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STUDIES ON NITROGEN CONTENT, YIELD AND YIELD COMPONENTS IN GUAR *(Cyamopsis tetragonoloba L. TAUB)* AS INFLUENCED BY RHIZOBIUM INOCULATION AND NITROGEN FERTILIZATION

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ABSTRACT

A pot experiment was conducted during the successive two summer seasons of 2008 and 2009 at a wire proof green house of Sakha Agricultural Research Station, Kafr El-Sheikh, governorate, Egypt. The experiment aimed to evaluate the effect of nitrogen fertilizer levels (N_0=without nitrogen fertilizer, N_1=10 kgN/fed, N_2=20 kg N/fed and N_3=30 kg N/fed) and three nitrogen fixing bacteria (Control=without inoculation, AZ_1 (Ga+650) and AZ_2 (Ga+500) as Rhizobium strains) on nodulation, yield and yield components of guar plant grown on three(sandy, calcareous and clay soils) kinds different soil types. The experiment was conducted in a spilt plot design with three replicates.

The Obtained results indicated that nodules dry weight increased significantly by adding 30 kg N/fed in the sandy soil whereas 20 kg N/fed (N_2) gave the highest values of nodules dry weight with calcareous and clayey soil. 20 kg N/fed (N_2) gave 289.44 and 289.44 mg/pot with clayey soil during first and second season, respectively. Also, inoculation with AZ_2 increased significantly nodules dry weight with all soil types and the maximum nodules dry weight was 229 mg/pot with calcareous soil in the 1st season and 228.58 mg/pot with clayey soil in the 2nd season. In addition the interaction effect between nitrogen fertilizer and inoculation with nitrogen fixing bacteria in clayey soil gave the highest dry weight of nodules after 60 days with N_2AZ_2 (20kg N/fed combined with AZ_2) of (840 and 640 mg/pot). Seed yield was increased significantly over control due to supplying with either 30 kg N/fed (N_3) or AZ_2 to a clayey soil. The highest seed yield values were obtained with 30 kg N/fed (N_3) it gave 42.56 and 41.97 g/pot with clayey soil in the 1st and 2nd season, respectively. It was found that 20 kg N/fed gave the highest straw yield (117.73 g/pot) in the 1st with clayey soil whereas adding Az2 had the highest straw yield was 100.53 g/pot in the 1st season.

Data also revealed that oil yield significantly increased with nitrogen levels and gave the highest yield with adding 30kg N/fed to clayey soil (4.45 g/pot) in the 1st and 2nd season, respectively. Also with AZ_2 the highest values of oil yield was 3.43 and 3.46 g/pot in the 1st and 2nd season.

Keywords: $AZ_{1=}$ (Ga+650) strains , AZ_2 (Ga+500)strains ,strain 650= Rhizobium sp strain and strain 500 = Bradyrhizobium japonicum strain, guar plant, yield , protein yield and oil yield

INTRODUCTION

The Egyptian soil has been suffering the lack of nutrients as a result of many reasons. Mineral fertilizer plays an important role in crop production, but unbalanced application of nutrients leads to productivity loss arising from soil exhaustion of macro and micro-nutrients (Bhandari *et al.*, 2002) and

(Yadvinder-Singh *et al.*, 2004). Continuous use of chemical fertilizers even in balanced proportion will not be able to sustain crop productivity due to deterioration in soil fertility (Zia *et al.* , 2000).

During the last decades, the increased costs of fertilizer production coupled with the progressively increasing use of chemical fertilizers are adding to the cost of crop cultivation. In addition, chemical fertilizers are harmful when they persist in the soil and enter the food chain. The intensive use of inorganic fertilizers; the progressive rise in their cost and their low efficiency have comprised expensive charges for the agricultural products, particularly in the developing countries. Thus, attempts have being under taken to found out a partial substitution for the usually applied chemical fertilizers by using biofertilzers, which are more cheaper and appropriately effective.

However, biofertilizers which considered as the most important factor in reducing the application of the chemical fertilizers and minimizing the induced environmental , such as those resulted from nitrogen [volatilized NH3 and / or leached NO3--] (Prevost and Bromfield, 2003).

Guar has been well grown in wide range of soils. The most excellent performance is on the fertile medium to light sandy loam soil with pH values of 7.5 to 8.0. Guar can be used as a green manure crop in newly cultivated areas in Egypt (Ghanem, 1990).

found that the guar (*Cyamposis tetragonoloba* L. Taub) is considered a promising leguminous forage crop especially in new reclaimed soils in Egypt due to its tolerance of drought, salinity and its wide adaptability in a variety of soils Al-Sheikh (2004). Guar is an excellent soil-improving crop and fits well in a crop-rotation program. In Australia, guar was found to add 196 lb N/acre to the soil plant system over three years (Undersander *et al.*, 1991).

Vara *et al.*, (1994) studied the response of soybean to *Rhizobium* inoculation they found significant increase in protein and oil yields.

Al-Sheikh (2004) revealed that the effect of nitrogen fertilization for guar, gave the highest number of nodules per plant and seed yield.

Ibrahim *et al.*, (2010) used *Bradyrhizobium* strains and found, they reported that significant improving in grain yield and yield (kg/ha), inoculation significantly enhanced the plant height and number of pods/plant. Treatment with *Bradyrhizobium* strains significantly affected oil content of the tested guar cultivars.

Bradyrhizobium inoculation to guar significantly improved nodulation and dry matter production particularly by locally isolated bradyrhizobia. Nitrogen fertilization improved dry matter production but depressed nodulation. (Mahdi and Mustafa, 2005).

The objective of this paper is to try to know the response of guar plant to inorganic nitrogen fertilization and inoculation with Rhizobium and their effects on yield, yield components and nitrogen content of guar plant

MATERIALS AND METHODS

Pot experiments:

A pot experiment was conducted using guar plant (Cyamopsis tetragonoloba L. Taub) at 15 May during 2008 and 2009 summer growing seasons at a wire proof green house of Sakha Agricultural Research Station, Kafr El-Sheikh governorate to evaluate the performance of inoculation with the selected active isolates on guar plant with mineral nitrogen fertilizer under different soil types. A split plot design was used with three replicates was conducted in this study for each soil. The main factor was nitrogen fertilizer (urea) treatment which was added to the soil at four rates (N_0=without nitrogen fertilizer, N_1=10 kgN/fed, N_2=20 kg N/fed and N_3=30 kg N/fed) as urea 46%N equal 0, 0.11, 0.22 and 0.33 gm urea/pot for either inoculated and uninoculated pots. Whereas the sub-factor was nitrogen fixing bacteria (biofertilizer treatments) were applied to the soil as follow (Control=without inoculation, AZ1 (Ga+650) and AZ2 (Ga+500) strains). Pots of 30 cm diameter and 35 cm height which hold 5 kg of different types of soils (clay, sandy and calcareous soils) were fertilized with the recommended dose of potassium and phosphorus which was added to all pots at the rate of (50 kg super phosphate/fed as Calcium super phosphate (6.76% P) equal to 0.75 gm calcium super phosphate per pot and 150 kg K2SO4/fed as potassium sulphate (41% K) equal to 0.25 gm of potassium sulphate per pot. 6 replicates(pots) were used 3 of them were taken for plants growth studies after 60 days, and the other 3 were left to the harvesting stages. Each pot contain 3 plants, 6 seeds were planted in each pot then thieved to 3 plants after 10 days of sowing (planting). The pots were watered to 60% of the water holding capacity of each soil.

Soil analysis:

Data in Table 1 show some physical, chemical and microbiological properties of the different experimental soils (sandy, calcareous and clayey soil) before planting. Soil samples were sieved then particle size distribution, was carried out using international pipette method according to Klute (1986). Saturation percentage and field capacity Soil reaction pH in 1:2.5 soil-water suspensions was determined and electrical conductivity (Ec), dS.m-1, at 25 C° in soil paste extract (Richards, 1954). Soluble ions were determined. Available N was determined using Kjeldahl method (Jackson, 1967). Available phosphorus was determined calorimetrically, available potassium was estimated by using flame photometer, organic matter percentage was determined by modified Walkly and Black Method according to (Jackson, 1967). Total calcium carbonate was determined by using volumetric calcimeter method, Cation exchange capacity was determined by using sodium and ammonium acetate (Page, 1982). Soil microbiology measurements were determined by counting total count of Bacteria, Actinomycetes and fungi according to Allen (1959).

Table 1: Some physical, chemical and microbiological properties of the experimental soils

Parameter	Clay soil	Calcareous soil	Sandy soil
Particle size distribution			
Clay %	54.6	6.7	1.7
Silt %	22.1	11.2	6.4
Coarse sand %	5.7	26.5	37.1
Fine sand %	17.6	55.6	54.8
Texture grade	Clayey	Sandy	Sandy
Saturation percentage (SP%)	80.6	29.8	16.2
Field capacity (FC%)	43.2	13.8	7.5
Wilting point (WP%)	21.5	7.1	3.8
Some chemical properties			
pH (1:2.5 water suspension)	8.4	7.6	7.4
EC (dS/m in soil paste extract)	3.9	3.4	2.8
Soluble cations, meq/L			
Ca^{++}	8.2	5.4	4.5
Mg^{++}	4.7	7.5	6.2
Na^{+}	26.5	23.1	19.0
K^{+}	0.4	0.3	0.3
Soluble anions, meq/L			
CO_3^{--}	0.0	0.0	0.0
HCO_3^{-}	5.5	7.5	3.5
Cl^{-}	18.6	16.2	13.3
SO_4^{--}	15.7	12.6	13.2
SAR	10.45	9.1	8.3
Macro elements, ppm			
Available N	43.6	19.3	13.1
Available P	10.5	7.3	6.2
Available K	420	330	280
Total $CaCO_3$ (%)	1.3	10.2	0.5
CEC (cmole/kg)	36.69	11	4
OM %	2.01	0.7	0.3
Microorganisms			
Total count of bacteria	31×10^{6}	68×10^{5}	45×10^{4}
Fungi	55×10^{4}	91×10^{3}	36×10^{3}
Actinomycetes	53×10^{5}	52×10^{3}	49×10^{3}

Seed inoculation

The seeds of guar were surface sterilized (Vincent, 1970) and inoculated with the strain of Rhizobium AZ_1 (Ga+650) and AZ_2 (Ga+500), strain 650 of Rhizobium sp and strain 500 of Bradyrhizobium japonicum. Locally strains were kindly supplied by Dept. of soil Microbiology at Sakha Agric. Res. Station. Ga isolated from nature population of Rhizobial present in soils of field crops culture, Field crops Res. Station and selected in previous experiment for efficient nitrogen fixation on guar (Somasegran and Hoben, 1994). In the preparation of the inoculants, the strains were purified (Vincent,1970) using yeast mannitol extract agar (YMA medium) with bromothymol blue as indicator. In a following step they were transferred in duplicate to conical flasks, capacity 500 ml. flasks holding 200 ml yeast mannitol broth media (YM media) were sterilized and inoculated by the strain under study. Incubation was carried out on rotary shaker (120 rpm) at 28 C° for 5-7 days in case of B. japonicum (strain 500) and for 3-5 days with Ga and strain 650. After this time period the inoculum of the strains 650 and 500 and isolate Ga containing 10^8 c.f.u.ml^{-1} were mixed in rate 1:1 to obtain AZ_1(650+Ga)and AZ_2(500+Ga) and inoculated with liquid culture (5 ml/ pot)

Plant growth studies:

After 60 days: Characteristics of nodules that existed on the root system were noted, Dry weight of shoots and roots was recorded. Plants were then dried at 70°C and the dry matter was weighted. Nitrogen in shoot and root was determined.

At harvest: each pot contains 3 plants which were cut at about 3 cm above the soil surface and separated into shoot and seeds whereas root samples were taken by using sieves and water stream to separate soil away from root. Samples were dried. Seeds were separated from straw. Straw yield was obtained. Biological yield (dry weight of straw and seed yield), was recorded, and some chemical analysis of plant were determined. Total nitrogen content of seeds, root and straw was determined by digesting them as described by Chapman and Parker (1963). The digested materials were distilled by Microkjeldahl method and the nitrogen content was determined by titration according to Black *et al.*, (1965). Protein yield also was calculated in straw and seed. Oil was determined in seeds according to AOAC, (1960).

Statistical analysis:

Data obtained from Experimental treatments were subjected to the analysis of variance and treatments means were compared using the L.S.D. method according to Steel and Torrie (1980)

RESULTS AND DISCUSSION

Nodulation

Data in Table 2 show that nodules number was high significantly responded to nitrogen fertilizer levels in both seasons. The highest value with sandy soil was 37.7 and 42.3 nodules/pot obtained as a result of adding 30 kg N/fed in the 1st and 2nd season, respectively. The increasing percentages of nodules number due to applying 30 kg N/fed were 22.7% and 54.88% compared to the control. Also, data indicated that number of nodules/pot increased due to guar inoculation with AZ_1 in sandy soil which high significantly (38.0, 34.75) in the 1st and 2nd seasons, respectively.

Whereas with calcareous soil, Data in Table 2 show that nodules number was insignificantly responded to nitrogen fertilizer levels and inoculation with nitrogen fixing bacteria (Rhizobium inoculation) in both seasons. The maximum increase in nodules number (66.65 and 53.21% over the control) was recorded by the application of 20 kg N/fed (N2) in the 1st and 2nd seasons, respectively. Also, Maximum values of nodules number (32.8 and 33.5) were found at AZ2 and AZ1in the 1st and 2nd season, respectively.

Table 2: Effect of nitrogen fertilization and nitrogen fixing bacteria on nodulation and N-content in shoot and root (mg /pot) of guar at 60 days age under sandy, calcareous and clayey soil

Treatments	Number of nodules/pot		Dry weight of nodules (mg/pot)		N-content in shoot(mg/pot)		N-content in root(mg/pot)	
	2008	2009	2008	2009	2008	2009	2008	2009
Sandy soil								
Main plot(A)								
N_0	30.70ab	27.33b	64.33b	73.00b	68.79d	64.95d	21.38c	18.90d
N_1	34.00a	28.33b	55.33b	60.67b	120.60c	98.75c	39.31c	29.18c
N_2	35.30b	31.33b	60.33b	62.40b	319.24b	310.48b	68.90b	57.44b
N_3	37.67a	42.33a	261.11a	221.78a	377.07a	395.19a	92.82a	86.86a
F test	*	**	**	**	**	**	**	**
LSD at 5%	3.94	6.65	19.98	40.90	30.64	23.27	21.46	10.18
Sub plot(B)								
Control	30.00b	27.50b	74.33b	64.72b	139.29c	146.61b	45.27a	40.35a
AZ_1	38.00a	34.75a	125.42a	112.00a	243.68b	250.10a	60.45a	51.22a
AZ_2	35.25a	34.75a	131.08a	136.67a	281.31a	255.31a	61.09a	52.72a
F test	**	**	**	**	**	**	*	N.S.
LSD at 5%	4.71	4.67	18.57	16.41	35.11	40.57	13.35	--
Interaction(A*B)								
F test	**	**	**	**	**	**	N.S.	N.S.
LSD at 5%	3.56	4.67	11.74	9.90	19.47	23.11	--	--
Calcareous soil								
Main plot(A)								
N_0	23.00 a	25.67 a	54.33 c	56.00 b	49.16 c	47.70 b	12.87 b	12.06b
N_1	27.33 ab	30.33 ab	67.33 bc	107.00 b	124.12 b	85.12 b	20.62 b	23.14b
N_2	38.33 ab	39.33 ab	269.67 a	225.00 a	249.94 a	288.92 a	58.35 a	67.55 a
N_3	34.00 b	32.33 b	105.67 b	84.00 b	168.36 b	269.30 a	53.39 a	64.27 a
F test	N.S.	N.S.	**	**	**	**	**	**
LSD at 5%	--	--	42.19	68.96	51.25	51.64	11.62	18.36
Sub plot(B)								
Control	27.25 a	30.75 a	63.25 b	74.75 b	94.01 b	128.59 b	23.40 b	\27.72 b
AZ_1	32.00 a	33.50 a	80.50 b	86.75 b	163.75 a	183.66 a	39.25 a	46.95 a
AZ_2	32.75 a	31.50 a	229.00 a	192.50 a	185.93 a	206.04 a	46.27 a	50.59 a
F test	N.S.	N.S.	**	**	**	**	**	**
LSD at 5%	--	--	38.20	45.67	40.99	23.23	7.35	8.17
Interaction(A*B)								
F test	N.S.	N.S.	**	**	**	**	**	**
LSD at 5%	--	--	23.04	28.88	28.40	16.10	11.39	10.70
Clayey soil								
Main plot(A)								
N_0	32.67 b	35.33 c	96.44 b	67.67 b	83.00 c	84.73 d	33.28 b	23.31 b
N_1	39.00 b	38.33 c	129.22 b	130.00 b	142.89 c	151.73 c	43.15 b	37.37 b
N_2	59.33 a	52.00 a	289.44 a	289.44 a	449.93 a	428.62 a	101.16 a	81.41 a
N_3	45.00 b	46.00 b	96.44 b	97.00 b	282.81 b	275.28 b	63.21 b	50.81 b
F test	*	**	**	**	**	**	**	**
LSD at 5%	10.82	5.07	61.38	66.56	68.67	51.34	31.50	23.58
Sub plot(B)								
Control	36.25 b	36.75 b	89.00 c	87.00 b	178.72 b	162.51 b	44.69 b	36.86 b
AZ_1	46.75 a	48.50 a	161.92 b	122.50 b	268.39 a	252.43 a	68.26 a	54.09 a
AZ_2	49.00 a	43.50 ab	207.75a	228.58 a	271.88 a	290.33 a	67.64 a	53.72 a
F test	*	*	**	**	**	**	**	**
LSD at 5%	10.31	7.52	29.63	31.95	41.87	40.06	13.59	11.10
Interaction(A*B)								
F test	N.S.	*	**	**	**	**	N.S.	**

Data in Table 2 show that nodules number was high significantly responded to nitrogen fertilizer levels with clayey soil in both seasons. The highest value with clayey soil was 59.33 and 52.00 nodules/pot obtained as a result of adding 20 kg N/fed in the 1st and 2nd season, respectively. The increasing percentages of nodules number due to applying 20 kg N/fed were 81.60% and 47.18% compared to the control. In respect guar inoculation with Rhizobium there was significant increase in nodules number in both seasons, the maximum values of nodules number (49.00 and 48.50) were found with AZ_2 and AZ_1 in the 1st and 2nd season, respectively. Concerning soil type it is recognized that the highest nodules number/pot was obtained with clayey soil. These results may be due to the effectiveness of Rhizobial inoculation under the clayey soil as result of high fertility(table1), such result was reported by El-Sheikh (1998a) and Abou Aly (2001).

In respect with nodules dry weight data in Table 2 indicated that there a highly significant increase with all soil kinds under the studied factors. While with nitrogen fertilizer levels, the highest values of nodules dry weight were obtained with N_3 (30 kg N/fed) in the sandy soil in both seasons. Whereas, N_2 (20 kg N/fed) gave the highest values of nodules dry weight with calcareous and clayey soil in both seasons. Also, Rhizobium inoculation (AZ_2) gave the highest values of nodules dry weight for all types of the used soil in both seasons.

In sandy soil the increasing percentages of nodules dry weight due to applying 30 kg N/fed were 260.11% and 203.81% compared to control in the 1st and 2nd season, respectively. The maximum increase with calcareous soil in nodules dry weight (396.4 and 301.8% over the control) was recorded by the application of 20 kg N/fed (N_2) in the 1st and 2nd season, respectively. The same trend were obtained with clayey soil, the increasing percentages of nodules dry weight were 200.1% and 327.7% compared to control in the 1st and 2nd season, respectively. Also, due to guar inoculation with Rizobium (AZ_2) the increasing percentages of nodules dry weight in sandy soil were 76.35% and 111.17% compared to control in the 1st and 2nd seasons, respectively. Also, calcareous soil gave an increasing percentage of 262.2% and 157.5% compared to control in the 1st and 2nd seasons, respectively. Clayey soil gave an increasing percentage of 133.4% and 162.7% compared to control in the 1st and 2nd season, respectively.

Concerning soil type, it was recognized that the maximum values of nodules dry weight was obtained with clayey soil (289.44 and 289.44 mg/pot) with application of 20 kg N/fed (N_2) in the 1st and 2nd season, respectively.

The interactions between nitrogen fertilizer and inoculation with Rizobium treatments gave a highly significant increase in nodules dry weight (Fig 1, 2 and 3) in both seasons with sandy, calcareous and clayey soil respectively. The highest value with sandy soil was 343.33 and 316.67 mg/pot with N_3AZ_2 (30 kg n/fed and inoculation with AZ_2 strains) in 1st and 2nd season, respectively. Fig. 2 shows the effect of inoculation with nitrogen dressing benefited guar plants more than control treatments in calcareous soil, the highest mean values of nodules dry weight was obtained with AZ_2 combined with 20 Kg N/fed increased the dry weight of nodules by 1159.3% and 920.4% over the control in the 1st and 2nd season, respectively.

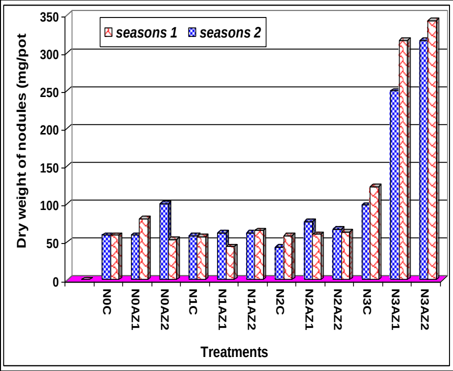

Fig. 1: interaction effect of nitrogen fertilizer and nitrogen fixing bacteria on nodules dry weight at 60 days under sandy soil during 2008-2009 seasons.

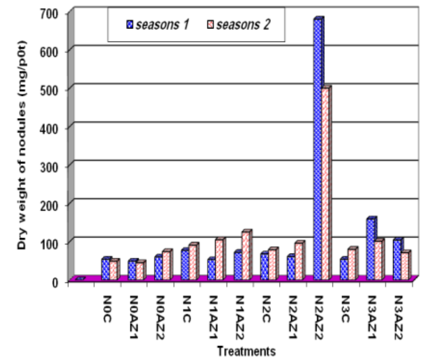

Fig. 2: interaction effect of nitrogen fertilizer and nitrogen fixing bacteria on nodules dry weight (mg/pot) at 60 days under calcareous soil during 2008-2009 seasons.

While in clayey soil, Fig 3 shows that AZ_2 combined with 20 Kg N/fed increased the dry weight of nodules by 912% and 1291.3% over the control in the 1st and 2nd season respectively. Such result was reported by El-Sheikh (1998a) and Abou Aly (2001). These results may be due to the effectiveness of Rhizobial inoculation and nitrogen fertilizer which enrich soil with a starter dose to encourage microorganisms to be more effective and increasing the amount of metabolites synthesized by guar plants and this in turn might account much for the superiority of green forage and seed yield/fed. These results agreement with those obtained by Ghalab *et al.* (2000), Gomma *et al.*, (2002), Mahdi and Mustafa, (2005), Osman *et al.*, (2007) and Hassan and Abdelghani, (2009).

N-content at 60 days

Data in Table 2 show that N-content in shoot was high significantly responded to nitrogen fertilizer levels in both seasons. The highest value with sandy soil was 377.07 and 395.19 mg/pot obtained as a result of adding 30 kg N/fed in the 1st and 2nd seasons, respectively. The increasing percentages of N-content in shoot due to applying 30 kg N/fed were 448.2% and 508.5% compared to control. Also, data indicated that N-content in shoot increased high significantly due to guar inoculation with AZ_2 in sandy soil. The N-content recorded (281.31, 255.31 mg/pot) in the 1st and 2nd season, respectively. Concerning the calcareous soil, Data in Table 2 show that N-content in shoot was significantly responded to nitrogen fertilizer levels and inoculation with nitrogen fixing bacteria (Rhizobium inoculation) in both seasons. The maximum increases in N-content in shoot compared to control are (408.4 and 505.1% which resulted due to the application of 20 kg N/fed (N_2) in the 1st and 2nd seasons, respectively. Also, maximum values of N-content in shoot (185.93 and 206.04 mg/pot) were obtained due to the inoculation by AZ2 in the 1st and 2nd season, respectively. Data in Table 2 show that N-content in shoot was high significantly responded to nitrogen fertilizer levels with clayey soil in both seasons. The highest value with clayey soil was 449.93 and 428.62 mg/pot obtained as a result of adding 20 kg N/fed in the 1^{st} and 2^{nd} season, respectively. The increasing percentages of N-content in shoot due to applying 20 kg N/fed were 442.1% and 405.9% compared to control. Also, guar inoculation with Rhizobium significantly increased the N-content in shoot in both seasons, the maximum values of N-content in shoot (228.58 and 271.88) were found with AZ_2 in the 1^{st} and 2^{nd} season, respectively. Concerning soil type it is recognized that the highest N-content in shoot was obtained with clayey soil. The positive effect of microbial inoculation on N content in guar plant is probably due to beneficial association between biofertilizers and partner, which improves the plant quality, these results are in harmony with the finding of Ghalab *et al.*, (2000); El-Fadaly *et al.*, (2003) and Hauka *et al.*, (2008).In respect with N-content in root data in Table 2 indicated that there a highly significant increase with all soil types under the studied factors. While with nitrogen fertilizer levels, the highest values of N-content in root were obtained with N_3 (30 kg N/fed) in sandy soil in both seasons. Whereas, N_2 (20 kg N/fed) gave the highest values of N-content in root with calcareous and clayey soil in both seasons. Also, Rhizobium inoculation (AZ_2) gave the highest values of N-content in root for all types of soil in both seasons.

In sandy soil the increasing percentages of N-content in root due to applying 30 kg N/fed were 334.1% and 359.6% compared to control in the 1^{st} and 2^{nd} seasons, respectively. Whereas, the maximum increase with calcareous soil in N-content in root (353.4 and 460.1% over the control) was recorded by the application of 20 kg N/fed (N_2) in the 1^{st} and 2^{nd} season, respectively. The same trend were obtained with clayey soil, the increasing percentages of N-content in root were 204% and 249.2% compared to control in the 1^{st} and 2^{nd} seasons, respectively. Also, due to guar inoculation with Rhizobium (AZ_2) the increasing percentages of N-content in root in sandy soil were 35% and 30.7% compared to control in the 1^{st} and 2^{nd} season, respectively. Also, calcareous soil gave an increasing percentage of 97.7% and 82.5% compared to control in the 1^{st} and 2^{nd} season, respectively. Clayey soil gave an increasing percentage of 52.7% and 46.7%, compared to control, in the 1^{st} and 2^{nd} seasons, respectively.

Concerning soil type, it was recognized that the maximum values of N-content in root was obtained with clayey soil (101.16 mg/pot) with application of 20 kg N/fed (N_2) in the 1^{st} season.

The interactions between nitrogen fertilizer and inoculation with Rhizobium treatments gave a highly significant increase in N-content in root (Fig 4, 5 and 6) in both seasons with sandy, calcareous and clayey soil. The highest value with sandy soil was 289.9 and 445.7 mg/pot with N_3AZ_2 (30 kg N/fed and inoculation with AZ_2 strains) in 1^{st} and 2^{nd} season, respectively. Fig. 5 shows that the inoculation with nitrogen levels benefited guar plants more than control treatments in calcareous soil, the highest mean values of N-content in root was obtained with AZ_2 combined with 20 Kg N/fed which increased the N-content in root by 813.1% and 1259.6% under the calcareous and 779.3% and 1023.5% under the clay soil over the control in the 1^{st} and 2^{nd} season, respectively.

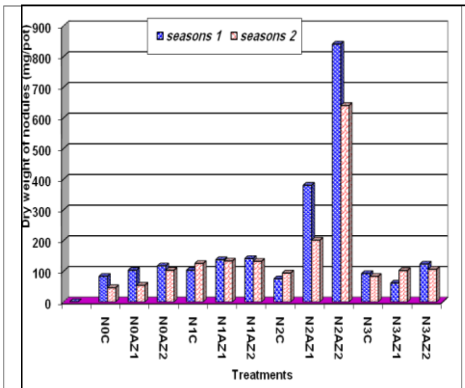

Fig. 3: interaction effect of nitrogen fertilizer and nitrogen fixing bacteria on nodules dry weight (mg/pot) at 60 days under clayey soil during nd 2008-2009 seasons.

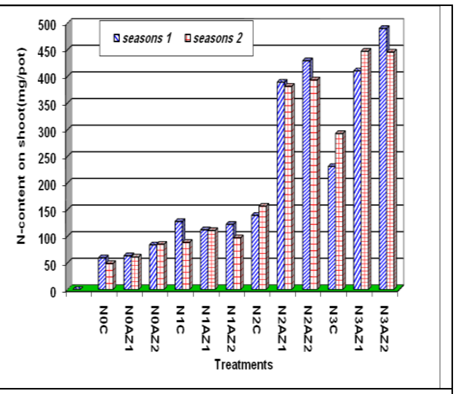

Fig. 4: interaction effect of nitrogen fertilizer and nitrogen fixing bacteria on N-content in shoot (mg/pot) at 60 days under sandy soil during 2008-2009 seasons.

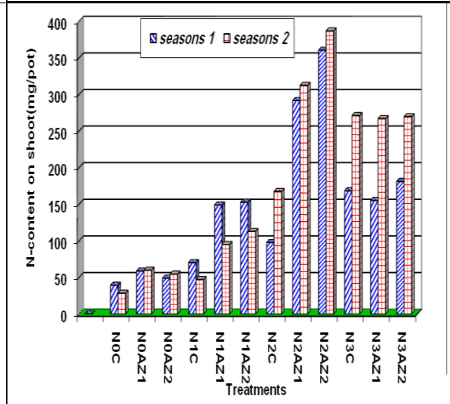

Fig. 5: interaction effect of nitrogen fertilizer and nitrogen fixing bacteria on N-content in shoot (mg/pot) at 60 days under calcareous soil during 2008-2009 seasons.

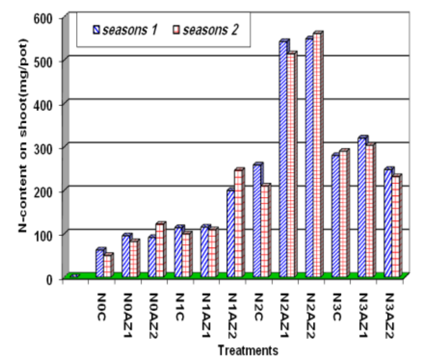

Fig. 6: interaction effect of nitrogen fertilizer and nitrogen fixing bacteria on N-content in shoot (mg/pot) at 60 days under clayey soil during 2008-2009 seasons.

These results may be due to The positive effect of microbial inoculation on N content in guar plant which improves the plant quality, these results are in harmony with the finding of Ghalab *et al.*, (2000), El-Fadaly *et al.*, (2003) and Hauka *et al.*, (2008).

Seed and straw Yield

Data in Table 3 show that seed dry weight was high significantly responded to nitrogen fertilizer levels in both seasons. The highest value with sandy soil was 32.65 and 32.39 g/pot obtained as a result of adding 30 kg N/fed in the 1st and 2nd season, respectively.

Table 3: Effect of nitrogen fertilization and nitrogen fixing bacteria on dry weight yield and N-content of seed and straw of guar at harvesting stage under sandy, calcareous and clayey soil

Treatments	Dry weight of seed yield (g/pot)		Dry weight of straw yield(g/pot)		N-content in seed (mg/pot)		N-content in straw (mg/pot)	
	2008	2009	2008	2009	2008	2009	2008	2009
Sandy soil								
Main plot(A)								
N_0	18.02 d	17.96 d	60.92 c	58.50 c	735.07 d	671.42 d	809.79 c	793.58 c
N_1	24.60 c	23.81 c	59.64 c	68.32 b	969.63 c	1004.73 cd	797.06 c	933.99 c
N_2	29.44 b	29.64 b	81.26 b	79.59 a	1407.92 bc	1451.70 b	1299.59 b	1188.18 b
N_3	32.65 a	32.39 a	92.73 a	84.89 a	1672.55 a	1663.72 a	1981.86 a	1684.17 a
F test	**	**	**	**	**	**	**	**
LSD at 5%	1.12	1.48	8.40	8.92	128.56	128.88	342.08	201.58
Sub plot(B)								
Control	24.59 b	23.96 b	62.70 c	59.91 c	1016.83 b	1070.01 b	909.93 b	838.44 b
AZ_1	26.79 a	26.64 a	72.28 b	71.98 b	1229.62 a	1239.53 a	1182.63 b	1101.23 b
AZ_2	27.16 a	27.25 a	85.93 a	86.62 a	1342.43 a	1284.14 a	1573.66 a	1510.26 a
F test	**	**	**	**	**	*	*	**
LSD at 5%	1.55	1.11	8.39	10.69	158.29	167.81	369.51	301.38
Interaction(A*B)								
F test	N.S.	**	*	N.S.	N.S.	N.S.	N.S.	N.S.
LSD at 5%	--	0.96	4.38	--	--	--	--	--
Calcareous soil								
Main plot(A)								
N_0	16.40 c	16.37 c	59.44 b	57.52 c	584.34 c	622.51 b	803.42 b	769.62
N_1	20.10 b	19.43 b	60.96 b	67.16 bc	801.56 b	792.05 b	873.01 b	1026.36
N_2	25.72 a	24.97 a	79.15 a	79.02 ab	1262.81 a	1277.95 a	1491.97 a	1557.48
N_3	26.25 a	26.16 a	82.74 a	82.24 a	1208.05 a	1210.63 a	1537.02 a	1529.73
F test	**	**	**	*	**	**	*	N.S.
LSD at 5%	2.08	1.65	12.78	12.77	203.89	195.16	450.33	--
Sub plot(B)								
Control	20.62 c	20.06 b	56.17 c	59.59 c	818.96 c	867.35 b	804.17 b	850.63 b
AZ_1	22.12 b	21.99 a	73.54 b	74.14 b	1027.77 cd	1008.17 a	1241.85 a	1325.98 a
AZ_2	23.62 a	23.16 a	82.01 a	80.73 a	1045.84 c	1051.83 a	1483.05 a	1485.79 a
F test	**	**	**	**	**	**	**	**
LSD at 5%	1.31	1.46	7.29	5.62	107.10	115.46	252.99	179.48
Interaction(A*B)								
F test	**	**	**	**	**	*	*	**
LSD at 5%	1.21	1.35	4.10	3.50	25.36	18.51	47.67	29.88
Clayey soil								
Main plot(A)								
N_0	23.55 d	23.22 d	60.04 d	60.44 d	897.54 d	891.86 c	971.25 b	868.77 c
N_1	25.73 c	25.31 c	78.13 c	69.94 c	1130.81 c	1247.90 b	1115.04 b	1089.82 c
N_2	39.36 b	39.39 b	117.73 a	109.87 a	2332.27 a	2112.52 a	2501.45 a	2342.57 a
N_3	42.56 a	41.97 a	93.30 b	97.84 b	1954.31 b	2080.68 a	1589.39 b	1767.38 b
F test	*	**	**	**	**	**	**	**
LSD at 5%	2.15	2.07	11.39	7.81	221.27	245.55	592.89	282.56
Sub plot(B)								
Control	31.26 b	30.71 c	73.57 c	68.25 c	1350.77 c	1436.52	1256.09 b	1135.60 c
AZ_1	32.52 b	32.32 b	87.81 b	86.28 b	1599.10 b	1609.43	1491.21 b	1512.32 b
AZ_2	34.62 a	34.39 a	100.53 a	99.03 a	1786.33 a	1703.76	1885.54 a	1903.48 a
F test	**	**	**	**	**	N.S.	**	**
LSD at 5%	1.27	1.50	7.09	6.46	161.29	--	379.38	371.69
Interaction(A*B)								
F test	**	**	**	**	**	*	**	**
LSD at 5%	0.94	1.11	3.54	3.05	20.69	57.55	56.82	54.01

The increasing percentages of seed dry weight due to were 81.2% and 80.4% compared to control. Also, data indicated that seed dry weight increased highly significant due to guar inoculation with AZ_2 in sandy soil seed dry weight recorded (27.16, 27.25 g/pot) in the 1^{st} and 2^{nd} season, respectively.

Whereas with calcareous soil, Data in Table 3 show that seed dry weight was significantly responded to nitrogen fertilizer levels and inoculation with nitrogen fixing bacteria (Rhizobium inoculation) in both seasons. The maximum increase in seed dry weight (60.1 and 59.8% over the control) was recorded by the application of 30 kg N/fed (N_3) in the 1^{st} and 2^{nd} season, respectively. Also, maximum values of seed dry weight (23.62 and 23.16 g/pot) were found with AZ_2 in the 1^{st} and 2^{nd} season, respectively.

Data in Table 3 show that seed dry weight was significantly responded to nitrogen fertilizer levels with clayey soil in both seasons. The highest value with clayey soil was 42.56 and 41.97 g/pot obtained as a result of adding 30 kg N/fed in the 1^{st} and 2^{nd} seasons, respectively. The increasing percentages of seed dry weight due to applying 30 kg N/fed to clayey soil were 80.7% and 80.8% compared to control. Data in table 3 reveal also that guar inoculation with Rhizobium gave significant increases in seed dry weight in both seasons, the maximum values of seed dry weight (34.62 and 34.39 g/pot) were found with AZ_2 in the 1^{st} and 2^{nd} season, respectively. Concerning soil type it is recognized that the highest seed dry weight was obtained with clayey soil. These results may be due to the beneficial association between inoculation with Rhizobium, which improves the plant quality and the kinetic effect of microorganisms on plant by producing growth plant hormones, auxin-like substances and nutrient cycling, these results are in harmony with the finding of Al-Sheikh (2004); Mohamed and Gomaa (2005); Sonbol *et al.*, (2007), and and Hauka *et al.*, (2008).

In respect with straw dry weight, data in Table 3 indicate that there are highly significant increases with all soil types under the studied factors except for the 2^{nd} season with calcareous soil. While with nitrogen fertilizer levels, the highest values of straw dry weight were obtained with N_3 (30 kg N/fed) in sandy and calcareous soil in both seasons. Whereas, N_2 (20 kg N/fed) gave the highest values of straw dry weight with clayey soil in both seasons. Also, Rhizobium inoculation (AZ_2) gave the highest values of straw dry weight for all types of soil in both seasons.

In sandy soil the increasing percentages of straw dry weight due to applying 30 kg N/fed were 52.2% and 45.1% compared to control in the 1^{st} and 2^{nd} season, respectively. Whereas, the maximum increase with calcareous soil in straw dry weight (39.2% and 43% over the control) was recorded by the application of 30 kg N/fed (N_3) in the 1^{st} and 2^{nd} season, respectively. With clayey soil, the increasing percentages of straw dry weight were 96.1% and 81.8% compared to control in the 1^{st} and 2^{nd} season, respectively. Also, due to guar inoculation with Rizobium (AZ_2) the increasing percentages of straw dry weight in sandy soil were 37.1% and 44.6% compared to control in the 1^{st} and 2^{nd} season, respectively. Also, calcareous soil gave an increasing percentage of 46% and 21.1% compared to control in the 1^{st} and 2^{nd} season, respectively. Clayey soil gave an increasing percentage 36.7% and 45.1% compared to control in the 1st and 2nd season, respectively.

Concerning soil type, it was recognized that the maximum values of straw dry weight was obtained with clayey soil (117.73 and 109.87 g/pot) with application of 20 kg N/fed (N_2) in the 1st and 2nd season, respectively. These results may be due to the kinetic effect of microorganisms on plant by producing growth plant hormones, auxin-like substances and nutrient cycling, these results are in harmony with the finding of Al-Sheikh (2004), Mohamed and Gomaa (2005), Sonbol *et al.*, (2007), and Hauka *et al.* (2008).

N-content at harvesting

Data in Table 3 show that N-content in seed was significantly responded to nitrogen fertilizer levels in both seasons, while it was insignificant with rhizobium inoculation in the 2nd season with clayey soil. The highest value with sandy soil was 1672.55 and 1663.72 mg/pot obtained as a result of adding 30 kg N/fed in the 1st and 2nd season, respectively. The increasing percentages of N-content in seed due to applying 30 kg N/fed were 127.5% and 147.8% compared to control. Also, data indicate that N-content in seed increased highly significant due to guar inoculation with AZ_2 in sandy soil which recorded (1342.43, 1284.14 mg/pot) in the 1st and 2nd season, respectively.

Concerning calcareous soil, N-content in seed was significantly increasing due to nitrogen fertilizer levels and inoculation with nitrogen fixing bacteria (Rhizobium inoculation) in both seasons. The maximum increase in N-content in seed (116.1 and 105.3% over the control) was recorded by the application of 20 kg N/fed (N_2) in the 1st and 2nd season, respectively. Maximum values of N-content in seed (1045.84 and 1051.83 mg/pot) were found with AZ_2 in the 1st and 2nd season, respectively.

Data in Table 3 show that N-content at harvest in seed was high significantly responded to nitrogen fertilizer levels with clayey soil in both seasons. The highest value with clayey soil was 2332.27 and 2112.52 mg/pot obtained as a result of adding 20 kg N/fed in the 1st and 2nd season, respectively. The increasing percentages of N-content in seed due to applying 20 kg N/fed in clayey soil were 159.9% and 136.9% compared to control. Also, due to guar inoculation with Rhizobium there was significant increase in N-content in seed in both seasons, the maximum values of N-content in seed (1786.33 and 1703.76 mg/pot) were found with AZ_2 in the 1st and 2nd season, respectively. Concerning soil type it is recognized that the highest N-content in seed was obtained with clayey soil. These results may be due to beneficial associated with inoculation with Rhizobium, which improves the plant quality and nutrient cycling. These results are in harmony with the finding of El-Kramany *et al.*, (2000), Al-Sheikh (2004), Gomaa *et al.*, (2006), and Hauka *et al.*, (2008).

In respect with N-content in straw, data in Table 3 indicate that there is significant increase with all soil types under the studied factors except for the 2nd season with calcareous soil it was insignificant. While with nitrogen fertilizer levels, the highest values of N-content in straw were obtained with N_3 (30 kg N/fed) in sandy in both seasons. The same trend was seen with calcareous soil in the first season. Whereas, N_2 (20 kg N/fed) gave the highest values of N-content in straw with clayey soil in both seasons. Also, Rhizobium inoculation (AZ_2) gave the highest values of N-content in straw for all types of soil in both seasons.

In sandy soil the increasing percentages of N-content in straw due to applying 30 kg N/fed were 144.7% and 112.2% compared to control in the 1st and 2nd seasons, respectively. Whereas, the maximum increase with calcareous soil in N-content in straw (91.3% and 102.4% over the control) was recorded by the application of 30 kg N/fed (N_3) in the 1st and 2nd season, respectively. With clayey soil, the increasing percentages of N-content in straw were 157.5% and 169.6% compared to control in the 1st and 2nd season, respectively. Guar inoculation with Rhizobium (AZ_2) gave increasing percentages of N-content in straw in sandy soil by 72.9% and 80.1% compared to control in the 1st and 2nd season, respectively. Also, calcareous soil gave an increasing percentage of 84.4% and 74.7% compared to control in the 1st and 2nd season, respectively. Clayey soil gave an increasing percentage 50.1% and 67.6% compared to control in the 1st and 2nd season, respectively.

Concerning soil type, it was recognized that the maximum values of N-content in straw was obtained with clayey soil (2501.45 and 2342.57 mg/pot) with application of 20 kg N/fed (N_2) in the 1st and 2nd season, respectively. These results may be due to the effect of microorganisms on plant by producing growth plant hormones and nutrient cycling. These results are in harmony with the finding of Al-Sheikh (2004), Sonbol *et al.*, (2007), and Hauka *et al.* (2008).

Protein% and oil yield

Data in Table 4 show that seed protein % was significant responded to nitrogen fertilizer levels in both seasons. The highest value with sandy soil was 32.31% and 31.81% obtained as a result of adding 30 kg N/fed in the 1st and 2nd season, respectively. The increasing percentages of seed protein % due to applying 30 kg N/fed were 26.95% and 36.88% compared to control. while, data indicated that seed protein % had insignificant due to guar inoculation, with AZ_2 in sandy soil which recorded (29.97, 28.63%) in the 1st and 2nd season, respectively.

Whereas with calcareous soil, Data in Table 4 show that seed protein % was significantly responded to nitrogen fertilizer levels in both seasons and inoculation with nitrogen fixing bacteria (Rhizobium inoculation) only in the 1st season seasons. The maximum increase in seed protein % (42.77 and 30.74% over the control) was recorded by the application of 20 kg N/fed (N_2) in the 1st and 2nd season, respectively. Also, maximum values of seed protein% (28.58 and 28.06 %) were found with AZ_2 in the 1st and 2nd season, respectively.

Data in Table 4 show that seed protein % was high significantly responded to nitrogen fertilizer levels with clayey soil in both seasons. The highest value with clayey soil was 36.33 and 33.31 % obtained as a result of adding 20 kg N/fed in the 1st and 2nd season, respectively. The increasing percentages of seed protein% due to applying 20 kg N/fed were 51.19% and 27.33% compared to control.

Table 4: Effect of nitrogen fertilization and nitrogen fixing bacteria on protein % of seed and straw, oil% and oil yield in seeds of guar at harvesting stage under sandy, calcareous and clayey soil

Treatments	Seed protein yield (g/pot)		Straw protein %		Seed oil %		Oil yield (g/pot)	
	2008	2009	2008	2009	2008	2009	2008	2009
Sandy soil								
Main plot(A)								
N_0	25.45_{b}	23.24_{b}	8.19_{b}	8.38_{b}	5.88_{b}	5.94_{b}	1.06_{d}	1.07_{d}
N_1	25.52_{b}	25.44_{b}	8.32_{b}	8.44_{b}	6.32_{b}	6.16_{b}	1.56_{c}	1.47_{c}
N_2	29.42_{a}	30.85_{a}	9.85_{b}	9.32_{b}	6.28_{b}	6.46_{b}	1.84_{b}	1.91_{b}
N_3	32.31_{a}	31.81_{a}	13.07_{a}	12.26_{a}	7.92_{a}	7.93_{a}	2.59_{a}	2.57_{a}
F test	*	**	*	**	**	**	**	**
LSD at 5%	3.84	3.36	2.82	1.35	0.64	0.67	0.15	0.18
Sub plot(B)								
Control	26.35_{a}	26.63_{a}	8.99_{a}	8.80_{a}	6.17_{b}	6.21_{b}	1.55_{b}	1.52_{b}
AZ_1	28.20_{a}	28.25_{a}	9.87_{a}	9.54_{a}	6.60_{ab}	6.68_{a}	1.79_{a}	1.82_{a}
AZ_2	29.97_{a}	28.63_{a}	10.71_{a}	10.46_{a}	7.03_{a}	6.98_{a}	1.95_{a}	1.93_{a}
F test	N.S.	N.S.	N.S.	N.S.	*	*	**	**
LSD at 5%	--	--	--	--	0.56	0.47	0.19	0.11
Interaction(A*B)								
F test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
LSD at 5%	--	--	--	--	--	--	--	--
Calcareous soil								
Main plot(A)								
N_0	22.00_{b}	23.65_{c}	8.28_{b}	8.33_{a}	5.87_{c}	6.08_{c}	0.97_{d}	1.00_{d}
N_1	25.82_{ab}	24.67_{bc}	8.98_{ab}	9.63_{a}	6.44_{c}	6.43_{c}	1.30_{c}	1.25_{c}
N_2	31.41_{a}	30.92_{a}	11.26_{a}	11.63_{a}	7.68_{b}	7.78_{b}	2.02_{b}	1.98_{b}
N_3	28.77_{a}	28.75_{ab}	11.63_{a}	11.65_{a}	8.77_{a}	8.87_{a}	2.30_{a}	2.32_{a}
F test	*	*	N.S.	N.S.	**	**	**	**
LSD at 5%	5.82	4.83	--	--	0.90	0.56	0.27	0.23
Sub plot(B)								
Control	24.77_{b}	25.74_{a}	8.95_{b}	8.86_{b}	6.43_{b}	6.63_{c}	1.36_{c}	1.35_{c}
AZ_1	28.58_{a}	28.06_{a}	10.27_{ab}	10.94_{a}	7.11_{b}	7.23_{b}	1.62_{b}	1.64_{b}
AZ_2	27.63_{a}	27.19_{a}	10.90_{a}	11.12_{a}	8.03_{a}	8.02_{a}	1.97_{a}	1.91_{a}
F test	**	N.S.	N.S.	*	**	**	**	**
LSD at 5%	2.17	--	--	1.77	0.72	0.46	0.21	0.13
Interaction(A*B)								
F test	N.S.	N.S.	N.S.	N.S.	N.S.	*	**	**
LSD at 5%	--	--	--	--	--	0.71	0.73	0.46
Clayey soil								
Main plot(A)								
N_0	24.03_{c}	26.16_{b}	10.10_{ab}	8.99_{b}	6.27_{c}	6.39_{c}	1.48_{c}	1.48_{c}
N_1	27.85_{b}	30.31_{a}	8.86_{b}	9.56_{b}	7.43_{b}	7.39_{b}	1.91_{c}	1.87_{c}
N_2	36.33_{a}	33.31_{a}	12.88_{a}	12.84_{a}	9.70_{a}	9.78_{a}	3.90_{b}	3.94_{b}
N_3	29.06_{b}	30.51_{a}	10.51_{ab}	11.33_{ab}	10.47_{a}	10.59_{a}	4.46_{a}	4.45_{a}
F test	**	**	N.S.	N.S.	**	**	**	**
LSD at 5%	2.66	3.07	--	--	1.11	0.98	0.44	0.46
Sub plot(B)								
Control	27.21_{b}	29.66_{a}	10.46_{a}	10.22_{a}	7.52_{c}	7.39_{c}	2.43_{c}	2.36_{c}
AZ_1	29.72_{a}	30.54_{a}	10.22_{a}	10.35_{a}	8.58_{b}	8.78_{b}	2.94_{b}	2.98_{b}
AZ_2	31.01_{a}	30.02_{a}	11.08_{a}	11.46_{a}	9.30_{a}	9.44_{a}	3.43_{a}	3.46_{a}
F test	*	N.S.	N.S.	N.S.	**	**	**	**
LSD at 5%	2.50	--	--	--	0.57	0.57	0.192	0.22
Interaction(A*B)								
F test	*	N.S.	N.S.	N.S.	**	**	**	**
LSD at 5%	1.93	--	--	--	0.88	0.88	0.66	0.75

Also, due to guar inoculation with Rhizobium there was significant increase in seed protein % in the first season, but insignificant in the second season, the maximum values of seed protein% (31.01%) were found with AZ_2 in the 1st season. Concerning soil type it is recognized that the highest seed protein % was obtained with clayey soil. These results are in harmony with the finding of Ghalab *et al.*, (2000) and Rugheim and Abdelghani (2009)

In respect with straw protein %, data in Table 4 indicate that there is no significant with clay and calcareous soil. While with sandy soil there is significant increase in straw protein % with nitrogen fertilizer levels, the highest values of straw protein %, were obtained with N_3 (30 kg N/fed) in sandy and calcareous soil in both seasons. N_2 (20 kg N/fed) gave the highest values of straw protein % with clayey soil in both seasons. Also, Rizobium inoculation (AZ_2) gave the highest values of straw protein % for all types of soil in both seasons.

Also, Rhizobium In sandy soil the increasing percentages of straw protein % due to applying 30 kg N/fed were 59.6% and 46.3% compared to control in the 1st and 2nd season, respectively. Whereas, the maximum increase with calcareous soil in straw protein% (40.46 and 39.86% over the control) was recorded by the application of 30 kg N/fed (N_3) in the 1st and 2nd season, respectively. While in clayey soil, the increasing percentages of straw protein % were 27.52% and 42.83% were recorded by the application of 20 kg N/ fed compared to control in the 1st and 2nd season, respectively. Also, due to guar inoculation with Rhizobium (AZ_2) the increasing percentages of straw protein % in sandy soil were 19.13% and 18.86% compared to control in the 1st and 2nd seasons, respectively. Also, calcareous soil gave an increasing percentage of 21.79% and 25.51% compared to control in the 1st and 2nd season, respectively. Clayey soil gave an increasing percentages of 5.93% and 12.13% compared to control in the 1st and 2nd season, respectively.

Concerning soil type, it was recognized that the maximum values of straw protein % was obtained with sandy soil (13.07%) with application of 30 kg N/fed (N_3) in the 1st season. These results are in harmony with the finding of El-Kramany *et al.*, (2000), Al-Sheikh (2004); Gomaa *et al.*, (2006), and Hauka *et al.*, (2008).

Data in Table 4 show that seed oil % was high significantly responded to nitrogen fertilizer levels in both seasons. The highest value with sandy soil was 7.92% and 7.93% obtained as a result of adding 30 kg N/fed in the 1st and 2nd seasons, respectively. Also, data indicate that seed oil % increased highly significant due to guar inoculation with AZ_2 in sandy soil which recorded (7.03, 6.98%) in the 1st and 2nd season, respectively.

Whereas with calcareous soil, Data in Table 4 show that seed oil % was significantly responded to nitrogen fertilizer levels and inoculation with nitrogen fixing bacteria (Rhizobium inoculation) in both seasons. The maximum increase in seed oil % (49.4 and 45.9% over the control) was recorded by the application of 30 kg N/fed (N_3) in the 1st and 2nd seasons, respectively. Also, maximum values of seed oil % (8.03 and 8.02%) were found with AZ_2 in the 1st and 2nd season, respectively.

Data in Table 4 show that the highest value of seed oil % with clayey soil was 10.47 and 10.59% obtained as a result of adding 30 kg N/fed in the 1st and 2nd season, respectively. Also, due to guar inoculation with Rhizobium there was a significant increase in seed oil % in both seasons, the maximum values of seed oil % (9,3 and 9.44%) were found with AZ_2 in the 1st and 2nd season, respectively. Concerning soil type it is recognized that the highest seed oil % was obtained with clayey soil. These results are in harmony with the finding of Ghalab *et al.*, (2000), Rugheim and Abdelghani (2009) and Ibrahim *et al.*, (2010)

In respect with oil seed yield, data in Table 4 indicate that there is a highly significant increase with all soil types under study factors. While with nitrogen fertilizer levels, the highest values of oil seed yield were obtained with N_3 (30 kg N/fed) in all soil types in both seasons. inoculation (AZ_2) gave the highest values of oil seed yield for all types of soil in both seasons.

In sandy soil the increasing percentages of oil seed yield due to applying 30 kg N/fed were 144.4% and 140.2% compared to control in the 1st and 2nd seasons, respectively. Whereas, the maximum increase with calcareous soil in oil seed yield (131.1 and 132% over the control) was recorded by the application of 30 kg N/fed (N_3) in the 1st and 2nd season, respectively. With clayey soil, the increasing percentages of oil seed yield were 201.4% and 200.7% compared to control in the 1st and 2nd season, respectively. Also, due to guar inoculation with Rhizobium (AZ_2) the increasing percentages of oil seed yield in sandy soil were 25.8% and 27% compared to control in the 1st and 2nd season, respectively. Also, calcareous soil gave increasing percentage of 44.9% and 41.5% compared to control in the 1st and 2nd season, respectively. Clayey soil gave increasing percentages of 41.2% and 46.6% compared to control in the 1st and 2nd season, respectively.

Concerning soil type, it was recognized that the maximum values of oil seed yield was obtained with clayey soil (4.46 g/pot) with application of 30 kg N/fed (N_3) in the 1st season. These results are in harmony with the finding of Ghalab *et al.*, (2000), Rugheim and Abdelgani (2009) and Ibrahim *et al.* (2010)

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دراسات على محتوى النيتروجين ومحصول ومكونات المحصول فى نبات الجوار تحت تاثير التلفيح البكتيرى والتسميد النيتروجينى

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**** معهد بحوث الأراضي و المياه والبيئة ، مركز البحوث الزراعية**

نفذت تجربتي اصص خلال موسمى صيف 2008 و 2009 في صوبة سلكية بمحطة سخا للبحوث الزراعية –محافظة كفر الشيخ-مصر. وكان هدف التجربة تقييم تاثير مستويات التسميد النيتروجينى (N_0=بدون تسميد نيتروجينى، N_1 =10كجم ن/فدان، N_2= 20كجم ن/فدان ، N_3=30كجم ن/فدان) والتلقيح البكتيرى بالبكتريا المثبتة لنيتروجين الهواء الجوى (كنترول بدون تلقيح، AZ_1 (خليط من سلالات Ga+650) ، AZ_2 (خليط من سلالات Ga+500)) على تكوين العقد الجذرية بعد 60 يوم والمحصول ومكونات محصول نبات الجوار تحت ظروف انواع مختلفة من الأراضى. وقد تم تنفيذ التجربتين في تصميم تجريبى قطع منشقة مرة واحدة فى ثلاث مكررات.

وتشير النتائج الى ان الوزن الجاف للعقد الجذرية زاد معنويا باضافة 30 كجم نيتروجين/فدان فى الأراضى الرملية بينما معدل 20 كجم نيتروجين/فدان اعطى اعلى قيم للوزن الجاف للعقد الجذرية فى الأراضى الجيرية والطينية. كذلك فان معدل 20كجم نيتروجين /فدان اعطى 289.44 ،289.44 مجم/اصيص فى الأراضى الطينية خلال الموسم الأول والثانى على الترتيب. كما اعطى التلقيح البكتيرى بـ AZ_2 زيادة معنوية للوزن الجاف للعقد الجذرية تحت ظروف جميع انواع الأراضى بالدراسة، وكان اعلى وزن جاف للعقد الجذرية 229 مجم/اصيص مع الأراضى الجيرية فى الموسم الأول و 228.58 مجم/اصيص مع الأراضى الطينية فى الموسم الثانى

كذلك فان تاثير التفاعل بين التسميد النيتروجينى والتلقيح البكتيرى فى الأراضى الطينية اعطى اعلى وزن جاف للعقد الجذرية بعد 60 يوم مع المعاملة N2Az2 (التسميد بـ 20 كجم نيتروجين على الفدان + التلقيح بـ AZ_2) معطيا (840 و 640 مجم/اصيص) فى الموسم الأول والثانى على التوالى.

كما ان محصول البذور زاد بصورة معنوية عن الكنترول كنتيجة لاضافة اما 30 كجم نيتروجين/فدان او التلقيح بـAZ2 فى الأراضى الطينية.كانت اعلى قيم لمحصول البذور لنبات الجوار مع اضافة 30 كجم نيتروجين /فدان التى اعطت 42.56 و 41.97 جم/اصيص فى الأراضى الطينية فى الموسم الأول والثانى على الترتيب. بينما وجد أن معدل 20كجم نيتروجين/فدان اعطى اعلى محصول قش (117.73 جم /اصيص) فى الموسم الأول مع الأراضى الطينية بينما اضافة AZ2 اعطت اعلى محصول قش (100.53 جم /اصيص) فى الموسم الأول

كما توضح النتائج ان محصول الزيت زاد بصورة معنوية مع زيادة معدلات التسميد النيتروجينى واعطىمعدل 30 كجم نيتروجين /فدان اعلى محصول زيت (4.46 و 4.45 جم/الأصيص) فى الموسم الأول والثانى على الترتيب. كذلك فان Az2 اعطت اعلى محصول زيت (3.43 ، 3.46 جم/اصيص) فى الموسم الأول والثانى على الترتيب

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