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ASSESSMENT OF THE DAMAGE AND CHEMICAL AND BIOLOGICAL CONTROL OF SOME CEREAL APHID SPECIES INFESTING WHEAT PLANTS IN EGYPT

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ABSTRACT: This work aimed to assessment the damage caused by the infestation with some cereal aphid species on wheat plants at Sharkia Governorate during 2017/2018 season. The results showed that the relationship between the yield of wheat plants and infestation of aphid was in negative correlation. The damage economic threshold level for aphid was 29.57 individuals/100 plant tillers, the economic injury level was 36.28 individuals/ 100 plant tillers. To assesse the efficacy of the tested insecticides against aphid under field conditions showed that chlorpyrifos was the most effective followed by thiamethoxam + abamectin and *Beauveria bassiana*. The residual effects of the tested insecticides were 100, 86.67 and 79.73% for the previous tested insecticides, respectively. The general effect of reduction percentages indicated 98.59, 69.75 and 79.73%, successively for the same tested insecticides in the first season (2016/2017). While the residual effect showed 80.77 to *Beauveria bassiana* , 86.9 to thiamethoxam + abamectin and 100 to chlorpyrifos .On the other hand , the general effects in the second season (2017/2018) were *Beauveria bassiana* (80.77), thiamethoxam + abamectin (70.7) and chlorpyrifos (99.06).

Key words: Cereal aphid species, wheat, damage, control, insecticides, entomofungus bio- pesticide.

INTRODUCTION

Wheat (*Triticum aestivum*) **(Mackey, 1966)** crop is considered to be one of the most important cereal crops in many countries of the world as the main source of food. In Egypt, wheat is main food resources for most Egyptian people. Wheat production is facing several difficulties and the gap between national production and consumption is increasing from year to another. These difficulties can be condensed in some reasons, *i.e.,* limitation of land resources, high rate of population growth, high rate of annual per-capita consumption, high production costs and infestation with pest insects, rodents, diseases and weeds.

As a result of the expansion of cultivated graminaceous plants the problems of insect pests have been increased. In the last years graminaceous plants were subjected to attack by a large number of insect pests throughout the growing seasons (**Hegab *et al.,* 1988; Hegab - Ola, 2001**). Among these insect pests, certain homopterous insects such as aphids, leafhoppers and wheat stemfly are of great economic importance insects which causes serious damage either directly by sucking plant juice or indirectly as vectors of virus diseases (**Hegab - Ola, 1997**). These insects caused considerable reduction in yield of wheat, *e.g.,* cereal aphids.

Kurppa (1989), El-Serafi *et al.* (1997), El-Defrawi *et al.* (1998) and El-Heneidy *et al.* (2003) found that cereal aphid was one of the most serious and abundant species causing damage in wheat Predominant cereal aphid species are the green bug, *Schizaphis graminum* (Rondani), bird cherry-oat aphid, *Rhopalosiphum padi* (L.) and *R. maidis* (R.) in Egypt **(El-Heneidy and Adly, 2012)**.

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Effect of chemical pesticides on aphid was extensively studied by several investigators (**Saad, 1997; Ebieda *et al.,* 1998; Simon – Delso, 2015)** however, chemical applications are often necessary to decrease aphid populations to acceptable levels. Therefore, the scope of the present study was to assess the damage caused by the cereal aphid and its control.

MATERIALS AND METHODS

Damage Assessment Caused by Cereal Aphid on Wheat Plants at Abu Kebeer During 2017/2018 Season

This experiment was conducted in the field cultivated with wheat variety Misr 1, used in this study. Seeds were acquired from Agricultural management at Abu Kebeer district, Sharkia Governorate, Egypt, during the growing season, 2017/2018 to determine the damage caused by some cereal aphids under field conditions. Samples each of 100 plant tillers were chosen randomly from 10 treatments, each one was divided to 5 replicates and each treatment was 20 m^2. The chosen plants were labeled and left to natural infestation. All plants received the same agricultural practices during the course of this experiment without application chemical control treatments during the investigation period. Weekly samples were considered and the numbers of adults and nymphs per each selected plant tiller were counted. The yield of each treatment (20 m^2) was assessed and weighted in kilogram.

Data were subjected to statistical analysis of assessment damage under field conditions according to some authors (**Hosny *et al.*, 1972; Salem and Zaki, 1985; Sherief *et al.*, 2009**).

Values corresponding calculation of yield per treatment were represented by straight line equation:

$\hat{Y}$= a + bx = y ± b (x- x') (**Golden. 1960**)

Where:

$\hat{Y}$ = expected yield,

a= y intercept, a constant representing,

b = slope of the regression line,

x = the number of aphid (x–x`) and designing regression line by Chi - χ^2 were assessed to calculate the economic injury level.

$$\chi^2 = \frac{\sum ai \times pi - (\sum ai \times p`)}{P` \times q}$$

$$pi = \frac{ai}{R}$$

n = number of replicates

ai = mean number of adults and nymphs, R= size of sample

$$P` = \frac{\sum pi}{n} \quad q` = 1 - p`$$

Control of Cereal Aphids on Wheat Plants

The insecticides used belonging to different groups of chemicals (Table 1) were as follows:

Biover (10.0 %WP)

Common name: *Beauveria bassiana*

Agriflex (18.56 SC)

Common name: thiamethoxam + abamectin

(15.24% thiamethoxam + 3.32% abamectin)

Pestban (48%EC)

Chemical name:

O,O- diethyl O-3,5,6- trichloro-2-pyridyl

Common name **chlorpyrifos**

Efficiency of Certain Insecticides Against Some Cereal Aphid Species Infesting Wheat Plants Under Field Conditions

The experiment was carried out at Abu kebeer during the seasons of 2016/2017 and 2017/ 2018. Experiments were set at a randomized block design. An area about (4 kirates) was divided into 4 plots (3 treatments for each insecticide used and 1 as control). Motor sprayer was used to spray the tested insecticides at recommended rate. Samples were of 20 infested plant tillers taken at random from each plot. Counts of aphid individuals were made just before treatment then after one, three, seven and ten days after application excepting in case of the entomofungus bio.pesticid counts were

Table 1. Insecticides used

Trade name	Formulation	Common name	Active ingredient (%)	Group	Recommended rate
Biover	WP	*Beauveria bassiana*	10	Entomofungus (*Beauveria bassiana*)	200 g /100 l water
Agriflex	SC	Thiamethoxam + abamectin	18.56	Neonicotinoids	240 ml /Fad.
Pestban	E.C	Chlorpyrifos	48	Organophosphorus	1 l /Fad.

Back motor (20 litter) was used in spray.

not practiced after one day. The reduction percentages of aphid population were calculated according to **Henderson and Tilton (1955)** as follows:

Percentage reduction in population =

$$\left[1-\frac{\text{(No. of insects in untreated plot before treatment} \times \text{No. of insects in treated plot after treatment)}}{\text{(No. of insects in untreated plot after treatment} \times \text{No. of insects in treated plot before treatment)}}\right] \times 100$$

RESULTS AND DISCUSSION

Damage Assessment Caused By Some Cereal Aphid species

Table 2 shows the numbers of cereal aphid species on wheat plants during the season of 2017/2018. The first appearance of aphid was on the first week of January. The maximum number of aphid was observed in T10, mean of population was 55.82 and the yield was 6.7 kg/20 m^2 while total minimum number in T1 was 206 individuals/100 plant tillers with the mean of 15.85 and grain yield was 9.5 kg/20 m^2. The results showed that the maximum number of aphids causing minimized the yield and the minimum of aphid number caused the yield vice versa.

Results obtained in Table 3 and Fig. 1 showed that during the season of 2017/2018, up to 29.57 individuals/ 100 plant tillers, the value of χ^2 (9.32) indicated that insignificant reduction occurred in yield from 8.6 to 8.4 kg /20 m^2 as a result of increasing the number of individuals/ 100 plant tillers from 28.29 to 29.57 while at number of 36.28 individuals/ 100 plant tillers , the χ^2 value became significant (16.23). In other words, when number of individuals/ 100 plant tillers reached to 36.28, significant drop in yield occurred and the value before 29.57 could be considered as economic threshold level. While, the relationship between the yield and the cereal aphid population was negative correlation in the previous season with a coefficient (r) valued -0.9915 and coefficient of regression (b) valued -0.0729.

Stern and Hagan (1959) proposed the concepts of an economic injury level (EIL) and economic threshold (ETL) as a rational comparison of the economic costs and benefits of pesticide use. Economic threshold level is defined as the lowest population density (number) that will cause economic damage, where economic damage is the amount of damage that equals the cost of control (**Stern *et al*., 1959; Pedigo *et al*., 1986). El-Defrawi *et al*. (1998)** reported that the economic injury levels (EIL) of the cowpea aphid, *Aphis craccivora* koch*,* damaging faba bean cultivar Giza 2 were evaluated in Beni-Suef Governorate (middle Egypt) during the 1994 to 1996 growing seasons. Percentage of plants infested with the aphid was taken as a criterion for initiating control measures. **El-Heneidy *et al*. (2003)** recorded that the use of economic thresholds as a basis for decision making is a fundamental component in integrated pest management (IPM). **Al-Habashy-Amal (2014)** studied the assessment of the damage of yield in sugar beet to infestation of *Cassida vittata.* The results showed that, the relationship between the infestation of *C. vittata* and sugar beet yield was negative correlation *i.e.,* the increasing adults and larvae infestation caused a decrease in the yield and vice versa. The economic injury level was 11.75 individuals/ plant, the damage economic threshold level was 10.95 individuals/plant in the first season, but the economic injury level was 11.35 individuals/ plant and the economic threshold level was 10.95 indviduals / plant in the second season.

Table 2. Number of aphid individuals/sample (100 plant tillers/treatment) under field conditions at Abu Keeber district, Sharkia Governorate and weight of grain yield/plot during 2017/2018 season

Weekly sample		Mean numbers of aphid individuals /100 plant tillers/ treatment									
		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
	1st	1	3.4	0	3	4	5	3.4	0	5.6	10
Jan.	2nd	2.6	4	3.6	5.6	7.6	8	7	8.6	20	26
	3rd	4.4	5.6	5	9	10	10.6	13.4	24	38	48
	4th	7	8	15.4	20	22.8	22	30	40	48	58
	1st	13	16	22	28	30	30.8	39.6	46	56	65.6
Feb.	2nd	17.6	18	29	35	34	36	42.8	54	78	83
	3rd	22.2	26	33.2	36	36.4	37.4	52	60	80	84
	4th	26.4	28.4	37.8	40	42.4	43.8	53.2	70	90	100
	1st	32	37.6	39.2	43.8	44.6	46	61.2	82	102	96
Mar.	2nd	35.8	37	41	50	47.4	51.6	68	86	88	103
	3rd	36.6	39.8	44.8	60	60.6	63	73	80	36	40
	4th	7.4	8	11.6	22	23	26	22.6	4	6.6	10
April	1st	0	2.2	2	6	5	4.2	5.4	2.2	1.4	2
Total		206	234	284.6	358.4	367.8	384.4	471.6	556.8	649.6	725.6
Mean		15.85	18	21.89	27.57	28.29	29.57	36.28	42.83	49.97	55.82
Yield (kg/ 20 m^2)		9.5	9.3	9.0	8.8	8.6	8.4	7.7	7.5	6.9	6.7

Table 3. Damage for the number of aphid individuals/100 plant tillers wheat determined during 2017/2018 season, at Abu Keeber District, Sharkia Governorate

Treat.	Yield (kg/ 20 m^2)	ai	R	Pi=ai/R	ai x pi	χ^2		
						Cal.	Tabulated	
							0.05	0.01
1	9.5	15.85	100	0.159	2.512	0.00		
2	9.3	18	100	0.180	3.240	0.16	3.841	6.635
3	9	21.89	100	0.219	4.792	1.24	5.991	9.210
4	8.8	27.57	100	0.276	7.601	4.81	7.815	11.345
5	8.6	28.29	100	0.283	8.003	7.15	9.488	13.277
6	8.4	29.57	100	0.296	8.744	9.32	11.07	15.086
7	7.7	36.28	100	0.363	13.162	16.23*	12.59	16.80
8	7.5	42.83	100	0.428	18.344	28.79	14.08	18.49
9	6.9	49.97	100	0.500	24.970	48.63	15.51	20.09
10	6.7	55.82	100	0.558	31.159	73.75	16.919	21.67

Damage started at 29.57 insects/100 plant tillers. ai = insects/ 100 plant tillers. R=size of sample (100 plant tillers). pi = ai /R.

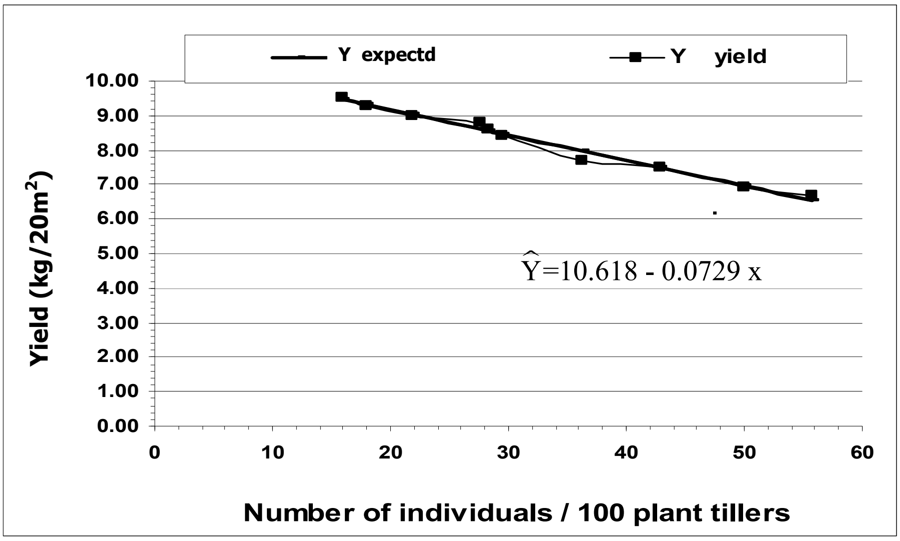

Fig. 1. The regression line between yield and number of aphid individuals during 2017 /2018 season

Control Study

First season (2016/2017)

Results presented in Table 4 show that the mean numbers of aphids (apterous and alate) were regularly decreased after treatment with all the examined compounds. This decreasing lasted till the end of 10, 7, 3 days in case of *Beauveria bassiana*, thiamethoxam + abamectin and chlorpyrifos, respectively. The general mean numbers of aphids were 35.77, 54.2 and 2.75 (individuals/sample) for the previously mentioned insecticides successively, compared with control which recorded 153.5 individuals/ sample.

As shown in Table 5, reduction percentages of the tested insecticides against aphid infesting wheat plants (*T. aestivum*) for the tested insecticides, *Beauveria bassiana* , thiamethoxam + abamectin and chlorpyrifos reduced by 41.3%, 60% and 100% for the tested insecticides after 3 days while chlorpyrifos recorded 94.38% in reduction after one day as initial reduction percentage, while the residual effects were 79.73, 86.67 and 100 for the previous tested insecticides, respectively. The general effect of reduction percentages recorded were79.73, 69.75 and 98.59 for the same tested insecticides consecutively. The tested insecticides could be descendingly arranged according to their reduction percentages of population according to their residual effect as follows: chlorpyrifos > thiamethoxam+abamectin >*Beauveria bassiana*.

Second season (2017/2018)

Results tabulated in Table 6 show that all the tested insecticides decreased the numbers of aphid population in regular way when compared with control. Results cleared that chlorpyrifos was the best pesticide. The general mean numbers of aphid were 37.67, 60.5 and 2 individuals/ sample for *Beauveria bassiana*, thiamethoxam+abamectin and chlorpyrifos , respectively, compared with 193.44 individuals/ sample which was recorded as a general mean number in the untreated plots (control).

Results presented in Table 6 indicat that initial effect of chlorpyrifos (96.23) while residual effect recorded 80.77 to *Beauveria bassiana*, 86.9 to thiamethoxam+abamectin and 100 to chlorpyrifos. On the other hand, the general effect of *Beauveria bassiana* 80.77, thiamethoxam+abamectin 70.7 and chlorpyrifos 99.06. The tested insecticides could be descendingly arranged according to their reduction percentages (residual effect) in aphids population as follows: chlorpyrifos > thiamethoxam+abamectin> *Beauveria bassiana*.

Table 4. Total numbers of aphids (adults and nymphs) infesting wheat plants during 2016/2017 season at Abu Keeber district, Sharkia Governorate

Treatment	Mean No. before treatment/ 20 plant tillers	Mean no. of aphid after treatment at indicated days				General mean
		1	3	7	10	
Control	122.75	135.5	148	156.5	174	153.5
Beauveria bassiana	146	-	103.3	4	0	35.77
Thiamethoxam +abamectin	158.5	140.4	76.25	0	0	54.2
Chlorpyrifos	177. 25	11	0	0	0	2.75

Table 5. Reduction percentages of the tested insecticides against cereal aphids, infesting wheat plants during 2016/2017 season at Abu Keeber district, Sharkia Governorate

Tested insecticide	Initial effect	Reduction percentage after treatment at indicated days			Residual effect	General effect
		3	7	10		
Beauveria bassiana	-	41.3	97.9	100	79.73	79.73
Thiamethoxam +abamectin	19	60	100	100	86.67	69.75
Chlorpyrifos	94.38	100	100	100	100	98.59

Table 6. Total numbers of aphids (adults and nymphs) infesting wheat plants during 2017/2018 season at Abu Keeber district, Sharkia Governorate

Treatment	Mean No. before treatment/sample	Mean no. of aphids after treatment at indicated days				General mean
		1	3	7	10	
Control	141	169.25	185.25	204.25	215	193.44
Beauveria bassiana	153	-	109. 25	3.75	0	37.67
Thiamethoxam +abamectin	166.75	156	86	0	0	60.5
Chlorpyrifos	176.25	8	0	0	0	2

Table 7. Reduction percentages of the tested insecticides against cereal aphids, infesting wheat plants during 2017/2018 season at Abu Keeber district, Sharkia Governorate

Tested insecticide	Initial effect	Reduction percentage after treatment at indicated days			Residual effect	General effect
		3	7	10		
Beauveria bassiana	-	45.6	96.7	100	80.77	80.77
Thiamethoxam +abamectin	22.1	60.7	100	100	86.9	70.7
Chlorpyrifos	96.23	100	100	100	100	99.06

These results are nearly similar to those obtained by some authors such as **Isa *et al.* (1972)** who evaluated toxicity of Dursban (chlorpyrifos), Lannate (methomyl) and Sevin (carbaryl) against *S. cretica.* Dursban was the most effective pesticide and gave the highest yield compared with untreated control. **Hashem (1998)** used two commercial formulations of mycoinsecticide *Beauveria bassiana* which were applied on wheat plants infested with aphids a comparative treatment with malathion 57.5% EC, experimental results showed that malathion was more effective than the two commercial formulations of the mycoinsecticide. **Dave (2013)** reported that neonicotinoids are the great widely used in all over the world. They are traveling through plant tissues, systematically and protecting all crop parts and are high applied to seed dressings. Neonicotinoids have influence for pest control and have a lot of uses in horticulture and farming arable because they have toxicity to most arthropods. Environmental concerns result to the prophylactic use of broad spectrum pesticides goes against the long established principles of IPM .

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تقدير الضرر والمكافحة الكيميائية والحيوية لبعض أنواع مَنْ الغلال على نباتات القمح في مصر

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هدف هذا البحث إلى تقييم الضرر المتسبب عن الإصابة بمَنْ الغلال على نباتات القمح في منطقة أبوكبير، محافظة الشرقية خلال موسم ٢٠١٨/٢٠١٧، أظهرت النتائج أن هناك علاقة ارتباط عكسية بين إنتاجية المحصول وتعداد حشرات المَنْ حيث يمكن بدأ المكافحة عندما يكون متوسط عدد الافراد ٢٩,٥٧ فرداً/١٠٠نبات، ولتقييم فاعلية المبيدات المختبرة على المَنْ تحت ظروف الحقل أوضحت النتائج أن مبيد كلوربيريفوس كان أكثر المبيدات فاعلية متبوعا بمبيد ثياميثوكسام + ابامكتين وفطر البوفاريا باسيانا حيث كان التأثير المتبقي للمبيدات المختبرة هو ١٠٠، ٨٦,٦٧ و٧٩,٧٣% على التوالي للمبيدات الحشرية المختبرة بينما كان التأثير العام لمستوى الانخفاض في التعداد هو، ٩٨,٥٩، ٦٩,٧٥، ٧٩,٧٣ للمركبات السابقة بنفس الترتيب في الموسم الأول ٢٠١٧/٢٠١٦، بينما سجل التأثير المتبقى في الموسم الثانى ٢٠١٧/٢٠١٨، ٨٠,٧٧ لفطر البوفاريا باسيانا، ٨٦,٩ لمبيد ثياميثوكسام + ابامكتين و ١٠٠ لمبيد كلوربيريفوس، أما التأثير العام كان ٨٠,٧٧ لفطر البوفاريا باسيانا، ٧٠,٧ لمبيد ثياميثوكسام + ابامكتين و٩٩,٠٦ لمبيد كلوربيريفوس، ويستفاد من هذا البحث في اختيار أنواع المركبات المناسبة لمكافحة حشرة مَنْ الغلال ضمن استراتجية المكافحة المتكاملة لهذه الآفة على نباتات القمح في محافظة الشرقية.

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