

THE TRIANGULAR RELATIONSHIPS BETWEEN NITROGEN FERTILIZATION, CEREAL APHID POPULATIONS AND THE CORRESPONDING DAMAGE TO WHEAT AT UPPER EGYPT

Abdel-Rahman M. A. A.¹ and A. M. Ali²

¹Plant Protection Research Institute, A.R.C., Egypt

²Plant Protection Department, Faculty of Agriculture, Assiut
University, Egypt

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ABSTRACT: The present field trails were carried out during 2003-2004 and 2004-2005 wheat growing seasons. The influence of some wheat varieties and different levels of nitrogen fertilization on the infestation of wheat by cereal aphids, damage assessment was completed under field conditions. The wheat varieties namely, Sakha 8, Beni-Suef 1 and Sids 6, demonstrate similar level of susceptibility to cereal aphids infestation. The reduction in the grain yield due to aphid infestation was considered harboured in Sakha 8, 19.01%, 18.05% in Beni-Suef 1 and 19.44% in Sids 6 varieties. Manipulation of nitrogen fertilization (120, 80, and 40 N-units / feddan) showed that the highest number of aphid survivors viz. 175.94 and 216.51 aphids / tiller for 2004 and 2005 seasons, respectively was recorded on the wheat plants which received the highest rate of N-fertilization i.e. 120 N-units / feddan. Therefore, the comparison between the increase in the grain yield and reduction due to aphid infestation in relation to N-fertilization revealed the presence of distant effect of 80 N-units / feddan is considered the most recommended rate. Generally, there were significant differences between the grain yield of wheat under controlled conditions (aphids free) and survivors left for natural aphid occurrence inhabiting wheat fields.

Key words: Wheat plants, nitrogen fertilization, cereal aphids, damage.

INTRODUCTION

Cereal aphid survivors are considered as the most abundant insect pest, inhabiting wheat plants in Upper Egypt. Aphid survivor

individuals are keen in responding high levels of nitrogenous fertilizers by farmers. Many works have been performed on the effect of nitrogen fertilization on the population density of cereal aphids

(Daniels *et al.*, 1968; Rizk *et al.* 1979; Moon *et al.* 1995; El-Lathy 1999 and Mahmoud 2005). The authors found that high infestation levels with cereal aphids inhabiting wheat plants receiving high rates of nitrogen fertilization. On the other hand, it was beneficial to seek the proper N units to be added which bring the least aphid establishment on wheat plants considered as IPM components strategies. Therefore, the present investigation was carried out to study the alternative response between cereal aphids, wheat food suitability for different levels of nitrogen fertilization are considered.

MATERIALS AND METHODS

The present study was carried out at the experimental Farm attached to Assiut University during 2003/2004 and 2004/2005 wheat growing seasons to evaluate the effect of wheat varieties and nitrogen fertilization on the infestation levels of wheat plants by cereal aphids individuals.

The rates of each variable were as follows:

Wheat cultivars (three treatments): Sakha 8, Beni-Suef 1 and Sids 6.

N-fertilization (4 treatments): 120, 80, and 40 N- units of

nitrogen / feddan and the control (check) plants.

The experiments were undertaken in split plot design in three replicates each of 1/100 feddan. Two sets of experiments in an equal size each of 36 plots were applied. The first experiment, wheat plants were kept free from aphid infestation by serial spraying aphicides (Aphox 50% DG) with the rate of 50 gm / 100 L. For the second experiment, wheat plants were left for natural infestation, sampling procedure starts soon after seedling emergence. Weekly samples were undertaken by simply counting different aphid morphs occurred on 10 wheat mean tillers picked out randomly. A number of ten plants from each plot was picked. At the end of the season, samples of wheat plants from an area of one m² detected for each plot were harvested separately either from treated or untreated experiments to evaluate the grain yield. Data obtained were statistically analyzed using analysis of variance and estimated means were grouped according to Duncan's multiple range test.

RESULTS AND DISCUSSION

Population of Cereal Aphid Complex

Data in Tables 1 & 2 show the changes in the population density of cereal aphids affected by nitrogen fertilizer of some wheat

Table 1. Mean number of cereal aphid complex on some wheat cultivars, as affected by N-fertilization during 2003-2004 wheat growing season

Fertilization levels	Mean number of aphids / tiller				
	Varieties				
	Sakha 8	Beni-Suef 1	Sids 6	Total	Mean
120 N-Units	139.81 ^a	199.20 ^a	188.91 ^a	527.92	175.97 ^a
80 N-Units	126.64 ^b	143.93 ^b	154.67 ^b	425.24	141.75 ^b
40 N-Units	122.31 ^b	114.16 ^c	120.16 ^c	356.63	118.88 ^c
Free (control)	101.36 ^c	96.60 ^d	92.91 ^d	290.87	96.96 ^d
Total	490.12	553.89	555.62	1000.66	533.55
Mean	122.53	138.47	139.16	400.16	133.39

Means in a column followed by the same letter are not significantly different at 0.05 level of probability.

Table 2. Mean number of cereal aphid complex on some wheat cultivars, as affected by N-fertilization during 2004-2005 wheat growing season

Fertilization levels	Mean number of aphids / tiller				
	Varieties				
	Sakha 8	Beni-Suef 1	Sids 6	Total	Mean
120 N-Units	235.36 ^a	208.47 ^a	205.69 ^a	649.52	216.51 ^a
80 N-Units	184.53 ^b	182.64 ^b	175.42 ^{bc}	542.59	180.86 ^b
40 N-Units	164.47 ^c	161.80 ^c	162.71 ^c	488.98	162.99 ^c
Free (control)	139.24 ^d	141.64 ^d	136.96 ^d	417.84	139.28 ^d
Total	723.60	694.55	680.78	2098.93	699.64
Mean	180.90	173.64	170.19	524.73	174.91

Means in a column followed by the same letter are not significantly different at 0.05 level of probability.

cultivars during 2004 and 2005 wheat growing seasons. The considered cereal aphids in this study namely: Oat-birdcherry aphid, *Rhopalosiphum padi* L.; corn leaf aphid, *R. maidis* (F.); greenbug, *Schizaphus graminum*

(Rond.). The careful integration of data in the tables reveal that the population density of cereal aphids during 2005 was relatively higher than that of 2004 since population in 2005 was about 1.31 times as high as 2004.

Data in the same Table showed that the three tested wheat cultivars have been infested approximately with the same number of aphids. The average number of aphids / tiller were 122.53, 138.47 and 139.16 aphids / tiller and 180.90, 173.64 and 170.19 aphids / tiller on Sakha 8, Beni-suef 1 and Sids 6 during 2004 and 2005, respectively. The statistical analysis yielded insignificant F value than revealing the presence of insignificant difference between aphid inhabiting variable wheat cultivars.

Data presented show also that the population of aphid individual increased significantly with the increase of nitrogen fertilization. Significant differences however were existed between the number of aphids on plants received different rates of N-fertilization, since the number of aphids / tiller were 175.97, 141.75, 118.88 and 96.96 and 216.51, 180.80, 162.99 and 139.28 during 2004 and 2005 seasons, respectively. These occurrence levels were correlated with the N-fertilization supplied at the rates of 120, 80, 40 N-units as well as without fertilizer. In general, unfertilized plants harboured the lowest number of aphids (96.96 and 139.28 aphids / tiller during 2004 and 2005, respectively), whereas those receiving 1.5 fertilization times the

recommended rate of fertilization (120 N-units / feddan) harbour the highest number of aphids (175.97 and 216.51 aphids / tiller during 2004 and 2005, respectively). At the recommended rate (80 N-units / feddan) or even of half of this rate (40 N-units / feddan), the plants showed an intermediate infestation, significantly less than the highest nitrogen applications.

The present results are in agreement with the findings of Archer *et al.* (1982), Ibrahim *et al.* (1986), Archer *et al.* (1995), Moon *et al.* (1995), Duffield *et al.* (1997) and Mahmoud (2005) who found that high infestation with certain cereal aphids inhabiting barley and wheat fields receiving high rates of nitrogen fertilization. It appears that high level of nitrogen improve the nutritional quality of the plants and subsequently increase pest fitness.

Grain Yield

Data of the grain yield weight during 2004 and 2005 seasons are presented in Tables 3 & 4. Data show that in the check wheat plants, the grain yield weights of the tested cultivars (Sakha 8, Beni-Suef 1 and Sids 6) were nearly the same i.e. without significant differences, since the average yield weights/ one m² were 788.95, 860.60 and 702.74gm during 2004; 760.51, 773.04 and 619.52 gm during 2005, respectively. For the infested plants, the yield / one m²

Table 3. Grain yield (gm / one m²) of wheat plants as affected by N-fertilization on some wheat varieties in infested and un-infested (control) plots during 2003-2004 wheat growing seasons.

Fertilization levels	Yield (gm) / one m ² and reduction (%)											
	Varieties											
	Sakha 8			Beni-Suef 1			Sids 6			Mean		
	Infested	Control	Reduction (%)	Infested	Control	Reduction (%)	Infested	Control	Reduction (%)	Infested	Control	Reduction (%)
120 N-Units	649.63b	839.10b	22.58	792.70a	1057.35a	25.03	736.05a	886.19a	28.23	726.13a	927.55a	21.72
80 N-Units	799.76a	970.85a	17.62	793.11a	847.33b	18.20	624.37b	795.24b	21.49	739.08a	871.14b	15.15
40 N-Units	663.79b	799.73b	16.99	670.53b	802.25b	16.42	485.92c	583.29c	16.69	606.75b	728.42b	16.70
Free (control)	475.62c	546.23c	12.93	630.68b	735.48c	14.25	475.62c	546.23c	12.93	527.31c	609.31c	13.46
Total	2588.80	3155.91	17.97	2887.02	3442.41	16.13	2321.96	2810.95	17.39	2599.27	3136.42	17.13
Mean	647.20	788.95	17.97	721.76	860.60	16.13	580.49	702.74	17.39	649.82	784.105	17.13

Means in a column followed by the same letter are not significantly different at 0.05 level of probability.

Table 4. Grain yield (gm / one m²) of wheat plants as affected by N-fertilization on some wheat varieties in infested and un-infested (control) plots during 2004-2005 wheat growing seasons.

Fertilization levels	Yield (gm) / one m ² and reduction (%)											
	Varieties											
	Sakha 8			Beni-Suef 1			Sids 6			Mean		
	Infested	Control	Reduction (%)	Infested	Control	Reduction (%)	Infested	Control	Reduction (%)	Infested	Control	Reduction (%)
120 N-Units	740.54a	965.74a	23.32	669.66a	877.00a	23.64	613.93a	816.58a	24.85	674.71a	886.44a	23.88
80 N-Units	630.91b	807.47b	21.87	663.68a	838.53a	20.85	576.54b	745.48b	22.66	623.71a	797.16b	21.76
40 N-Units	607.76b	742.05c	18.09	604.01a	752.74b	19.75	400.24c	499.76c	19.91	537.34b	664.85c	19.18
Free (control)	451.87c	526.78d	14.22	530.99b	623.89c	14.89	348.13d	416.26d	16.37	443.66c	522.31d	15.06
Total	2431.08	3042.04	20.08	2468.34	3092.16	20.17	1938.84	2478.08	21.76	2279.42	2870.76	20.59
Mean	607.77	760.51	20.08	617.08	773.04	20.17	484.71	619.52	21.76	569.85	717.69	20.59

Means in a column followed by the same letter are not significantly different at 0.05 level of probability.

were 647.20, 721.76 and 649.82 gm during 2004 and 607.77, 617.08 and 484.71 gm / one m² during 2005 for Sakha 8, Beni-Suef 1 and Sids 6, respectively. Percentage of reduction due to aphid infestation was found to be 17.97, 16.13 and 17.39% during 2004 and 20.08, 20.17 and 21.76% during 2005 for Sakha 8, Beni-Suef 1 and Sids 6, respectively.

Regardless of the growing seasons, the average grain yield in the check plants / one m² were 774.73, 816.82 and 661.13 gm / one m² as compared with 627.49, 669.42 and 532.60 gm / one m² in the plants which exposed to natural aphid infestation on Sakha 8, Beni-Suef 1 and Sids 6, respectively. The reduction in the grain yield due to aphid infestation was 19.01% in Sakha 8, 18.05% in Beni-Suef 1 and 19.44% in Sids 6. The statistical analysis when worked out revealed insignificant differences between varieties. There is no pronounced differences between the two cultivars due to the aphid infestation.

According to grain yield of wheat plants in relation to nitrogen fertilization and aphid infestation. Data in Tables 3 & 4 show the grain yield of wheat plants supplied with different rates of N-fertilization in the untreated plants, as well as in those exposed to the natural aphid infestation. In the

first experiment the average grain yield gm / one m² in the plots received 120, 80 and 40 N-units / feddan and those which did not receive fertilizer were, respectively, 927.55, 871.14, 728.42 and 609.31 gm / one m² during 2004 and 886.44, 797.16, 664.85 and 522.31 gm / one m² during 2005. In the second experiments (infested plants) the averages grain yield / one m² were 726.13, 739.08, 606.75 and 527.31 gm / one m² during 2004 and 674.71, 623.71, 537.34 and 443.66 gm / one m² during 2005. The reduction due to aphid infestation as shown in Tables 4&5 were 21.72%, 15.15%, 16.70% and 13.46% during 2004 and 23.88%, 21.76%, 19.18% and 15.06% during 2005 in the plots supplied with 120, 80, 40 N-units and without adding fertilizers, respectively.

Regardless of the wheat growing seasons, in the check treatments, the average grain yield / one m² in the plots received 120, 80, and 40 N-units / feddan and without fertilizer were 906.995, 834.15, 696.64 and 567.81 gm / one m² comparing with 700.42, 681.39, 572.04 and 485.48 gm / one m² in the naturally infested plants, respectively. The corresponding reduction in the yield due to aphid infestation were, 22.78, 18.31, 17.89 and 14.19%.

In general, it could be concluded, however, that the highest grain yield production was obtained when wheat plants were supplied with the rate of 120 N-units nitrogen / feddan. Meanwhile, the lowest production was the other way round when the wheat plants were not supplied with fertilization. It is also clear that the plots received high level of nitrogen fertilization demonstrated high level of aphid infestation and showed reliable reduction in the yield figures, (Tables 4 & 5). Therefore, the relation between the grain yield and reduction due to aphid infestation was negative and significant when N-fertilization with rate of 80 N-units / feddan could be recommended.

From the above mentioned results, it seems that there were negative significant differences between the grain yield in the wheat plants and the corresponding natural aphid infestation. The combined analysis between the two experiments concerning the grain yield (regardless of wheat cultivars and nitrogen fertilization) showed that the reduction in the yield due to aphid infestation reached 17.13 and 20.59% during 2004 and 2005, respectively with an average of 19.38%.

Many investigators came to the same conclusion, under natural

aphid infestation conditions. The losses in grain yield due to aphids was found to be 16.65% (Enayate *et al.* 1984); 26-32% (Papp and Mesterhazy, 1993); 4-37% (Tamam, 1989); 14-16% (Mohamed, 1994) and 18% (Abdel-Rahman, 1997).

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العلاقة الثلاثية بين تعداد حشرات من النجيليات والتسميد النيتروجيني والفقد في محصول القمح بصعيد مصر

محمد علاء الدين احمد عبد الرحمن^١ - عبد الوهاب محمد علي^٢
^١ معهد بحوث وقاية النباتات - مركز البحوث الزراعية
^٢ قسم وقاية النباتات - كلية الزراعة - جامعة اسيوط

أجريت هذه الدراسة خلال موسمي ٢٠٠٤ ، ٢٠٠٥ من مواسم زراعة القمح بهدف معرفة تأثير بعض أصناف نباتات القمح المنزرعة وكذا مستويات مختلفة من التسميد النيتروجيني على إصابة نباتات القمح بحشرات من النجيليات وأيضا تقييم الضرر الحادث لنباتات القمح نتيجة الإصابة بحشرات المن تحت هذه الظروف من مستويات التسميد.

أوضحت الدراسة أن الأصناف المختبرة وهم سخا ٨ ، بنى سويف ١ ، سدس ٦ ، كان لهم نفس درجة الحساسية للإصابة بحشرات من النجيليات. ووجد أن الفقد الحادث بمحصول هذه الأصناف نتيجة الإصابة بحشرات المن ١٩.١% للصنف سخا ٨ ، ١٨.٠٥% للصنف بنى سويف ١ ، ١٩.٤٤% للصنف سدس ٦.

بينت الدراسة أيضا أن مستوى الإصابة بحشرات المن يزداد بدرجة معنوية مع زيادة معدلات التسميد النيتروجيني حيث تم تسجيل أعلى تعداد لحشرات من النجيليات على النباتات المسددة بمعدل ١٢٠ وحدة نيتروجين للفدان بالمقارنة بمعدلات التسميد الأخرى المستخدمة (٨٠ ، ٤٠ وحدة تسميد نيتروجيني). لذلك يوصى باستخدام المعدل ٨٠ وحدة تسميد نيتروجيني للفدان. وعموما أتضح من هذه الدراسة أن هناك فروق معنوية عالية في محصول نباتات القمح التي تم مكافحة حشرات المن بها وبين تلك التي لم تتروك للإصابة الطبيعية بحشرات المن بدون مكافحة.