EFFECT OF NITROGEN LEVELS, SOWING DATES AND SPACINGS ON INFESTATION WITH THE THE LEAFMINER *AGROMYZA NIGRIPES* (MEIGEN)(DIPTERA: AGROMYZIDAE).

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Abstract

The effect of 4 nitrogenous fertilization levels, 3 sowing dates and row spacing on infestation with the leafminer *Agromyza nigripes* (Diptera : Argomyzidae) on wheat grain yield was investigated at El-Gemmeiza Agric. Res.St., Gharbia Governorate, during the wheat growing seasons 1993-1994 and 1994-1995. Results indicated that percentage infested leaves and number of mines and alive larvae significantly increased by increasing nitrogen levels, except up to a rate of 80 kg/fed. Further increase of N fertilization insignificantly affected insect infestation or population. All considered parameters and grain yield were significantly decreased by delaying sowing dates.Row spacing had no discernable effect although grain yield was significantly increased at 20 cm spacing. Interactions between N level x sowing date, N level x row spacing and sowing date x row spacing expressed a significant effect on percentage infestation number of mines and alive larvae as well as grain yield. Interactions of N level x sowing date x row spacing on numbers of mines and alive larvae were significant in 1993-94 and 1994-95 seasons and on infestation and grain yield in 1994-95 seasons only. With the application of nitrogen rates of 40,50, 60, 70, 80 and 90 kg/fed. to wheat plants sown on Dec.10 at 20 cm row spacing emphasized that, all considered parameters were significantly reduced. Also, plants gave grain yields at a rate of 60 kg N/fed. compared to those receiving up to 80 and 90 kg N/fed. in 1995-96 and 1996-97 seasons. It is, thus, recommended that application of N at a rate of 60 kg/fed. to wheat plants sown by early December at 20 cm row spacing significantly reduced infestation and produced the highest grain yield.

INTRODUCTION

Agricultural practices are easy, cheap, effective and safe methods for pest control as they involve alterning the habit to be less favourable for pests reproduction and survival. Such effects may be direct on the pest itself or indirect by encouraging natural enemies or increasing plant tolerance. Several authors reported that certain agricultural practices i.e. nitrogen fertilizer, sowing date and spacing reduce the population density of dipterous pests. Rawat and Sahu (1969), De Bach

(1974) and D'Aguilar et al., (1978) on wheat; Bethke et al., (1987) and Hanna et al., (1987) on tomato and Yein and Das (1990) on rice.

The leafminer, *Agromyza nigripes* (Meigen) attacks wheat in Egypt. It is a widely distributed species with 2-90%infestation. It is parasitized by six hymenopterous species, but not in sufficient numbers (El-Serwy, 1994). To converse and promote these natural enemies and avoid insecticide application cultural control is recommended as a safe method.

The present work aimes to clarify the relationship between nitrogen levels, sowing dates and spacings on *A.nigripes* infestation in wheat fields.

MATERIALS AND METHODS

Four field experiments were conduced at El-Gemmeiza Agric. Res. St., Gharbia Governorate, during 1993-1997 wheat growing seasons.

In 1993 and 1994 seasons, experimental treatments were 36 representing combinations of four nitrogen fertilizer levels (0, 40, 80, and 120 kg/fed.), three sowing dates (Nov. 30, Dec. 10 and 20 in 1993 and Dec. 10, 20 and 30 in 1994), and three row spacings (20, 25 and 30 cm). Split-split plot design was used with four replicates. Nitrogen fertilization, sowing dates and row spacing were randomly assigned to the main-,sub-and sub-sub plots, respectively.

In 1995 and 1996 seasons, each experiment included six nitrogen levels (40, 50, 60, 70, 80 and 90 kg/fed.) applied four times in a complete randomized block design. Sowing date was Dec. 10 and row spacing was 20 cm.

In all experiments, the experimental unit was 10.5m2 (1/400 of fed.). Experimental units were separated by one meter wide borders. Seeds of the wheat variety "Gemmeiza 1" were drilled in rows by hand at a rate of 60 kg/fed. Nitrogen fertilizer was used in the form of ammonium nitrate (33.5% N) and applied in two equal doses before the first and the second irrigations. Normal recommended cultural practices were followed uniformly, and insecticides were entirely avoided.

For every considered treatment, the upper four leaves on 50 random main shoots were visually examined at 10 day intervals from 11-31 March (3 leaf samples) and classified as infested and non infested. Infested leaves were examined under the stereomicroscope and the numbers of mines and alive larvae were recorded. At harvest, a random area of 1 m2 was harvested from the inner rows of each experimental unit to determine the grain yield/feddan.

RESULTS AND DISCUSSION

1. Infestation as affected by

1.1 Nitrogen levels

Data in Table 1 show that, infestation rate was significantly higher on fertilized plants than unfertilized ones in 1993-1994 and 1994-1995 seasons. For both seasons, infestation was significantly lower on plants receiving 40 kg N/fed. than those receiving 80 to 120 kg. Mines and alive larvae counts increased progressively with increase of N rates. All fertilizer treatments were significantly different.

Table 1. Effect of nitrogen levels, sowing dates and row spacings on % infested leaves and number of mines and alive larvae of *A.nigripes* and grain yield in 1993-1994 and 1994-1995 seasons.

Factors	1993-1994 season				1994-1995 season			
	Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain* yield (Ardab / fed.)	Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain* yield (Ardab / fed.)
Nitrogen levels (kg/fed.)								
0	39.0	65.4	49	8.66	26.9	31.1	21	7.78
40	47.9	82.6	59	14.14	31.2	36.8	28	12.84
80	57.5	114.3	67	15.39	335.7	46.7	33	14.56
120	58.6	126.4	83	14.99	36.2	49.1	37	13.86
L.S.D. at 0.05%	1.4	2.8	2.2	0.09	0.6	0.5	0.7	0.1
L.S.D. at 0.01%	2.0	4.0	3.1	0.14	0.9	0.8	1.0	0.14
Sowing dates								
1 st	60.5	124.0	7.1	14.34	45.4	60.8	42	13.38
2 nd.	49.2	93.1	64	13.12	30.8	36.5	26	12.28
3 rd.	42.6	74.5	58	12.41	21.4	25.4	21	11.12
L.S.D. at 0.05%	1.5	2.5	1.2	0.09	0.6	0.6	0.5	0.11
L.S.D. at 0.01%	2.0	3.4	1.6	0.12	0.9	0.9	0.6	0.15
Row spacing (cm)	50.7	93.7	63	13.39	33.4	40.7	30	12.47
20	51.6	101.5	64	13.26	32.1	41.3	30	12.24
25	50.0	96.3	67	13.24	32.0	40.7	30	12.08
30								
L.S.D. at 0.05%	1.3	1.8	1.2	0.08	0.5	N.S.	N.S.	0.08
L.S.D. at 0.01%	N.S..	2.4	1.6	0.10	0.7	-	-	0.11

Data in Table 2 indicate that, infested leaves, mines and alive larvae were significantly lower on the plants receiving 40-50 kg N than those receiving 80-90 kg in both 1995-1996 and 1996-1997 seasons. On the other hand, applying N at rate of 60 kg resulted in significant reduction of infestation rate in the first season,

Table 2. Effect of nitrogen levels on % infested leaves and numbers of mines and alive larvae of *A.nigrips* and grain yield in 1995-1996 and 1996-1997 seasons.

Nitrogen levels (kg/fed.)	1995-1996 season				1996-1997 season				General means of			
	Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain* yield (Ardab / fed.)	Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain* yield (Ardab / fed.)	Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain* yield (Ardab / fed.)
40	29.8	35.6	21	12.71	26.3	28.0	21	12.42	28.0	31.8	20	12.56
50	29.33	35.2	21	15.69	26.5	28.2	22	13.00	27.9	31.7	21	14.35
60	29.1	36.3	24	16.37	27.5	30.8	24	13.85	28.3	33.5	24	15.11
70	33.7	43.1	24	15.62	30.2	33.5	29	13.60	332.0	38.3	26	14.61
80	33.2	43.7	28	16.03	34.3	37.0	31	13.29	33.7	40.4	29	14.66
90	35.0	43.7	33	14.330	40.3	45.3	3.1	13.52	37.6	46.0	32	13.91
L.S.D. at 0.05 %	2.7	1.6	1.4	0.42	4.7	2.2	1.9	0.27	3.8	1.0	1.1	0.24
L.S.D. at 0.01 %	3.8	2.2	1.9	0.59	6.5	3.0	2.6	0.37	5.1	1.3	1.5	0.32

number of alive larvae in the second season, and number of mines in both seasons when compared to those receiving 70 kg.

According to L.S.D. values for the general means of infested leaves at 0.05% level, tested treatments can be classified into low, moderate and high levels including: 40-60, 80 and 90 kg N/fed., respectively. However, infestation was insignificantly different on plants receiving 60 or 70 kg N. On the other hand, there were significant differences between all treatments with respect to the numbers of mines and alive larvae, except at the rates of 40-50 kg N, where the differences were insignificant.

Previous results infer that infestation was markedly affected by increasing N rates and was accompanied by an obvious increase of the number of mines and alive larvae. Such results reflect that plants receiving higher nitrogen rates were more preferred for oviposition and larval survival. This goes in line with the results obtained by Bethke et al., (1987) and Minkenberg and Fredrix (1989) for *Liriomyza trifolii* on tomato. On the contrary, Yein and Das (1990) reported that the ephydrid *Hydrellia philippina* decreased by increasing nitrogen levels on rice. However, the leafminer *Liriomyza sativa* density on snap beans was not affected by nitrogen levels, (Hanna et al., 1987). D'Aguilar et al., (1978) mentioned that infestation rate with *Agromyza* spp on wheat in France was reduced by decreasing nitrogen rates.

1.2. Sowing dates

Table 1 indicates that the percentage of infested leaves as well as the numbers of mines and alive larvae were significantly decreased by delaying sowing dates in both 1993-1994 and 1994-1995 seasons. Alterning the sowing date has been a recognized method of cultural control for Hessian fly, flea beetle, thrips, gall moth and shoot-fly on wheat (De Bach, 1974; Rawat and Sahu, 1969) and cereal aphid on barley (Ba Angood and Stewart, 1980).

1.3. Row spacing

Table 1 further reveals that, the relationship between row spacing and percentage infestation is, apparently, uncertain. It was significantly increased at distances of 25cm compared to 30cm in 1993-1994 season and 20 cm compared to 25-30 cm in 1994-1995 season. In 1993-1994 season, the highest numbers of mines and alive larvae occurred at 25 and 30 cm, respectively, with significant differences when compared with 20cm row spacing. However, during 1994-1995 season,

both parameters at all tested row spacings were insignificantly different. The effect of spacing on insect infestation was discussed by Yein and Das (1990) and *Soliman* and Abd El-Aleim (1997) who reported that in rice fields infestation with *Scirophaga intertulas* and *Sogatella furcifera* increased with increase of plant density, while increase of plant density decreased *Hydrellia philippina* and *Chilo agamemnon* infestations.

1.4. Interactions

There were significant interactions between N level x sowing date, N level x row spacing and sowing date x row spacing. Every two factors influenced infestation percentage and number of mines and alive larvae in both 1993-1994 and 1994-1995 seasons, Tables 3, 4 and 5. In both seasons, the highest values for all considered

Table 3. Nitrogen level x sowing date interactions for % infested leaves, numbers of mines and alive larvae of *A.nigripes* and grain yield in 1993-1994 and 1994-1995.

Nitrogien levels (kg/fed.)	Sowing date	1993-1994 season				1994-1995 season			
		Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain yield (Ardab / fed.)	Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain yield (Ardab / fed.)
0	1 st.	46.6	90.8	55	9.6	35.2	42.3	23	8.45
	2 nd.	41.3	63.3	51	8.48	27.6	31.8	22	7.82
	3 rd.	29.2	42.2	42	7.89	17.9	19.3	18	7.06
40	1 st.	57.0	102.8	61	14.98	43.8	55.8	39	14.42
	2 nd.	46.0	81.9	59	14.04	28.9	30.9	24	13.01
	3 rd.	40.7	63.1	57	13.38	20.9	23.6	21	11.1
80	1 st.	69.2	142.4	75	16.8	50.8	72.3	52	15.8
	2 nd.	55.4	106.1	65	15.2	33.8	40.8	27	14.47
	3 rd.	47.9	94.3	62	14.16	22.6	26.8	21	13.41
120	1 st.	69.2	160	102	16.0	51.8	72.9	53	14.84
	2 nd.	54.1	121	83	14.77	32.7	42.3	32	13.83
	3 rd.	52.6	98.3	71	14.2	24.2	32.0	26	12.92
L.S.D. at 0.05%		2.9	4.9	2.3	0.18	1.2	1.3	0.9	0.21
L.S.D. at 0.01%		4.0	6.7	3.2	0.25	1.7	1.8	1.2	0.29

parameters took place at the rate of 120 kg N/fed. at the first sowing date in addition to a rate of 80 kg N/fed. at the 1 st. sowing date in 1994-1995 season, Table 3. Plants receiving N at a rate of 120 kg/fed. and 30cm row spacing harboured the highest means for all parameters in 1993-1994. However, during 1994-1995, per-

centage infested leaves and number of mines reflected high means at the rate of 120 kg N/fed. combined with 25cm row spacing, but the largest number of alive larvae occurred at the same fertilizer level combined with 20 cm spacing, Table 4. The highest means for all parameters were recorded at the first sowring date in both seasons. It interacted with all row spacings during the first season and with 20cm in the case of percentage infestation and 25cm in that of number of mines and alive larvae in the second season, Table 5.

N level x sowing date x row spacing interaction was significant for the number of mines and alive larvae in both seasons and for percentage infestation during the second season, Table 6. The highest values for the number of mines and alive larvae were found on the plants receiving 120 kg N/fed. at the 1st sowing date and with 30cm row spacing during the first season. During the second season, all parameters showed high means at the same nitrogen level and sowing date combined with 20 cm spacing in the cases of % infestation and alive larvae and with 25cm in that of number of mines.

2. Grain yield as affected by
2.1 Nitrogen levels

Grain yield was significantly affected by nitrogenous fertilizer, Table 1. In 1993-1994 and 1994-1995 seasons, it significantly responded to N fertilizer up to 80 kg/fed.

Results in Table 2 emphasize that plants receiving 60 kg/fed. gave higher grain yields than those receiving lower or higher rates. For both seasons, differences between 60 kg N/fed. and all other fertilizer treatments were significant, but grain yield varied at that N fertilizer level when compared to treatments receiving 80 and 70 kg N/fed. during the 1993-1994 and 1994-1995 seasons, respectively, but differences were statistically insignificant. The general mean for yield was significantly higher on plants receiving 60 kg N/fed. than those receiving other rates. Such result agrees with the observations on certain wheat cultivars at different locations in Egypt (Saad et al., 1984; Salem 1984; Khalil et al., 1986).

2.2. Sowing dates

Table 1 reveals that, grain yield was significantly reduced by delaying sowing dates in 1993-1994 and 1994-1995 seasons. Makki et al., (1987) came to a similar result.

2.3. Row spacing

Grain yield was significantly increased at 20 cm spacing than at 25 or 30 cm spacings in 1993-1994 and 1994-1995 seasons, respectively. Table 1 reflects that narrow row spacing of wheat gave higher grain yield. This goes is agreement with Hagras (1985) and Eissa et al., (1995).

Table 4. Nitrogen level x row spacing interactions for % infested leaves, numbers of mines and alive larvae of *A.nigripes* and grain yield in 1993-1994 and 1994-1995 seasons.

Nitrogien levels (kg/fed.)	Row spacing (cm)	1993-1994 season				1994-1995 season			
		Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain yield (Ardab / fed.)	Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain yield (Ardab / fed.)
0	20	37.5	62.3	51	8.8	28.1	31.9	20	7.92
	25	39.4	65.3	51	8.72	27.1	31.7	21	7.91
	30	40.0	68.8	47	8.45	25.5	29.8	22	7.49
40	20	49.0	83.4	58	14.24	32.1	36.6	28	13.29
	25	49.1	85.2	57	14.16	30.5	35.5	27	12.52
	30	45.6	79.2	62	14.0	31.0	38.2	30	12.73
80	20	57.3	103.8	66	15.43	37.2	47.1	33	14.78
	25	59.6	127.1	69	15.34	33.9	46.7	35	14.57
	30	55.7	111.9	67	15.39	36.1	46.3	32	14.34
120	20	58.8	125.3	77	15.04	36.3	47.3	40	13.89
	25	58.5	128.7	78	14.84	36.9	51.2	336	13.94
	30	58.6	125.4	93	15.09	35.3	48.8	35	13.77
L.S.D. at 0.05%		2.3	3.8	2.3	0.16	1.0	1.6	0.9	0.16
L.S.D. at 0.01%		N.S.	5.0	3.1	0.22	1.3	2.1	1.2	0.21

2.4. Interactions

There were significant interactions between N level x sowing date, N level x row spacing and sowing date x row spacing thus indicating that those variables jointly influenced grain yield in 1993-1994 and 1994-1995 season, Tables, 3, 4 and 5. For both seasons, the highest values of grain yield were obtained at the rate of 80 kg N/fed. and the first sowing date, Table 3. Application of N at rate of80 kg/ fed. with 20-30cm in 1993-1994 and 20cm in 1994-1995 gave the highest grain yield values, Table 4. The highest yield values at the first sowing date were recorded at 20cm spacing in 1993-1994 and 20-30 cm spacings in 1994-1995, Table 5.

N level x sowing date x row spacing interaction for grain yields was significant in 1994-1995, Table 6. The highest yield occurred with 80 kg N/fed. at the 1st sowing date combined with 20-25 cm row spacings.

Previous results lead to the conclusion that the leafminer *A.nigripes* infestation increased by increasing nitrogenous fertilization rates, earlier sowing dates and narrow row spacing. Application of N at a rate of 60 kg/fed. to wheat plants sown by early December at 20 cm row spacing, significantly reduced infestation and produced the highest grain yield. Such results support the recommendation that reduction of nitrogenous fertilization in wheat field is regarded as one of the effective cultural control tactics against *A.nigrips* infestation. Further research is still needed on earlier sowing dates in November to determine the optimum date for sowing that minimizes leafminer damage in wheat fields.

Table 5. Sowing date x row spacing interactions for % infested leaves, numbers of mines and alive larvae of *A.nigripes* and grain yield in 1993-1994 and 1994-1995 seasons.

Nitrogien levels (kg/fed.)	Row spacing (cm)	1993-1994 season				1994-1995 season			
		Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain yield (Ardab / fed.)	Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain yield (Ardab / fed.)
0	20	61.2	124.6	72	14.53	47.4	60.9	41	13.41
	25	60.1	124.3	72	14.25	45.8	61.9	44	13.55
	30	60.1	123.1	70	14.25	42.9	59.7	41	13.17
40	20	48.3	86.2	62	13.16	31.2	36.5	28	12.56
	25	51.4	99.0	65	13.17	31.2	37.4	26	12.17
	30	48.0	94.1	66	13.04	29.9	35.6	25	12.12
80	20	42.5	70.4	55	12.44	21.6	24.8	21	11.44
	25	43.5	81.3	54	12.38	19.4	24.4	20	10.98
	30	41.8	71.8	65	12.41	23.2	27.0	23	10.95
120	20	2.6	4.2	2.0	0.14	0.8	1.3	0.8	0.53
	25	3.5	5.6	2.7	N.S.	1.1	1.8	1.1	0.70
	30								
L.S.D. at 0.05%									
L.S.D. at 0.01%									

Table 6. Mean percentage of infested leaves, numbers of mines and alive larvae of *A.nigripes* and grain yield as influenced by nitrogen level, sowing date and row spacing in 1993-1994 and 1994 - 1995 seasons.

Factor			1993-1994 season				1994-1995 season			
Nitrogien levels (kg/fed.)	sowing date	Row spacing (cm)	Infested eaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain yield (Ardab / fed.)	Infested leaves %	Mean no.of mines/ 100 leaves	Mean no. of alive larvae/ 100 leaves	Grain yield (Ardab / fed.)
0	1st	20	47.2	93.5	60	9.86	38.3	44.0	18	8.44
		25	44.0	81.8	58	9.63	33.3	39.5	25	8.88
		30	48.0	97.0	48	9.3	34.0	43.3	26	8.02
	2 nd	20	38.4	57.3	53	8.55	26.0	29.3	23	8.90
		25	43.6	68.8	51	8.58	32.0	38.8	22	7.74
		30	41.9	64.0	49	8.3	24.8	27.5	21	7.64
	3 rd	20	27.0	36.2	41	7.99	20.0	22.5	20	7.25
		25	30.5	45.2	43	7.95	16.0	16.8	16	7.12
		30	30.1	45.2	43	7.75	17.8	18.5	19	6.82
40	1st	20	58.5	109.0	63	15.28	42.3	53.3	36	14.59
		25	67.6	107.0	60	15.0	44.3	55.5	39	14.46
		30	54.9	92.2	60	14.68	44.8	58.5	42	14.22
	2 nd	20	45.9	73.8	53	14.18	33.8	33.0	26	13.51
		25	49.3	85.0	62	14.03	28.0	28.8	23	12.67
		30	43.0	87.0	61	13.91	25.0	31.0	24	12.84
	3 rd	20	42.8	67.5	57	13.28	20.3	23.5	21	11.76
		25	40.4	63.5	49	13.45	19.3	22.3	20	10.43
		30	39.0	58.2	64	13.43	23.3	25.0	23	11.12
80	1st	20	69.6	132.2	74	16.93	54.0	72.8	51	15.82
		25	71.5	152.0	85	16.63	50.3	73.8	57	15.95
		30	66.6	143.0	67	16.85	48.0	70.7	49	15.66
	2 nd	20	53.0	100.5	62	15.15	34.0	43.8	28	14.82
		25	58.5	116.8	62	15.3	30.5	37.5	27	14.33
		30	54.9	101.0	70	15.18	37.0	41.3	26	14.28
	3 rd	20	49.1	78.8	62	14.23	23.5	24.8	19	13.70
		25	48.9	112.5	60	14.1	21.0	28.8	22	13.43
		30	45.6	91.8	64	14.15	23.3	27.0	22	13.09
120	1st	20	69.4	163.5	91	16.08	55.3	73.5	58	14.80
		25	67.1	156.5	85	15.74	55.3	78.8	55	14.92
		30	71.0	160.0	105	16.18	44.8	66.5	47	14.80
	2 nd	20	55.9	113.2	79	14.77	31.0	40.0	35	13.82
		25	54.1	125.5	85	14.77	34.3	44.8	31	13.95
		30	52.4	124.2	87	14.78	32.8	42.3	30	13.74
	3 rd	20	51.1	99.0	61	14.27	22.8	28.5	26	13.07
		25	54.2	104.0	65	14.0	21.3	30.0	22	12.94
		30	52.4	92.0	88	14.33	28.5	37.5	29	12.76
L.S.D. at 0.05%			N.S.	6.3	4.0	N.S.	1.7	2.7	1.6	0.28
L.S.D. at 0.01%			-	8.4	5.4	-	2.3	3.6	2.1	0.37

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تأثير التسميد بمستويات مختلفة من النيتروجين ومواعيد ومسافات الزراعة على إصابة نباتات القمح بصانعة أنفاق الأوراق *Agromyza nigripes* (Meigen)

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درس تأثير أربعة مستويات مختلفة من التسميد النيتروجينى (٠,٠ ، ٤٠ ، ٨٠ ، ١٢٠ كجم/ فدان) وثلاثةمواعيد زراعة (٣٠ نوفمبر ، ١٠ و ٢٠ ديسمبر فى موسم ١٩٩٣ - ١٩٩٤ و ١٠ ، ٢٠ و ٣٠ ديسمبر فى موسم ١٩٩٤ - ١٩٩٥) وثلاثة مسافات زراعة (٢٠ ، ٢٥ و ٣٠ سم) على إصابة نباتات القمح بصانعة الأنفاق *Agromyza nigripes* ومن عائلة Agromyzidae ورتبة ذات الجناحين ومحصولها من الحبوب وذلك بمحطة البحوث الزراعية بالجميزة بمحافظة الغربية خلال موسمى ١٩٩٣ - ١٩٩٤ و ١٩٩٤ - ١٩٩٥. وقد بينت النتائج المتحصل عليها أن النسبة المئوية للأوراق المصابة وعدد الأنفاق واليرقات الحية ازدادت معنوياً بزيادة مستوى التسميد النيتروجينى باستثناء النسبة المئوية للإصابة عند زيادة التسميد النيتروجينى عن ٨٠ كجم / فدان حيث كان التأثير غير معنوى. وأدى تأخير مواعيد الزراعة إلى انخفاض معنوى فى قيم جميع المعايير المستخدمة لقياس الإصابة الحشرية وكذلك محصول الحبوب.ولم يظهر لمسافات الزراعة تأثير مميز ، إلا أن محصول الحبوب زاد زيادة معنوية عند الزراعة على مسافة ٢٠ سم. وأظهر التفاعل بين مستوى النيتروجين x موعد الزراعة ومستوى النيتروجين x مسافة الزراعة وموعد الزراعة x مسافة الزراعة تأثيراً معنوياً على النسبة المئوية لإصابة الأوراق وعدد الأنفاق واليرقات الحية وكذلك محصول الحبوب. وقد كان للتفاعل بين مستوى النيتروجين x موعد الزراعة x مسافة الزراعة تأثير معنوى على عدد الأنفاق واليرقات الحية فى موسمى ١٩٩٣ - ١٩٩٤ ، ١٩٩٤ - ١٩٩٥ وعلى كل من النسبة المئوية للاصابة ومحصول الحبوب فى موسم ١٩٩٤ - ١٩٩٥. وباضافة النيتروجين بمعدل ٤٠ ، ٥٠ و ٦٠ ، ٧٠ ، ٨٠ ، ٩٠ كجم/ فدان للنباتات المنزرعة فى ١٠ ديسمبر وعلى مسافة ٢٠ سم. وجد أن جميع المعايير المستخدمة إنخفضت معنوياً ،كما ازداد محصول الحبوب على النباتات المسمدة بمعدل ٦٠ كجم نيتروجين / فدان مقارنة بتلك المسمدة بمعدل ٨٠ ، ٩٠ كجم نيتروجين / فدان فى موسمى ١٩٩٥ - ١٩٩٦ ، ١٩٩٦ - ١٩٩٧. ويمكن التوصية بأن إضافة السماد النيتروجينى بمعدل ٦٠ كجم/فدان لنباتات القمح المنزرعة فى أوائل ديسمبر وعلى مسافة ٢٠ سم تؤدى إلى انخفاض معنوى فى الإصابة والحصول على أعلى محصول من الحبوب.