6 + 2.7	63.4 + 4.0

SD* = Standard deviation

Table (2) Mean numbers of aphids, percentages of parasitism, and prevailing temperature and relative humidity on two wheat varieties, Sakha 69 and Sakha 61; Sakha Agricultural Res. Station, during 1998/99 wheat growing season.:

Date		Mean no. of aphids / 20 wheat tillers		Parasitism %	Mean temperature C ^o	Mean relative humidity %
Month	Week	Sakha 69	Sakha 61			
Dec., 1998	4 th	0	0	0	13.7	58.7
Jan., 1999	1 st	19	13	0	15.3	59.6
	2 nd	112	25	1	14.6	59.7
	3 rd	128	28	1	12.8	57.4
	4 th	129	33	3	13.7	56.5
	Mean + SD*	97.00 + 52.58	24.75 + 8.50	1.25 + 1.26	14.1 + 1.1	58.3 + 1.6
Feb., 1999	1 st	178	23	6	11.5	61.4
	2 nd	223	18	9	12.4	58.6
	3 rd	18	17	25	13.4	58.5
	4 th	19	14	10	12.9	58.2
	Mean + SD*	109.5 + 106.67	18.00 + 3.74	12.50 + 8.50	12.6 + 1.8	59.2 + 1.5
Mar., 1999	1 st	38	19	8	16.1	58.2
	2 nd	25	18	26	15.7	55.3
	3 rd	51	7	14	16.6	57.0
	4 th	9	21	10	15.5	55.3
	Mean + SD*	30.75 + 17.97	16.25 + 6.29	14.50 + 8.06	16.0 + 0.5	56.5 + 1.4
Apr., 1999	1 st	43	153	4	17.3	59.8
	2 nd	93	72	2	16.0	59.8
	3 rd	50	68	1	16.2	55.8
	4 th	7	1	0	19.7	64.5
	Mean + SD*	48.25 + 35.28	73.50 + 62.21	1.75 + 1.71	17.3 + 1.7	60.0 + 3.6
General mean + SD*		67.18 + 65.72	31.18 + 36.97	7.06 + 8.15	14.9 + 2.1	58.5 + 2.3

SD* = Standard deviation

the highest peak of 223 aphids / 20 tillers by the second week of Feb. (12.4 C⁰ and 58.6% RH). Thereafter, the population fluctuated till the end of the season recording three weak peaks in the first and third week of March (38 and 51 aphids / 20 tillers) and in the second week of April (93 aphids / 20 tillers). A gradual increase of population occurred on Sakha 61 recording moderate peak of 33 aphids / 20 tillers in the last week of Jan., 1999 and another weak peak of 19 aphids / 20 tillers in the first week of March, while the highest mean number (153 aphids) was recorded by early April at a mean temperature of 17.3 C⁰ and 59.8 % RH.

It is noted that the highest number of aphids / 20 wheat tillers was observed on Sakha 69 through Jan. and Feb., when monthly means of temperature and RH were 14.1 C⁰ & 58.3 % and 12.6 C⁰ & 59.2 %RH during both months, respectively. On the other hand, Sakha 61 exhibited maximum numbers through Jan. and April. The means of temperature and relative humidity during April were 17.3 C⁰ and 60.0 %RH.

Concerning the third season, results in Table (3) clarify that, aphids appeared in very low numbers by the 1st week of Jan., 2000 at low temperature (10 C⁰) and 62.7 % RH and lasted till the 3rd Table (3) Mean numbers of aphids, percentages of parasitism, prevailing temperature and relative humidity on two varieties of wheat, Sakha 96 and Sakha 61, Sakha agricultural Res. Station during 1999/2000 wheat growing season.

Date		Mean no. of aphids / 20 wheat tillers		Parasitism %	Mean temperature C ⁰	Mean relative humidity %
Month	Week	Sakha 96	Sakha 61			
Dec., 1999	4 th	0	0	0	12.7	54.5
Jan., 2000	1 st	3	1	0	10.0	62.7
	2 nd	4	2	0	12.0	58.3
	3 rd	6	2	1	11.4	56.3
	4 th	11	3	1	12.2	56.3
	Mean ± SD*	6.00 ± 3.56	2.0 ± 0.82	0.5 ± 0.58	11.4 ± 1.0	58.4 ± 3.0
Feb., 2000	1 st	12	3	3	12.8	58.9
	2 nd	16	6	5	12.9	61.4
	3 rd	18	25	7	12.4	59.2
	4 th	26	11	8	13.2	58.4
	Mean ± SD*	18.00 ± 5.89	11.25 ± 9.74	5.75 ± 2.22	12.8 ± 0.3	59.5 ± 1.3
Mar., 2000	1 st	18	11	11	15.2	59.6
	2 nd	21	18	12	14.2	63.4
	3 rd	24	12	16	12.7	55.7
	4 th	34	6	10	16.5	60.3
	Mean ± SD*	24.25 ± 6.95	11.75 ± 4.92	12.25 ± 2.63	14.7 ± 1.6	59.8 ± 3.2
Apr., 2000	1 st	8	6	11	18.9	54.3
	2 nd	5	4	10	17.0	58.0
	3 rd	2	2	0	16.7	56.8
	4 th	6	0	0	20.5	61.4
	Mean ± SD*	3.75 ± 3.50	3.0 ± 2.98	5.25 ± 6.08	18.3 ± 1.8	57.6 ± 3.0
General mean ± SD*		12.24 ± 10.08	6.59 ± 6.86	5.59 ± 5.36	14.2 ± 2.8	58.6 ± 2.7

SD* = Standard deviation

week of April. During this period, the aphid population fluctuated recording the highest mean number on Sakha 69 (34 aphids / 20 wheat tillers) in the last week of March at mean temperature of 16.5 C⁰ and 60.3 %RH. Meanwhile, Sakha 61 harbored the highest population of 25 aphids / 20 wheat tillers in the 3rd week of Feb. at mean temperature of 12.4 C⁰ and 59.2 %RH. It can be noted that, high population of aphids occurred during Feb. and March, where monthly means of temperature and relative humidity were 12.8 C⁰ & 59.5 %RH and 14.7 C⁰ & 59.8 % during the two months, respectively.

The obtained results are in agreement with those of Salem and Khallafallah, (1998) who reported that the high population of aphids on wheat plants were recorded through Feb. and March in 1995/96 and 1996/97 seasons at Kafr El-Sheikh Governorate. Also, El-Heneidy (1991) found that the highest rates of aphid infestation were observed during March of 1988/89 and 1989/90 seasons in upper Egypt.

Based on the general mean of aphids throughout the whole season (Table 4), it appears that Sakha 69 was significantly more infested than Sakha 61 in the three tested seasons. Also, aphid numbers on the two varieties were significantly higher in the first season than that of the second one, while the third season exhibited the lowest number. This might be due to the differences in temperature and relative humidity or / and natural enemies, since the general means of temperature and relative humidity were 13.6C⁰ & 63.4 %, 14.91 C⁰ & 58.49 % and 14.19 C⁰ & 58.56 % during the first, second and third season, respectively. The same observations were obtained by El-Hariry (1979), Attia & Abdel Rahim (1989) and Salem & Khalafalla (1998) who reported that, the population density of aphids in wheat fields was affected by the prevailing weather factors , especially relative humidity and temperature.

Table (4): General means of aphids, percentage of parasitism, prevailing temperature and relative humidity on two varieties of wheat; Sakha 96 and Sakha 61 during three successive wheat growing seasons of 1997/98, 1998/99 and 1999/2000 .

Season	General mean of aphids/ 20 wheat tillers		*LSD at 5%	Parasitism %	General mean of	
	Sakha 69	Sakha 61			Temperature °C	Relative humidity %
1997/98	106 + 137.18	46.69 + 42.09	12.07	11.50 + 14.31	13.6 + 2.7	63.4 + 4.0
1998/99	67.18 + 65.72	31.18 + 36.97	10.38	7.06 + 8.15	14.9 + 2.1	58.5 + 2.3
1999/2000	12.24 + 10.08	6.59 + 6.86	3.67	5.59 + 5.36	14.2 + 2.8	58.6 + 2.7
*LSD at 5%	10.89	5.77		4.39		

* L.S.D. = least significant difference

2-Seasonal abundance of aphid parasitoids in wheat fields:-

Table (1) indicate that, in the first season, the parasitism was recorded one week later of aphid appearance (3rd week of Jan., 1998) and disappeared completely in early April. The highest percentage of parasitism (54%) was recorded on the third week of March at 12.7 C⁰ and 57.2 %RH. Monthly mean of parasitism during Feb. (11.5%) and March (29.5%) coincided with the highest aphid infestation.

In the second season, the parasitism was recorded from the second week of Jan., 1999 and lasted till the third week of April (Table 2). During this period, two peaks of parasitism were observed; the first peak was in the third week of Feb. with a mean of 25% (at 13.4 C and 58.5 %RH) and the other was in the second week of March (26 %) at 15.7 C and 55.3 %RH.

With regard to the third season, data presented in Table (3) reveal that the parasitism was firstly recorded two weeks later of aphid appearance (3rd week of Jan., 2000). Then, it increased gradually forming a maximum percentage of 16% by the third week of March at mean temperature of 12.7 C⁰ and 55.7 %RH. After that, it decreased and completely disappeared by the third week of April. The highest percentage of parasitism (13%) during March synchronized with the high number of aphids. These results agreed with those obtained by El-Heneidy & Attia (1989) and El-Heneidy (1991) who reported that, the high rates of

parasitism (mostly March) coincided with the highest aphid infestation in wheat fields in middle and upper Egypt.

Based on the percentages of parasitism throughout the whole season (Table 4), it is clear that, the highest percentage of 11.5 % which was recorded in the first season, was significantly higher than that of the second season (7.1 %) and the third one (5.8 %) without significant differences.

Three species of aphid parasitoids were identified as: *Aphidius matricariae* Hal., *Aphidius colemani* and *Praon* sp. The first parasitoid was the most dominant, since it represented 57 % of the total emerged parasitoids followed by 29 and 14 % for *A. colemani* and *Praon* sp. , respectively.

It may be concluded that the high percentage of parasitism mostly occurred during Feb. and March in the three tested seasons coincided with the highest period of aphid infestation. This might indicate the important role of parasitoids as a bio-control agents in wheat fields as mentioned by El-Heneidy & Attia, (1989) in middle Egypt and El-Heneidy, (1991) in upper Egypt.

3 - Wheat grain yield losses due to aphids infestation under field conditions:-

Data presented in Table (5) indicate the grain yield loss of wheat due to the natural infestation with aphids during the two successive seasons , 1997/98 and 19998/99. Results indicate that the grain yield loss of Sakha 69 did not significantly differ in the two seasons since, it recorded 1.39 and 1.2% (LSD at 5% = 0.29) in the first and second season, respectively in spite of receiving the highest number of aphids (106 aphids / 20 tillers) in the first season. This may be due to that the recorded numbers of aphid population were not sufficient to cause economic damage.

The same trend was observed for Sakha 61, but the percentage of grain yield loss was 4.41 and 4.36% (LSD at 5% = 0.38) in the first and second season, respectively. This may be due to the high infestation late in the second season. It is to be noted that, Apablaza and Robinson (1967) found that aphid infestation of wheat plants at advanced stages of plant growth caused a considerable reduction in kernel weight. It can be concluded that, aphid number – grain yield loss relationship was not clear, since Sakha 61 which exhibited the lowest number of aphids in the two seasons, recorded higher grain yield loss . This may be due to its lower tolerance to aphid infestation. However, the relationship between yield loss and level of aphid numbers under field

conditions is limited, since the insect did not cause a problem every year and the population numbers are not sufficient to cause economic damage (Hammond and Fedigo, 1982)

Finally, it can be concluded that, the population density of aphids varied from one season to another as a result of differences in temperature and relative humidity or / and other factors. The high percentage of parasitism coincided with

Table (5):- Grain yield loss due to aphid infestation in wheat fields during 1997/98 and 1998/98 seasons at Kafr El-Sheikh Governorate.

Season	Variety	General mean of aphids/20 wheat tillers	Mean grain yield / m ² (kg.)		Grain yield loss %
			No Malathion control	Malathion treated	
1997/98	Sakha 69	106.00 + 137.18	0.568 + 0.01	0.576 + 0.03	1.39
	Sakha 61	46.69 + 42.09	0.542 + 0.01	0.567 + 0.06	4.41
1998/99	Sakha 69	67.18 + 65.72	0.675 + 0.05	0.682 + 0.04	1.03
	Sakha 61	31.18 + 36.47	0.702 + 0.03	0.734 + 0.03	4.36

the high aphid infestation. Also, Sakha 61 recorded higher grain yield loss in the two tested seasons in spite of exhibiting the lowest number of aphids.

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الناتج الخاص العسري

وفرة عشائر المن والطفيليات المصاحبة في حقول القمح وعلاقتها بالمحصول
بكفر الشيخ

علي ممدوح علي ناصف ، السيد محمد السيد خلف الله ،
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معهد بحوث وقاية النباتات بالدقي

تم إجراء التجربة بمزرعة محطة البحوث الزراعية بسخا كفر الشيخ ، جمهورية مصر العربية خلال مواسم القمح ٩٧/١٩٩٨ ، ٩٨/١٩٩٩ ، ٩٩/٢٠٠٠ م لتقدير وفرة عشيرة المن وعشائر الطفيليات المصاحبة علي صنف القمح سخا ٩٦ ، سخا ٦١ وعلاقة ذلك بالمحصول تحت الظروف المناخية لشمال دلتا النيل .
دلت النتائج المتحصل عليها أن تعداد المن كان أعلى بدرجة معنوية في الموسم الأول عن الموسم الثاني ، بينما وجد أقل تعداد للمن في الموسم الثالث . كان الصنف سخا ٦٩ أكثر إصابة بالمن عن الصنف سخا ٦١ .

سجلت أعلى نسبة تطفل في الموسم الأول تلاه الموسم الثاني والثالث . تزامنت أعلى نسبة تطفل والتي لوحظت في فبراير ومارس مع فترة الإصابة العالية بالمن خلال المواسم الثلاثة . تم التعرف علي ثلاثة أنواع من طفيليات المن هي *Aphidius matricariae* Hal. (كان الأكثر سيادة) ، تلاه

Praon sp colemani ثم

كانت العلاقة بين تعداد المن والنقص في محصول الحبوب غير واضحة في هذه الدراسة حيث لوحظ نقص كبير في محصول الصنف سخا ٦١ بالرغم من إصابته بتعداد أقل من المن عن الصنف سخا ٦٩ في موسمي التقدير (٩٧/١٩٩٨ ، ٩٨/١٩٩٩ م) ولم تكن هناك فروق معنوية للنقص في نفس الصنف في موسمي التقدير . برهن الصنف سخا ٦٩ أنه أكثر تحملاً للإصابة بالمن .