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RESPONSE OF SOME MAIZE HYBRIDS TO BIO AND CHEMICAL NITROGEN FERTILIZATION

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ABSTRACT: **Two field experiments were conducted in 2005 and 2006 seasons at Sheiba village, Zagazig destrict, Sharkia Governorate, Egypt, [to study the effect of both biofertilizer and chemical nitrogen fertilizers with N levels (50, 80, 110 and 140 kg N/faddan) on growth, yield and its components of three maize hybrids (SC 10, SC 122 and TWC 310). A split-split plot design with three replicates was used.**

The results indicated that, maize hybrids were significantly differed in each of plant height, ear height, ear leaf area, SPAD value (chlorophyll content), ear length, number of grains/ear, 100-grain weight, grain yield/plant, biological yield (ton/faddan), grain yield(ton/faddan) and harvest index. Three ways hybrid 310 was superior than the other two maize hybrids in most growth characters, yield and its components.

The results revealed that, the inoculation with biofertilizer N-fixer (cerealine) caused significant increases in most the studied characteristics except ear height, number of ears/plant and harvest index.

Increasing nitrogen fertilizer levels from 50, 80,110 to 140 kg N/faddan increased significantly all growth, yield and its component characters under this study.

Regarding the interaction effects maize hybrid TWC 310 had the heaviest grain under cerealine inoculation as well as application of the highest N level (140 kg N/fad.).

Key words: Maize hybrids, biofertilization, yield components, harvest index.

INTRODUCTION

Maize (*Zea mays*, L.) is a major cereal crop in Egypt as well as in the world, it occupies the third most important cereal after wheat and rice. Maize grains are widely used for human and animal feeding, also are used as a row material for many industrial products.

It is well known that maize genotyps differ in their yielding abilities depending on the genetic make up and its interaction with the environmental conditions. Many workers found significant differences among the tested maize varieties, of them Salem (1999), El-Metwally *et al.* (2001), Oraby and Sharhan (2002) and Oraby *et al.* (2003)

Abd El-Gawad *et al.* (1995) reported that inoculation with N-fixing bacteria had no appreciable effect on grain yield of maize and most of its components. Wherease, Hassanein *et al.* (1997) reported that biofertilizer treatments significantly increased plant height, ear height, ear length, number of grains/row, grain weight/ear and grain yield/faddan compared to uninoculation plants. Farthermore, Atta-Allah (1998) reported that biofetilizer treatments significantly increased. plant height, ear length, number of grains/row. grain weight/ear and grain yield /fad. compared to uninoculated plants.

Nitrogen is a component of many important organic compounds in plants varying from proteins to nucleic acids (Fageria *et al.*, 1997). Also, nitrogen is the nutrient that most often limits maize yield (Rhoads and Bennett, 1990). Many investigators concluded that nitrogen fertilizer is important in controlling the growth and yield characteristics of maize under clay soils. Plant height, ear height and ear leaf area of maize were significantly increased by raising nitrogen fertilizer rate up to 140 kg N/fad of them El-Zeir *et al.* (1998), El-Sheikh (1998), Salem (1999), Ahmed and El-Sheikh (2002) and Oraby and Sarhan (2002). Grain yield/fad, ear length, number of ears/plant, number of grains/row and per ear, 100-grain weight, ear grain weight, biological yield/fad. and harvest index were significantly increased by increasing nitrogen fertilizer levels up to 150 kg N/fad. These results were obtained by El-Sheikh (1998), El-Zeir *et al.* (1998), Salem (1999), Barbieri *et al.* (2000), Schoot (2000). Abd El-Hamid and Saleem (2001), El-Metwally *et al.* (2001), Oraby and Sarhan (2002) , Oraby *et al.* (2003.) and Oraby *et al.* (2005a and b).

MATERIALS AND METHODS

The present investigation was conducted at Sheiba village, Zagazig destrict, Sharkia Governorate, during 2005 and 2006 summer growing seasons.

This study aimed to investigate the effect of biofertilization and nitrogen fertilizer levels (50, 80, 110 and 140 kg N/fad.) on growth, yield and its components of three maize hybrids S.C.10, S.C.122 and T.W.C. 310.

Prior to sowing, seed inoculation was carried out using the biofertilizer cerealine (produced by Ministry of Agriculture, Egypt). The N2-Fixer inoculation efficient nitrogen fixing strains of *Azosprillum lipoferum* and *Bacillus polymax*. Inoculation was performed by mixing grains with the appropriate amounts of cerealine (one gm/100 gm maize grains) using Arabic gum as adhesive material. The coated grains were then air dried in the shade for 30 minutes and sown immediately. Four nitrogen fertilizer levels (50, 80, 110 and 140 kg N/fad.)were applied.

Asplit-split plot design with three replications was used, where maize hybrids occupied the main plots. The two biofertilization treatments were allotted to the sub plot, whereas the nitrogen fertilization levels were randomly distributed in the sub-sub plots. Nitrogen fertilizer was in form of urea (46 % N), and was added in two equal doses, the first one was applied just before the first irrigation and after thinning and the second one was applied just before the second irrigation.

The area of the sub-sub plots was 18.9 m^2 (4.2 x 4.5 m) which included six ridges of 70 cm width and 4.5 m length.

The soils of the experimental fields were clay in texture having a pH 7.6 and 7.4; 1.30 and 1.26 organic matter content and containing 5.2 and 5.8 ppm available N, 13 and 16 ppm available P and 220 and 227 ppm available K for the upper 30 cm of the soil surface in the two successive seasons 2005 and 2006, respectively.

The preceding crop was wheat in the two growing seasons, planting date was 25 and 28 of May during the two growing season, respectively. Maize plants were thinned to one plant/hill after 18 days from sowing (and before the first irrigation). Planting density was 20000 plants/fad. by 30 cm between hills and 70 cm between ridges. Ordinary superphosphate (15.5% P_2O_5) at the rate of 100 kg/fad. and potassium sulphate (48 % K_2O) at the rate of 50 kg/fad. were added as basical fertilization in the two seasons just before sowing. The other prevailing agronomic practices in the region were followed.

Data Recorded

The two outer ridges (1st and 6th) were considered as border ridges. Next to the two outer ridges (2nd and 5th) were used for recording growth characters and to determine yield components.

Growth characteristics

After 75 days from sowing, a sample of five gaurded plants from each sub-sub plot were taken at random to measure the following growth characteristics i.e., plant height (cm), ear height (cm) and ear leaf area cm^2 (leaf area of blade only),also total chlorophyll content for the main ear leaf, was measured using chlorophyll meter which estimate SPAD value, according to Castelli et al. (1996) .

Yield and its components

At harvest: ten guarded plants were taken from the 2nd and 5th ridges in each sub-sub plot, then number of ears/plant, ear length (cm), number of rows/ear, number of grains/row, number of grain /ear, grain weight (gm)/ ear, 100-grain weight (gm) and grain yield (gm)/plant were recorded. Grain yield (ardab/fad.), which adjusted to15.5 % moisture content, biological yield (ton/fad.) and harvest index were determined from the central two ridges.

Statistical Analysis

Analysis of variance and combined analysis for the two seasons were carried out as described by Snedecor and Cochran (1982). The differences among treatments were compared using Duncan,s Multiple Range Test (Duncan, 1955), where means had the different lettere were statistically significant, while those means followed by the same letters were statistically insignificant. In the interaction tables, capital and small letters were used to compare between means in row and colums, respectively.

RESULTS AND DISCUSSION

Growth

Maize hybrids differences

Data in Tables 1 and 2 show the three maize hybrids under this study were significantly differed in plant height, ear leaf area and chlorophyll content in both growing seasons and their combined analysis. Therefore, this mize hybrids were differed in genes controlling the above mentioned chracters.

In both growing seasons and their combined, the three-way cross 310 hybrid was superior than

Table 1. Plant height and ear height as affected by maize hybrid, biofertilization and nitrogen fertilization levels in the two seasons and their combined

Main effects and interactions	Plant height (cm)			Ear height (cm)		
	First season	Second season	Combined	First season	Second season	Combined
Maize hybrids (H):						
SC 10	317.52^{c}	318.27^{c}	317.89^{c}	156.49^{b}	158.50^{b}	157.50^{c}
SC 122	326.17^{b}	333.76^{b}	329.97^{b}	169.80^{a}	170.26^{a}	170.03^{b}
TWC 310	353.92^{a}	357.10^{a}	355.51^{a}	172.63^{a}	174.95^{a}	173.79^{a}
F-test	**	**	**	*	*	*
Biofertilization (B) :						
Un-inoculation	327.92^{b}	334.56	331.24	165.86	167.79	166.83
Inoculation	337.16^{a}	338.22	337.69	166.76	168.01	167.38
F-test	**	N. S.	*	N.S.	N.S.	N.S.
Nitrogen fertilization levels (N):						
50 kg N/fad.	264.62^{d}	275.59^{d}	270.11^{d}	138.83^{c}	139.27^{c}	139.05^{d}
80 kg N/fad.	328.56^{c}	336.79^{c}	332.67^{c}	158.44^{b}	159.70^{b}	159.07^{c}
110 kg N/fad.	361.24^{b}	361.03^{b}	361.14^{b}	181.96^{a}	183.87^{a}	182.92^{b}
140 kg N/fad.	375.72^{a}	372.14^{a}	373.93^{a}	186.01^{a}	188.78^{a}	187.40^{a}
F-test	**	**	**	**	**	**
Interactions:						
H x B	N.S.	N. S.	N.S.	N.S.	N. S.	N.S.
H x N	**	**	**	**	N. S.	**
B x N	N.S.	N. S.	N.S.	N.S.	N. S.	N.S.

Table 2. Ear leaf area (cm^2) and chlorophyll of ear leaf as affected by maize hybrid, biofertilization and nitrogen fertilization levels in the two seasons and their combined

Main effects and interactions	Ear leaf area (cm^2)			Chlorophyll of ear leaf		
	First season	Second season	Combined	First season	Second season	Combined
Maize hybrids (H):						
SC 10	632.26^{b}	639.60^{b}	635.93^{b}	50.16^{b}	50.03^{b}	50.10^{c}
SC 122	647.73^{ab}	650.82^{ab}	649.27^{ab}	51.93^{b}	51.85^{ab}	51.89^{b}
TWC 310	655.35^{a}	666.03^{a}	660.69^{a}	53.40^{a}	53.32^{a}	53.36^{a}
F-test	*	*	*	**	*	*
Biofertilization (B) :						
Un-inoculation	629.04^{b}	638.19^{b}	633.62	50.99^{b}	50.40^{b}	50.70
Inoculation	661.16^{a}	666.10^{a}	663.63	52.67^{a}	52.40^{a}	52.54
F-test	**	**	**	**	**	**
Nitrogen fertilization levels (N):						
50 kg N/fad.	539.39^{d}	546.88^{d}	543.14^{d}	45.22^{d}	45.42^{d}	45.32^{d}
80 kg N/fad.	608.12^{c}	621.79^{c}	614.96^{c}	51.43^{c}	50.87^{c}	51.15^{c}
110 kg N/fad.	703.43^{b}	706.58^{b}	705.01^{b}	54.49^{b}	53.88^{b}	54.19^{b}
140 kg N/fad.	729.50^{a}	733.33^{a}	731.42^{a}	56.18^{a}	55.42^{a}	55.80^{a}
F-test	**	**	**	**	**	*
Interactions:						
H x B	N.S.	*	N.S.	N.S.	N.S.	N.S.
H x N	N.S.	*	*	N.S.	*	**
B x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table 3. Ear length (cm) and number of rows /ear as affected by maize hybrid, biofertilization and nitrogen fertilization levels in the two seasons and their combined

Main effects and interactions	Ear length (cm)			Number of row /ear		
	First season	Second season	Combined	First season	Second season	Combined
Maize hybrids (H):						
SC 10	19.81^{b}	21.51	20.66^{c}	14.20^{b}	13.50	13.85^{b}
SC 122	20.77^{a}	21.62	21.20^{b}	14.56^{a}	13.64	14.10^{a}
TWC 310	21.42^{a}	22.15	21.76^{a}	14.60^{a}	13.78	14.19^{a}
F-test	*	N.S.	*	*	N.S.	*
Biofertilization (B) :						
Un-inoculation	20.06^{b}	21.14^{b}	20.60^{b}	14.19^{b}	13.34^{b}	13.77^{b}
Inoculation	21.27^{a}	22.39^{a}	21.83^{a}	14.72^{a}	13.94^{a}	14.33^{a}
F-test	**	**	*	*	*	*
Nitrogen fertilization levels (N):						
50 kg N/fad.	15.58^{d}	17.33^{d}	16.46^{d}	12.43^{d}	11.64^{d}	12.04^{d}
80 kg N/fad.	19.72^{c}	21.57^{c}	20.65^{c}	14.28^{c}	13.08^{c}	13.68^{c}
110 kg N/fad.	23.06^{b}	23.49^{b}	23.28^{b}	15.34^{b}	14.68^{b}	15.01^{b}
140 kg N/fad.	24.31^{a}	24.65^{a}	24.48^{a}	15.77^{a}	15.15^{a}	15.46^{a}
F-test	**	**	**	**	**	**
Interactions:						
H x B	N.S.	N.S.	*	*	N.S.	N.S.
H x N	N.S.	N.S.	*	N.S.	N.S.	N.S.
B x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table 4. Number of grains/row and per ear as affected by maize hybrid, biofertilization and nitrogen fertilization levels in the two seasons and their combined

Main effects and interactions	Number of grains/row			Number of grains/ ear		
	First season	Second season	Combined	First season	Second season	Combined
Maize hybrids (H):						
SC 10	41.26^{b}	42.03	41.66	610.24^{b}	590.95	600.60^{b}
SC 122	42.90^{ab}	42.27	42.59	624.36^{ab}	591.57	607.97^{b}
TWC 310	43.51^{a}	42.73	43.12	649.90^{a}	594.41	622.16^{a}
F-test	*	N.S.	N.S.	*	N.S.	*
Biofertilization (B) :						
Un-inoculation	41.16^{b}	41.27^{b}	41.22^{b}	598.73^{b}	565.07^{b}	581.90^{b}
Inoculation	43.96^{a}	43.41^{a}	43.69^{a}	657.60^{a}	619.55^{a}	638.58^{a}
F-test	**	**	**	**	**	**
Nitrogen fertilization levels (N):						
50 kg N/fad.	28.16^{d}	26.91^{d}	27.54^{d}	351.27^{d}	313.43^{d}	332.35^{d}
80 kg N/fad.	39.13^{c}	38.63^{c}	38.88^{c}	559.53^{c}	505.35^{c}	532.44^{c}
110 kg N/fad.	50.25^{b}	50.68^{b}	50.47^{b}	770.97^{b}	744.87^{b}	757.92^{b}
140 kg N/fad.	52.70^{a}	53.16^{a}	52.93^{a}	830.90^{a}	805.59^{a}	818.25^{a}
F-test	**	**	**	**	**	**
Interactions:						
H x B	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
H x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
B x N	**	N.S.	*	N.S.	N.S.	N.S.

the other two hybrids SC10 and SC 122 in plant height, ear height and cholorophyll content of ear leaf followed by SC 122 while, SC10 was in the third order. Thus, TWC 310 had broad genetic base and more responsive two agriculture practices and environmental conditions. These results are in agreements with those reported by Ahmed and El-Sheikh (2002), El-Metwally *et al.* (2001) and Oraby *et al.* (2003).

Biofertilizer effect

Data in Tables 1 and 2 show the effect of inoculation with cerealine on growth of maize hybrid characters (plant height, ear height, ear leaf area and chlorophyll content of ear leaf) in the two growing seasons and their combined analysis.

Growth of the three maize hybrids were improved by the application of cerealine. Inoculation with the biofertilizer caused significant increases in plant height (first season), ear leaf area and chlorophyll content of ear leaf, all this growth characters were positively increased by the application of nitrogen fixer biofertilizer cerealine. Ear height was not significantly affected by cerealine biofertilization, this was true in the two growing seasons and their combined analysis. These results are in agreements with those obtained by Abd El-Gawad *et al.* (1995), Hassa nein *et al.* (1997) and Atta-Allah (1998). Ear height was not significantly affected by application of cerealine biofertilization, this was true in the two growing seasons and their combined analysis.

Nitrogen fertilization effect

The favourable effect of nitrogen fertilizer on growth was also observed as shown in Tables 1 and 2.

All above mentioned growth traits were beneficial by such application: plant height, ear height, ear leaf area and chlorophyll content of ear leaf (SPAD value) were positively and continuously responded to any increment of nitrogen fertilizer up to 140 kg N/faddan. This result was fact in the two seasons and their combined analysis. These results are in agreements with those obtained by El-Zeir *et al.* (1998), Salem (1999), El-Metwally *et al.* (2001), Oraby and Sarhan (2002) and Oraby *et al.* (2003).

Yield and its Components

Maize hybrids effect

Data in Tables 3, 4, 5, 6 and 7 show the effects of maize hybrid, biofertilization and nitrogen fertilization levels on ear length, number of rows/ear, number of grains/row and per ear, 100-grain weight, grain yield/plant,

Table 5. 100- grain weight and number of ears /plant as affected by maize hybrid, biofertilization and nitrogen fertilization levels in the two seasons and their combined

Main effects and interactions	100- grain weight (g)			Number of ears /plant		
	First season	Second season	Combined	First season	Second season	Combined
Maize hybrids (H):						
SC 10	28.97[c]	29.25[c]	29.11[c]	1.242	1.225	1.234
SC 122	30.86[b]	30.36[b]	30.61[b]	1.250	1.233	1.242
TWC 310	31.76[a]	31.92[a]	31.84[a]	1.250	1.258	1.254
F-test	**	**	**	N.S.	N.S.	N.S.
Biofertilization (B) :						
Un-inoculation	29.58[b]	29.39[b]	29.49[b]	1.220	1.233	1.226
Inoculation	31.48[a]	31.63[a]	31.56[a]	1.270	1.244	1.257
F-test	**	**	*	N.S.	N.S.	N.S.
Nitrogen fertilization levels (N):						
50 kg N/fad.	24.41[d]	25.05[d]	24.73[d]	1.089[c]	1.111[c]	1.100[c]
80 kg N/fad.	29.44[c]	29.22[c]	29.33[c]	1.211[b]	1.211[b]	1.211[b]
110 kg N/fad.	33.46[b]	33.24[b]	33.35[b]	1.333[a]	1.300[a]	1.316[a]
140 kg N/fad.	34.81[a]	34.53[a]	34.67[a]	1.356[a]	1.333[a]	1.345[a]
F-test	**	**	**	*	*	*
Interactions:						
H x B	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
H x N	N.S.	N.S.	*	N.S.	N.S.	N.S.
B x N	N.S.	N.S.	*	N.S.	N.S.	N.S.

Table 6. Grain yield/plant and biological yield/fad. as affected by maize hybrid, biofertilization and nitrogen fertilization levels in the two seasons and their combined

Main effects and interactions	Grain yield (g)/plant			Biological yield (ton/fad).		
	First season	Second season	Combined	First season	Second season	Combined
Maize hybrids (H):						
SC 10	246.49[b]	237.95	242.22[b]	7.299[b]	6.485[b]	6.892[c]
SC 122	246.50[b]	239.42	242.96[b]	7.416[b]	7.138[a]	7.277[b]
TWC 310	270.42[a]	252.56	261.49[a]	7.911[a]	7.190[a]	7.551[a]
F-test	*	N.S.	*	*	*	*
Biofertilization (B) :						
Un-inoculation	233.45[b]	220.17[b]	226.81[b]	7.340[b]	6.812[b]	7.076[b]
Inoculation	275.98[a]	266.45[a]	270.96[b]	7.740[a]	7.063[a]	7.402[a]
F-test	**	**	**	*	**	*
Nitrogen fertilization levels (N):						
50 kg N/fad.	95.96[d]	89.29[d]	92.63[d]	5.159[d]	4.785[d]	4.972[d]
80 kg N/fad.	198.06[c]	180.22[c]	189.14[c]	6.756[c]	6.339[c]	6.548[c]
110 kg N/fad.	335.95[b]	323.12[b]	329.54[b]	8.793[b]	7.923[b]	8.358[b]
140 kg N/fad.	387.91[a]	380.62[a]	384.27[a]	9.462[a]	8.704[a]	9.083[a]
F-test	**	**	**	**	**	**
Interactions:						
H x B	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
H x N	N.S.	*	N.S.	**	**	**
B x N	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table 7. Grain yield (ardab/fad) and harvest index as affected by maize hybrid, biofertilization and nitrogen fertilization levels in the two seasons and their combined

Main effects and interactions	Grain yield (ardab/fad)			Harvest index		
	First season	Second season	Combined	First season	Second season	Combined
Maize hybrids (H):						
SC 10	23.69[b]	23.63	23.66[b]	42.62[b]	46.96[b]	44.79[c]
SC 122	23.75[b]	23.97	23.86[b]	46.34[a]	48.26[b]	47.30[b]
TWC 310	24.49[a]	24.23	24.36[a]	46.60[a]	52.01[a]	49.31[a]
F-test	*	N.S.	*	*	*	*
Biofertilization (B) :						
Un-inoculation	23.33[b]	23.57[b]	23.45[b]	45.11	49.08	47.10
Inoculation	24.64[a]	24.32[a]	24.48[a]	45.27	49.07	47.17
F-test	**	*	**	N.S.	N.S.	N.S.
Nitrogen fertilization levels (N):						
50 kg N/fad.	17.228[d]	17.44[d]	17.334[d]	42.39[b]	45.82[b]	44.11[b]
80 kg N/fad.	23.077[c]	23.05[c]	23.064[c]	43.22[b]	47.53[b]	45.38[b]
110 kg N/fad.	27.049[b]	26.85[b]	26.949[b]	47.14[a]	51.43[a]	49.29[a]
140 kg N/fad.	28.567[a]	28.44[a]	28.503[a]	48.01[a]	51.52[a]	49.77[a]
F-test	**	**	**	*	*	*
Interactions:						
H x B	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
H x N	*	*	*	**	**	**
B x N	*	N.S.	*	N.S.	*	*

biological yield (ton/faddan), grain yield (ton/faddan) and harvest index.

Among the three maize hybrids, there were significant differences in each of 100-grain weight, biological yield ton/ faddan in both seasons and combined while, ear length, number of rows/ear, number of grains/ear, grain yield per plant (gm) and grain yield ton/ faddan in both seasons stated significant differences among the tested hybrids in the first season and combined analysis. Whereas, there was a significant difference among the studied maize hybrids in number of grains/row in the first season only. The three ways cross 310 was superior than the other two maize hybrids in the most traits under this study. In both seasons TWC 310 outyield significantly the single hybrids in all the studied yield and its attributes, except number of both grains per row and ears per plant. The superiority of TWC 310 hybrid in almost grain yield components may be due to for its superiority in growth characteristics i.e. plant height, ear height, ear leaf area and chlorophyll content of ear leaf as shown in Tables (1 and 2).

In addition to, SC 122 surpassed SC10 in ear length, 100-grain weight, biological yield and harvest index as in the same trend of some growth characters i.e. plant height, ear height and chlorophyll content of ear leaf. These differences among the three maize hybrids depending on the genetic make up and its interaction with the environmental conditions. The differences among maize hybrids were observed by Eisa (1998), Salem (1999), Ahmed and El-Sheikh (2002), Oraby and Sarhan (2002) and Oraby *et al* (2003).

Biofertilization effect

Application of cerealine as biofertilizer caused significant increase in each of ear length, number of rows/ear, number of grains/row and per ear, 100-grain weight, grain yield per plant, biological yield/faddan and grain yield per faddan in the two growing seasons and their combined analysis as shown in Tables (3, 4, 5, 6 and 7).

Data of the combined analysis reveal that inoculation maize grains with cerealine caused increases 5.99, 9.74, 7.02, 19.47, 6.41 and 4.39 % in number of grains /rows, number of grains/ear, 100-grain weight, grain yield /plant, biological yield/fad and grain yield/fad, respectively.

This increases in grain yield resulted from the added nitrogen fixed by cerealine, which improved plant growth and increased yield components (number of rows/ear, number of grains/row and per ear, 100-grain weight and grain yield per plant). Similar results were obtained by Abd El-Gawad *et al.* (1995).

Harvest index was not affected by inoculation with nitrogen fixing bacteria (cerealine).

Nitrogen fertilization effects

Data in Tables 3, 4, 5, 6, and 7 showed that grain yield and its attributes were positively and significantly responded to increasing N fertilizer levels.

According to these data, ear length, number of rows/ear, number of grains per row and ear as well as 100-grain weight were significantly increased by any increment of N fertilizer level up to 140 kg N/faddan. Whereas, number of ears per plant and harvest index were significantly increased up to 110 kg N/ faddan only. This was the fact in both seasons and their combined analysis.

Grains yield per plant was significantly increased with each increment in N fertilizer level.

Also, N application significantly increased yield sink capacity of maize through increasing ear length, number of rows/ear, number of grains/row, number of ears/plant and 100-grain weight, indicating the prominent effect of N up to 140 kg N/faddan.

Each increase in N fertilizer from 50 to 140 kg N/faddan, was accompanied by a significant increase in both grain and biological yields/faddan. This was valid in the two seasons and the combined analysis. In this respect, similar results were obtained by Abd El-Hamid and Saleem, (2001).

Data of the combined analysis as shown in Tables 4, 5, 6, 7 and 8 reveal that inoculation maize grains with cerealine caused increases 5.99, 9.74, 7.02, 19.47, 4.61 and 4.39. % in number of grains/rows, number of grains/ear, 100 grain weight, grain yield/plant, biological yield/faddan and grain yield/ faddan, respectively. Wherease, harvest index was not affected by inoculation with nitrogen fixing bacteria (cerealine).

These increases in grain yield and its components may be due to the pormotion effect of nitrogen on sink and leaf area (source).

Data in Tables 4,5,6,7 and 8 show the effect of nitrogen fertilization on ear length, number of rows/ear, number of grains/row and per ear, 100-grain weight, grain yield/plant, biological yield, grain yield /faddan and harvest index. The results revealed that, any increment in chemical nitrogen fertilizer caused a significant favourable increase effects on yield and its components under this study.

Increasing nitrogen levels from 50 to140 kg N/faddan increased ear length with 56.0, 42.2 and 48.7% , respectively in the two seasons and their combined.

Number of rows/ear was highly significantly increased with nitrogen application. Any increase in nitrogen levels than 50 up till 140 kg N/faddan, increased significantly number of rows/ear in the two seasons and the combined. The combined data reveal that the increase in this trait were 26.87, 30.15 and 28.41 %, respectively.

Regarding the effect of nitrogen fertilization levels on number of grains/row and per ear, data show highly significant effect of nitrogen on these traits, since any increment in nitrogen levels was followed by significant increase in number of grains/row and per ear. This was a fact in the two seasons and their combined analysis. The increase in the number of grains per row and per ear due to raising of N level up to 140 kg nitrogen/faddan amounted to 87.14, 97.55, 92.08

and 136.54, 157.02, 146.20%, respectively for the combined data.

Regarding the effect of nitrogen fertilization levels on 100-grain weight, data show highly significant. With each increment in nitrogen fertilizer was followed by a significant increase in 100-grain weight. These results were true in the two growing seasons and combined data. The increases in 100-grain weight due to raising of N levels from 50 , 80, 110 to 140 kg N/faddan amounted to 40.19, 18.21 and 3.95 %-age, respectively for combined data.

The effect of nitrogen fertilization levels on grain yield/ plant was highly significant. Increasing nitrogen levels from 50 up to 140 kgN/faddan increased grain yield /plant with 314.84 % for combined data.

Irrespective of the other studied factors in the present investigation, N-fertilization was very effective on all yield characteristics studied viz., ear length, number of rows /ear, number of grains /row and per ear, 100-grain weight and grain yield/plant which showed remarkable differences due to various nitrogen levels (Tables 4, 5, 6 and 7). All the yield components studied herein responded positively to more nitrogen application up to 140 kg N/fad.

The grain yield/faddan was obviously controlled by nitrogen application. Any increase in nitrogen fertilization doses was followed by a significant increase in the grain yield and biological yield. These results were confirmed in both seasons and their combined analysis Tables (7and 8).

The combined data indicated that application of 50, 80, 110 and 140 kg N/ fad resulted in increases of 31.70,68.10 and 82.68% for grain yield/fad and 33.06, 55.47 and 64.43 % for biological yield /fad, respectively.

This might be due to the good influence of that major element on the growth traits and the attributing characteristics of maize grain yield (Tables 2,3 and 4). These results are in agreements with those obtained by El-Zeir *et al.* (1998), Ahmed and El-Sheikh (2002), Oraby and Sarhan (2002) and Oraby *et al.* (2003).

Concerning the interaction effects of biofertilization treatment and nitrogen fertilizer levels on most of the grain yield/fad and its components were significant, but no further information more than those got from the main effects of the two tested factors could be obtained.

The results in Tables 8 and 9 and the response curves in Figs (1, 2,3 and 4) show that increasing

Table 8. Interaction effect between biofertilization treatment and nitrogen fertilization levels on: grain number/row, 100grain weight, grain yield/plant and grain yield/fad (combined data).

Biofertilizer treatment	Grain number /row				100-grain weight			
	N fertilizer level (kg N/fad)				N fertilizer level (kg N/fad)			
	N_1	N_2	N_3	N_4	N_1	N_2	N_3	N_4
Bo	D 25.09b	C 37.37b	B 50.08a	A 52.33a	D 23.33a	C 28.15b	B 32.32b	A 34.06b
B1	D 29.97a	C 40.97a	B 50.84a	A 53.53a	C 26.08a	B 30.50a	A 34.37a	A 35.27a

Biofertilizer treatment	Grain yield gm/plant				Grain yield (ardab/fad)			
	N fertilizer level (kg N/fad)				N fertilizer level (kg N/fad)			
	N_1	N_2	N_3	N_4	N_1	N_2	N_3	N_4
Bo	D 77.46b	C 165.717 b	B 305.072b	A 359.006 b	D 16.219 b	C 22.219b	B 26.572b	A 28.297a
B1	D 107.729 a	C 212.567a	B 354.00 a	A 409.00 a	D 18.451a	C 23.429a	B 27.429a	A 28.711a

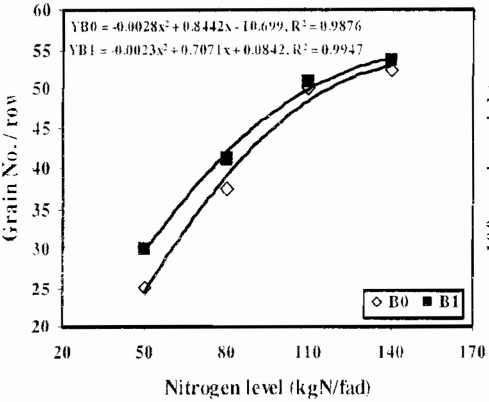
N_1 = 50 kg N/fad, N_2 = 80 kg N/fad, N_3 = 110 kg N/fad and N_4 = 140 kg N/fad.
Bo = Without bio-fertilizer and B_1 = Cerealine application

Table 9. Interaction effect between maize hybrids and N fertilizer levels on: ear leaf area (cm^2), 100-grain weight, grain yield (g) plant and grain yield (ardab/fad (combined data).

Maize hybrids	Ear leaf area (cm^2)				100-grain weight (g)			
	N fertilizer level (kg N/fad)				N fertilizer level (kg N/fad)			
	N_1	N_2	N_3	N_4	N_1	N_2	N_3	N_4
SC10	D 524.9c	C 588.1c	B 705.4b	A 747.6a	D 23.76b	C 27.59c	B 31.67c	A 33.41b
SC122	D 543.5b	C 620.6b	B 695.4c	A 724.0b	D 25.01a	C 29.12b	B 33.51b	A 34.80a
TWC310	C 569.9a	B 636.1a	A 714.1a	A 722.6b	C 25.41a	B 31.28a	A 34.86a	A 35.79a

Maize hybrids	Grain yield g/plant				Grain yield ardab/fad			
	N fertilizer level (kg N/fad)				N fertilizer level (kg N/fad)			
	N_1	N_2	N_3	N_4	N_1	N_2	N_3	N_4
SC10	D 89.1b	C 181.4b	B 316.4c	A 381.9b	D 17.29b	C 23.85a	B 27.20a	A 28.57a
SC122	D 95.4a	C 182.8b	B 323.2b	A 370.4c	D 17.63a	C 21.91b	B 26.43b	A 28.66a
TWC310	D 93.2a	C 203.0a	B 349.0a	A 400.4a	D 17.06b	C 23.07b	B 27.21a	A 28.27a

N_1 = 50 kg N/fad, N_2 = 80 kg N/fad, N_3 = 110 kg N/fad and N_4 = 140 kg N/fad.
Bo = Without bio-fertilizer and B_1 = Cerealine application



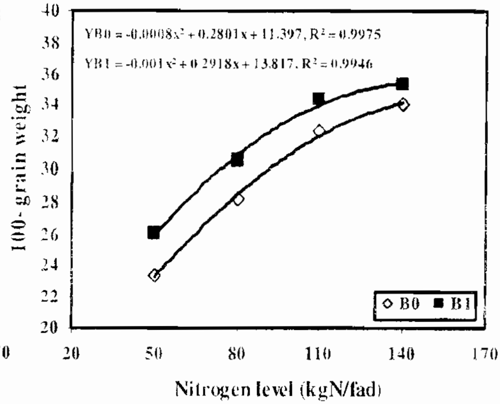
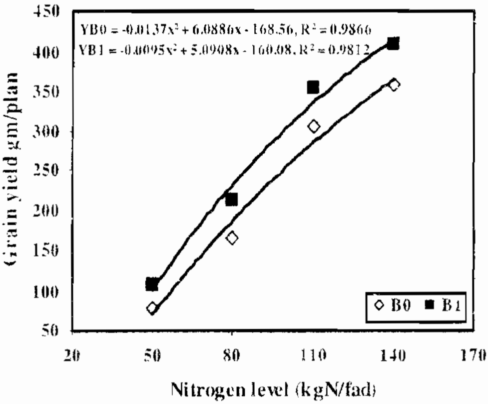


Fig. 1. Interaction between biofertilization treat. and nitrogen fertilization levels on grain No/row.

Fig. 2. Interaction between biofertilization treat. and nitrogen fertilization levels on 100-grain weight (gm).



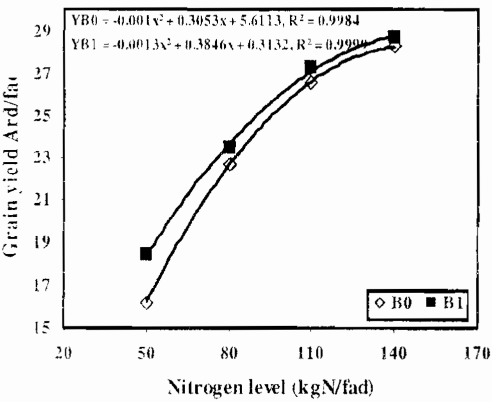


Fig. 3. Interaction between biofertilization treat. and nitrogen fertilization levels on grain yield (gm/plant).

Fig. 4. Interaction between biofertilization treat. and nitrogen fertilization levels on grain yield (ardab/fad).

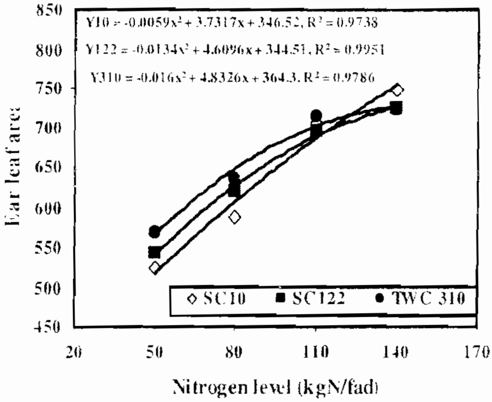


Fig. 5. Interaction between Maize hybrids and nitrogen fertilization levels on Ear leaf area.

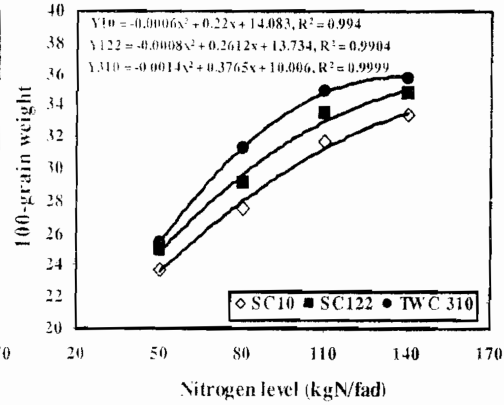


Fig. 6. Interaction between Maize hybrids and nitrogen fertilization levels on 100-grain weight.

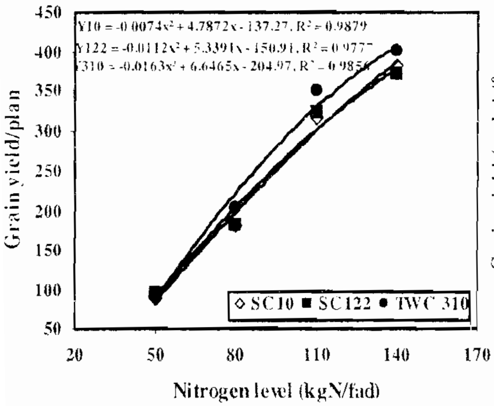


Fig. 7. Interaction between Maize hybrids and nitrogen fertilization levels on grain yield (gm/plant).

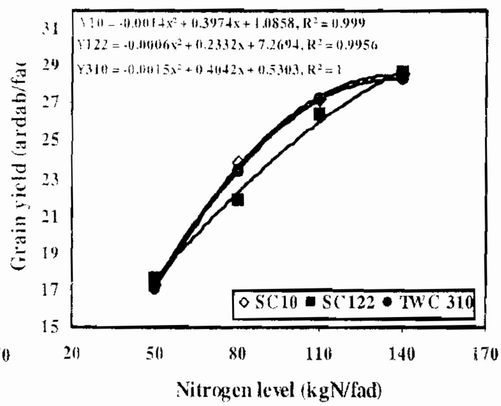


Fig. 8. Interaction between Maize hybrids and nitrogen fertilization levels on grain yield (ardab/fad).

N level up to 140 kg/fad increased significantly grain yield/fad, grain number/row, 100-grain weight and grain yield/plant. This was always true under application of biofetilizer or without. Also, under all N-fertilizer levels studied, grain yield/fad and its prior components were higher with inoculation of cerealine than those without inoculation. It is clear that grain yield/fad of maize showed quadratic relationship with N fertilizer and both biofertilizer treatments.

The interaction effect between maize hybrids and N fertilizer levels on ear leaf area, 100-grain weight, grain yield per both plant and fad was highly significant as show in Tables (8 and 9).

The mentioned traits continuously and significantly responded to increment of N fertilizer from 50 up to 140 kg N/fad. This was a fact for the three tested hybrids, except ear leaf area and 100-grain weight of TWC 310. The two later characters of TWC 310 responded only up to 110 kg N/fad. These results were supported by the quadratic curves as shown in Figs (1,2,3 and 4).

Concerning the differences among the tested maize hybrids, it can be observed that, TWC 310 was superior in 100-grain weight and grain yield/plant under the tested N fertilizer levels, while SC10 recorded the higher ear leaf area when maize plants received of 140 kg N/fad.

Under the lowest N level, SC 122 outyielded the other two hybrids whereas, opposite case was observed when maize plants received of 80 and 110 kg N/fad. Finally, ther'nt any different among the three hybrids in grain yield/fad under the highest N level. The response curves in Figs (1,2,3 and 4) supported the mentioned results.

Grain yield per fad and its components, i.e. grain number/row, 100-grain weight and grain yield/plant were higher for inoculated plants were more than those for un-inoculated ones under any N fertilizer level.

Under any N fertilizer level, grain yield and its components i.e. grain number/row, 100-grain weight any grain yield/plant for the inoculated plants were higher than those for the un-inoculated ones.

On other direction, grain yield/fad, grain number/row and 100-grain weight significantly responded to N fertilizer under un-inoculation by cerealine. Whereas grain yield per plant took the opposite trend.

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استجابة بعض هجن الذرة الشامية للتسميد الحيوي والكيماوي

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أقيمت تجربتان حقليتان في مزرعة خاصة بقرية شيبة – مركز الزقازيق– محافظة الشرقية وذلك خلال موسمي الزراعة ٢٠٠٥ و٢٠٠٦م ، بهدف دراسة تأثير المعاملة بالسماد الحيوي المثبت لنيتروجين الهواء الجوي لا تكافليا (السيريالين) وعدم المعاملة به عند استخدام أربعة مستويات من السماد الإزوتي الكيمائي (٥٠ و ٨٠ و ١١٠ و ١٤٠ كجم نيتروجين للفدان)علي صفات النمو والمحصول ومكوناته لثلاثة هجن من الذرة الشامية (هجين ثلاثي ٣١٠ ، هجين فردي ١٠ و هجين فردي ١٢٢) وكان التصميم المستخدم هو القطع المنشقة مرتان في ثلاث مكررات.

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلي :

١- اختلفت الهجن معنويا في معظم الصفات وأهمها ارتفاع النبات ، ارتفاع الكوز، مساحة ورقة الكوز، طول الكوز ، عدد الحبوب بالكوز ، وزن الـ ١٠٠ حبة ، محصول النبات الفردي، دليل الحصاد ، محصول فدان الحبوب ومحصوله البيولوجي وقد تفوق الهجين ثلاثي ٣١٠ في معظم الصفات يليه هجين فردي ١٠ .

٢- أوضحت النتائج أنه في حالة المعاملة باستخدام التسميد الحيوي (إضافة السيريالين) أدي إلي زيادة معنوية في محصول حبوب / فدان و معظم الصفات المدروسة مقارنة بعدم إضافة السماد الحيوي في حين لم تتأثر معنويا صفات ارتفاع الكوز، عدد الكيزان علي النبات، دليل الحصاد بإضافة السيريالين كسماد حيوي.

٣- أظهرت النتائج أن جميع الصفات تحت الدراسة تأثرت معنوياً بإضافة السماد الأزوتي حيث حدث تفوق معنوي بزيادة معدلات التسميد الأزوتي من ٥٠ حتى ١٤٠ كجم نيتروجين /فدان.

٤- علاوة علي ذلك أظهرت النتائج حدوث تفاعل معنوي بين عوامل الدراسة سواء بين الهجن والتسميد الحيوي أو بين هجن الذرة الشامية والتسميد الكيماوي أو بين التسميد الحيوي والتسميد الكيماوي. حيث تفوق الهجين الثلاثي ٣١٠ تحت ظروف إضافة السماد الحيوي أو السماد الأزوتي (١٤٠ كجم ن/فدان) علي باقي الهجن.

لذا توصي هذه الدراسة تحت ظروف الأراضي الطينية والتي تتميز بارتفاع نسبة القلوية بها بزراعة هجين ثلاثي ٣١٠ مع إضافة السماد الأزوتي بمعدل ١٤٠ كجم ن/فدان وذلك مع استخدام السماد الحيوي (السيريالين).