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Population Densities of *Shizaphis graminum* (Rond.) (Homoptera: Aphididae) and its Associated Natural Enemies on Three Wheat Varieties

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Abstract

The population density, trends of *Shizaphis graminum* and its associated natural enemies were assessed in three wheat varieties, Debeira, El nilein and Baladi in the Demonstration Farm of Sudan University of Sciences and Technology during three successive seasons 2004/2005, 2005/2006 and 2006/2007. The greenbug started to appear and build up in the field in the third week of November and reached its peak in January. The infestation in season 2005/2006 was low compared to the other two seasons. Debeira variety harboured the greatest number of *S. graminum* followed by El nilein and Baladi varieties. The wheat aphid was found to be attacked by many predators and parasitoid, namely syrphid flies, coccinellids, green lacewing and the parasitoid *Aphelinus sudanensis*. Debeira variety harboured more predators and parasitoid than the other two varieties.

Keywords: *Shizaphis graminum* (Rond.), Natural enemies, Wheat varieties

Introduction

Wheat is the second most important cereal crop after sorghum in the Sudanese diet (Farah, 1996). Its cultivation started in North of the country , but since early 1960s, then moved southwards to be cultivated in Gezira, New Halfa, Rahad, White and Blue Niles, Khartoum and Darfour States (Ibrahim, 1996).There are 18 different genetic components to fit the different conditions and sowing dates (Mohamed, 2002). The main varieties grown in the Sudan are Condor, Debeira, Giza, Wadi El neel and El nilein (FAO, 1997).

Wheat yields in all producing areas have been characterized by high variability and generally low levels compared to the potential revealed by research results (Faki, 1996). Many factors are thought to affect the productivity of wheat during its growing season. These factors are either biotic and abiotic (Solh, 1996). Insect pests are the most important biotic factors affecting the crop. Schmutterer (1969) listed about 11 species of insects as pests of crops in the Sudan. However the most prevalent ones are aphids, termites, central shoot fly, stem borer, rodents and birds (El khidir, 1977). In nature aphids are prone to attack by many natural enemies and are easy to control due to their non-flying habits, sluggish movement and sedentary way of feeding (Sharaf Eldin *et al.*, 1996). In the Sudan, predators are the most effective species against aphids while parasitoids are rare (Shmutterer, 1969 and Sharaf Eldin *et al*., 1996). The predators prevalent

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in the Sudan are coccinellids, chrysopids, and syrphid. The objectives of this study are:

1. Evaluation of the susceptibility of three wheat varieties to *S. graminum*.
2. Study the natural enemies associated with this pest on three different wheat varieties.

Materials and Methods

The experiments were conducted in the Demonstration Farm of the Faculty of the Agricultural Studies, Sudan University of Sciences and Technology. The land was cleaned, ploughed, harrowed, leveled and divided into 12 equal plots each 16m2 (4 x 4m). Three wheat seed varieties namely Debeira, El nilein and Baladi were sown on November-2004, 2005 and 2006 for three successive seasons. Wheat seeds were sown on rows (North-South) at spacing of 20cm between rows in flat land and 5cm depth of the hole. Supper phosphate and urea were added as recommended. Ten plants were randomly selected from each plot. The number of greenbug (nymphs and adults) predators and mummies were recorded. The counts were done regularly at weekly intervals.

Results

The greenbug appeared in the field in the third week of November during season 2004/05. However, in seasons 2005/06 and 2006/07 the species appeared in the second week of December. The population density of the greenbug increased with time in the three varieties during the three seasons. It reaches its peak during January. Then the population density started to decline towards the end of the season. The highest population density of the pest (52.41%) was recorded in season 2006/07 and the lowest one (5.89%) was recorded in season 2005/06 (Tables 1, 2 and 3). Debeira variety harboured the greatest number of *S. graminum* during the three seasons compared to the other two varieties (Fig.1).

The wheat aphid was found to be attacked by many predators and parasitoid, namely syrphid flies, coccinellids, green lacewing and *A. sudanensis*. Syrphid fly was the most dominant predator followed by coccinellids and green lacewing. Its density was very low during season 2005/06 compared to the other two seasons. Debeira variety harboured more predators (58.5%) than El nilein (27.74%) and Baladi (13.76%). The second most important predators recorded during this study were the coccinellids. These include: *Hippodamia variegata*, *Cydonia vicina*, *Coccinella undecimpunctata* and *Scymnus* sp.The *H. variegata* was the most prevalent one. The other coccinellids were present in very low densities. A large number of predators beetles were reported during season 2006/07 (60.71%) and the lowest one was reported during season 2005/06 (6.85%). More beetles were observed in Debeira plots and the lowest was seen in Baladi plots. The third important predator is *C. carnea*. The predator was reported during late December in small numbers. The highest percent averages (56.49%, 47.97% and 52.87%) were recorded in Debeira plots in the three seasons. Contrary to that the lowest ones were found in Baladi plots (17.64%, 21.49% and 18.83%) tables 4 and 5.

A. sudanensis is a tiny parasitoid, and its presence is oftenly known by the presence of black mummies among the greenbug colonies. The highest percent

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of the infestation by the parasitoid was reported in Debeira plots (57.04%, 51.92% and 67.44%) and the lowest ones were recorded from Baladi plants (17.94%, 19.23% and 13.33%). The population densities of the parasitoid were higher in season 2004/05 (87.65%) than the other two seasons (1.45%) and (10.89%).

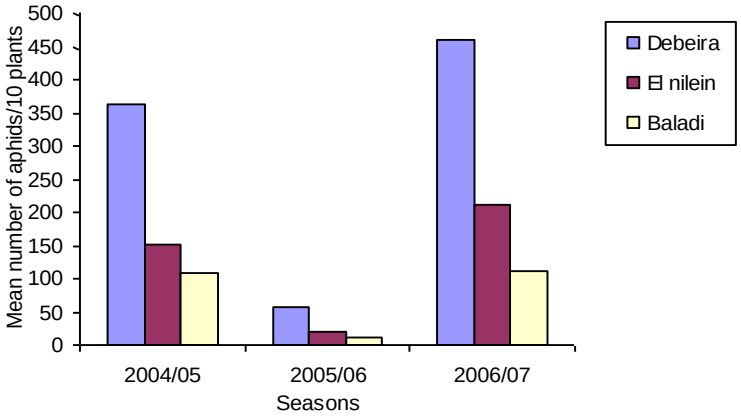

Fig.1. Average density of *S. graminum* on three wheat varieties during the seasons 2004/05, 2005/06 and 2006/07

Table 1. Average number of greenbug aphid (*S. graminum*) on three wheat varieties during season 2004/05

Time(weeks) / Varieties	Average number of aphids/10 plants													
	November		December					January				February		
	1	2	3	4	5	6	7	8	9	10	11	12	13	Average/week
Debeira	0.25 (0.08)	29 (1.34)	123.3 (2.05)	164.3 (2.14)	283.3 (2.41)	198.5 (2.26)	452.3 (2.62)	728 (2.79)	755.8 (2.82	961.5 (2.92)	631.8 (2.74)	328 (2.46)	74.5 (1.81)	363.8 (2.15)
El nilein	3 (0.27)	8 (0.93)	66.5 (1.79)	101.3 (1.91)	136 (2.09)	66 (1.77)	194 (2.27)	327.3 (2.49)	375.3 (2.44)	300.5 (2.44)	243.5 (2.32)	131 (2.11)	22.8 (1.33)	151.9 (1.85)
Baladi	1.75 (0.23)	2.75 (0.43)	40.8 (1.55)	60.3 (1.76)	142.8 (2.14)	45.3 (1.63)	144.5 (2.13)	288.8 (2.45)	160.8 (2.19)	157.8 (2.19)	235.3 (2.31)	103 (1.99)	12 (0.93)	107.4 (1.69)
LSD	-	0.5	0.28	0.2	0.19	0.33	0.26	0.2	0.35	0.32	0.22	0.27	0.42	-
CV%	244	35.1	9.6	7.7	6.4	13.0	8.6	6	10.7	8.9	7.1	9.1	22.1	-
	NS	*	*	*	*	*	*	*	*	*	*	*	*	-

Data in brackets were transformed to log (x + 1)
NS Not significantly different
* Significantly different at 5%

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Table 2. Average number of greenbug aphid (*S. graminum*) on three wheat varieties during season 2005/06

Time (weeks) / Varieties	Average number of aphids/10 plants													
	November		December				January				February			
	1	2	3	4	5	6	7	8	9	10	11	12	13	Average/week
Debeira	0	0	26.5	43	101.3	122.5	179.8	94.25	82.25	51.75	19.75	12	2.7	56.59
	(0)	(0)	(1.37)	(1.61)	(1.95)	(1.99)	(2.17)	(1.94)	(1.88)	(1.69)	(1.22)	(1.1)	(0.55)	(1.34)
El nilein	0	0	15.25	21.25	18.25	42.25	77	37	26.5	14.5	7.5	8.75	3	20.88
	(0)	(0)	(1.06)	(1.2)	(1.2)	(1.62)	(1.77)	(1.52)	(1.38)	(1.12)	(0.90)	(0.87)	(0.58)	(1.02)
Baladi	0	0	2.50	6.25	9.25	32.5	23.5	20.25	24.25	6.25	5	2.75	1.25	10.3
	(0)	(0)	(0.39)	(0.8)	(0.71)	(1.41)	(1.37)	(1.22)	(1.34)	(0.68)	(0.74)	(0.37)	(0.27)	(0.72)
LSD	-	-	0.15	0.26	0.64	0.31	0.34	0.42	0.34	0.58	0.24	-	-	-
CV%	0	0	39.8	22.96	36.36	13.35	13.83	19.21	15.99	36.26	18.14	46.23	22.36	-
	NS	NS	*	**	*	*	*	*	*	*	*	NS	NS	-

Data in brackets were transformed to log (x + 1)
NS Not significantly different
* Significantly different at 5%
** Significantly different at 1%

Table 3. Average number of greenbug aphid (*S. graminum*) on three wheat varieties during season 2006/07

Time (weeks) / Varieties	Average number of aphids/10 plants												
	December			January				February				March	
	1	2	3	4	5	6	7	8	9	10	11	12	Average/week
Debeira	0	12.50	70	266.3	248	732.5	889	600	1108.3	549.5	208.5	96.75	460.4
	(0)	(1.07)	(1.79)	(2.35)	(2.35)	(2.86)	(2.95)	(2.77)	(3.04)	(2.73)	(2.23)	(1.98)	(2.19)
El nilein	8.25	12	39	80.75	73	319	526.8	395.3	532	282.5	25.5	25.25	211.5
	(0.38)	(1.09)	(1.59)	(1.90)	(1.83)	(2.48)	(2.69)	(2.42)	(2.64)	(2.41)	(1.39)	(1.34)	(1.85)
Baladi	8.0	6.50	21.5	59	51.5	204.8	296.5	173	171.3	124	42.75	19	111
	(0.6)	(0.86)	(1.34)	(1.74)	(1.71)	(2.28)	(2.41)	(2.21)	(2.19)	(2.01)	(1.57)	(1.18)	(1.67)
LSD	-	-	0.238	0.234	0.253	0.249	0.238	0.28	0.358	0.307	0.384	0.434	-
CV%	115.7	24.5	10.96	8.67	8.84	6.82	6.46	8	10.1	9.4	16.35	21.09	-
	NS	NS	*	**	**	*	*	*	*	*	*	*	-

Data in brackets were transformed to log (x + 1)
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Table 4. Average percent of *X. aegyptium*, coccinellids, *C. carnea* and *A. sudanensis* associated with three wheat varieties during seasons 2004/05, 2005/06 and 2006/07

Seasons / Natural enemies	Average percent occurrence of the different natural enemies species			
	2004/05	2005/06	2006/07	Average
X. aegyptium	8.15	35.92	32.42	25.50
Coccinellids	7.06	26.86	33.72	22.55
C. carnea	1.17	4.75	7.38	4.43
A. sudanensis	83.61	32.48	26.51	47.53

Table 5. Average percent of natural enemies complex associated with *S. graminum* on three wheat varieties during the three seasons 2004/05, 2005/06 and 2006/07

Seasons / Wheat varieties	Average percent of natural enemies on three wheat varieties			
	2004/05	2005/06	2006/07	Average
Debeira	56.49	47.97	52.87	52.44
El nilein	25.87	30.54	28.31	28.24
Baladi	17.64	21.50	18.83	19.32

Discussion

The greenbug is the most abundant aphid on wheat fields. This was confirmed by Kannan (1999). Numerous factors are involved in appearance and the behaviour of the aphid population. Weather conditions are the main factors specially temperature (Trdan and Mileroj (1999)), the crop stage (Aslam *et al*., (2004), Rios and Conde (1986)), natural enemies (Gair *et al*., (1987)) and others. Wheat variety plays an important role in the occurrence of the greenbug. Debeira variety for instance harboured the greatest number of *S. graminum* followed by El nilein, while the Baladi variety harboured the least population densities. The differences among the wheat varieties may be due to differences in the morphology, growth parameters and the plant biochemical characteristics (Mohamed 2001). The infestation in season 2005/06 was low compared to the other two seasons, (2004/05 and 2006/07) due to the relatively high temperature recorded during this season. The wheat aphid was found to be attacked by many predators and parasitoids in the field, namely syrphid flies, coccinellids, green lacewings and the parasitoid *A. sudanensis*. The findings of this study are similar to those reported by Gair *et al*., (1987). The population densities of the predators

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during season 2005/06 were very low compared to the other two seasons (2004/05 and 2006/07). This may be attributed to the lower population densities of aphids recorded during season 2005/06. The highest numbers of the predators were recorded in Debeira variety and the lowest ones were recorded in Baladi. Debeira variety harbourd the highest number of greenbug and the Baladi harbourd the lowest. This agreed with Kual (2003) and Aheer *et al*., (2007). Also the variation of the predator densities is affected by wheat varieties. This may be due to the effect of trichomes (hairs on the leaf surface) that are present in Baladi variety with short and dense forms which impact negatively the walking and searching behaviour of the predator.

The greenbug was found to be parasitized by *A. sudanensis* as indicated by the presence of black mummies among the greenbug colonies. The population densities of the parasitoid were higher in season 2004/05 than the other two seasons (2005/06 and 2006/07). This may be due to the presence of cotton crop in the adjacent field of wheat that is thought to facilitate the build up of the parasitoid population to concide with the appearance of the greenbug aphid. The lowest population of the parasitoid was recorded in season 2005/06 because of the reduced density of the host population compared to the other two seasons. The highest level of parasitization was recorded in Debeira variety and the lowest one was recorded in Baladi variety. This could be explained by the fact that the Debeira variety has the maximum population of aphids, while Baladi was comparatively resistant having the minimum aphids density. Also Baladi plants were characterized with dense trichomes as mentioned by Mohamed (2001) and this interferes negatively with the searching patterns of the parasitoid and consequently affects the parasitoid efficiency. The parasitoid could play an important role in the control of the green bud, specially if we know that the genus *Aphelinus* was not reported as hyperparasite of any other primary parasitoid as mentioned by Van Lenteren *et al*., (1997).

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الكثافة العددية لمنْ القمح الأخضر وأعدائه الطبيعيين في ثلاثة أصناف من القمح

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مستخلص البحث

تناولت الدراسة كثافة ووجود منْ القمح الأخضر فى ثلاثة أصناف من القمح: دبيره والنيلين وبلدي وذلك فى مزرعة جامعة السودان للعلوم والتكنولوجيا خلال ثلاثة مواسم زراعية 2005/2004، 2006/2005 و2007/2006. ظهرت الآفة في الحقل في الإسبوع الأخير من شهر نوفمبر وأعلى نسبة إصابة سجلت في شهر يناير. أدني نسبة إصابة فى موسم 2006/2005 مقارنة بالموسمين الآخريين. أعلي نسبة إصابة كانت في صنف دبيرة ويليه النيلين ثم بلدى. لوحظ خلال الدراسة تواجد عدد من المفترسات والطفيليات التى تهاجم منْ القمح الأخضر في الحقل وتشمل الذباب الحائم وأبو العيد ومفترس أسد المنْ وطفيل *Aphelinus sudanensis* وقد سجلت أعلى نسبة للمفترسات والطفيل في صنف دبيرة مقارنة بالنيلين و بلدي.

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