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EFFECT OF PLANT DENSITY, ORGANIC MANURE, BIO AND MINERAL NITROGEN FERTILIZERS ON MAIZE GROWTH AND YIELD AND SOIL FERTILITY

BY

Badr, M. M.A.* and Sanaa A.Othman**
* Field Crops Research Institute, Agric. Rec. Center.
** Soil, Water and Environment Res. Instit., Agric. Res. Center.

ABSTRACT

Two field experiments were performed at Gemmeiza Agricultural Research Station, Gharbia Governorate, during 2003 and 2004 seasons, to study the effect of three plant densities (16.000, 20000 and 24000 plant/fad), three treatments of organic manure & bio-fertilizer(Zero, organic manure and bio-fertilizer) and four nitrogen fertilizer rates (Zero, 60, 80 and 100kg N/fad) on growth, yield and yield components of maize besides soil fertility status at harvest . Split-split plot design with three replicates was used. The results could be summarized as follows:

1- Plant and ear heights of maize plants were significantly increased by increasing plant density in both seasons whereas, area of topmost ear leaf was significantly decreased by increasing plant density in both seasons. Number of grains/ row and100-grain weight were significantly decreased due to increasing plant density in the two seasons of study. Grain yield was increased significantly in the first season, while the differences did not reach the significance level in the second one, as the plant density increased.
2- All of the studied growth characters of maize plants were increased significantly by adding organic manure or treating the seeds with the bio-fertilizer (microbin) .Moreover, grain yield and its components followed the same trend.
3- Increasing nitrogen fertilizer rate from zero up to 100 kg N/fad increased significantly the studied maize growth, yield and yield components characters. Increases in maize grain yield/fad were 80.41, 122.62 and 156.08 % with N rates of 60, 80 and 100 kg N /fad, compared with the control treatment, in the first seasons and 32.43, 49.19 and 56.77 % in the second one, respectively.
4- Maize grain yield was significantly affected due to the interaction of plant densities and N-rates in 2003 season. Moreover, in 2003 and 2004 seasons the organic or bio-fertilizers interacted with N- rates to alter the grain yield character.
5- The treatment of 24000 plant/fad +microbin +60 kg N/fad resulted in the highest value of kg grains/ kg N added (NUE). In addition, the highest value of grain N-uptake was due to the combination of 16000 plant/fad + microbin + 100 kg N/fad rate. As for the soil fertility, the combination of 16000plant/fad +microbin +100 kg N/fad rate, proved to be the most proper in this respect.

6- Nitrogen use efficiency (NUE) increased as the plant density increased. Addition of organic fertilizer or treating the seeds with microbin (bio-fertilizer) seemed to increase NUE values. Nevertheless, increasing N-rate resulted in reduced NUE values.
7- Increasing the plant density slightly decreased the grain N-uptake value, while, addition of organic fertilizer or treating the seeds with microbin enhanced such character. Value of grain N-uptake gradually increased due to increasing N-rate up to 100 kg N/fad.
8- Values of residual soil N were decreased as plant density increased, while an opposite trend was observed under addition of organic fertilizer or treating the seeds with microbin. In addition, increasing N-rate resulted in gradual increases in such character.

Generally, it could be recommended that planting maize at 20000 or 24000 plant / fad and treating maize seeds with microbin as a bio- fertilizer and fertilization at the rate of 100 kg N / fad is the most proper combination in order to attain the highest maize grain yield and conserving the soil fertility under Gemmeiza area conditions.

INTRODUCTION

Maize is the most important summer cereal crop in Egypt. The cultural practices play an important role in maize growth and its production. Plant density, organic manure & biofertilizer and nitrogen fertilizer are considered among the most important factors affecting maize yield. Some growth characters (plant height, ear height) were decreased by increasing plant density El-Deeb (1990) and Matta *et al.* (1990). Whereas, leaf area and yield components characters i.e. number of grains/row and 100-grain weight were increased by increasing plant density, Badr *et al.* (1997) and El-Douby *et al.* (2001). Number of rows/ear was not significantly affected due to increasing plant population (El-Gezawy, 1996). El-Douby *et al.* (2001) stated that maize grain yield was significantly increased due to increasing plant density.

Organic manure is an important nitrogen source for maize grain yield. It also improves the physical properties of the soil. El-Koumey (1993), Mehta *et al.* (1994), Faisel and Shalaby (1998), Nofal (1999) and Gomma and EL-Douby (2002) reported that maize grain yield and its components were increased significantly by adding organic manure.. Recently, many investigators have used some biofertilizers to reduce the bad impacts on the environment due to usage of the nitrogenous fertilizers. Treating maize seeds with biofertilizer besides addition of nitrogen fertilizers improved maize growth and yield and its components(Garcia *et al.*, 1995; Zahran *et al.* 1997; EL- Douby, 2002 and Salah *et al.* (2003).

Ear height was significantly affected by increasing nitrogen fertilizer up to 120 or 125 kg N/fad (Matta *et al.*, 1990 and EL-Douby *et al.* 2002). Moreover, maize yield and most of yield components such as ear/length, number of grains/row, 100-grain weight and grain yield/ fad were significantly increased by increasing nitrogen fertilizer levels up to 140 kg N/fad (EL-Sheikh, 1998; EL–Gezawy, 1996; Gomma and EL-Douby, 2002 and Othman *et al.*, 2005).

The present investigation aims to study the effect of plant density, organic manure & bio-nitrogen fertilizers and nitrogen fertilizer and their interactions on maize growth, yield and its components under Gemmeiza soil conditions. The influence of the adopted treatments on nitrogen use efficiency, grain N-uptake and soil residual N were also considered.

MATERIALS AND METHODS

The present investigation was performed at Gemmeiza Agricultural Research Station, EL-Gharbia Governorate during 2003 and 2004 seasons, to study the effect of plant densities, organic manure, bio-fertilizer (microbin) and nitrogen fertilizer on maize (*Zea mays* L.), growth, yield and yield components. The experimental design was split- split plot with three replicates. Plant densities treatments i.e. 16000, 20000 and 24000 plant/fad were occupied the main plots, while, organic manure and biofertilizer (microbin) were arranged in the sub-plots and nitrogen fertilizer rates i.e. Zero, 60, 80 and 100 kg N/fad were allocated to the sub- sub plots. The sub- sub experimental plot area was 8.4m^2 (1/500 faddan) and consisting of 4 ridges with 0.7 m width and 3.0 m length. The soil is silty-clay in texture and some of its chemical and physical characteristics are shown in Table (1). The preceding winter crop was wheat in both seasons. Organic manure was applied during land preparation at the rate of 20m^3/fad. Bio-fertilizer used is Microbin (A mixture of Azospirilium sp., Azotobacter sp., Bacillus megatherium var.phosphaticum, pseudomonas sp. and Mycorrhiza sp.) .Mineral N- fertilizer was ammonium nitrate (33.5%N) and the tested rates were applied in two equal doses, just before the first and second irrigations.

Table (1): Some chemical characteristics* of the experimental site in 2003 and 2004 seasons:

Total N%	Soluble cations (meq/100 g soil)				Soluble anions (meq/100 g soil)				Ec (mmohs /cm)	OM %
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-}	HCO_3^{-}	Cl^{-}	SO_4^{-}		
2003 season										
0.113	0.43	0.35	0.47	0.02	0.11	0.79	0.25	0.1	1.92	1.85
2004 season										
0.123	0.23	0.21	0.41	0.02	--	0.61	0.23	0.03	1.17	1.92

* Determined according to Black (1965).

Maize seeds (Hybrid Sc.10) were sown on June 3rd and 5th in 2003 and 2004 seasons, respectively. Maize was planted at one side of the ridge at distances 25, 30 and 37.5 cm apart to give the plant densities of 24000, 20000 and 16000 plant/fad, respectively . All the recommended cultural practices, for maize production in the area, were followed in both seasons. At silking stage, ten entire ear-node leaves were sampled from each sub-sub plot, for nitrogen determination, in order to investigate the plant nutritional status. At the same time, soil samples were taken to determine total nitrogen percent at such growth stage. At harvest, samples of guarded 10 plants were taken, from sub-sub plots, to determine plant height(cm), leaf area (cm^2), ear height {cm}. Number of rows/ ear, number of grains/row, 100- grain weight (g), (average of 5 measurements), and grain

yield/fad were estimated from each sub-sub plots. Maize grain yield was adjusted to 15.5% moisture content. Moreover, soil samples were collected to determine the residual soil N. Total N in plant leaves and in the soil was determined as described in A.O.A.C. (1984). The collected data was statistically analyzed according to Snedecor and Cochran (1980) and the treatment means were compared by the Least Significant Difference (L.S.D.) at 5% level of probability.

RESULTS AND DISCUSSION

1- Effect of plant density:

Results in Table (2) showed that the growth characters i.e. plant and ear heights of maize plant were significantly increased by increasing plant density from 16000 up to 24000 plant/fad. On the other hand, leaf area of topmost ear, as growth character of maize, was significantly decreased in both seasons. These results are mainly due to the inter- competition among maize plants due to higher population for light, nutrients and other environmental factors which are required for enhancing these characters. Such results are in accordance with those obtained by Matta *et al.*(1990) and El-Douby *et al.* (2001).

Table (2): Effect of plant densities, organic & bio-fertilizers and N-fertilization rates on some maize growth characters and N contents in ear node-leaf and soil

Character / Treatment	Plant height (cm)		Ear height (cm)		Leaf area (cm2)		Total N%*	
	2003	2004	2003	2004	2003	2004	In leaf	In soil
A: Plant densities								
A1 16000 plant/fad	290.0	274.9	139.4	129.3	729.0	694.5	1.97	0.152
A2 20000 plant/fad	296.8	280.2	142.9	134.6	707.4	692.6	1.90	0.144
A3 24000 plant/fad	302.5	297.7	148.1	139.0	695.4	680.0	1.78	0.138
LSD at 0.05	1.392	2.446	0.984	1.636	0.890	2.931	-	-
B: Organic& bio-fertilizers								
B1 Check	291.1	276.0	139.5	131.9	697.0	672.3	1.75	0.138
B2: Organic fert, 20m²/fad	297.9	283.2	144.2	133.9	709.5	694.9	1.93	0.152
B3: Microbin	302.3	291.7	146.8	137.1	725.4	699.8	1 98	.0144
LSD at 0.05	1.573	2.612	0.929	1.085	2.086	3.379	-	-
C: N- fertilizer levels								
C1 Zero	241.1	229.9	137.7	124.2	611.2	601.1	1.44	0.124
C2 60 kg N/fad	285.4	271.8	141.8	132.8	688.6	642.0	1.81	0.139
C3 80 kg N/fad	314.0	295.6	145.2	137.6	744.8	723.2	2.07	0.151
C4 100 kg N/fad	348.0	337.2	149.3	142.6	797.8	789.7	2.22	0.165
LSD at 0.05	1.656	2.589	1.051	1.115	2.809	2.976	-	-

* The N contents in ear node leaf and in the soil were determined at 60 days after planting in 2004 season

Maize yield components characters i.e. no. of grains/row, no. of rows/ear and 100-grains weight were significantly decreased by increasing plant density in both seasons as shown in Table (3). This result is mainly due to that the plants grown at higher densities are less vigorous than plants in low density. These results are coincided with those obtained by Badr *et al.*(1993) and Shams EL-Din and El-Habbak (1996). Number of rows/ear was decreased in the two seasons, and difference reached the significance in the first season only by increasing plant density, Table (3).

This result may be due to these character is mainly considered a genetic character and rarely affected by cultural practices. As for maize grain yield, data in Table (3) showed that plant density significantly affected such character in the first season only. Data also revealed that there is no significant difference between 24000 and 20000 plant/fad. and the highest maize grain yield was obtained under plant density of 24000 plant/fad followed by 20000 one, while the lowest value was obtained at 16000 plant/fad in both seasons. The increases in grain yield at 24000 plant/fad was estimated to 4.86 and 19.84 % over 20000 and 16000 plant/fad in the first season, and to 5.24 and 10.13 % in the second one, respectively. Similar results were obtained by Matta *et al.* (1990) and El-Douby *et al.* (2001).

2- Effect of organic and bio-fertilizer (microbin):

Adding organic manure to the soil or treating maize seeds, just before planting, with bio- fertilizer (microbin) increased significantly the growth characters i.e. plant height, ear height and leaf area of topmost ear in both seasons, as shown in Table (2). In general, the results clearly indicated that there were significant differences between organic and bio-fertilizers and bio-fertilizer recorded the highest values for these characters than organic manure. Similar results were obtained by El-Koumey (1993) and Matta *et al.* (1990).

The studied yield components characters of maize i.e. number of grains/row and 100-grain weight were significantly increased by organic manure and bio-fertilizer application, in both seasons, as shown in Table (3). This result may be due to soil fertility, which resulted from application of either organic manure or bio-fertilizer, and responsible for considerable improvement in growth characters. Grain yield of maize was significantly increased by applying organic or bio-fertilizers in comparison with the check, in both seasons, as shown in Table (3). Grain yield of maize behaved the same trend of the studied yield components in both seasons. The increases in grain yield/fad were 12.16and 18.04% for organic and bio-fertilizers, compared with the check treatment (without fertilizer application) in the first season, and 12.44 and 19.11 % in the second one, respectively. Results obtained by El-Koumey (1993), Faisel and Shalaby (1998) indicated that maize grain yield and its components increased significantly by adding (FMY). Moreover, Garcia *et al.* (1995), Zahran *et al.* (1997) and El-Douby (2002) indicated that growth, yield and yield components of maize increased with application of bio-fertilizer.

3- Effect of mineral nitrogen fertilizer:

Data in Table (2) indicated clearly that increasing nitrogen rate from 60 up to 100 kg N/fad significantly increased all of the studied growth maize traits in both seasons and the highest values were recorded with 100 kg N/fed rate. Furthermore, data showed that increasing nitrogen levels significantly increased maize grain yield/fad., Table (3). These results are agree with those obtained by Faisel *et al.*(1997), El-Douby (2002), Gomma and El-Douby (2002) and Othman, *et al.*(2005). The present results are confirming the vital role of N- fertilizer in plant growth, as it is necessary for photosynthesis, cell division and meristematic activity in plant organs which reflected on maize grain yield. Grain yield/fad was increased by 156.08, 121.62 and 80.41% over the control with 100, 80 and 60 kg N/fad in the first season, and 56.77, 49.19 and 32.43% in the second one, respectively.

Table (3): Effect of plant densities, organic & bio-fertilizers and N –rates on maize grain yield and its components in 2003 and 2004 seasons

Character	Grain yield (ton/fad)		No of rows/ear		No of grains/row		100- grain weight (gm)	
Treatment	2003	2004	2003	2004	2003	2004	2003	2004
A: Plant densities								
A1 16000 plant/fad	2.52	2.37	13.43	13.24	42.97	40.97	38.28	36.28
A2 20000 plant/fad	2.88	2.48	13.16	13.00	41.53	39.58	36.22	34.22
A3 24000 plant/fad	3.02	2.61	13.03	12.88	40.53	38.54	34.31	32.36
LSD at 0.05	0.59	NS	NS	0.479	0.389	0.446	0.333	0.333
B: Organic & bio-fertilizers								
B1 Check	2.55	2.25	12.91	12.77	37.74	35.50	34.31	32.31
B2 Organic fertilizer 20m^3/fad	2.86	2.53	13.09	12.93	43.33	41.39	36.25	34.31
B3 Microbin	3.01	2.68	13.62	13.43	44.19	42.20	38.25	36.25
LSD at 0.05	0.474	0.16	0.481	0.495	0.321	0.342	0.32	0.381
C: N- fertilizer levels								
C1 Zero	1.48	1.85	12.50	12.35	36.96	34.97	33.03	31.04
C2 60 kg N/fad	2.67	2.45	13.07	12.90	40.04	38.04	35.04	33.04
C3 80 kg N/fad	3.28	2.76	13.43	13.27	42.00	40.07	37.00	35.07
C4 100 kg N/fad	3.79	2.90	13.83	13.65	47.70	45.70	40.00	38.00
LSD at 0.05	0.592	0.09	0.360	0.357	0.362	0.393	0.297	0.362

As for the influence of the adopted treatments on total N% in both maize leaves and the soil, at silking stage, data in Table (2) revealed that increasing plant density was accompanied with lower values of leaves N%, which is due to the dilution effect. In addition, a regular reduction in soil N content %, due to increasing the plant density, which may be resulted from greater soil N depletion under higher plant densities, and vice versa. Data also demonstrated that soil addition of organic fertilizer or treating the maize seeds with microbin(bio- fertilizer) resulted in higher values of total N% for both plant leaves and the soil as well, comparable with the check.. Data also indicated that increasing N- rate seems to increase, gradually, total N content% of plant leaves and the soil which are in parallel with grain yield values at harvest. In the present study, the nutritional status of maize plants at silking stage, due to the adopted treatments, is a good evidence for values of most growth, grain yield and its components characters. Similar findings were obtained by Othman *et al.*(2004) with maize –silage yield.

4-Interaction effects:

With respect to the interaction effects on maize growth characters, it is clear that the ear height was the lonely affected character due to the interaction of the adopted treatments, Tables (4a and 4b). The treatment of 24000 plant/fad with 100 kg N/fad revealed the highest figures (155.7 and 147.0 cm) in 2003 and 2004 seasons, respectively, Table (4a). Moreover, the interaction of plant densities, organic & bio-fertilizers and N-rates significantly influenced the ear height character in 2003 season. The highest value (158.3 cm) was obtained due to the effect of treatment 24000 plant/fad, microbin and 100 kg N/fad. As for interactions of the adopted treatments on

maize yield and its components, data revealed significant effects on grain yield, no. of rows/ear and no. of grains/row characters, Tables 5a through 5e. A significant effect on maize grain yield was obtained due to interaction of plant densities and N –rates in 2003 season. The highest figure(4.19 ton/fed) was recorded due to the plant density of 24000 plant/fad with the N –rate of 100 kg N/fad, Table (5a) . Moreover, the interaction of organic & bio- fertilizers and N-rates significantly affected maize grain yield in 2003 and 2004 seasons, and the highest grain yields (4.11 and 3.02 ton/fad)were obtained by the treatment of microbin with 100 kg N /fad, respectively, Table (5 b). Similar results were obtained by EL-Naggar *et al.*(2005) who found that the highest value for maize grain yield was resulted from the interaction of the bio-fertilizer Azospirillum +the highest N-rate i.e. 120 kg N/fed.

Table (4a): Interaction effect of plant densities and N-fertilization rates on ear height in 2003 and 2004 seasons

Treatment	N –fertilization rate, (kg N /fad)			
	Zero	60	80	100
	2003 season			
Plant densities				
16000 plant/fad	133.6	138.6	141.7	144.0
20000 plant/fad	137.6	141.7	144.3	148.2
24000 plant/fad	142.0	145.2	149.6	155.7
LSD 0.05	1.384			
	2004 season			
Plant densities				
16000 plant/fad	117.9	126.5	133.4	139.5
20000 plant/fad	125.4	133.9	137.5	141.4
24000 plant/fad	129.3	137.9	141.9	147.0
LSD 0.05	1.467			

Table (4 b): Interaction effect of plant densities, organic & bio-fertilizers and N-fertilization rates on ear height in 2003 season

Treatment		N-fertilization rate, (kg N/fad)			
		Zero	60	80	100
2003 season					
16000 plant/fad	**Check**	126.3	134.6	137.0	139.7
	Org.fert., 20m³/fad	134.3	139.0	144.0	145.0
	Microbin	140.0	142.0	144.0	147.3
20000 plant/fad	**Check**	133.0	136.7	142.7	146.0
	Org.fert., 20m³/fd	137.0	144.0	145.0	148.7
	Microbin	142.7	144.3	145.3	150.0
24000 plant/fad	**Check**	140.0	142.0	144.7	151.3
	Org.fert., 20m³/fed	141.7	146.0	148.3	157.3
	Microbin	144.3	147.7	155.7	158.3
LSD at 0.05		1.384			

Organic & bio-fertilizers as interacted with N-rates significantly influenced no. of rows/ear, and this was true in the two seasons of study, Table (5 b). The highest values of no. of rows/ear (14.51 and 14.33) were obtained due to the combination of microbin+ 100kg N/fad rate in 2003 and 2004 seasons.

The character of no. of grains/row was significantly affected due to the different interactions of the adopted treatments, Tables 5 b, c, d and e. The highest values of no. of grains/row, in 2003 and 2004 seasons, were(52.22 and 50.22) (45.75 and 43.75), (49.11 and 47.11); and (53.67 and 51.67), respectively, under the combinations of (microbin + 100 kg N/fad), (16000 plant/fad+ microbin), (16000 plant/fad + 100 kg N/fad) and (16000 plant/fad + nitrobin +100 kg N/fad).

5- Nitrogen Use Efficiency (NUE)

Data in Table (6) revealed that increasing the plant density resulted in gradual increase in NUE value since the increase % were 5.50 and 11.08 due to the plant densities of 20000 and 24000 plants/fed, compared to 16000 one, respectively. Moreover, addition the organic fertilizer or treating maize seeds with the bio-fertilizer (microbin) seems to increase the NUE value, comparable to the check, and microbin was superior in this respect. In addition, increasing N-rate seems to reduce NUE value under the adopted treatments and this trend was previously stated by EL-Naggar *et al.* (2005) and Othman *et al.*(2005). Data indicated that the most proper combination of treatments under study, to maximize NUE. is 24000 plants/fad+ 60 kg N/fad+ microbin.

6- Grain N-uptake, kg/fad

As for grain N-uptake character, it seems to reduce slightly as the plant density increase and the reduction% values were 1.05 and 2.42 with plant densities of 20000 and 24000 plants/fad, comparable with 16000 one, Table (6). Either addition the organic fertilizer or treating the seeds with microbin resulted in increased N-uptake values, compared with the check, and microbin is superior in this respect. Furthermore, increasing the N-rate up to 100 kg N/fad resulted in higher values of grain-N uptake under the adopted treatments. The highest grain N-uptake was achieved with the combination of 16000 plant/fad +100 kg N/fed+ microbin. These findings are similar to those reported by EL-Naggar *et al.*(2005) and Othman *et al.* (2005) .

Table (5 a): Interaction effect of plant densities and N-fertilization on maize grain yield in 2003 season

Treatment	Nitrogen fertilization rate, (kg N/fad)			
	2003 season			
Plant densities	Zero	60	80	100
16000 plant/fad	1.43	2.49	2.91	3.26
20000 plant/fad	1.48	2.74	3.37	3.93
24000 plant/fad	1.54	2.79	3.56	4.19
LSD at 0.05	0.780			

Table (5b): Interaction effects of organic & bio-fertilizers and N-fertilization rates on grain Yield, No of rows/ear and No of grains/row in 2003 and 2004 seasons

Treatment	N-fertilization, kg N/fad			
	Zero	60	80	100
	2003 Season			
Check	1.44	2.44	2.90	3.41
Organic fert., 20m^3/fad.	1.49	2.68	3.42	3.86
Microbin	1.53	2.89	3.52	4.11
LSD at 0.05	0.780			
No of rows/ear				
Check	12.11	12.87	13.28	13.39
Organic fert., 20m^3/fad.	12.60	12.98	13.20	13.59
Microbin	12.76	13.36	13.82	14.51
LSD at 0.05	0.47			
No of grains/row				
Check	34.78	36.44	37.67	40.59
Organic fert., 20m^3/fad.	37.67	41.00	44.89	50.00
Microbin	38.44	42.67	43.43	52.22
LSD at 0.05	0.477			
2004 season				
Grain yield, ton/fad				
Check	1.63	2.10	2.53	2.74
Organic fert., 20m^3/fad.	1.81	2.65	2.84	2.93
Microbin	2.10	2.67	2.91	3.02
LSD at 0.05	0.150			
No of rows/ear				
Check	12.02	12.71	13.13	13.20
Organic fert., 20m^3/fad.	12.42	12.82	13.04	13.42
Microbin	12.60	13.17	13.62	14.33
LSD at 0.05	0.356			
No of grains/row				
Check	32.78	34.44	35.89	38.89
Organic fert., 20m^3/fad.	35.67	39.00	42.89	48.00
Microbin	36.48	40.67	41.44	50.22
LSD at 0.05	0.163			

Table (5 c): Interaction effect of plant densities and organic & bio fertilizers on No. of grains/row in 2003 and 2004 seasons

Treatment	Check	Organic fert. (20 m^3/fad)	microbin
	2003 season		
16000 plant/fad	38.42	44.75	45.75
20000 plant/fad	37.50	43.00	44.08
24000 plant/fad	36.42	42.42	42.50
LSD at 0.05	0.422		
2004 season			
16000 plant/fad	36.42	42.75	43.75
20000 plant/fad	35.67	41.00	42.08
24000 plant/fad	34.42	40.42	40.76
LSD at 0.05	0.450		

Table (5 d): Interaction effect of plant densities and N –fertilization rates on No. of grains/ row in 2003 and 2004 seasons

Treatment	N-fertilization rate, kg N/fad			
	Zero	60	80	100
	2003 season			
16000 plant/fad	38.11	41.44	43.22	49.11
20000 plant/fad	36.78	40.00	40.78	47.56
24000 plant/fad	36.00	38.67	41.00	46.44
LSD at 0.05	0.477			
	2004 season			
16000 plant/fad	36.11	39.44	41.22	47.11
20000 plant/fad	34.78	38.00	40.00	45.56
24000 plant/fad	34.03	36.67	39.00	44.44
LSD at 0.05	0.518			

Table (5 e): Interaction effect of plant densities, organic &bio-fertilizers and N- fertilizer rates on No. of grains/row in 2003 and 2004 seasons

Treatment		N-fertilization rate, (Kg N/fad)			
Plant densities	Organic & bio fertilizers.	Zero	60	80	100
		2003 season			
16000 plant/fad	Check	36.00	37.00	38.67	42.00
	Org.fert., 20 m^3/fad	38.67	42.67	46.00	51.67
	microbin	39.67	44.67	45.00	53.67
20000 plant/fad	Check	34.67	36.67	37.67	41.00
	Org.fert20m^3/fad	37.67	40.67	44.00	49.67
	microbin	38.00	42.67	43.67	52.00
24000 plant/fad	Check	33.67	35.67	36.67	35.67
	Org.fert., 20 m^3/fad	36.67	39.67	44.67	48.67
	microbin	37.07	40.67	41.63	51.00
LSD at 0.05		0.627			
		2004 season			
16000 plant/fad	Check	34.00	35.00	36.67	40.00
	Org.fert., 20 m^3/fad	36.67	40.67	44.00	49.67
	microbin	37.67	42.67	43.00	51.67
20000 plant/fad	Check	32.67	34.67	36.33	39.00
	Org.fert20m^3/fad	35.67	38.67	42.00	47.67
	microbin	36.00	40.67	41.67	50.00
24000 plant/fad	Check	31.67	33.67	34.67	37.67
	Org.fert., 20 m^3/fad	34.67	37.67	42.67	46.67
	microbin	35.77	38.67	39.67	49.00
LSD at 0.05		0.681			

Table (6): Effect of plant densities, organic & bio-fertilizers and N-fertilization rates on N-use Efficiency, N-uptake in grains for maize plant and total N% in soil at harvest (2004 season)

Treatment	16000 plants/fed			20000 plants/fed			24000 plants/fed		
	Check	Organic fertilizer 20m³/fad	microbin	Check	Organic fertilizer 20m³/fad	microbin	Check	Organic fertilizer 20m³/fad	microbin
N-rate	Nitrogen Use Efficiency (kg grain/kg N added)								
Zero kg/fad	-	-	-	-	-	-	-	-	-
60, kg/fad	33.00	39.50	42.17	35.67	43.83	45.33	36.50	45.00	46.00
80, kg/fed	30.00	33.00	34.87	31.88	35.37	35.50	33.00	38.12	38.75
100, kg/fad	26.60	28.10	29.10	26.90	28.80	29.40	28.60	31.10	32.20
Mean	29.87	33.58	35.38	31.48	36.00	36.74	32.70	38.07	38.98
N- rate,	N-uptake in grains(kg/fad)								
Zero,kg/fad	22.40	25.63	31.16	22.01	25.48	31.04	21.79	25.20	30.94
60, kg/fad	28.31	36.26	38.96	28.14	36.16	38.35	27.48	35.10	37.26
80, kg/fad	32.88	38.81	41.29	32.77	38.49	40.90	32.34	38.12	40.77
100, kg/fad	33.78	39.06	43.36	33.62	38.59	42.04	33.03	38.25	41.54
Mean	29.34	34.94	38.69	29.13	34.68	38.08	28.66	34.17	37.63
N-rate,	Total N% in soil at harvest								
Zero kg/fad	0.089	0.095	0.100	0.082	0.090	0.095	0.077	0.084	0.086
60, kg/fad	0.095	0.101	0.105	0.087	0.095	0.099	0.081	0.088	0.090
80, kg/fad	0.109	0.108	0.110	0.097	0.102	0.109	0.091	0.100	0.105
100, kg/fad	0.115	0.118	0.119	0.105	0.110	0.115	0.100	0.107	0.109
Mean	0.102	0.106	0.109	0.093	0.099	0.104	0.087	0.095	0.098

7-Residual total soil -N

Value of residual soil N seems to decrease as the plant density increased since the reduction % were 7.55 and 12.26 with plant densities of 20000 and 24000 plants/fad, in comparison with 16000 one. The residual soil- N values were higher due to addition the organic fertilizer or treating the seeds with microbin, compared with check treatment, and microbin was the superior in this respect. Data also revealed that increasing the N –rate resulted in higher values of residual soil-N, and these results are in accordance with those of EL-Naggar *et al.*(2005).

It could be recommended that, under Gemmeiza area conditions, planting maize at 20000 or 24000 plant/fad, treating the maize seeds by microbin as a bio-fertilizer and fertilization at the rate of 100 kg N/fad to obtain the maize grain yield potentiality besides conserving the soil fertility.

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تاثير الكثافة النباتية والتسميد العضوى والحيوى والنتروجينى على النمو والمحصول ومكوناتة للاذرة الشامية وخصوبة التربة

مصطفى محمود عبدالنبى بدر*، سناء عبد المنعم عثمان**

* معهد بحوث المحاصيل الحقلية-مركز البحوث الزراعية

** معهد بحوث الاراضى والمياة والبيئة-مركز البحوث الزراعية.

أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بالجميزة – محافظة الغربية – خلال موسمي الزراعة ٢٠٠٣-٢٠٠٤ م لدراسة تأثير ثلاثة كثافات نباتية (١٦-٢٠-٢٤ ألف نبات/فدان) والتسميد البلدي والحيوي (صفر، سماد بلدي، سماد حيوي (ميكروبين) وأربعة مستويات للتسميد الأزوتي (صفر، ٨٠، ١٢٠، ١٠٠ كجم أزوت/فدان) على نموالمحصول ومكوناته للذرة الشامية وخصوبة التربة . استخدم تصميم القطع المنشقة لمرتين في ثلاثة مكررات ويمكن تلخيص أهم النتائج المتحصل عليها كالآتي:-

١- أدت زيادة الكثافة النباتية للذرة الشامية من ١٦ إلى ٢٠ إلى ٢٤ ألف نبات/فدان إلى زيادة معنوية لارتفاع كل من النبات والكوز بينما نقصت مساحة ورقة الكوز معنويا خلال موسمي الزراعة – زادت صفات كلا من عدد حبوب الصف ووزن ١٠٠ حبة معنويا بينمانقصت صفة عدد حبوب الصف معنويا خلال موسم واحد فقط. ادت زيادة الكثافة النباتية الى تناقص كفاءة استخدام النتروجين والنتروجين المتبقى بعد الحصاد بينما ازداد (قليلا) النتروجين الممتص فى الحبوب.

٢- زادت كل صفات الذرة الشامية تحت الدراسة معنويا بتسميد الذرة الشامية بالسماد البلدي أوبالسماد الأزوتي الحيوي (ميكروبين) وقد تفوق السماد الحيوي على السماد البلدي خلال موسمي الزراعة. زادت كفاءة استخدام النتروجين والنتروجين الممتص فى الحبوب والمتبقى فى التربة نتيجة لاضافة السماد البلدى اومعاملة التقاوى بالميكروبين.

٣- أدت زيادة مستويات التسميد الأزوتي من صفر إلى ١٠٠ كجم أزوت/فدان إلى زيادة معنوية لكل من صفات النموالمحصول ومكوناته للذرة الشامية وكانت الزيادة في محصول الحبوب١٥٦,٠٨و١٢١,٦٢و٨٠,٤١ % في الموسم الأول٦٦,٧٧و٤٩,١٩ و٣٢,٤٥ % في الموسم الثاني (مقارنة بالكنترول) مع معدلات التسميد ١٠٠ ، ٨٠ ، ٦٠ كجم نيتروجين فدان على التوالى.ادت زيادة التسميد النتروجينى الى تناقص كفاءة استخدام النتروجين وعلى العكس زادت قيم النتروجين الممتص بالحبوب والمتبقى فى التربة عند الحصاد.

٤- محتوى النتروجين بورقة الكوز(فى طور الحريرة) يعتبر دليلا جيدا لصفات النموالمحصول ومكوناتة عند الحصاد

توصى هذة الدراسة بزراعة الذرة الشامية(هـ ف ١٠) بكثافة نباتية ٢٠٠٠٠ او٢٤٠٠٠ نبات/ فدان مع استخدام التسميد الحيوي(ميكروبين) والتسميد النيتروجينى ١٠٠ كجم /فدان لانتاج افضل محصول للاذرة الشامية مع المحافظة على خصوبة التربة.