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RESPONSE OF TWO MAIZE HYBRIDS FOR BACTERIAL INOCULATION, ORGANIC AND MINERAL NITROGEN FERTILIZATION

BY

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ABSTRACT

This study was carried out at the Agricultural Research and Experimental Center of the Faculty of Agriculture, Moshtohor, Benha University, Egypt to determine the effect of two bacterial inoculation(noninoculation, inoculation with mixture of *Azotobacter+Azospirillum*) and seven N fertilizer rates [zero, 60 kg N mineral (60 kg M), 120 kg N mineral (120 kg M), 60 kg N organic (60 kg O), 120 kg N organic (120 kg O), 30 kg N mineral (30 kg M) + 30 kg N organic (30 kg O) and 60 kg N mineral (60 kg M) + 60 kg N organic (60 kg O)/fed] on growth and chemical composition of grains of two maize hybrids [Single cross 30k8(S.C. 30k8) and Single cross 30k9(S.C. 30k9)]. The most important results which were obtained from this study were as follows:

The differences between the two studied maize hybrids were significant with regard to protein percentage, protein yield per fed, N, P and K contents in maize grains in both seasons, leaf area of topmost in the first season, as well as, ear height and stem diameter in the second season. Maize hybrid S.C. 30k9 resulted in higher mean values of the above characters than S.C. 30k8.

Bacterial inoculation with mixture of *Azotobacter+Azospirillum* affected significantly ear height, stem diameter, leaf area of topmost, protein percentage, protein yield per fed, N, P and K contents in maize grains in both seasons.

Maize plant height, stem diameter, protein percentage, protein yield per fed, N, P and K contents in maize grains in both seasons were significantly increased by increasing N fertilizer rates. Application of either 120 kg M/fed or 60 kg M+60 kg O/fed gave the highest values of the above mentioned characters.

Effect of the interaction between maize hybrids and bacterial inoculation was significant on P content in both seasons. S.C. 30k9 and inoculation with mixture of *Azotobacter +Azospirillum* gave the highest value of this trait.

Effect of the interaction between maize hybrids and N fertilizer rates was significant on ear height, stem diameter, P and K contents in maize grains in both seasons. Maize hybrid S.C. 30k9 under 120 kg M/fed or 60 M+60 O kg/fed gave the highest values of the above mentioned characters.

Effect of the interaction between bacterial inoculation and N fertilizer rates was significant on protein percentage and N content in maize grains in both seasons. Inoculation with mixture of *Azotobacter+Azospirillum* under 120 kg M /fed or 60 M+60 O kg/fed gave the highest values of the above mentioned characters.

Effect of the interaction between maize hybrids, bacterial inoculation and N fertilizer rates was significant on protein percentage, N and P contents in maize grains in both seasons. Maize hybrid S.C. 30k9 and inoculation with mixture of *Azotobacter + Azospirillum* under 120 kg M/fed or 60 M+60 O kg/fed gave the highest values of the above mentioned characters.

Key words: Maize hybrids, N organic& inorganic, Growth, and Chemical content in maize grains.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in Egypt and the world. Maize is still a major traditional food and feed crop in many regions. Furthermore, the grain is a key industrial raw material for very diverse purposes. In Egypt great attention has been paid to increase its total production. This could be achieved by using high yielding cultivars, bacterial inoculation and fertilization. In this connection, maize cultivars differ in growth, grain yield and yield components as reported by El-Bana (2001); El-Wakil (2002); Hamed (2003); El-Aref *et al.* (2004); Nofal *et al.* (2005); Moser *et al.* (2006); Atta (2007) and Hassan *et al.* (2008).

Bio-fertilizer has been identified as an alternative to chemical fertilizer to increase soil fertility and crop production in sustainable farming. Microbial inoculums not only increased the nutritional assimilation of plant (total N, P and K), but also improved soil properties, such as organic matter content and total N in soil (Wu *et al*, 2006). Inoculated maize grains with *Azotobacter* and *Azospirillum* or a mixture of them increased growth, yield, yield components and chemical content of maize grains as reported by Metwally *et al.* (2007); Aly *et al.* (2008) and Gholami *et al.* (2009).

With regard to growth characters, grain yield, yield components and chemical content of maize grains were positively affected by increasing the rate of nitrogen (mineral and organic or mineral+organic) fertilizers as reported by El-Bana and Gomaa (2000); Abd El–All (2002); Saleh and Nawar (2003); Suleiman (2004); Abdel-Hameed (2005); Bader and Othman (2006); El-Maihy (2007); Shisanya *et al.* (2008) and Ayoola and Makinde (2009).

The aim of this investigation was to study the effect of bacterial inoculation and nitrogen fertilization (mineral and organic or mineral+organic) on growth and chemical content in grains of two maize hybrids.

MATERIALS AND METHODS

This investigation was conducted at the Agricultural Research and Experimental Center of the Faculty of Agriculture, Moshtohor, Benha University, Qalyoubia Governorate, Egypt, in 2007 and 2008 seasons, to study the effect of two bacterial inoculation and seven N fertilizer rates on growth and chemical content in grains of two maize hybrids.

The investigated soil was clayey in texture with pH values of 8.06 and 8.02, organic mater contents of 1.91and 1.98%, total N contents of 0.14 and 0.12%, total P contents of 0.13 and 0.14% and total K contents of 0.48 and 0.49% in the first and second growing seasons, respectively. The experimental sites were preceded by wheat in the two seasons. Each experiment included 28 treatments consist of the combinations of two maize hybrids [Single cross 30k8 (S.C. 30k8) and Single cross 30k9 (S.C. 30k9)], two bacterial inoculation (noninoculation, inoculation with mixture of *Azotobacter+Azospirillum*) and the seven N fertilizer rates [zero, 60 kg N mineral (60 kg M), 120 kg N mineral (120 kg M), 60 kg N organic (60 kg O), 120 kg N organic (120 kg O), 30 kg N mineral (30 kg M) + 30 kg N organic (30 kg O) and 60 kg N mineral (60 kg M) + 60 kg N organic (60 kg O)/fed].

The bacterial inoculation was conducted by efficient strains of nitrogen fixing bacteria namely, *Azotobacter chroococcum* and *Azospirillum brasilense* supplied by the Microbiology Department, Soil, Water, and Environment Research Institute, ARC, Giza, Egypt. The used maize hybrids i.e. S.C.30K8 and S.C.30K9 were developed by Pioneer Company.

The used organic fertilizer was farmyard manure (FYM) whose chemical composition is presented in Table(1). The manure was applied during soil preparation before sowing, while the rates of the mineral N

fertilizer in the form of urea 46% N were added at two equal doses, the first dose after thinning just before the first irrigation while the second one was applied just before the second irrigation in both seasons.

Table (1): Some characteristics of the farmyard manure used in the study.

Characteristic	2007 season	2008 season
Moisture %	35.50	34.40
Total C%	15.6	16.4
Total N%	0.98	0.94
Total P%	0.42	0.38
Total K%	0.92	0.96
C/N ratio	16:1	17:1
Organic matter %	26.89	28.28
pH(1:5)	7.80	7.98
EC(1:5) dSm^{-1}	3.8	3.4

A spilt plot design with three replications was used in each trial. The four treatments of the combinations between two maize hybrids and two bacterial inoculations were allocated with main plots and the seven treatments for nitrogen were distributed randomly in the sub plots. Each sub-sub plot was 10.5 m^2 (1/400 fed) consisting of 5 ridges, 3.5 m long and 70 cm width while, the distance between plants was 25 cm.

Before sowing of maize hybrids soil samples were taken from plots for soil analysis. At planting, super phosphate (15.5%), at a rate of 30 kg P_2O_5/fad was applied. Maize grains were inoculated with a mixture of *Azotobacter+ Azospirillum* immediately at planting where the adhesive glue material was added to 500 mL of mild hot water, splashed on grains and then the bacterial strains were added, well mixed with grains and air dried for adhesion. Maize grains were planted on 28th and 18th of May in the first and second seasons, respectively. All recommended cultural practices for the region were followed in both seasons.

Random samples of ten plants were taken from each sub-sub plot at the 85 day from planting to determine plant height (cm), ear height (cm), stem diameter (cm), leaf area of topmost ear (cm^2) and number of ears/plant.

Grains were oven dried at 60-70 °C for 48 hours ground to pass through a 0.5 mm sieve and sub samples of 0.2 g portions were wet digested using a mixture of sulphuric (H_2SO_4) and perchloric ($HClO_4$) acids. The digest was analyzed for N, P and K. Total nitrogen percentage in grains according to the modified micro Kjeldahl method (A.O.A.C., 1990). Crude protein content in grains was estimated by multiplying nitrogen percentage X 6.25. Protein yield / feddan = Grain yield kg x crude protein content. Potassium was evaluated in the acid digest by flame photometer according to the method described by Jackson (1973). Phosphorus was determined in the digest using the method of Murphy and Riley (1962).

Data of the experiments were statistically analyzed according to Gomez and Gomez (1984). L.S.D test at 0.05 level of probability was used to compare between means.

RESULTS AND DISCUSSION

1- Effect of the studied varieties of maize, inoculation and N fertilizer rates on its growth parameters:

1.1- Varietal differences.

Data in Table (2) show effect of the varietal differences on growth parameters i.e. plant and ear height, stem diameter, number of ears per maize plant and leaf area of topmost in the first and second seasons. Ear height, stem diameter and leaf area of topmost of maize were significantly affected by the two maize hybrids under study in one season out of two. Maize hybrid S.C. 30k9 gave higher mean values of the above mentioned parameters. On the other hand, the difference between two maize hybrids was not significant on plant height and number of ears per plant in both seasons.

These differences may be due to the genetical differences between the two studied maize hybrids. Similar results were obtained by El-Bana (2001); El-Wakil (2002); Hamed (2003); El-Aref *et al.* (2004); Nofal *et al.* (2005); Moser *et al.* (2006); Atta (2007) and Hassan *et al.* (2008).

1.2- Effect of the bacterial inoculation.

Maize ear height, stem diameter and leaf area of topmost of maize were significantly increased by bacterial inoculation in both seasons as shown in Table (2). Stem diameter increased with the inoculation by 6.81% and 5.47% compared to noninoculated plants in the first and second seasons, respectively. Leaf area of topmost ear maize increased with the inoculation by 2.67 and 4.54% compared to noninoculated plants in the first and second seasons, respectively. On the other hand, plant height and number of ears per plant were not significantly affected by bacterial inoculation in both seasons. These microorganisms may produce some substances which improve plant growth. Similar results were obtained by Wu *et al.* (2006); Metwally *et al.* (2007); Aly *et al.* (2008) and Gholami *et al.* (2009).

1.3- Effect of rate of the applied N.

Maize plant height, stem diameter, number of ears per plant and leaf area of topmost in both the studied seasons as well as, ear height in the second one, were significantly increased by increasing N fertilizer rate as shown in Table (2). Application of 120 kg M /fed in the mineral form gave higher values for the above mentioned parameters. Application of N rate 120 M/fed in the mineral form significantly increased maize stem diameter in the first season by 49.40, 29.71, 36.81, 21.68, 17.52 and 5.45%, compared with the zero, 60 kg M, 60 kg O, 120 kg O, 30 kg M + 30 kg O and 60 kg M+60 kg O/fed respectively. In the second season, the corresponding increases were 52.80, 31.40, 33.99, 23.07, 16.23 and 4.61%, respectively. Increasing nitrogen rate from 0 to 60 kg M, 120 kg M, 60 kg O, 120 kg O, 30 kg M + 30 kg O and 60 kg M+60 kg O /fed caused significant increases in number of ears per maize plant of about 17.35, 40.49, 12.39, 19.83, 15.70 and 30.57%, respectively in the first season, and corresponding increases of about 13.82, 35.77, 12.19, 17.09, 10.56 and 25.20%, respectively in the second season. Similar results were obtained by El-Bana and Gomaa (2000); Abd El-All (2002); Saleh and Nawar (2003); Suleiman (2004); Abdel-Hameed (2005); Bader and Othman (2006); El-Maihy (2007); Shisanya *et al.* (2008) and Ayoola and Makinde (2009).

2- Effect of maize variety, inoculation and rate of the applied N fertilizer on chemical components of maize grains.

2.1- Varietal differences.

Data in **Table (3)** show effect of the varietal differences on protein percentage, protein yield per feddan, N, P and K contents in maize grains in the first and second seasons. The difference between the two maize hybrids were significant on protein percentage, protein yield per feddan, N, P and K contents in maize grains in both seasons. S.C. 30k9 gave higher mean values of protein yield per feddan (359.29 and 367.29 kg), those attained due to S.C, 30k8 (311.38 and 322.55 kg) in both seasons. In the first and second seasons 1679 and1122 mg kg^{-1} increases in N content of maize grains occurred in the first and second seasons due to S.C. 30k9 than S.C. 30k8. These results agree with those obtained by El-Bana (2001); El-Wakil (2002); Hamed (2003);

El-Aref *et al.* (2004); Nofal *et al.* (2005); Moser *et al.* (2006); Atta (2007) and Hassan *et al.* (2008).

2.2- Effect of the bacterial inoculation.

Bacterial inoculation affected significantly protein percentage, protein yield per feddan, N, P and K contents in maize grains in the first and second seasons as shown in Table (3). Protein yield per feddan increased due to the inoculation by 7.15 and 4.63% compared to the noninoculated plants in the first and second seasons, respectively. N content in maize grains increased with the inoculation by 587 and 600 mg kg^{-1} compared to non-inoculated plants in the first and second seasons, respectively. Similar results were obtained by Wu *et al.* (2006); Metwally *et al.* (2007); Aly *et al.* (2008) and Gholami *et al.* (2009).

2.3- Effect of rate of the applied N.

Protein percentage, protein yield per feddan, N, P and K contents in maize grains were significantly increased by increasing rate of the applied N fertilizer in the first and second seasons as shown Table (3). In the first season, applying N rates 60 kg M, 120 kg M, 60 kg O, 120 kg O, 30 kg M + 30 kg O and 60 kg M+60 kg O /fed caused significant increases in protein yield of maize by 45.75, 97.17, 19.87, 40.88, 39.19 and 89.94%, respectively when compared to the control treatment (zero nitrogen fertilization). In the second season, the respective increases were 35.20, 96.54, 21.94, 40.77, 32.09 and 82.61%. The differences in effect of nitrogen content on maize grains between the 60 kg M/fed and 120kg O/fed were not significant in both seasons. The present results show clearly the influence of nitrogen on increasing the nutritive value of cereals. This result is mainly due to the effect of nitrogen application on increasing protein percentage in maize grains and grain yield per feddan. Such results are in agreement with those of El-Banna and Gomaa (2000); Abd El-All (2002); Saleh and Nawar (2003); Suleiman (2004); Abdel-Hameed (2005); Bader and Othman (2006); El-Maihy (2007); Shisanya *et al.* (2008) and Ayoola and Makinde (2009).

Table (2): **Growth parameters of maize plant as affected by variety, inoculation and rate of the applied N fertilizer at the 85 age day in 2007 (S1) and 2008 (S2) seasons.**

Treatments	Plant height (cm)		Ear height(cm)		Stem diameter (cm)		Number of ears $plant^{-1}$		leaf area of topmost (cm^2)	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Verities										
S.C.30K8	299.83	296.07	146.21	144.47	2.28	2.22	1.44	1.42	927.00	950.83
S.C.30K9	295.90	294.33	146.76	146.28	2.27	2.28	1.45	1.44	952.74	960.41
L.S.D at 5%	N.S	N.S	N.S	1.71	N.S	0.06	N.S	N.S	23.78	N.S
Inoculation										
Nonin.	295.40	293.04	145.26	144.66	2.20	2.19	1.42	1.41	927.45	934.38
Inoc.	300.33	296.09	147.71	146.09	2.35	2.31	1.47	1.45	952.29	976.86
L.S.D at 5%	N.S	N.S	1.23	1.07	0.07	0.06	N.S	N.S	23.78	40.85
N rates (kg/fed)										
Zero	274.08	269.75	137.58	134.41	1.84	1.78	1.21	1.23	871.25	881.50
60 M	290.83	287.00	144.08	146.41	2.12	2.07	1.42	1.40	927.58	929.42
120 M	314.00	312.83	156.66	154.25	2.75	2.72	1.70	1.67	1017.75	1050.75
60 O	289.83	290.75	141.58	141.16	2.01	2.03	1.36	1.38	890.00	899.16
120 O	295.91	294.33	144.41	143.33	2.26	2.21	1.45	1.44	922.50	920.00
30 M+30 O	306.50	301.58	149.75	148.25	2.34	2.34	1.40	1.36	967.33	986.00
60 M+60 O	313.91	310.16	151.33	149.83	2.60	2.60	1.58	1.54	982.67	1022.50
L.S.D at 5%	10.63	8.64	N.S	1.95	0.09	0.05	0.07	0.06	16.70	20.99

M=Mineral O=Organic N.S=Insignificant

Table (3): Some chemical components of maize grains as affected by variety, inoculation and rate of the applied N fertilizer in 2007 (S1) and 2008 (S2) seasons.

Treatments	Protein (%)		Protein yield fed^{-1} kg		N (mg.kg^{-1})		P (mg.kg^{-1})		K (mg.kg^{-1})	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Verities										
S.C.30K8	7.37	7.64	311.38	322.55	11756	12234	3884	3912	23331	23666
S.C.30K9	8.39	8.34	359.29	367.29	13435	13356	4074	4083	24938	25074
L.S.D at 5%	0.07	0.16	4.82	9.90	130	221	49	103	1092	1018
Inoculation										
Nonin.	7.68	7.80	323.75	337.12	12302	12495	3868	3880	22304	22699
Inoc.	8.07	8.17	346.91	352.72	12889	13095	4090	4114	25965	26042
L.S.D at 5%	0.07	0.16	4.82	9.90	130	221	49	103	1092	1018
N rates (kg/fed)										
Zero	6.92	7.02	227.27	239.25	10954	11248	3077	3219	18776	18553
60 M	8.06	8.04	331.26	323.47	12916	12872	4271	4309	25003	25348
120 M	8.59	8.77	448.12	470.23	13758	14050	4567	4510	28077	27454
60 O	7.58	7.66	272.45	291.75	12136	12287	3477	3542	20931	21973
120 O	8.02	8.10	320.19	336.80	12831	12966	3745	3702	23563	24113
30 M+30 O	7.65	7.80	316.34	316.04	12254	12499	4243	4241	24826	25115
60 M+60 O	8.32	8.52	431.69	436.91	13320	13645	4472	4459	27766	28036
L.S.D at 5%	0.19	0.18	18.64	16.96	226	166	87	151	1229	1467

M=Mineral O=Organic N.S=Insignificant

3. Interactions effect:

Effect of the interaction between maize hybrids and bacterial inoculation was significant on P content in maize grains (Table 4a). S.C. 30k9 under inoculation with a mixture of *Azotobacter+Azospirillum* gave higher P value than the S.C. 30k8.

The effect of the interaction between maize hybrids and rate of the applied N fertilizer was significant on ear height, stem diameter, P and K contents in maize grains in the combined analysis (Table 4b). Maize hybrid S.C. 30k9 under 120 kg M/fed or 60 M+60 O kg/fed gave the highest values of the above mentioned characters.

Table (4 a): Effect of the interaction between maize hybrid and bacterial inoculation on P content in maize grains (over the combined analysis)

Maize hybrids	S.C. 30K8	S.C. 30K9
Bacterial inoc.	P mg.kg^{-1}	
Nonin.	3851	3899
Inoc.	3946	4259
L.S.D at 5%	85	

N.S=Insignificant

Effect of the interaction between bacterial inoculation and rate of the applied N fertilizer was significant on protein percentage and N content in maize grains (Table 4c). Inoculation with a mixture of *Azotobacter* + *Azospirillum* under 120 kg M /fed or 60 M+60 O kg/fed gave the highest values of the above mentioned characters.

Effect of the interaction between maize hybrids, bacterial inoculation and N fertilizer rates was significant on protein percentage, N content and P content in maize grains in the combined analysis (Table 4d). Maize hybrid S.C. 30k9 and inoculation with mixture of *Azotobacter+Azospirillum* under 120 kg M/fed or 60 M+60 O kg/fed gave the highest values of above characters.

Table (4 b): **Effect of the interaction between maize hybrid and rate of the applied N fertilizer on ear height, stem diameter, P and K contents in maize grains (over the combined analysis)**

Maize hybrids	S.C. 30K8	S.C. 30K9	S.C. 30K8	S.C. 30K9	S.C. 30K8	S.C. 30K9	S.C. 30K8	S.C. 30K9
N rates (kg/fed)	Ear height(cm)		Stem diameter(cm)		P mg.kg^{-1}		K mg.kg^{-1}	
Zero	136.58	135.42	1.80	1.80	2900	3397	18537	18792
60 M	142.42	148.08	2.27	1.92	4244	4337	23506	26845
120 M	155.66	155.25	2.66	2.81	4547	4532	25764	29766
60 O	141.00	141.75	2.00	2.03	3455	3565	22269	20636
120 O	143.66	144.08	2.23	2.23	3629	3819	23909	23766
30 M+30 O	147.83	153.33	2.22	2.45	4124	4361	24106	25834
60 M+60 O	150.25	147.75	2.55	2.66	4390	4542	26398	29404
L.S.D at 5%	1.80		0.07		121		1336	

M=Mineral O=Organic N.S=Insignificant

Table(4 c): **Effect of the interaction between bacterial inoculation and rate of the applied N fertilizer on protein percentage and N content in maize grains (over the combined analysis)**

Bacterial inoc.	Nonin.	Inoc.	Nonin.	Inoc.
N rates (kg/fed)	Protein%		N mg.kg^{-1}	
Zero	6.76	7.19	10820	11382
60 M	7.92	8.19	12679	13110
120 M	8.59	8.78	13762	14045
60 O	7.31	7.94	11695	12729
120 O	7.79	8.34	12461	13336
30 M+30 O	7.68	7.77	12313	12440
60 M+60 O	8.16	8.69	13062	13904
L.S.D at 5%	0.17		229	

M=Mineral O=Organic N.S=Insignificant

Table(4 d): Effect of the interaction between maize hybrids, bacterial inoculation and rate of the applied N fertilizer on Protein percentage, N and P contents in maize grains (over the combined analysis)

Maize hybrids		S.C. 30K8	S.C. 30K9	S.C. 30K8	S.C. 30K9	S.C. 30K8	S.C. 30K9
Treatments		Protein%		N mg.kg^{-1}		P mg.kg^{-1}	
Nonin.	Zero	6.52	6.99	10442	11199	3109	3064
	60 M	7.44	8.41	11900	13459	4175	4142
	120 M	8.17	9.03	13075	14450	4422	4394
	60 O	6.72	7.89	10748	12642	3422	3421
	120 O	7.22	8.35	11558	13365	3559	3514
	30 M+30 O	7.55	7.83	12099	12529	3980	4262
	60 M+60 O	7.85	8.47	12567	13559	4289	4499
Inoc.	Zero	6.75	7.63	10545	12220	2692	3730
	60 M	7.83	8.55	12534	13687	4312	4534
	120 M	8.40	9.15	13442	14650	4672	4670
	60 O	7.53	8.35	12042	13416	3489	3709
	120 O	7.83	8.85	12507	14167	3700	4125
	30 M+30 O	6.93	8.62	11089	13792	4269	4459
	60 M+60 O	8.37	9.00	13392	14417	4492	4585
L.S.D at 5%		0.24		323		171	

M=Mineral O=Organic N.S=Insignificant

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استجابة هجينان من الذرة الشامية للتلقيح البكتيرى والتسميد النيتروجينى العضوىوالمعدنى

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أجريت هذه الدراسة بمركز البحوث الزراعية بكلية الزراعة بمشتهر – جامعة بنها خلال موسمى ٢٠٠٧ ، ٢٠٠٨ بهدف دراسة تأثيرالتلقيح البكتيرى (بدون تلقيح ،التلقيح بمخلوط من الأزوتوباكتر والآزوسبيريللم) وسبعة مستويات من التسميد النيتروجينى المعدني والعضوي (صفر،٦٠ ، ١٢٠ كجم ن معدني في صورة يوريا، ٦٠ ، ١٢٠ كجم ن عضوي في سماد بلدي، ٣٠ كجم ن معدنى+٣٠ كجم ن عضوى و ٦٠ كجم ن معدنى+٦٠ كجم ن عضوى للفدان) على صفات النمو والمحصول ومكوناته والتحليل الكيميائى للحبوب لهجينين من الذرة الشامية (هجين فردى ٣٠ ك٨ و هجين فردى ٣٠ ك٩). وتتلخص أهم النتائج المتحصل عليها على النحو التالى :-

إختلفت الهجن المنزرعة معنويا في كل من % للبروتين ومحصول الفدان من البروتين ومحتوى الحبوب من كل النيتروجين والفوسفور والبوتاسيوم في كلا موسمي الزراعة وتم الحصول على أعلى القيم للصفات السابقة من الهجين الفردي ٣٠ ك٩.

تأثر معنويا بالتلقيح البكتيري بخليط من "الأزوتوباكتر + الآزوسبيريللم" كل من إرتفاع الكوز وسمك الساق ومساحة ورقة الكوز والنسبة المئوية للبروتين ومحصول البروتين للفدان ومحتوى الحبوب من كل من النيتروجين والفوسفور والبوتاسيوم في كلا موسمي الزراعة حيث أعطى التلقيح البكتيري أعلى القيم للصفات السابقة مقارنة بعدم التلقيح.

زاد كل من إرتفاع النبات وسمك الساق وعدد كيزان النبات ومساحة ورقة الكوز والنسبة المئوية للبروتين ومحصول البروتين للفدان ومحتوى الحبوب من كل من النيتروجين والفوسفور والبوتاسيوم في كلا موسمي الزراعة زيادة معنوية بزيادة معدلات التسميد النيتروجيني حيث اعطى مستوى التسميد ١٢٠ كجم ن معدني/فدان أعلى قيم للصفات السابقة.

أثر التفاعل بين هجيني الذرة الشامية والتلقيح البكتيري تأثيرا معنويا على كل من محتوى الحبوب من الفوسفور في كلا موسمي الزراعة حيث أعطى الهجين الفردي ٣٠ ك٩ الملقح بخليط من "الأزوتوباكتر + الآزوسبيريللم" أعلى القيم للصفات السابقة.

كان للتفاعل بين هجيني الذرة الشامية ومستويات التسميد النيتروجيني تأثيرا معنويا على كل من إرتفاع الكوز وسمك الساق و محتوى الحبوب من الفوسفور والبوتاسيوم في كلا موسمي الزراعة وأعطى الهجين الفردي ٣٠ ك٩ تحت مستوي تسميد ١٢٠ كجم ن معدني/فدان أو "٦٠ كجم ن معدني + ٦٠ كجم ن عضوي" /فدان أعلى القيم للصفات السابقة الذكر.

تأثرت النسبة المئوية للبروتين ومحتوى الحبوب من النيتروجين في كلا موسمي الزراعة تأثيرا معنويا بالتفاعل بين التلقيح البكتيري ومستويات التسميد النيتروجيني حيث كانت أفضل معاملة هي التلقيح البكتيري بخليط من "الأزوتوباكتر+الأزوسبيريللم" تحت مستوى تسميد نيتروجيني ١٢٠ كجم ن معدني/فدان أو "٦٠ كجم ن معدني + ٦٠ كجم ن عضوي" /فدان للحصول على اعلى القيم للصفات السابقة الذكر.

أثر التفاعل بين كل من هجيني الذرة الشامية والتلقيح البكتيري والتسميد النيتروجيني تأثرا معنويا على كل من النسبة المئوية للبروتين ومحتوى الحبوب من النيتروجين والفوسفور والبوتاسيوم في كلا موسمي الزراعة حيث أعطى الهجين الفردي ٣٠ ك٩ الملقح بخليط من "الأزوتوباكتر+ الأزوسبيريللم" تحت مستوى تسميد نيتروجيني ١٢٠ كجم ن معدني/فدان أو "٦٠ كجم ن معدني + ٦٠ كجم ن عضوي" /فدان أعلى القيم للصفات سالفة الذكر.