INCIDENCE OF DIFFERENT MORPHS OF THE GREENBUG, *Schizaphis graminum* (ROND.), DISPERSAL ABILITY, NATALITY RATE AND PERCENTAGE OF APHID STAGES ON WHEAT PLANTS IN SOHAG GOVERNORATE, UPPER EGYPT

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Abstract: Occurrence of all morphs of the greenbug, *Schizaphis graminum*, dispersal ability, natality rate and percentage of aphid stages were studied on wheat plants at Shandaweel Agricultural Research Station, Sohag Governorate, upper Egypt in 2004/2005 and 2005/2006 seasons. The multiple-regression analysis between biological parameters of aphids versus biotic and abiotic factors was calculated. Generally, data revealed that: 1- The peak numbers of nymphs were (60189 and 37700 nymphs/100 tillers) during 2005 and 2006 seasons, respectively. Nymph numbers were 1.78 times in the first season more than in the second one. 2- Adult females reached the highest level (2724 and 1684 females/100 tillers) during 2005 and 2006 seasons, respectively. The population of adult females was higher in 2005 season (10019 females/100 tillers) than in the second one (5047 females/100 tillers). 3- The percentage of winged adult females in relation to the total numbers of adult females was 100% at the beginning of infestation in the second half of January. Afterwards, winged adults migrated to plants until reached 62.36% and 47.96% in 2005 and 2006 seasons, respectively. The average percentage of winged females was higher in the second season than in the first one. 4- The average of natality rate per female was 16 and 25 nymphs i.e., 2 and 4 nymphs/female per day during 2005 and 2006 seasons, respectively. 5- The average percentage of winged adults (alatae), wingless adults (apterae) and nymphs was (1.5%, 2.8% and 95.7%) and (1.7%, 2.1% and 96.2%) during 2005 and 2006 seasons, respectively. This means that nymphs constituted the highest percentage of individuals in relation to the total of aphid population. 6- The multiple regression analysis to the effect of plant age, maximum, minimum, average daily temperatures and average relative humidity on the total numbers of adult females, data revealed that minimum temperature and average relative humidity in 2005 and 2006 seasons, respectively, played the important role in regulating adult females of *S. graminum*. While, on the total number of nymphs, data revealed that minimum temperature and average relative humidity were responsible for all reduction of nymph population of *S. graminum* in 2005 and 2006 seasons, respectively. Data on the natality rate, revealed that minimum temperature and plant age were the most important factors affected natality rate of *S. graminum* during 2005 and 2006 seasons, respectively.

Key words: greenbug, wheat, dispersal, natality, aphid stages.

Introduction

The greenbug, *Schizaphis graminum* (Rondani) is one of the most important insect pest of cereal crops in Upper Egypt (Ali and Rizk 1980, Ali and Darwish 1990 and Mahmoud 2005). The pest is capable of attacking and injuring wheat during winter and sorghum during summer. It may cause yield losses of wheat plants either directly by feeding or indirectly through their role as vectors of plant viruses (Hill 1975, Pfadt 1978 and Milne and Delves 1999). Also, this pest developed biotypes capable of survival on supposedly resistant and barely varieties (Barbulescu 1978, Puterka *et al.*, 1988 and Porter *et al.*, 1991). El-Khidir (1977) mentioned that this pest produced no sexual forms, and the population consisted mainly of apterous females. Also, the author mentioned that some winged females appeared at times, but did not become numerous until the plants grew old. This species formed large colonies along the leaves, the life-span averaged 30.7 days, and individual females produced 43-81 nymphs at the rate of 10 females/day.

The aim of the present study was to clarify the occurrence of different stages of the greenbug, *S. graminum*, and also to determine the dispersal ability and the natality rate of this aphid in the field, and finally to know the effect of certain climatic factors and plant age on both insect stages and natality rate. All of these main elements are useful in establishment of insect management systems, for example, the numbers of winged females arriving to wheat plant, can be used as indicator on population size which will form during the season.

Materials and Methods

This study was carried out at Shandaweel Agricultural Research Station, Sohag Governorate, during two successive seasons (2004/2005 and 2005/2006). An area of about ½ feddan was divided into 20 plots of equal size and cultivated with the wheat variety (Giza 168) on 29th November in both seasons. All normal agricultural practices were used and no insecticides were used. Random samples of 100 tillers (5/tillers/plot) were taken periodically at seven days intervals from the beginning of aphid appearance until the maturity of the plants. Wing and wingless females and nymphs, each was recorded separately. The percentages of winged females were used as index for the dispersal ability. The natality rate per female was calculated by dividing the total number of nymphs by the total numbers of adults (Salem, 2003).

The meteorological date (temperature as well as relative humidity) were recorded at each inspection date. Records were obtained from the Meteorological Station located at El-Menshah

district, 22 km south of Sohag Governorate.

The relationships between adult counts, nymph counts and natality rate/female, and the weather factors as well as plant age were analyzed by using multiple regression analysis.

Results and Discussion

1- Nymph numbers:

Nymphs started with low numbers (278 and 573 nymphs/100 tillers) on 12th and 14th January during 2005 and 2006 seasons, respectively. The number of nymphs increased rapidly till it reached the peak (60189 and 37700 nymphs/100 tillers) on 15th and 11th March during 2005 and 2006 seasons, respectively, then decreased sharply to reach the lowest level (294 and 2648 nymphs/100 tillers) between 5th April and 25th March, during 2005 and 2006 seasons, respectively, and the number of nymphs disappeared during April, (see tables 1 and 2).

The favorable period for nymphs occurrence extended from mid February to the end of March during both seasons. The number of nymphs/season in the first season was 1.78 times more than in the second one, which may be accounted by the presence of higher numbers of total adult females on wheat tillers in the first season (10019 females/100 tillers) than in the second season (5047 females/100 tillers).

These results are in agreement with the results obtained by Salem (2003) who reported that the highest counts of nymphs on wheat tillers were noticed during the period extending from mid February to the end of March.

2- Adult females:

As shown in Tables 1 and 2, the number of adults was (51 and 63 females/100 tillers) on 12th and 14th January in 2005 and 2006 seasons, respectively. Afterwards, the infestation reached the highest level (2724 and 1684 females/100 tillers) on 15th and 11th March during 2005 and 2006 seasons, respectively.

The total of adult females was higher in the first season (10019 females/100 tillers) than in the second one (5047 females/100 tillers), which may attributed to the higher numbers of winged adults that infested wheat tillers in 2005 season (3518 females/100 tillers) than in 2006 season (2281 females/100 tillers).

These results are in corresponding with the results of El-Heneidy and Abdel-Samad (2001), Abdel-Samad and Gomaa (2004) and Mahmoud (2005), who referred that *S. graminum* infestation started in January and gradually increased to reach its maximum by mid March, then decreased towards the end of the season.

Table(1): Total numbers of all morphs of *S. graminum* / 100 wheat tillers and natality rate during 2005 season.

Sampling date	Adult females			% alate from total numbers of adult females	Nymphs	Natality rate /female
	Alate	Aptera	Total			
Jan. 12	51	0	51	100	278	5
19	133	0	133	100	293	2
26	88	0	88	100	775	9
Feb. 2	111	067	178	62.36	2679	15
9	198	213	411	48.18	4353	11
16	217	433	650	33.38	8575	13
23	376	729	1105	34.03	21425	19
March 1	490	1134	1524	32.15	35807	24
8	617	1316	1933	31.92	47337	24
15	1014	1710	2724	37.22	60189	22
22	211	740	951	22.19	35967	38
29	012	176	188	6.38	7540	40
April 5	0	083	83	0.0	294	4
12	0	0	0	0.0	0	0
Total	3518	6601	10019	607.81	225512	226
Average	251	472	716	43.42	16108	16
%of all stages	1.50	2.80			95.7	

Table(2): Total numbers of all morphs of *S. graminum* / 100 wheat tillers and natality rate during 2006 season.

Sampling date	Adult females			% alate from total numbers of adult females	Nymphs	Natality rate /female
	Alate	Aptera	Total			
Jan. 14	63	0	63	100	573	9
21	078	0	78	100	2200	28
28	97	0	97	100	4004	41
Feb. 4	121	0	121	100	5981	49
11	176	191	367	47.96	9387	26
18	210	410	620	33.87	12180	20
25	269	319	588	45.75	16222	28
March 4	391	522	913	42.83	25131	28
11	731	953	1684	43.41	37700	22
18	132	254	386	34.20	11406	30
25	13	117	130	10.0	2648	20
April 1	0	0	0	0.0	0	0
Total	2281	2766	5047	658.02	127432	301
Average	190	231	421	54.84	10619	25
%of all stages	1.7	2.1			96.2	

3- Dispersal ability (percentage of winged adults):

Obviously, data in tables (1 and 2) revealed that the percentage of winged adults in relation to the total numbers of adult females was 100% in the three and four consecutive samples of both 2005 and 2006 seasons. Also, the three and four consecutive samples of both seasons did not contain any aptera adults. These winged females began to build population.

Afterwards, winged adults migrated to plants until reached 62.36% and 47.96% on 2nd and 11th February of both seasons, respectively. Finally, the adults completely disappeared on 5th and 1st April during both seasons, respectively. The average percentages of winged females per season were 43.42 and 54.84% during both seasons, respectively. These results are in agreement with those obtained by El-Komy (1999), who found that the infestation percentage of late morph of *S. graminum* was 100% as migrants, in comparison to apterous adults.

4- Natality rate:

As shown in Tables (1 and 2), the natality rate was low on 19th, 12th and 14th January (2, 5 and 9 nymph/female) during 2005 and 2006 seasons, respectively. Afterwards, it increased to reach the maximum level on 25th March and 4th February during both seasons (37.83 and 49.43 nymph/female), respectively. The average natality rate/female was 16 and 25 nymphs/female i.e., 2 and 4 nymphs/female/ day, during both seasons, respectively. These results are in harmony with Pfadt (1978), who mentioned that young adults of greenbug bear three or four offspring each day. El-Komy (1999) concluded that every female produced a mean number of 23.8 and 11.6 nymphs on wheat genotypes Giza 163 and Giza 164, respectively. Also, Salem (2003) mentioned that the average natality rate/female on wheat genotype Giza 163 was 17.81 and 24.33 nymphs i.e., 2.5 and 3.5 nymphs/female/day during 1999/2000 and 2000/2001 seasons.

5- Percentage of aphid stages:

Data in Tables (1 and 2) indicated that nymphs were common as compared with the other forms of *S. graminum*. It consisted generally of 95.7 and 96.2% during 2005 and 2006 seasons, respectively, when compared with 2.8 and 2.1%, and 1.5 and 1.7% of grand total for apterous and alate forms during both seasons, respectively.

This little percentage of alate females migrated to wheat seedlings or other areas or hosts to initiate the infestation on wheat.

These results are similar to those obtained by Mahmoud (2005), who reported that nymphs constituted the highest percentage of individuals followed by apterae and alatae on wheat plants.

Table(3): Metrological data of 2005 and 2006 seasons, using to calculate multiple regression analysis.

Metrological data of 2005 season					Metrological data of 2006 season				
Sampling date	Temperature (ºC)			R.H. %	Sampling date	Temperature (ºC)			R.H. %
	Max.	Min.	Mean			Max.	Min.	Mean	
Jan. 12	17.86	3.77	10.02	64.43	Jan. 14	19.44	6.00	12.72	51.28
19	18.79	5.43	12.11	62.29	21	19.41	4.29	11.85	50.00
26	19.21	4.93	12.07	61.14	28	22.23	7.54	14.68	47.00
Feb. 2	24.14	6.64	15.39	55.71	Feb. 4	21.00	5.64	13.32	47.43
9	18.34	5.29	11.81	58.29	11	21.43	6.60	14.01	46.14
16	18.83	3.54	11.18	58.14	18	20.39	6.29	13.34	46.86
23	28.10	10.07	19.09	59.71	25	24.74	9.16	16.95	48.29
March 1	26.13	10.24	18.19	57.00	March 4	28.85	13.71	21.28	47.43
8	29.77	10.73	20.25	54.00	11	25.17	10.99	18.08	44.29
15	25.03	8.30	16.66	57.71	18	24.33	9.59	16.96	42.86
22	23.93	8.27	16.90	52.86	25	30.79	11.96	21.37	42.00
29	25.51	8.64	17.08	55.29	April 1	25.86	11.76	18.81	46.57
April 5	28.93	12.13	20.53	54.29					
12	35.00	14.41	24.71	54.29					

6- Multiple-regression analysis between:

a. The total number of adult females of *S. graminum*, plant age and weather factors.

As shown in Table (4) there was insignificant positive simple correlation coefficient between plant age, maximum temperature, minimum temperature, average daily temperature (shown in table 3) and adult females number, except for average relative humidity this correlation was negative during 2005 and 2006 seasons. Also, the obtained results generally indicated that minimum temperature and average temperature during 2005 season, average relative humidity and maximum temperature during 2006 season played the most important role in regulating *S. graminum* adult females populations.

Table(4): Multiple regression analysis between the total number of adult females of *S. graminum*, plant ages and weather factors during 2005 and 2006 seasons.

Variable removed	r	R	R^2 x 100	Decrease in R^2 x 100	Efficiency
2005 season					
Non	-	0.3142	9.87	-	-
Plant age (days)	0.2297	0.3031	9.19	0.68	0.6637
Max. temp. (ºC)	0.2253	0.2905	8.44	1.33	1.3915
Min. temp. (ºC)	0.2012	0.2425	5.88	3.99	3.8731
Avg. temp. (ºC)	0.2282	0.2611	6.82	3.05	2.9618
Avg. R.H (%)	-0.2137	0.2976	8.86	1.01	0.9840
2006 season					
Non	-	0.7693	59.19	-	-
Plant age (days)	0.2903	0.6620	43.83	15.26	8.5605
Max. temp. (ºC)	0.2712	0.5686	32.33	26.86	14.9669
Min. temp. (ºC)	0.4091	0.6780	45.97	13.22	7.3632
Avg. temp. (ºC)	0.3428	0.6090	37.09	22.10	12.3162
Avg. R.H (%)	-0.2715	0.5523	30.50	28.69	15.9842

r = Simple correlation coefficient. R = Multiple correlation coefficient.

R^2 = Coefficient of determination.

b. The total number of nymphs of *S. graminum*, plant age and weather factors.

The data of 2005 and 2006 seasons (Table 5) indicated that there was insignificant positive simple correlation between plant age, maximum temperature, minimum temperature, average daily temperature, average relative humidity and nymph numbers, except for average relative humidity this correlation was negative. The multiple regression analysis revealed that the five studied variables were responsible for 17.13% and 54.58% of the changes in *S. graminum* nymphs population during 2005 and 2006 seasons, respectively. Most of the changes in pest populations, however, were due mainly to minimum temperature and average relative humidity during 2005 and 2006 seasons, respectively. This means that, the two variables played the most important role in regulating *S. graminum* populations.

Table (5): Multiple regression analysis between the total number of nymphs of *S. graminum*, plant ages and weather factors during 2005 and 2006 seasons.

Variable removed	r	R	R^2 x 100	Decrease in R^2 x 100	Efficiency
2005 season					
Non	-	0.4138	17.13	-	-
Plant age (days)	0.3152	0.4066	16.53	0.60	0.6615
Max. temp. (ºC)	0.2737	0.3678	13.52	3.61	4.0151
Min. temp. (ºC)	0.2577	0.3419	11.69	5.44	6.0576
Avg. temp. (ºC)	0.2887	0.3438	11.82	5.31	5.9114
Avg. R.H (%)	-0.3293	0.4086	16.69	0.44	0.4855
2006 season					
Non	-	0.7388	54.58	-	-
Plant age (days)	0.2906	0.6224	38.74	15.84	10.4919
Max. temp. (ºC)	0.3096	0.5940	35.28	19.30	12.7791
Min. temp. (ºC)	0.4429	0.6806	46.33	8.25	5.4638
Avg. temp. (ºC)	0.3784	0.6249	39.33	15.53	10.2837
Avg. R.H (%)	-0.2665	0.5574	31.07	23.51	15.5655

r = Simple correlation coefficient. R = Multiple correlation coefficient.
R^2 = Coefficient of determination.

c. Multiple-regression analysis between the natality rate of *S. graminum*, plant age and weather factors.

Data in Table (6) revealed that there was insignificant positive simple correlation between natality rate and four variables (plant age, maximum temperature, minimum temperature and average daily temperature), except for average relative humidity, it was negative during 2005 season. On the contrary, there was insignificant negative simple correlation between the five variables and natality rate during 2006 season.

Most of the changes in natality rate of *S. graminum* were due to minimum temperature and plant age during 2005 and 2006 seasons, respectively. These two variables being the only factors that affect natality rate of *S. graminum*.

The forementioned results agree with that of Abou-Elhagag and Abdel-Hafez (1998) and Mahmoud (2005), who referred that the average daily temperature,

minimum temperature, maximum temperature and average relative humidity considered the most important factors, which play the most important role in regulating aphid population in wheat field. Over and above, Honek and Martinkova (2004) indicated that the wheat plant age influenced on distribution of the cereal aphid, *Metopolophium dirhodum* (Walker) on spring wheat plants.

Table(6): Multiple regression analysis between the natality rate of *S. graminum*, plant ages and weather factors during 2005 and 2006 seasons.

Variable removed	r	R	R^2 x 100	Decrease in R^2 x 100	Efficiency
2005 season					
Non	-	0.6240	38.94	-	-
Plant age (days)	0.3530	0.5907	34.89	4.05	7.5187
Max. temp. (ºC)	0.1164	0.5944	35.33	3.61	6.7029
Min. temp. (ºC)	0.0088	0.5572	31.05	7.89	14.6565
Avg. temp. (ºC)	0.1412	0.5826	33.94	5.00	9.2774
Avg. R.H (%)	-0.4610	0.6206	38.51	0.43	0.7872
2006 season					
Non	-	0.6879	47.32	-	-
Plant age (days)	-0.3649	0.5794	33.57	13.75	23.1772
Max. temp. (ºC)	-0.1763	0.6615	43.76	3.56	6.0103
Min. temp. (ºC)	-0.3128	0.6700	44.89	2.43	4.1011
Avg. temp. (ºC)	-0.2506	0.6662	44.38	2.94	4.9627
Avg. R.H (%)	-0.0055	0.6476	41.94	5.38	9.0773

r = Simple correlation coefficient. R = Multiple correlation coefficient.
R^2 = Coefficient of determination.

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تواجد الأطوار المختلفة لمن القمح الأخضر ، القدرة على الإنتشار ، معدل الولادة والنسبة المئوية لتواجد الأطوار المختلفة على نباتات القمح بمحافظة سوهاج - مصر العليا

فرغل أحمد على سلمان

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - دقى - جيزة

دُرس تواجد الأطوار المختلفة لمن القمح الأخضر ، القدرة على الإنتشار، معدل الولادة والنسبة المئوية لتواجد الأطوار المختلفة على نباتات القمح . بمحطة البحوث الزراعية بجزيرة شندويل - محافظة سوهاج - مصر العليا . كما دُرست أيضاً العلاقة بين تعداد الحوريات ، تعداد الحشرات الكاملة ، معدل الولادة والعوامل الجوية وعمر النبات عن طريق تحليل الإنحدار المركب.

وقد تمخضت الدراسة عن ما يلى :-

1- بلغ أقصى تعداد للحوريات (60189 ، 37700 حورية على 100خلفة من النباتات) خلال موسمى 2005 ، 2006م على التوالى . ولقد كان مجموع الحوريات فى الموسم الأول أكبر من الموسم الثانى بمقدار 1.78 مرة .

2- بالنسبة للأطوار الكاملة وصلت إلى أعلى مستوى لها (2724 ، 1684 أنثى على 100 خلفة من النباتات) خلال موسمى 2005 ، 2006م على التوالى . ولقد كان مجموع الإناث فى الموسم الأول (10019 أنثى على 100خلفة من النباتات) أعلى من الموسم الثانى (5047 أنثى على 100خلفة من النباتات).

3- بالنسبة للنسبة المئوية للإناث الكاملة المجنحة نسبة إلى المجموع الكلى لعدد الإناث الكاملة (مجنح أو غير مجنح) كانت 100% فى بداية الإصابة خلال النصف الثانى من يناير وبعد ذلك فإن الإناث المجنحة هاجرت إلى نباتات القمح حتى وصلت إلى 62.3 ، 47.96% خلال موسمى 2005 ، 2006م. ولقد كانت النسبة المئوية للإناث المجنحة أعلى فى الموسم الثانى عن الموسم الأول .

4- كان متوسط معدل الولادة للإنثى 16 ، 25 حورية أى 2 ، 4 حورية / أنثى واحدة فى اليوم خلال موسمى 2005 ، 2006م على التوالى.

5- كان متوسط نسبة التواجد للإناث المجنحة وغير المجنحة والحوريات هو (1.5، 2.8 ، 95.7%) و (1.7 ، 2.12 ، 96.2%) خلال موسمى 2005 ، 2006م على التوالى .

6- أظهر تحليل الإنحدار المركب لتأثير عمر النبات ودرجة الحرارة القصوى ودرجة الحرارة الصغرى ومتوسط درجة الحرارة ومتوسط الرطوبة على :-

أ) المجموع الكلى للإناث الكاملة : أن العاملين الأكثر أهمية فى تنظيم التعداد هما درجة الحرارة الصغرى ومتوسط الرطوبة خلال موسمى 2005 ، 2006م على التوالى.

ب) المجموع الكلى للحوريات : كانت درجة الحرارة الصغرى ومتوسط الرطوبة النسبية هما المؤثرتان على المجموع الكلى للحوريات خلال موسمى 2005 ، 2006م على التوالى.

ج) أما فيما يتعلق بمعدل الولادة كانت درجة الحرارة الصغرى وعمر النبات أكثر تأثيراً على معدل الولادة خلال موسمى 2005 ، 2006م على التوالى .