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EFFECT OF NITROGEN FERTILIZER, DEFOLIATION AND PLANT DENSITY ON MAIZE GRAIN YIELD

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Abstract

The present investigation was carried out during 1998 and 1999 seasons at Zarzoora Experimental Station (EL-Beheira governorate) to study the effect of nitrogen level (zero, 100, 120 and 140 kg N/fed) and defoliation on maize yield at 15 days after silking (no defoliation, defoliation below topmost ear leaf, defoliation above topmost ear leaf and defoliation of all leaves as well as plant densities (16000, 20000 and 24000 plants/fed.). The experiments were arranged in split-split plot design with three replications. The results obtained in combined analysis were as follows.

1. Planting maize at the rate of 24000 plants/fed significantly increased plant height, barren plants% and lodged and broken plants %, but decreased stem diameter, % plants with two ears, ear length, ear diameter, no. of kernels/row and ear weight. 20000 plants/fed. recorded the highest grain yield, whereas 16000 plants/fed gave the lowest.
2. Increasing nitrogen level up to 140 kg N/fed increased most of the characters of maize under study i.e. plant height, ear height, stem diameter, two-eared plants %, ear length, ear diameter, no. of kernels/row and ear weight, whereas barren plants %, lodged and broken plants % were decreased. Shelling % and no. of rows/ear were not significantly affected. Grain yield increased by 168.6, 214.21 and 220.26 % of unfertilized maize by increasing nitrogen fertilizer to 100, 120 and 140 kg N/fed, respectively.
3. Stem diameter, plants carried two ears %, ear length, ear diameter, no. of kernels/row and ear weight were significantly affected by defoliation treatments, the highest values for these characters were obtained by undefoliating of maize plants. While, plant height, ear height, no. of rows/ear and shelling % were not significantly affected by defoliation. Barren plants % and lodged and broken plants % gave

the highest values by defoliating all leaves or leaves above topmost ear leaf. Nodefoliation and defoliation of leaves below topmost ear leaf on the one hand showed the highest maize grain yield/fed compared with defoliation of all leaves or leaves above the topmost ear leaf on the other hand, were the lowest.

4. Stem diameter, plants carried two ears %, lodged and broken plants %, ear diameter and number of grains /row were significantly affected by plant density x nitrogen level and nitrogen level x defoliation interaction. Ear weight was affected by nitrogen level x defoliation of maize plants. Also, ear length and grain yield/fed. were affected by plant density x nitrogen level, plant density x defoliation , nitrogen level x defoliation and plant density x nitrogen level x defoliation interactions.

5. Response of maize yield to nitrogen fertilizer was studied using quadratic polynomial model under three plant densities i.e 24000, 20000 and 16000 plants/fed over two growing seasons. Results showed that maize yield significantly responded to nitrogen fertilization and that response was quadratic under the three densities.

INTRODUCTION

Maize is the most important summer cereal crop in Egypt. Cultural treatments play an important role in increasing maize production. Population density, N fertilizer level, defoliation ...etc. are considered among the most important factors affecting maize yield. Some growth and agronomic characters i.e. plant and ear height, lodged and broken plants% and barren plants% were reduced by increasing plant density whereas stem diameter was decreased by increasing population density, El-Douby (1987), El-Hossary and Salwau (1989), El-Deeb (1990), Matta *et al.* (1990) and Badr *et al.* (1993) . Several investigations showed that yield component such as ear length, ear diameter, no. of kernels/row, plants with two ears % and ear weight significantly decreased by increasing plant density, Badr *et al.* (1993), El-Sheikh (1993), Basha (1994), , El-Gezawy (1996) and Shams El-Din and El-Habbak (1996). On the other hand, El-Douby (1987), El-Hossary and Salwau (1989) and Salwau (1993), Showed that no. of rows/ear and shelling percentage were not influenced by increasing plant density. Grain yield of maize significantly increased by increasing plant density up to 24.000 plants /fed. , El-Gezawy (1996) and Shams El-Din and El-Habbak (1996).

Some growth and agronomic characters such as plant and ear height, stem diameter, barrens plants% and lodged and broked plants% were affected by application of N fertilizer (El-Sheikh, 1993; Basha, 1994; El-Gezawy, 1996 and Shams El-Din and El-Habbak, 1996). Also, most yield and yield component characters of maize, except shelling % on one season, significantly increased by increasing N fertilizer level up 130 or 150 kg N/fed, while number of rows/ear was not effected by adding N fertilizer (El-

Hossary and Salwau, 1989; El-Deeb, 1990; Matta *et al.*,1990; Salwau, 1993; Moshtohory, 1995 and El-Gezawy, 1996).

Many farmers are used to defoliate maize plants to feed cattle. Chen *et al.* (1978), showed that removal of upper leaves had more direct effect compared with removal of lower leaves, Diaz (1983) indicated that upper and middle leaves contributed almost 80% of total dry matter to maize grain yield, however, ear number and grain yield were not affected by lower leaves removal. Salwau and Shams El-Din (1992), recorded that stripping leaves up to the topmost ear leaf gave the lowest yield and yield components , but stripping below ear leaf had no significant effect on the above mentioned characters. Also, they found that the interaction between N levels and defoliation gave a significant effect on ear weight and shelling percentage in one season out of two , but the other characters of growth and yield and its components were not significantly affected by the interaction.Mimbar and Susilowati (1995) and Lales *et al.*, (1996), reported that grain yield of maize significantly reduced when all leaves above the ear were excised, however, removal of the top 3 leaves above the ear did not significantly reduce seed yield. Sentait and Dejene (1992) showed that kernel size and grain yield of maize declined linearly with number of leaves removed. On the other hand, Subedi (1996) found that defoliation of maize by removal of leaves below and above the ear had no effect on maize grain yield.

Selection of the most appropriate rate of nitrogen fertilizer is a major decision affecting the profitability of maize production and the effect of agriculture environment. Decisions concerning optimal levels of fertilization involve some types of model to the yield data collected when several rates of fertilizer are applied. Balko and Russell (1980), Cerrato and Blackmer, (1990), Fox and Piekielek, (1983) and Ashmawy (1995) studied response of maize yield to nitrogen fertilizer. They found that the response of maize yield to nitrogen was quadratic.

MATERIALS AND METHODS

Two field experiments were carried out at Zarzoora Experimental Station in El-Beheira governorate during 1998 and 1999 seasons to determine the effect on maize grain yield of four N fertilizer levels (0, 100, 120 and 140 kg N/fed.) and four defoliation treatments at 15 days after silking (no defoliation, defoliation of leaves below topmost ear leaf, defoliation of leaves above topmost ear leaf and defoliation of all leaves) as well as three plant densities (16000, 20000, and 24000 plant/fed.). The treatments were assigned in split split- plot design with three replications. Plant population

densities were arranged at random in the main plots, N fertilizer levels were arranged in the sub-plots and defoliation treatments were allocated to the sub sub- plots. The experimental plot area was 10.5 m^2 (1/400/fed), consisting of 5 ridges, 3.0m long and 70.0cm wide.

Table 1. Some physical and chemical properties of the soil as means of the two growing seasons of the experimental area.

Physical characters	Values	Chemical characters	Values
Texture class	clay	Available N*	1.5%
Soil PH	7.8	Available P*	0.4%
Organic matter	2.2 %	Available K*	0.69%

*Available N. P. and K. were determined according to Black (1965)

Hybrid maize cultivar S.C.10 was sown on June 25th and 29th in 1998 and 1999 seasons, respectively, in hills 25,30 and 37.5 cm apart to give 24000, 20000 and 16000 plants/fed. Nitrogen fertilization was given in the form of ammonium nitrate (33.5% N) at two equal doses before the first and second irrigations. Defoliation treatments were started at 15 days after silking. The normal cultural practices were carried out as recommended.

Random samples of 10 plants and 10 ears were taken from sub sub- plots at harvesting time to determine the plant height (cm), ear height (cm), stem diameter (mm), ear length (cm), ear diameter (mm), no of rows/ear, no of grains /row, ear weight and shelling percentage. Plants with two ears%, barren plants %, lodged and broken plants% and grain yield (kg)/fed. were estimated from all plants in the sub sub- plots. Maize grain yield was adjusted to 15.5% moisture content.

To study maize yield response to nitrogen fertilizer a quadratic polynomial model was used and it was estimated using the following formula:

$$Y = a + bx + cx^2$$

Where y: is the grain yield per feddan in kgs.

a: is the intercept (constant).

b: is the linear coefficient .

c: is the quadratic coefficient.

x: is the level of nitrogen fertilizer applied in kg/fed.

Data combined over seasons were statistically analyzed and Duncan Multiple

Range Test was used to compare between means at 5% levels of significance (Duncan 1955).

RESULTS AND DISCUSSION

Effect of plant density:

Results in Table (2) revealed that maize performance plants was significantly affected by increasing plant density in all studied characters except, number of rows /ear and shelling percentage in combined analysis. The results clearly indicated that maize planted at 24000 plant/fed. gave the highest values compared to both 20000 and 16000 plants/fed. This was true for some growth and agronomic characters i.e. plant height, ear height, barren plants% and lodged and broken plants%. The increase in these characters in dense populations is mainly due to the increased competition among maize plants for light, nutrients and other environmental factors which are required for growth . Such results are in accordance with those obtained by El-Hosary and Salwau (1989), El-Deeb (1990), Matta *et al.* (1990) and Shams El-Din and El-Habbak (1996).

Stem diameter (mm) and all yield component characters of maize i.e. plants with two ears%, ear length, ear diameter, no. of kernels/row and ear weight significantly decreased as a result of increasing population density in combined analysis. This result is mainly due to that plants grown at higher densities are less vigorous than plants in low density, and this might be responsible mainly for the reduction in ear characters and ear weight . This result agrees with several results reported by El-Deeb (1990), Matta *et al.* (1990), Badr *et al.* (1993) and Shams El-Din and El-Habbak (1996).

Number of rows/ ear and shelling percentage showed no response to plant density since these characters are mainly considered as a genetical one.

For grain yield/fed., data in Table (2) indicated that grain yield significantly affected by plant density. Grain yield gave the highest value at 20000 plants/fed. followed by 24000 plants/fed. and the lowest value was obtained from 16000 plants/fed. The increases in grain yield at 20000 plants/fed. was estimated to 7.05 and 24.97% over 24000 and 16000 plants/fed.,respectively. This result is in harmony with those obtained by El-Douby (1987), El-Deeb (1990) and Shams El-Din and El-Habbak (1996). It could be concluded that planting 20000 plants/fed of maize can be recomended.

Table 2. Effect of plant density on some growth, grain yield and yield components characters of maize in 1998, 1999 and their combined analysis

Treatments	Plant density								
	1998			1999			Combined		
Characters	16000	20000	24000	16000	20000	24000	16000	20000	24000
Plant height (cm)	294.5 c	301.8 b	311.9 a	299.5 c	307.5 b	315.6 a	297.0 c	304.7 b	313.8 a
Ear height (cm)	140.0 c	146.4 b	151.3 a	125.9 c	134.8 b	139.4 a	132.9 c	140.6 b	145.3 a
Stem diameter (mm)	19.9 a	19.2 a	17.5 b	19.4 a	18.4 b	16.9 c	19.7 a	18.8 b	17.2 c
Barren plants%	12.15 c	16.40 b	20.52 a	9.77 c	13.29 b	14.83 a	10.96 c	14.84 b	17.68 a
Lodged & broken plants%	13.44 c	17.10 b	21.23 a	10.54 c	13.46 b	18.39 a	11.99 c	15.99 b	19.81 a
Ear length (cm)	18.48 a	16.83 b	14.92 c	19.69 a	17.65 b	16.10 c	19.08 a	17.24 b	15.51 c
Ear diameter (mm)	41.92 a	39.58 b	36.50 c	42.10 a	40.58 b	38.02 c	42.01 a	40.08 b	37.26 c
No. of rows/ear	13.50 a	13.46 a	13.46 a	13.83 a	13.63 a	13.58 a	13.67 a	13.54 a	13.52 a
No.of kernels//row	38.71 a	35.27 b	31.15 c	37.92 a	34.79 b	32.46 c	38.31 a	35.03 b	31.80 c
Plants with two ears%	16.89 a	14.10 b	10.31 c	17.71 a	13.63 b	10.15 c	17.30 a	13.87 b	10.23 c
Ear weight(g)	199.25 a	192.88 b	183.46 c	205.15 a	197.92 b	187.39 c	202.20 a	195.40 b	185.43 c
Shelling%	82.08 a	82.35 a	81.94 a	81.89 a	82.00 a	81.94 a	81.99 a	82.18 a	81.94 a
Grain yield kg/fed	17.93 c	21.94 a	21.02 b	19.24 c	24.50 a	22.37 b	18.58 c	23.22 a	21.69 b

Means followed by the same letters are not different at the probability of 5% Duncan's L.S.R. test

Effect of N fertilizer Rates:

Table (3) shows that nitrogen fertilizer levels have significantly affected all characters under study, except no. of rows/ear and shelling percentage which were not significantly affected in combined analysis. The results revealed that maize plants fertilized with 140 kg N/fed. gave the highest values followed by those receiving 120,100 kg N/fed. and unfertilized plants, respectively. This was true in each of plant height, ear height and stem diameter which were higher with 140, 120 and 100 kg N/fed. compared to the unfertilized treatment . The increase in these characters due to the increase in nitrogen application may be attributed to the increase in meristimatic activity, stimulation of cell elongation and auxin production in maize plants. These results are in agreement with those obtained by El-Deeb (1990) and El-Sheikh (1993).

Barren plants% and lodged and broken plants% were significantly reduced by increasing nitrogen from zero to 100 ,120 and 140 kg N/fed. Similar results were reported by Matta *et al.* (1990) and Shams El-Din and El-Habbak (1996).

Concerning no. of rows/ear and shelling %, the present study indicated no significant effect on these characters which are rarely influenced by cultural practices compared with other characters. Shams El-Din and El-Habbak (1996) showed that number of rows/ear in both seasons and shelling percentage in one out of two seasons were not significantly affected by nitrogen fertilizer level up 130 kg N/fed.

With regard to some yield components i.e. plants with two ears %, ear length , ear diameter, no. of kernels/row and ear weight were significantly affected by N fertilizer level. The highest values of yield components characters were obtained with highest dose of nitrogen fertilizer i.e. 140kg N/fed. Also the increase in maize grain yield due to the increase in nitrogen level is a results of the effect of N fertilizer in increasing yield components. The application of 100, 120 and 140 kg N/fed. increased grain yield over zero (control treatment) by 168.6%, 214.22% and 220.26% respectively in combined analysis. These results are in agreement with those reported by Salwau (1993), Moshtohory *et al.* (1995) and El-Gezawy (1996).

3. Defoliation effect:

Table (4) shows that the differences between maize defoliation treatments were significant for stem diameter, % of plants with two ears, % of barren plants, % of lodged and broken plants, ear length , ear diameter, no. of kernels/row and grain yield . No significant differences in plant height, ear height , no. of rows/ear and shelling per-

Table 3. Effect of nitrogen level on some growth, grain yield and yield component characters of maize in 1998, 1999 and combined analysis

Treatments	Nitrogen fertilizer levels											
	1998				1999				Combined			
Characters	Zero	100	120	140	Zero	100	120	140	Zero	100	120	140
Plant height (cm)	267.4 c	295.1 b	324.3 a	324.3 a	286.6 c	308.0 b	315.6 ab	320.1 a	276.9 c	301.6 b	319.9 a	322.02 a
Ear height (cm)	119.7 c	148.3 b	156.7 a	158.8 a	100.9 d	133.2 c	146.4 b	153.1 a	110.3 d	140.8 c	151.5 b	155.9 a
Stem diameter (mm)	16.1 d	18.5 c	20.1 b	20.8 a	15.9 d	17.9 c	19.1 b	19.9 a	16.1 d	18.2 c	19.6 b	20.4 a
Barren plants%	29.19 a	15.57 b	11.67 c	8.58 d	23.72 a	11.81 b	9.14 c	5.86 d	26.46 a	13.89 b	10.40 c	7.22 d
Lodged & broken plants%	25.5 a	18.89 b	14.61 c	9.03 d	23.17 a	15.69 b	11.64 c	6.03 d	24.83 a	17.29 b	13.13 c	7.53 d
Ear length (cm)	11.92 d	16.78 c	18.50 b	19.78 a	11.81 d	18.42 c	20.00 b	21.03 a	11.86 d	17.6 c	19.25 b	20.4 a
Ear diameter (mm)	31.14 d	39.00 c	43.17 b	44.03 a	31.44 d	40.81 c	43.44 b	45.25 a	31.29 d	39.90 c	43.31 b	44.64 a
No.of rows/ear	13.00 c	13.28 bc	13.61 ab	14.00 a	12.58 c	13.56 c	14.44 a	14.44 a	12.78 c	13.28 b	14.03 a	14.22 a
No.of kernels/row	18.17 d	38.14 c	40.69 b	43.17 a	17.39 d	37.94 c	41.22 b	43.67 a	17.78 d	38.04 c	40.96 b	43.42 a
Plants carried two ears%	3.03 d	14.14 c	18.44 b	19.44 a	3.89 d	13.53 c	18.36 b	19.53 a	3.46 d	13.85 c	18.40 b	19.49 a
Ear weight (g)	136.97 d	200.0 c	210.17 b	220.31 a	145.0 d	203.10 c	216.20 b	223.0 a	140.99 d	201.54 c	213.17 b	221.67 a
Shelling%	82.0 a	82.39 a	81.81 a	82.31 a	80.58 a	81.72 a	82.58 a	82.89 a	81.29 a	82.06 a	82.19 a	82.60 a
Grain yield kg/fed	8.16 d	21.64 c	25.48 b	25.9 a	8.73 d	23.7 c	27.57 b	28.16 a	8.44 d	22.67 c	26.52 b	27.03 a

Means followed by the same letters are not significantly different at 5% probability according to Duncan's L.S.R. test

Table 4. Effect of defoliation on some growth, grain yield and yield characters of maize in 1998, 1999 and combined analysis.

Treatments	Defoliation											
	1998				1999				Combined			
Characters	D1	D2	D3	D4	D1	D2	D3	D4	D1	D2	D3	D4
Plant height (cm)	301.5 a	302.8 a	302.5 a	303.2 a	311.8 a	310.1 a	304.6 ab	204.8 ab	306.6 a	306.5 a	303.5 a	304.0 a
Ear height (cm)	146.8 a	146.9 a	144.0 a	145.7 a	131.1 a	133.0ab	135.9 ab	134.5 a	139.0 a	140.0 a	137.9 a	140.1 a
Stem diameter (mm)	19.4 a	19.0 ab	18.9 ab	18.1 b	19.4 a	18.4 b	17.8 c	17.3 c	19.4 a	18.7 b	18.3 c	17.7 c
Barren plants%	15.78 b	16.03 ab	16.56 ab	17.06 a	10.58 c	11.81 b	13.75 a	14.39 a	13.18 c	13.92 b	15.15 a	15.72 a
Lodged & broken plants%	16.14 b	16.56 b	18.03 a	18.31 a	12.06 b	13.92 ab	15.42 a	15.14 a	14.10 b	15.24 b	16.72 a	16.72 a
Ear length (cm)	17.78 a	17.56 a	16.50 b	15.14 c	19.17 b	18.36 b	17.14 c	16.58 d	18.47 a	17.96 b	16.82 c	15.86 d
Ear diameter (mm)	41.08 a	40.42 a	38.81 b	37.03 c	42.47 a	41.39 b	39.33 c	37.75 d	41.78 a	40.90 b	39.07 c	37.90 d
No.of rows/ear	13.72 a	13.56 a	13.33 a	13.28 a	14.00 a	13.67 ab	13.44 ab	13.61 ab	13.86 a	13.61 a	13.39 a	13.44 a
No.of kernels/row	38.94 a	37.08 b	33.69 c	30.44 d	36.94 a	36.00 b	34.17 c	33.11 d	37.94 a	36.54 b	33.93 c	31.78 d
Plants carried two ears%	19.56 a	14.17 b	11.56 c	9.81 c	15.94 a	14.97 a	13.17 b	11.22 d	17.75 a	14.57 b	12.36 c	10.51 d
Ear weight (g)	207.58 a	203.25 b	180.81 c	175.81 d	206.28 a	203.81 a	190.42 b	186.78 c	206.93a	203.53 b	185.61 c	181.29 d
Shelling%	82.14 a	82.08 a	82.17 a	82.11 a	82.03 a	81.86 a	82.00 a	81.89 a	82.08 a	81.97 a	82.08 a	82.00 a
Grain yield kg/fed	22.77 a	22.61 a	18.60 b	17.21 c	23.31 a	23.20 a	21.21 b	20.42 c	23.04 a	22.90 a	19.90 b	18.82 c

Means followed by the same letters are not significantly different at 5% level according to Duncan's L.S.R. test

centage were found in combined analysis. . Similar results were obtained by Salwau and Shams El-Din (1992). Number of rows/ear and shelling percentage were not affected by defoliation.

As for % barren plants and % of lodged and broken plants, defoliation of all leaves of maize and defoliation of the leaves above topmost ear showed more effect compared to nodefoliation and defoliation below topmost ear treatments . Table (4) shows that the differences between the averages of stem diameter, % of plants carrying two ears, ear length, ear diameter, number of kernels/row and ear weight significantly affected by different treatments of defoliation in combined analysis. Nodefoliation treatment recorded the highest values for the previous characters, followed by stripping leaves below topmost ear, defoliation above topmost ear leaf and defoliation of all leaves of maize plants, resp. These results are in harmony with results obtained by Chen *et al.* (1978), Dias (1983) and Salwau and Shams El- Din (1992).

As shown in Table (4), there was no significant effect between zero defoliation treatment and stripping leaves below topmost ear leaf. Stripping all leaves of maize plant and stripping the above leaves topmost ear leaf significantly decreased grain yield compared to undefoliation and stripping the below leaves topmost ear leaf. Maize grain yield of zero defoliation treatment outyielded the defoliation treatments by 0.61, 15.77 and 22.42 % for stripping leaves below topmost ear leaf, stripping leaves above topmost ear leaf and stripping all leaves of maize plants resp., compared with undefoliation treatment. This is mainly because of the greatest reduction in yield components , which is mainly attributed to the removal of the photosynthetic surface. This results is in accordance with those reported by Chen *et al.* (1978), Dias (1983) and Salwau and Shams El-Din (1992).

It could be concluded that stripping leaves below topmost ear leaf gave the least reduction in grain yield/fed. due to the leaves above topmost ear leaf is the most necessary in converting solar energy to chemical energy and accumulation of dry matter.

4. Interaction effects:

Data in Table (5) indicated that stem diameter, plants with two ears %, lodged and broken plants %, ear length, ear diameter, number of grains/row, ear weight and grain yield/fed. significantly affected by the interactions in combined analysis.

Stem diameter, plants with two ears %, lodged and broken plants, %, ear diameter and number of grains/row were significantly affected by the interaction between

Table 5. Significance, highest value and combination of the interaction effects factors on some maize characters in combined analysis.

Characters	D X N	Highest value	D X def.	Highest value	N X def.	Highest value	D X N X def.	Highest value
Stem diameter (mm)	D1 X N4	21.4	--------	-------	N4 X def.1	21.2	-------	
Plants carried two ears%	D1 X N4	24.04	----------	-------	N4 X def.1	24.22	-------	
Lodged and broken plants%	D1 X N1	29.92	----------	--------	N4 X def.1	27.5	-------	
Ear length (cm)	D1 X N4	22.17	D1 X def.1	20.54	N4 X def.1	21.72	D1 x def 1 x N4	23.5
Ear diameter (mm)	D1 X N4	46.79	--------	--------	N4 X def.1	47.17		
No. of grains/row	D1 X N4	46.71	----------	--------	N4 X def.1	46.83		
Ear weight (g)	--------	-------	--------	---------	N4 X def.1	232.22		
Grain yield (kg)/fed	D1 X N4	29.7	D2 X def.1	25.09	N4 X def.1	29.17	D2 x def 2 x N3	32.67

D= Plant density
D1= 16000 plant /fed
D2= 20000 plant /fed
D3= 24000 plant/fed

def. = Defoliation
def.1= undefoliation
def.2= defoliation low topmost ear leaf.
def.3= defoliation above topmost ear leaf.
def.4= defoliation all leaves at plant

N = Nitrogen levels
N1= zero kg N/fed
N2= 100 kg N/fed
N3= 120 kg N/fed
N4= 140 kg N/fed

plant density with nitrogen fertilizer level and nitrogen level with defoliation of maize plants. The highest values were obtained with D1 X N4 and N4 X def.1 for each of stem diameter, plants with two ears %, ear diameter and number of grains/row, whereas the highest values were obtained with D1 X N1 and N4 X def.1 respectively, and ear weight were significantly affected by interaction between nitrogen level with defoliation of maize plants, and N4 X def.1 gave the highest value.

Ear length and grain yield/fed significantly affected by plant density with nitrogen level, plant density with defoliation treatment, nitrogen level X defoliation and plant density X defoluiation X nitrogen level. The interaction between D1 X N4, D1 X def.1, N4 X def.1 and D1 X def.1 X N4 recorded the highest values for ear length. On the other hand, the interaction between D2 X def.1, D2 X N4, N4 X def.1 and D2 X def.2 X N3 gave the highest values for grain yield.

Selection of the most appropriate rate of nitrogen fertilizer is a major decision affecting the profitability of maize production and the effect of agriculture on the environment. Decisions concerning optimal levels of fertilization involve some types of model to the yield data collected when several rates of fertilizer are applied.

Response of maize yield to nitrogen fertilizer was studied using quadratic polynomial model. This response was studied under three plant densities i.e 24000, 20000 and 16000 plants/fed over the two seasons of experiment. Fig.1 a, b and c showed that maize yield significantly responded to nitrogen fertilization and that response was quadratic under the three densities. These results were in agreement with those obtained by Balko and Russell(1980), Cerrato and Blackmer (1990), Fox and Piekielek (1983) and Ashmawy (1995).

The results indicated that response of maize yield to nitrogen fertilizer was not affected by the plant density. It is clear from fig.1 that the maximum yield of maize could be obtained by appling 120 kg/fed. Also it could be concluded that planting 20000 plants/fed. defoliation below topmost ear leaf of maize plants and application of 120 kg N/fed. can be recommended.

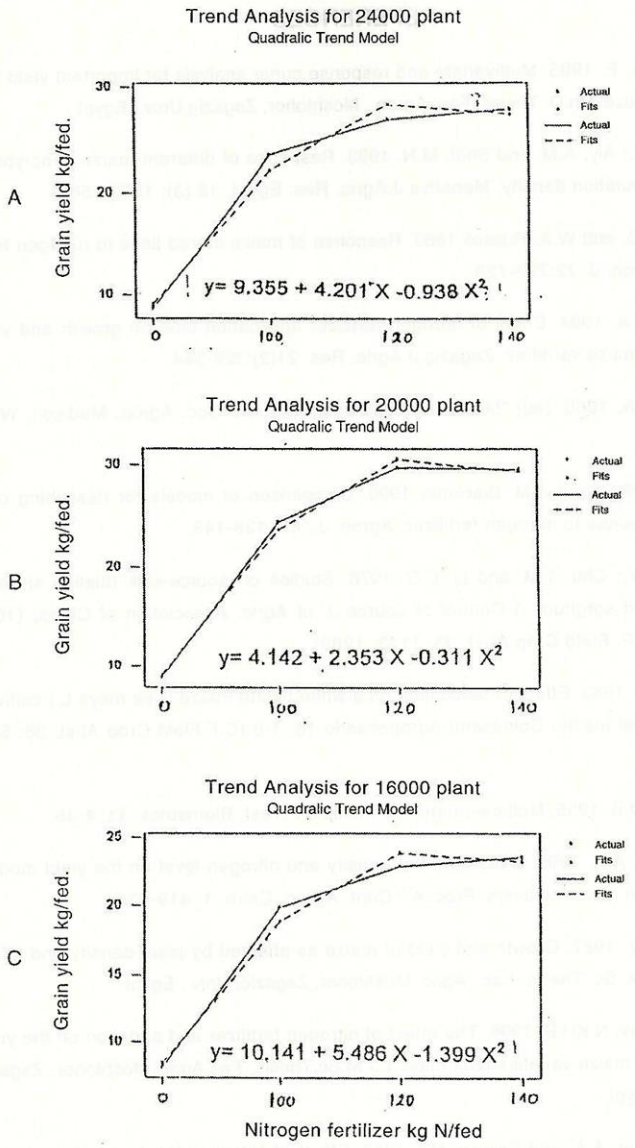

Fig. 1. The trend analysis of grain yield under osme levels of nitrogen fertilizer for different plant density

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تاثير الكثافة النباتية والتسميد الأزوتى والتوريق على محصول الذرة الشامية

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أقيمت تجربتان حقليتان خلال موسمي ١٩٩٨ ، ١٩٩٩ في محطة بحوث زرزورة (محافظة البحيرة) وذلك لدراسة تأثير الكثافة النباتية (١٦،٢٠،٢٤ الف نبات /فدان) ومستويات التسميد الأزوتى (صفر،١٠٠،١٢٠،١٤٠ كجم ازوت/فدان) وكذا التوريق (بدون توريق- توريق الأوراق السفلى للكوز العلوى- توريق الأوراق العليا للكوز العلوى- توريق كل الأوراق على النبات) وكان التصميم التجريبى المستخدم هو القطع المنشقة مرتين فى ثلاث مكررات وكانت اهم النتائج المتحصل عليها بعد تحليل الضم كالأتى:

١-ادت زراعة نبات الذرة الشامية عند ٢٤ الف نبات /فدان الى زيادة معنوية لصفات ارتفاع الكوز- النسبة المئوية للنباتات المذكرة وايضا النسبة المئوية للنباتات الراقدة والمكسورة، بينما قلت صفات قطر الساق والنسبة المئوية للنباتات الحاملة اكثر من كوز- طول الكوز- سمك الكوز- عدد حبوب الصف ووزن الكوز - سجلت الكثافة النباتية (٢٠٠٠٠) نبات/فدان اعلى قيمة لمحصول حبوب الذرة الشامية بينما سجلت الكثافة النباتية (١٦٠٠٠) نبات/فدان اقل قيمة.

٢-ادت زيادة التسميد الأزوتى حتى ١٤٠كجم/فدان الى زيادة لمعظم صفات نمو الذرة الشامية تحت الدراسة مثل ارتفاع النبات- ارتفاع الكوز- سمك الساق- النسبة المئوية للنباتات الحاملة اكثر من كوز- طول الكوز- سمك الكوز- عدد الحبوب بالصف وكذا وزن الكوز- بينما حدث العكس لصفات النسبة المئوية للنباتات المذكرة والنسبة المئوية للنباتات الراقدة والمكسورة- ولم تتاثر صفات كلا من النسبة المئوية لمعدل التفريط وعدد صفوف الكوز. ادى اضافة ١٠٠، ١٢٠، ١٤٠ كجم ازوت/فدان زيادة ١٦٨,٦٪ ، ٢١٤,٢١٪ ، ٢٢٠,٢٦٪ على الترتيب بالمقارنة بمعاملة عدم التسميد.

٣-سجلت معاملة عدم توريق نباتات الذرة الشامية اعلى قيم لصفات سمك الساق- النسبة المئوية للنباتات الحاملة اكثر من كوز- طول الكوز- سمك الكوز- عدد الحبوب بالصف وكذا وزن الكوز. ولم تتاثر عدد صفوف الكوز والنسبة المئوية لمعدل التفريط. كما ادى توريق كل اوراق النبات وكذا توريق الأوراق اعلى الكوز العلوى الى زيادة ٪ لكل من النباتات المذكرة والنباتات الراقدة والمكسورة . ايضا تفوق محصول الذرة الشامية فى معاملتى عدم التوريق وازالة الأوراق السفلى للكوز العلوى بالمقارنة بمعاملتى ازالة كل الاوراق على النبات او الأوراق العليا للكوز العلوى.

٤-تاثرت صفات كل من سمك الساق ، النسبة المئوية للنباتات الحاملة لاكثر من كوز، النسبة المئوية للنباتات الراقدة والمكسورة، قطر الكوز وعدد الحبوب بالصف بالتفاعل بين الكثافة النباتية ×

التسميد الأزوتى وبين التسميد الأزوتى × توريق نباتات الذرة الشامية، كذلك تاثر وزن الكوز بالتفاعل بين التسميد الأزوتى× توريق نباتات الذرة الشامية، بينما تاثر طول الكوز ومحصول الحبوب/ الفدان بالتفاعل بين التسميد الأزوتى و الكثافة النباتية وبين توريق نباتات الذرة الشامية × الكثافة النباتية وبين التسميد الأزوتى × التوريق وبين الكثافة النباتية × التسميد الأزوتى × توريق نباتات الذرة الشامية.

٥-ثبت من دراسة المنحنيات عن العلاقة بين استجابة الذرة الشامية للتسميد النتروجينى تحت كثافات مختلفة لعدد النباتات فى الفدان، ان هناك استجابة معنوية لمحصول الذرة الشامية للتسميد النتروجينى وهذه الأستجابة لم تتاثر بالكثافات المختلفة لعدد النباتات فى الفدان محل الدراسة ، وكان اعلى محصول للذرة الشامية امكن الحصول عليه ناتج من المعاملة ١٢٠ كج نتروجين/فدان.