EFFECT OF BACTERIAL INOCULATION AND NITROGEN FERTILIZATION ON GROWTH, NODULATION AND YIELD OF SOME PEANUT (*ARACHIS HYPOGAEA)* CULTIVARS

ABSTRACT

Pot and field experiments were carried out during the summer growing seasons to evaluate the response of peanut cultivars, "Giza 5"and "Giza 6"to inoculation with *Bradyrhizobium* individually or mixed with *Azospirillum, Azotobacter chroococcum* or *Bacillus polymyxa* as co-inocula under two rates of nitrogen fertilizer. Results indicated that inoculation generally increased all tested parameters (plant growth, microbial activity in the rhizosphere and yield of peanut cultivars). Mixed inoculation showed the highest values of shoot and root dry weights, compared to *Bradyrhizobium* alone. A comparison between the different inocula for their effect in enhancing shoot, root dry weights followed the descending order: *Bacillus polymyxa +Rh> Azospirillum+Rh> Azotobacter chroococcum+Rh> Bradyrhizobium* alone. The higher figures were recorded for *Bacillus polymyxa +Rh* which gave increases in dry weights of shoots up to 52.05 and 39.96% and of roots up to 97, 26 and 103.63% for "Giza5" and "Giza 6" cultivars, respectively. Nodulation was significantly augmented by inoculation, and more clearly with the coinoculation.

Key words: *Bradyrhizobium, Azospirillum, Azotobacter chroococcum, Bacillus polymyxa,* Diazotrophs, Legumes.

INTRODUCTION

Plant growth promoting rhizobacteria (PGPR) are one class of beneficial bacteria inhabiting the soil ecosystem **(Klopper *et. al.*, 1986; Frankenberger and Arshed, 1995)**and Arshed and Frankenbergar, 1998).These bacteria significantly affect plant growth by increasing nutrient cycling , suppressing pathogens by producing antibiotics and siderophores or bacterial and fungal antagonistic substances and /or by producing biologically active substances, such as auxins and other plant hormones. A diverse array of bacteria inoculating species of *Pseudomonas, Azospirillum, Azotobacter, Bacillus, Klebsiella , Enterobacter* and *Serratia* have been shown to promote plant growth, as well as, promote nodulation in many legume species (Li and Alexander, 1990). The ability of *Azospirillum* to produce phytohormones has been hypothesized to playa major role in promoting nodulation in legumes **(Yahalam *et al.*, 1990*).*** Auxins may also be important for maintaining functional root nodules; effective nodules have a high IAA content than ineffective nodules **(Badenoch- Jones *et al.*,1983).** *Azotobacter* and *Bacillus polymyxa* are N_2-fixing bacteria that inhabiting the soil and can enhance plant growth by producing growth stimulators and cytokinins **(Barea and Brown, 1974).**

Co-inoculation of legumes with *Rhizobium* (PGPR) has received increasing attention in recent years. Co-inoculation with *Bacillus* and *Pseudomonas* increased nodule number, nodule fresh weight, nitrogenase activity, leg hemoglobin content and total soluble protein content in root nodule of *Phaseolus vulgaris* and *soybean* **(Srinivasan *et al.*, 1996; Chebotar *et al.*,*2001).***

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Groundnut is an important oil seed crop of Egypt and occupies a prominent position both in regard to area and production in the world. The major constraint in production is fertilizer requirements especially in sandy soil. It is grown in Egypt for human fresh consumption and production, due to its highly oil, protein and carbohydrates content, in addition to its advantages in newly reclaimed soils.

In the present paper, we studied the effects of inoculation by *Bradyrhizobium* alone or mixed *with Azospirillum, Azotobacter chroococcum* or *Bacillus polymyxa* as co-inocula and nitrogen fertilizer on plant growth, nodulation and crop yield of two genotypes of peanut cultivars.

MATERIALS AND METHODS

1. The Pot Experiment:

Response of peanut *(Arachis hypogaea)* cultivars, i.e., "Giza 5" and "Giza6", to inoculation with *Bradyrhizobium* individually or mixed with *A. chroococcum, Azospirillum* or *B. polymyxa* as co-inoculant in presence of half or full dose of N fertilizer was studied in a greenhouse experiment in summer season. Pots (30 w. x 30 h. cm), were filled with 8kg of sandy soil each and fertilized with supper phosphate (15.5 % P_20_S) at a rate of 150 kg /fed. and potassium sulphate (48% K_20)at a rate of 50 kg/fed. before sowing. Five seeds were sown in each pot. After 15 days from sowing, seedlings were thinned to 3 plants per pot and the nitrogenous fertilization (NH_4N0_3) was achieved at two rates 50and 100 % of recommended dose, i.e. 15kgN *I* fed. and 30kgN/ fed. Microbial Determinations

A: Dehydrogenase activity: was carried out according to **Thalman (1967).**

B. Total bacterial count: Total bacteria were counted according to the method described by **(Difco 1985).** Plant growth characters: Shoot and root dry weights as well as nodulation status.

2.The Field Experiment

The influence of inoculation with different efficient N_2 -fixing bacteria in presence of different rates of mineral nitrogen fertilizer (NH_4N0_3) was studied under field conditions in a summer season of the year next to the pot experiment, at Ismailia Agricultural Research Station.

Bacterial inoculants

Single and dual diazo trophic inocula were used to inoculate peanut seeds, as follows:

1. Control (uninoculated).
2. Rhizobia, *Bradyrhizobium* [strains 601 +3456]
3. Rhizobia + *Azotobacter chroococcum.*
4. Rhizobia +*Bacillus polymyxa.* Rhizobia +*Azospirillum brasilense.*
5. Mixed inoculum (Rhizobia + *Azotobacter chroococcum+ Bacillus polymyxa + Azospirillum brasilense.)*

Some physio-chemical properties of the soil are given in Table (1). Methods of analyses were according to **Page *et al*.(1982).**

Table (1) A analytical data of the experimental soil.

A. Physical Properties

	Particle size distr., %			
$CaC0_3$, %				**Textural class**
	Clay	Silt	Sand	
1.90	6.61	4.80	88.59	Sandy

Organic matter 0.028 %

B. Chemical Properties

PH*	EC**	Soluble cations				Soluble anions (meq/L)			
		Ca^{++}	Mg^{++}	K^{+}	Na^{+}	$C0_3$	$HC0_3^{-}$	Cl^{-}	$S04^{--}$
7.63	7.20	0.36	0.32	0.	0.56	----	0.41	0.36	0.61

* In the PH 1: 2.5 soil/water suspension & ** EC 1: 5 soil/water extract (w/v).

RESULTS AND DISSECTION

1. The Pot Experiment

Data in Tables (2 and 3) indicate that inoculation with *Bradyrhizobium.* Individually r mixed with *A. chroococcum* , *Azospirillum* or *B. polymyxa* as co--inoculant significantly increased shoot and root dry weights both plant cultivars at 30, 60 and 90 days after sowing. The mean values of shoots were 6.79, 7.07, 9.26, 8.79 and 6.09 and 5.66, 6.23, 7.18, 6.96 and 5.13 g / plant and of roots were 0.86, 1.01, 1.25, 1.22 and 0.73and 0.64, 0.74, 0.91, 0.84 and 0.55 g/plant for the peanut cultivars "Giza 5" and "Giza 6", inoculated with *Rh. +A. chroococcum*, *Rh.* **+** *Bacillus polymyxa*, *Rh.* **+** *Azospirillum* , *Bradyrhizobium* alone and un-inoculated plants, respectively.

Shoot and root dry matter production for the cultivar, “Giza 5" exhibited increases of 23.5 and 37.77 % over the control "Giza 6", respectively. Co-inoculation gave higher increase, as compared with *Bradyrhizobium* alone and un-inoculated plants for both cultivars. Increases were 23.3 and 37.4% and 19.9 and 32.3 % for shoots of "Giza 5" and "Giza6", respectively. Also, the co-inoculation caused a significant increases in root dry weights, compared to *Bradyrhizobium sp.* alone and un-inoculated plants with the two crop cultivars, when they gave 34.8 and 58.9 % and 29.6 and 50.9 % for the cultivars "Giza 5" and "Giza 6", respectively. It was also observed that a comparison between the different inoculant, for their effect on increasing shoot and root dry weights of peanut plants, showed the following descending order: *Rh.+ Bacillus polymyxa* **>** *Rh.+ Azospirillum* **>** *Rh.+A. chroococcum* > *Bradyrhizobium* alone.

Integration of the co-inoculation with the full dose of N-fertilizer resulted in significantly higher shoot and root dry weights of both cultivars. Increasing N--fertilizer rate from 10 kg/fed. to 20 kg/fed. gave average increases of 40.4 and 44.2 % of shoot and root dry weights, respectively. Such increases might be due to stimulation of vegetative growth, as well as, by improving dinitrogen fixation by bacterial inocula and production of plant growth regulators such as phytohormones and vitamins. Such growth regulators promote plant root proliferation, respiration rate and metabolism enhancing mineral and water uptake in the inoculated plants. These results agree with those obtained by **Srivastava** and **Ahlawat (1995), Burdman and Okon (1997) Carla(1997), Omar *et al*.(2000), Swelim and Abdel-Wahab (2000), and Mekhemar (2001).**

Table (2): Effect of inoculation with bacterial diazotrophs at different levels of mineral N-fertilizer (NH_4N0_3) on shoot dry weight of peanut cultivars after 30, 60 and 90 of sowing.

Bacterial inocula	Nitrogen fertilizer (kg/fed.)	Shoot d.wt.(2 plants)							
		Giza 5				Giza 6			
		Days after Sowing							
		30	60	90	mean	30	60	90	mean
Control	10	2.49	5.94	7.30	5.24	2 . 20	4.53	6.93	4.55
	20	4.61	6.36	9.88	6.95	3.01	6.07	8.07	5.71
	mean	3.55	6.15	8.59	6.09	2.60	5.30	7.05	5.13
Bradyrhizobium (Rh)	10	2.70	6.64	8.16	5.83	2.30	4.68	7.14	4.71
	20	4.74	7.55	11.01	7.76	3.71	6.14	10.01	6.62
	mean	3.72	7.09	9.58	6.79	3.00	5.41	8.57	5.66
Azotobacter chroococcum+ Rh	10	3.02	6.66	8.70	6.12	2.65	5.10	7.83	5.19
	20	5.04	10.14	12.68	9.28	4.29	6.81	10.74	7.28
	mean	4.03	8.80	10.69	7.07	3.47	5.95	9.28	6.23
Bacillus polymyxa +Rh	10	3.13	8.19	11.07	7.46	2.75	5.61	9.68	6.01
	20	5.28	12.14	15.81	11.07	4.48	7.04	13.54	8.35
	mean	4.20	10.16	13.44	9.26	3.61	6.32	11.61	7.18
Azospirillum brasilense + Rh	10	3.12	7.54	10.79	7.15	2.80	5.21	9.16	5.72
	20	5.18	11.89	14.27	10.44	4.45	6.97	13.21	8.21
	mean	4.15	9.71	12.53	8.79	3.62	6.09	11.18	6.96

LSD		5%	1%		5%	1%	5%	1%
Peanut cultivars	A	0.58	0. 58	A X B	0.07	0.1	A X B X C	
Bacterial inoculants	B	0.71	1.08	A X C	0.04	0.05	0.11	0.14
Nitrogen fertilizers	C	0.34	0.5	B X C	0.07	0.10		

Table (3): Effect of inoculation with bacterial diazotrophs at different levels of mineral N-fertilizer (NH_4N0_3) on root dry weight *gI* plant) of peanut cultivars

Bacterial inocula	Nitrogen fertilizer (kg/fed.)	Peanut Cultivars							
		Giza 5				Giza 6			
		Days after sowing							
		30	60	90	mean	30	60	90	mean
Control	10	0.22	0.67	0.98	0.62	0.18	0.46	0.70	0.44
	20	0.46	0.94	1.14	0.84	0.47	0.73	0.81	0.67
	mean	0.34	0.81	1.06	0.73	0.32	0.59	0.75	0.55
Bradyrhizobium (Rh)	10	0.27	0.84	1.08	0.73	0.22	0.53	0.82	0.52
	20	0.56	1.17	1.25	0.99	0.52	0.85	0.94	0.77
	mean	0.41	1.00	1.16	0.86	0.37	0.69	0.88	0.64
Azotobacter chroococcum+Rh	10	0.33	0.94	1.27	0.84	0.29	0.62	0.89	0.60
	20	0.64	1.29	1.60	1.17	0.57	0.96	1.15	0.89
	Mean	0.48	1.11	1.43	1.01	0.43	0.79	1.02	0.74
Bacillus polymyxa +Rh	10	0.38	1.14	1.68	1.06	0.34	0.71	1.03	0.69
	20	0.73	1.55	2.06	1.44	0.67	1.10	1.61	1.12
	mean	0.55	1.34	1.87	1.25	0.51	0.91	1.32	0.91
Azospirillum brasilense + Rh	10	0.38	1.10	1.64	1.04	0.36	0.64	0.93	0.64
	20	0.70	1.49	2.02	1.40	0.70	1.02	1.43	1.05
	mean	0.54	1.29	1.83	1.22	0.53	0.83	1.18	0.84

L.S.D. at level of:	5%	1%		5%	1%		5%	1%
Peanut cultivars	A 0.06B	0.10	AxB	0.02	0.03	AxBxC	0.03	0.04
Bacterial inocula	0.12 C	0.19	AxC	0.01	0.02			
Nitrogen fertilizer	0.01	0.02BxC		0.02	0.03			

It was observed that raising the N fertilizer dose generally favored nodulation process (number and dry weights of nodules) of the two peanut cultivars. Plants of the cultivar "Giza5" exhibited increases 56.55 and 115.38 % in number and dry weight of nodules, respectively, higher over than those of the" Giza 6"cultivar. Nodulation process was more pronounced at the 90 th day, compared to the 50th day after sowing, when they gave increases of 49.77 and 177.47 % for number and dry weight of nodules, in respect (Table, 4). Co-inoculation significantly augmented nodulation, when compared with *Bradyrhizobium* alone and the un-inoculated plants, when they gave mean values of 80.41, 73.33, 53.95,42.29 and 19.87 nodule / plant,

and 0.340, 0.302,0.218,0.169 and 0.0528 g dry weight of nodules / plant inoculated with *Rh. + Azospirillum, Rh. + Bacillus polymyxa, Rh. +A. chroococcum, Bradyrhizobium* alone and the un-inoculated plants (control), respectively. These data are in harmony with results obtained by EI-Sayed, 1999, found a significant influence of co -inoculation *(Rhizobium* plus *Bacillus polymyxa)* on nodulation of lentil compared to *Rhizobium* alone. The observed benefits on lentil by combined inoculation might be due to the cumulative effects such as supply of N and P to the crop in addition to growth promoting substances produced by these organisms. Also, **Rodelas *et al*.(1999) clearly** revealed that mixed inoculation *(Rhizobium* plus *Azotobacter chroococcum)* had a significant effect on nodulation. **Burdman *et al.*,(1996)** found that inoculation with *Rhizobium* and *Azospirillum.* Increased nodule number and dry weight as well as plant growth parameters of chickpea and *Phaseolus vulgaris.*

Total bacterial count and Enzyme Activity

Data in Tables (5and 6) obviously showed that inoculation with *Bradyrhizobium* individually or mixed with *Azotobacter chroococcum , Azospirillum* or *Bacillus polymyxa* remarkably increased total microbial count and dehydrogenase activity (DHA) in the rhizosphere soil of the inoculated plants of both cultivars. Results indicated that the co-inoculation was more effective, when gave mean values 7.39, 7.81, 7.62 and 7.15, 7.30, 7.24 (log number of cfu / g dry soil) compared to *Bradyrhizobium* alone and the un-inoculated plants (control), when gave 7.16, 7.06 and 7.08, 6.81(log number of cfuJ g dry soil) for "Giza5" and "Giza6", respectively. Means of increases over *Bradyrhizobium sp* alone and control were 6.23, 7.73% and 2.12, 6.16 % with both cultivars, "Giza5" and "Giza6", respectively. *Rh.+ Bacillus polymyxa* was more promotoive, as compared with *Rh.* **+** *Azospirillum sp* or *Rh. + Azotobacter chroococcum* , when they gave 8.00 cfu *lg* dry soil after 60^{th} day from sowing. It was also observed that the best increase was found after 60^{th} days from sowing with two levels of N-fertilizer.

In regard to mineral fertilizer nitrogen levels, it was shown that 20kgN/fed. (as recommended dose)was the favorite level for the microbial growth in the peanut rhizosphere. It was indicated that the total microbial count in the peanut rhizosphere area had increased gradually with increasing the nitrogen level. These results agree with those obtained by **Milosev *et al* .(1996), Pandey *et al*.,(1998), El-Gizy *et al*.(1999) and Panwar *et al.* (2000).**

Table (4): Effect of inoculation with diazotrophs at different levels ofN-fertilizer (NH4N03) on nodulation of peanut cultivars

Bacterial inoculants	Nitrogen fertilizer (kg/fed.)	Cultivars: Giza 5						Giza 6					
		nodules No / plant			.nodules d.wt /plant			nodules No/plant			nodules d.wt /plant		
		Days after sowing						Days after sowing					
		50	90	mean	50	90	mean	50	90	mean	50	90	mean
Control	10	17.66	24.00	20.83	0.046	0.069	0.057	13.33	19.33	16.33	0.034	0.040	0.037
	20	18.33	27.66	22.99	0.052	0.087	0.069	15.66	23.00	19.33	0.040	0.052	0.046
	mean	17.99	25.83	21.91	0.049	0.078	0.063	14.49	21.65	17.83	0.037	0.046	0.041
Bradyrhizobium (Rh)	10	41.00	57.00	49.00	0.101	0.391	0.246	29.33	32.66	30.99	0.086	0.086	0.086
	20	47.66	61.66	54.66	0.110	0.402	0.256	34.00	35.00	34.50	0.088	0.092	0.090
	mean	44.33	59.33	51.83	0.105	0.396	0.251	31.66	33.83	32.74	0.087	0.089	0.088
Azotobact chroococcum+ Rh	10	50.66	67.00	58.83	0.126	0.422	0.274	36.00	48.00	42.00	0108	0.121	0.114
	20	58.00	71.33	64.66	0.139	0.434	0.286	39.33	52.33	45.83	0.118	0.140	0.129
	mean	54.33	69.16	61.74	0.132	0.428	0.280	37.66	50.16	43.91	0.113	0.130	0.121
Bacillus porymyxa+Rh	10	55.33	116.33	85.83	0.131	0.600	0.365	44.00	54.33	49.16	0.111	0.136	0.123
	20	63.66	145.00	104.33	0.152	0.784	0.468	48.66	59.33	53.99	0.151	0.354	0.252
	mean	59.49	130.66	95.08	0.141	0.692	0.416	46.33	56.83	51.57	0.131	0.245	0.187
Azospirillum brasilense+Rh	10	59.00	117.66	88.33	0.140	0.598	0.369	47.66	65.33	56.49	0.115	0.316	0.215
	20	70.66	154.33	112.49	0.173	0.808	0.491	57.00	71.66	64.33	0.174	0.396	0.285
	mean	64.83	135.99	100.41	0.156	0.703	0.429	52.33	68.49	60.41	0.144	0.356	0.250

L.S.D. at level for:		5%		1%			5%		1%	
		NO.	dw.	NO.	dw.		No.	dw.	No.	dw.
Peanut cultivars	A	12.73	0.05	19.28	0.08	AxB	2.20	0.005	2.92	0.007
Bacterial inocula	B	23.81	0.11	36.08	0.16	AxC	1.17	0.003	1.56	0.004
Nitrogen fertilizer	C	4.00	0.01	5.92	0.02	BxC	2.20	0.005	2.92	0.007
	AxBxC	2.54	0.006	3.37	0.009					

Table (5): Effect of inoculation with bacterial diazotrophs at different levels of N Fertilizer (NH4N03) on total microbial count log number (cfu /g soil) of peanut cultivars.

Bacterial incula	Nitrogen fertilizer kg/fed.	Peanut Cultivars							
		Giza 5				Giza 6			
		Days after sowing							
		30	60	90	mean	30	60	90	mean
Control	10	6.99	7.14	6.98	7.03	6.52	7.07	6.73	6.77
	20	7.05	7.20	7.02	7.09	6.68	7.11	6.79	6.86
	mean	7.02	7.17	7.00	7.06	6.60	7.09	6.76	6.81
Bradyrhizobium (Rh)	10	7.10	7.28	7.04	7.14	7.05	7.18	6.91	7.04
	20	7.14	7.34	7.10	7.19	7.12	7.27	6.99	7.12
	mean	7.12	7.31	7.07	7.16	7.08	7.22	6.95	7.08
Azotobacter chroococcum+Rh	10	7.28	7.68	7.01	7.32	7.12	7.23	6.93	7.09
	20	7.41	7.89	7.10	7.46	7.22	7.42	7.03	7.22
	mean	7.34	7.78	7.05	7.39	7.17	7.32	6.98	7.15
Bacillus polymyxa +Rh	10	7.52	7.93	7.82	7.75	7.26	7.40	7.10	7.25
	20	7.66	8.07	7.91	7.88	7.37	7.55	7.15	7.35
	mean	7.59	8.00	7.86	7.81	7.31	7.47	7.12	7.30
Azospirillum brasilense +Rh	10	7.35	7.79	7.35	7.49	7.23	7.32	7.05	7.20
	20	7.60	7.97	7.73	7.76	7.38	7.38	7.12	7.29
	mean	7.47	7.88	7.54	7.62	7.30	7.35	7.08	7.24

Table (6): Effect of inoculation with diazotrophs at different levels of N-fertilizer (NH_4N0_3) on dehydrogenase activity (ul H/ g dry soil) of peanut cultivars .

Bacterial inoculants	Nitrogen fertilizer level (kg/fed.)	Peanut Cultivars									
		Giza 5					Giza 6				
		Days after sowin2									
		21	45	75	100	Mean	21	45	75	100	mean
Control	10	1149.67	1690.43	2104.39	1689.26	1236.12	578.54	1025.88	1549.10	788.33	1060.46
	20	1354.65	1943.52	2353.97	1961.56	1903.42	1078.01	1450.37	1851.30	928.15	1326.95
	mean	1252.16	1816.97	2229.18	1825.41	1569.77	978.27	1238.12	1700.20	858.24	1193.71
Bradyrhizobium (Rh)	10	1298.01	2128.95	2255.24	2067.30	1937.37	1045.43	1346.13	1609.74	1319.56	1330.21
	20	1626.78	2304.36	2544.92	2145.49	2155.38	1172.22	1950.53	2141.48	1468.91	1683.28
	mean	1462.39	2216.65	2400.08	2106.39	2046.37	1108.82	1648.33	1875.61	1394.23	1506.74
Azotobacter c hroococcum+Rh	10	1628.78	2137.47	2865.66	2171.54	2200.86	1016.86	1837.77	2072.32	1534.06	1615.25
	20	1859.82	2376.52	3128.27	2419.21	2445.95	1212.31	2233.19	2574.98	1950.53	1992.75
	mean	1744.30	2256.99	2996.96	2295.37	2323.41	1114.48	2035.48	2323.65	1742.29	1804.00
Bacillus polymyxa+Rh	10	1666.37	2243.26	2718.82	2451.20	2269.91	1443.33	2317.89	2707.23	1987.12	2113.89
	20	2065.30	2653.17	3810.86	2648.77	2794.52	1858.32	2507.83	3527.20	2414.69	2577.01
	mean	1865.83	2448.21	3264.84	2549.98	2532.02	1650.82	2412.86	2617.21	2200.90	2345.45
Azospirillum+ Rh	10	1720.50	2238.21	2720.32	2386.55	2266.39	1500.99	2092.86	2590.52	1755.08	1648.61
	20	1970.58	2527.85	3292.66	2526.88	2579.49	1824.24	2490.29	3059.62	2268.27	2410.60
	mean	1845.54	2383.03	3006.49	2456.71	2422.94	1662.61	2291.57	2825.07	2011.67	2029.61

L.S.D. at level of:	5%A	1%		5%	1%		5%	1%
Peanut cultivars	154.45B	234.01	AxB	249.20	327.50	AxBxC	352.43	463.16
Bacterial inocula	288.94C	437.79	AxC	133.20	175.05			
Nitrogen fertilizer	94.56	124.56	BxC	249.20	327.50			

Data in Table (6) illustrated that DHA activity in rhizosphere soil of peanut was greater when the co-inoculation was used for seeds before sowing as it , gave 2323.41, 2532.02, 2422.94 and 1804.00, 2345.45and 2029.61 ul H/g dry soil /hr with the cultivars "Giza 5" and "Giza 6", respectively. While *Bradyrhizobium* and control showed 2046.37, 1569.77 and 1556, 1193.71 ulH/g dry soil /hr. The values for the co-inoculation effect on DHA activity as compared with *Bradyrhizobium sp.* alone and control were 18.55, 54.55% and 36.69, 72.54 % with two cultivars "Giza 5"and "Giza 6", respectively. The highest values of DHA were recorded at the 75^{th} day of cultivation. In all cases, it was obvious that inoculation with a mixture of *Bradyrhizobium sp.* plus *Bacillus polymyxa* gave considerably higher DHA activity values compared to by those obtained by the other treatments and control. In respect with supplementation with graded levels of chemical N-fertilizer, data clearly reveal that the co-inoculation simultaneously with halfN dose from that recommended (10kg *N/fed.)* resulted in a higher DHA activity in soil compared to the full dose on N fertilizer. It could be seen that there was a gradual response to increasing the N levels. In other words, the greatest value of DHA activity was observed with the full dose **O** fN -fertilizer (20kg N *Ifed.),* as compared with the lower dose (10kg *N/fed.).* This increase attributed to increasing total microbial counts. These results are in harmony with those recorded by **Okon and Itzigsohn (1995); Pan des *et al*.(1998*);* EI-Kholy and Omar(2000) and Verma *et al*.(2001).**

Peanut Straw and Seed Yield:

Results of Table (7) indicated that straw and seed yields of peanut crops were promoted by inoculation with *Bradyrhizobium* individually or mixed with *A. chroococcum* or *Azospirillum sp* or *Bacillus polymyxa* in presence of the different rates **O** f N -fertilizer, compared to the with uninoculated plants. Results were more obvious when the co-inoculation by *Bradyrhizobium* plus *A. chroococcum* , *Azospirillum* , *B. polymyxa* was used, as compared with *Bradyrhizobium* alone and the uninoculated plants (control), when gave (20.13, 19.66, 22.98, 16.69 and 14.14) and (18.61, 18.73, 20.83, 13.92 and 11.03) g pod! Plant, for the cultivars "Giza 5" and "Giza 6", respectively.

Table (7): Effect of inoculation with diazotrophs in combination with N-fertilizer (NH_4N0_3) on [seed and straw]. yields of peanut cultivars .

Bacterial inocula	Nitrogen fertilizer rates (kg/fed.)	Peanut Cultivars			
		Giza 5		Giza 6	
		Yield (g/plant.)			
		Seed	Straw	Seed	Straw
Control	10	13.27	15.40	10.24	12.97
	20	15.02	19.39	11.83	15.85
	mean	14.14	17.39	11.03	14.41
Bradyrhizobium (Rh)	10	15.67	17.40	12.83	15.24
	20	17.72	25.20	15.01	18.29
	mean	16.69	21.30	13.92	16.76
Azotobacter chroococcum+Rh	10	18.19	23.45	16.60	19.41
	20	22.07	32.15	20.63	29.77
	mean	20.13	27.80	18.61	24.59
Bacillus polymyxa+Rh	10	20.16	25.27	18.63	23.58
	20	25.80	37.48	23.04	34.69
	mean	22.98	31.37	20.83	29.13
Azospirillum brasilnse+Rh	10	17.83	21.88	16.36	20.92
	20	21.49	31.80	21.10	31.11
	mean	19.66	26.84	18.73	26.01

L.S.D. at level of:		5%		1%			5%		1%	
for:		S.	St.	S.	St.		S.	St.	S.	St.
Peanut cu1tivars	A	0.81	1.25	1.23	1.90	AxB	1.19	1.26	1.59	1.68
Bacterial inocula	B	1.53	2.34	0.31	2.55	AxC	0.63	0.67	0.85	0.90
Nitrogen fertilizer	C	0.45	0.47	0.60	0.63	BxC	1.19	1.26	1.59	1.68
						AxBxC	1.69	1.78	2.25	2.38

They gave (27.80, 26.84, 31.37,21.30 and 17.39) and (24.59, 26.01, 29.13,16.76 and 14.41) g straw /plant of the cultivars "Giza 5" and "Giza 6", respectively. The increases in pod yield was (42.36, 39.03, 62.51and 18.03%) and (68.72, 69.93, 88.84 and 26.20 %) over the control for the cultivars "Giza 5" and "Giza 6", respectively. Extents of increase of straw yield was (59.86, 54.34, 80.39 and 22.48 %) and (70.64, 80.49,102.15 and 16.30 %) over the control of the cultivars "Giza 5" and "Giza 6",when inoculated by *Bradyrhizobium sp.* plus *A. chroococcum* , *Azospirillum sp, B. polymyxa* and *Bradyrhizobium sp.* alone respectively. Also, Data in Table (7) show that the peanut "Giza 5" exhibited increases of 13.86 and 12.16 % over "Giza 6" in pod and straw yields, respectively. In the other hand, nitrogen application significantly increased grain and straw yields, i.e. 20.50 and 41.60 % for the full N dose over the half dose with grain and straw yields, respectively.

These increases in grain and straw yields may be attributed to the available nitrogen supplemented with the inoculated N_2- fixing . Production of plant growth regulators, such as phytohormones and vitamins might also contribute. These results are in agreement with those obtained by **Rodelas *et al*.(1999*);* Omar *et al*.(2000)and Mekemar(2001).**

2. Field Experiment plant Growth

Results in Tables (8and 9) showed that inoculation with *Bradyrhizobium* individually or mixed with *Azotobacter chroococcum* , *Azospirillum sp.* , *Bacillus polymyxa* or a mixture of all in presence of half or full dose of N fertilizer significantly increased shoot and root dry weights after 30, 60 and 100 days from sowing. These results were more obvious at the full dose of mineral nitrogen fertilizer. The highest response of peanut plants to inoculation was recorded when plants were inoculated with *Bradyrhizobium* + a mixture of all inoculant and the plants supplemented with the full dose of N-fertilizer. Increases were 42.44 and 42.54% and 42.26 and 39.13 % for shoot and root dry weights cultivars "Giza 5" and "Giza 6", respectively over those of the uninoculated plants.

Table (8): Effect of inoculation with diazotrophs with N-fertilizer (NH_4N0_3) on shoot dry weight (g/ plant) of the peanut cultivars.

Bacterial inculants	Nitrogen fertilizer (kg/fed.)	Peanut Cultivars							
		Giza 5				Giza 6			
		Days after sowing							
		30	60	100	mean	30	60	100	Mean
Control	10	3.50	7.83	9.04	6.79	3.23	6.20	7.85	5.76
	20	3.97	9.20	11.70	8.29	3.89	8.93	11.41	8.07
	mean	3.73	8.51	10.37	7.54	3.56	7.56	9.63	6.91
Bradyrhizobium (Rh)	10	3.87	8.13	9.95	7.31	3.65	6.41	8.35	6.13
	20	4.44	10.66	13.59	9.56	4.60	9.33	11.75	8.56
	mean	4.15	9.39	11.77	8.43	4.12	7.87	10.05	7.34
Azotobacter chroococcum+ Rh	10	3.90	8.11	10.10	7.37	3.88	6.73	8.77	6.46
	20	4.85	12.11	14.70	10.55	4.58	9.55	12.66	8.93
	mean	4.37	10.11	12.40	8.96	4.23	8.14	10.71	7.69
Bacillus polymyx +Rh	10	4.22	9.58	12.40	8.73	4.05	7.87	10.86	7.59
	20	5.18	14.58	16.73	12.16	5.15	12.53	15.33	11.00
	mean	4.70	12.08	14.56	10.44	4.82	10.20	13.09	9.29
Azospirillum brasilense +Rh	10	4.02	9.17	12.04	8.41	3.85	7.89	10.31	7.35
	20	4.99	13.91	15.27	11.39	5.00	12.33	13.71	10.34
	mean	4.51	11.54	13.65	9.90	4.42	10.11	12.01	8.84
Mixed Inoculant	10	4.17	9.96	12.31	8.81	4.13	8.13	11.23	7.83
	20	5.51	15.48	17.06	12.68	5.33	14.23	16.08	11.88
	mean	4.84	12.72	14.68	10.74	4.73	11.18	13.65	9.85

L.S.D. at level of:	5%	1%		5%	1%		5%	1%
Peanut cultivars A	0.23	0.37	AXB	0.17	0.23	AXBXC	0.24	0.32
Bacterial inocula B	0.41	0.64	AXC	0.10	0.13			
Nitrogen fertilizer C	0.22	0.34	BXC	0.17	0.23			

Table (9): Effect of inoculation with bacterial diazotrophs with N-fertilizer (NH_4N0_3) on root dry weight (g/ plant) of peanut cultivars.

Bacterial inculants	Nitrogen fertilizer (kg/fed.)	Peanut							
		Giza 5				Giza 6			
		Days after sowing							
		30	60	100	mean	30	60	100	mean
Control	10	0.33	1.00	1.20	0.84	0.32	0.94	1.21	0.82
	20	0.53	1.23	1.54	1.10	0.46	1.12	1.51	1.03
	mean	0.43	1.11	1.37	0.97	0.39	1.03	1.36	0.92
Bradyrhizobium (Rh)	10	0.36	1.10	1.25	0.90	0.33	1.02	1.23	0.86
	20	0.58	1.37	1.68	1.21	0.50	1.17	1.54	1.07
	mean	0.47	1.23	1.46	1.05	0.41	1.09	1.38	0.96
Azotobacter chroococcum+ Rh	10	0.40	1.12	1.32	0.94	0.36	1.02	1.31	0.89
	20	0.66	1.47	1.88	1.33	0.59	1.23	1.73	1.18
	mean	0.53	1.29	1.60	1.13	0.47	1.12	1.52	1.03
Bacillus polymyxa +Rh	10	0.43	1.21	1.67	1.10	0.40	1.12	1.51	1.01
	20	0.72	1.84	2.10	1.55	0.71	1.62	1.86	1.39
	mean	0.57	1.52	1.88	1.32	0.55	1.37	1.68	1.20
Azospirillum Brasilense +Rh	10	0.41	1.19	1.56	1.05	0.40	1.11	1.46	0.99
	20	0.73	1.73	1.94	1.46	0.69	1.56	1.76	1.33
	mean	0.57	1.46	1.75	1.25	0.54	1.33	1.61	1.16
Mixed Inocula *+Rh.*	10	0.44	1.26	1.76	1.15	0.42	1.18	1.58	1.06
	20	0.76	1.88	2.20	1.61	0.74	1.76	2.02	1.51
	mean	0.60	1.75	1.98	1.38	0.58	1.47	1.80	1.28

L.S.D. at level of:		5%	1%		5%	1%		5%	1%
Peanut cultivars	A	0.02	0.04	AxB	0.02	0.03	AxBxC	0.24	0.32
Bacterial inocula	B								
Nitrogen fertilizer	C	0.03	0.05	BxC	0.04	0.05			

In general peanut cultivar " Giza 5 " exhibited higher s hoot a nd root dry weights (12.19 and 8.25 % over "Giza 6"). Irrespective of inoculation, higher doses of N-fertilizer improved plant growth, compared with the lower one in the un-inoculated plants. Results agree with those obtained by **Raverkar and Konde (1988) and Gall and Fabbri (1991).** They found that inoculation of peanut with *Rhizobium* plus *Azospirillum sp.* increased dry matter a 2- fold as compared with those inoculated with only *Rhizobium.* **Srinivasan *et al.*(1996); Burdman *et al.*(1996) Singh;(1996); EI-Komy and Abdel- Wahab(1998) and Rodelas *et al.*, (1999).** found that inoculation of *Phaseolus vulgaris* ,chick pea and faba bean plants with *Rhizobium* plus *Azospirillum* ,*Bacillus* significantly increased plant growth, dry matter compared with *Rhizobium* alone.

Nodulation status

Data in Table (10) revealed that inoculation of peanut with *Bradyrhizobium* individually or mixed with *Azotobacter chroococcum* or *Azospirillum* , *Bacillus polymyxa*, a mixture of all inoculant as a co-inoculation significantly increased nodule numbers and dry weights ,compared to the un-inoculated plants. Inoculation with *Bradyrhizobium* increased nodule numbers and their dry weights (per plant), when recorded the percentages 30.82and 26.24 % and 144.64 and 10.47 % for the peanut cultivars "Giza 5" and" Giza 6", respectively. Also, the co- inoculation exerted higher increases in the nodule numbers and dry weights, this was more obvious with *Bradyrhizobium* + a mixture of all inoculant , i.e. 118.82 and 86.06 % and 262.50 and 38.09 % over the un-inoculated plants (control) in numbers of nodules and their dry weights with the peanut cultivars "Giza 5" and "Giza 6", respectively. It can be seem that there was a gradual response in such parameters for the cultivars, owing to the increase in nitrogen fertilizer doses. The mean values of nodule numbers per plant were 58.32, 64.91, 94.66, 97.49 , 97.58 and 44.58 and 44.49, 49.91, 58.74, 62.41, 65.57 and 35.24 with the peanut cultivars "Giza 5" and "Giza 6", when inoculated with *Bradyrhizobium, Rh. + A. chroococcum, Rh. + B. polymyxa, Rh. + Azospirillum sp., Rh. +* a mixture of all inoculate and the uninoculated plants (control), respectively. The mean values of dry weights of nodules were 0.274, 0.301, 0.408, 0.404, 0.406 and 0.112 and 0.116, 0.123,0.136,0.141,0.145 and 0.105 *g!* Plant for the peanut Giza 5 and Giza 6, respectively. Similar results were obtained by **Srinivasan *et al*.(1996); Burdman *et al*.(1996);Singh(1996); Clara(1999)and Swelim** and **AbdelWahab (2000).** They found that inoculation legumes with *Rhizobium* plus *Azospirillum sp* or *Bacillus sp.or A. chroococcum* increased the numbers of nodules and their dry weight.

Microbiological aspects

Data in Tables (11 and 1 2) showed that inoculation with *B radyrhizobium* s *p.* individually or mixed with *Azotobacter chroococcum* , *Azospirillum sp.* or *Bacillus polymyxa* or a mixture of all inoculant, as co-inoculation, at half or full dose of N fertilizer remarkably increased total bacterial count and dehydrogenase activity in rhizosphere soil, as compared with the un-inoculated plants. Stimulation of bacterial population and activities in rhizosphere soil of the inoculated plants was more pronounced when the co-inoculation with *Bradyrhizobium* sp. plus a mixture of all inoculant was used. This result was true in most of plant growth stages and in the presence of the two N-fertilizer doses. Total bacterial count and dehydrogenase activity in rhizosphere soil gradually increased, reaching their maximal levels at the 60th day of cultivation then decline. In regard to the levels of chemical N-fertilizer, it was found that elevating the N amount was coincident with the increased total bacterial count and dehydrogenase activity in rhizosphere soil of peanut plants, reaching its maximal in the presence of the full N dose.

Data in Tables (11 and12) showed that the cultivar "Giza 5" exhibited increases of 2.85 and 12.57 % over "Giza 6" in the total bacterial count and dehydrogenase activity in rhizosphere soil, respectively. These increases may be due to diazotrophs inoculation which stimulated root surface area, and in turn encouraged root exudation. It is also expected that the rhizosphere of peanut plants would support proliferation of microorganisms and their activities, as compared with the uninoculated plants. These results came in agreement with those obtained by **Strzelczyk *et al*.(1994*);* EI-Gizy *et al.(*1999) and Omar *et al.* (2000).**

Table (11): Effect of inoculation with bacterial diazotrophs at the different levels of N-fertilizer $CNH4N0_3$) on the total bacterial count [log number (cfu /g soil)] of the peanut cultivars.

Bacterial inoculant	Nitrogen fertilizer (kg/fed.)	Peanut Cultivars							
		Giza 5				Giza 6			
		Days after sowing							
		30	60	100	mean	30	60	100	mean
Control	10	7.20	7.25	7.02	7.15	6.66	7.05	6.62	6.77
	20	7.30	7.38	7.14	7.27	6.87	7.15	6.91	6.97
	mean	7.25	7.31	7.08	7.21	6.76	7.10	6.76	6.87
Bradyrhizobium (Rh)	10	7.24	7.08	7.12	7.14	7.01	7.38	6.78	7.05
	20	7.40	7.49	7.24	7.37	7.13	7.62	7.03	7.26
	mean	7.32	7.28	7.18	7.25	7.07	7.50	6.91	7.15
Azotobacter chroococcum+ Rh	10	7.64	7.75	7.19	7.52	7.10	7.48	7.29	7.29
	20	7.76	7.80	7.32	7.62	7.32	7.69	7.69	7.56
	mean	7.70	7.77	7.25	7.57	7.21	7.58	7.49	7.42
Bacillus polymyxa +Rh	10	7.66	7.83	7.73	7.74	7.21	7.73	7.40	7.44
	20	7.85	7.94	8.05	7.94	7.43	7.82	7.93	7.72
	mean	7.75	7.88	7.89	7.84	7.32	7.77	7.66	7.58
Azospirillum brasilense +Rh	10	7.45	7.47	7.60	7.51	7.16	7.53	7.31	7.33
	20	7.60	7.82	7.77	7.73	7.36	7.71	7.83	7.63
	mean	7.52	7.64	7.68	7.62	7.26	7.62	7.57	7.48
Mixed Inoculant	10	7.66	7.86	7.98	7.83	7.26	7.73	7.45	7.48
	20	7.84	7.93	8.25	8.01	7.46	7.93	8.01	7.80
	mean	7.75	7.89	8.11	7.91	7.36	7.83	7.73	7.64

Table (12): Effect of inoculation with bacterial diazotrophs at the varying levels of N-fertilizer (NH_4N0_3) on dehydrogenase activity in rhizosohere soil (ul Hl g dry soil) of the peanut cuI'

Bacterial inoculant	Nitrogen fertilizer (kg/fed.)	Peanut Cultivars									
		Giza 5					Giza 6				
		Days after sowing									
		21	45	75	100	mean	21	45	75	100	mean
Control	10	2269.27	3137.29	3454.87	3096.70	2989.53	1858.32	3337.26	3530.21	3018.02	2935.95
	20	2432.15	3819.38	3836.42	3709.63	3449.39	2139.47	3965.72	3912.10	3762.25	3444.88
	mean	2350.71	3478.33	3645.64	3403.16	3219.46	1998.89	3651.49	3721.15	3390.12	3190.41
Bradyrhizobium (Rh)	10	2715.32	3456.54	4297.49	4037.39	3626.68	2193.60	4044.91	4172.21	3759.74	3542.61
	20	3047.09	4442.84	4797.66	4413.77	4175.34	2513.84	4377.68	4657.33	4065.96	3903.70
	mean	2881.20	3949.69	4547.57	4225.57	3901.01	2353.72	4211.29	4414.77	3912.85	3723.15
Azotobacter chroococcum+ Rh	10	3772.77	5355.96	5799.99	4705.95	4908.66	2327.41	4174.71	5124.42	4503.47	4032.50
	20	4470.90	6725.15	6728.66	6070.12	5998.71	3079.16	5466.22	5912.25	5221.65	4919.82
	mean	4121.83	6040.55	6264.32	5388.03	5453.68	2703.28	4820.46	5518.33	4862.56	4476.16
Bacillus Polymyxa+Rh	10	3164.86	5533.37	6753.72	6272.59	5431.13	3022.03	5462.21	5482.25	5126.42	4773.22
	20	4327.51	5849.61	8129.41	6787.29	6273.45	3439.50	5889.70	6410.92	5616.56	5339.17
	mean	3746.18	5691.49	7441.56	6529.94	5852.29	3230.76	5675.95	5946.58	5371.49	5056.19
Azospirillum brasilense+Rh	80	2949.36	4364.65	5196.09	5141.46	4412.89	2368.51	5040.73	4655.83	4224.33	4072.35
	160	3230.51	4959.04	6281.62	5353.96	4956.29	2723.83	5666.18	5024.19	4362.15	4444.08
	mean	3089.93	4661.84	5738.85	5247.71	4684.58	2546.17	5353.45	4840.01	4293.24	4258.21
Mixed inoculant	10	3252.56	5800.50	5372.50	4397.76	4705.83	2511.84	5340.42	5103.87	4317.04	4318.29
	20	3678.05	6790.30	5623.58	5600.53	5423.11	2791.49	6143.79	5375.50	4577.65	4722.10
	mean	3465.30	6295.40	5498.04	4999.14	5064.47	2651.66	5742.11	5239.68	4447.34	4520.19

L.S.D. at level of: 5% 1% 5% 1% 5% 1%

Peanut cultivars

Bacterial inocula

Nitrogen fertilizer 5%

Feed and Straw Yields

Inoculation with *Bradyrhizobium* individually or mixed with *Azotobacter chroococcum ,Azospirillum* , *Bacillus polymyxa* , a mixture of all at half and full recommended doses ofN fertilizer significantly increased seed and straw yields of both plant cultivars Table (13). Inoculation with *Bradyrhizobium* and co-inocula gave increase 10.00 and 47.08% and 9.09 and 48.05% in grain yield compared with un inoculated plants, with the cultivars "Giza 5" and "Giza 6", respectively. Increases in straw yield were 7.38 and 16.62 % and 12.00 and 27.00% over the uninoculated plants, respectively.

From the fore mentioned results, the co-inoculation was more promotive than *Bradyrhizobium* alone. Also, such results were more obvious with the co-inoculation with *Bradyrhizobium sp.* plus a mixture of all inoculate with increases of (62.22 and 54.54 %) in grain and straw yields, respectively, over the control. Similar results were obtained by **Burdman *et al.(1996);* Singh(1996); EI-Sayed (1999); Rodelas *et al*(l999), Omar *et al*.(2000);*and* Mekhemar (2001).** They reported that coinoculation with *Rhizobium* and *Azospirillum sp.* , *Azotobacter chroococcum* , *Bacillus polymyxa* significantly increased grain and straw yields of *Phaseolus vulgaris,* chick pea, lentil and faba bean plants. Crop increases may be attributed to available nitrogen supplemented by the inoculated organism due to its high N_z fixation activity. Production O f growth promoting substances i.e., IAA, gibberellins and cytokinine-like substances also enhanced plant growth and increase grain and straw yields. With respect to supplementation with graded levels of chemical Fertilizer, data clearly revealed that higher dose of N-fertilizer (l00 % of recommended dose)increased straw and grain yields compared to the lower one .Increase in crop yield with increasing in the nitrogen supply, might be due to the increase in dry weight of vegetative organs which could be considered as a criterion for the photosynthetic efficiency of the plant. These results are in agreement with those obtained by **EI-Gizy *et al.(* 1999); Omar *et al.(2000)* and Massoud(2001).**

Table (13): Effect of inoculation with bacterial diazotrophs at different levels of Nfertilizer (NH_4N0_3) on seed and straw (ton /fed. yield of the peanut cultivars.

Bacterial inocula	Nitrogen fertilizer (kg/fed.)	Peanut Cultivars			
		Giza 5		Giza 6	
		Yield *ton!* fed.			
		Seed	Straw	Seed	Straw
Control	10	0.82	1.62	0.70	1.63
	20	0.98	2.44	0.84	1.88
	mean	0.90	2.03	0.77	1.75
Bradyrhizobium (Rh)	10	0.88	1.66	0.73	1.73
	20	1.11	2.70	0.96	2.20
	mean	0.99	2.18	0.84	1.96
Azotobacter chroococcum+Rh	10	1.17	1.95	0.98	1.97
	20	1.42	2.78	1.26	2.53
	mean	1.29	2.36	1.12	2.25
Bacillus polymyxa+Rh	10	1.16	1.87	0.97	1.93
	20	1.61	2.91	1.38	2.74
	mean	1.38	2.39	1.17	2.33
Azospirillum brasilense+Rh	10	1.02	1.81	0.87	1.86
	20	1.31	2.73	1.29	2.43
	mean	1.16	2.27	1.08	2.11
Mixed inoculant	10	1.24	1.97	1.01	1.95
	20	1.69	2.94	1.38	2.39
	mean	1.46	2.45	1.19	2.17

L.S.D. at level of:		5%		1%			5%	1%	
For:		G.	St.	G.	8t.		G.	G.	8t.
Peanut cultivars	A	0.05	0.18	0.07	0.28	AxB	0.06	0.08	0.20
Bacterial inocula	B	0.08	0.31	0.13	0.49	AxC	0.03	0.04	0.11
Nitrogen fertilizer	C	0.02	0.06	0.03	0.08	BxC	0.06	0.08	0.20
						AxBxC	0.09	0.12	0.28

REFERENCES

Arshed, M. and W.T.Jr. Frankenberger (1998). Plant growth regulating substances in the rhizosphere :microbial production and functions. Advances in Agronomy, 62: 146-151.

Badenoch-Jones.J.; B.G.Rolfe and D.S.Letham (1983). Phytohormones, *Rhizobium* mutants and nodulation in legumes. Plant PhysioI., 73:347-352.

Burdman , S.;and Y.Okon (1997). Effects of *Azospirillum brasilense* on nodulation and growth of common bean *(Phaseolus vulgaris).* Soil BioI. Biochem.,.29, (5/6) :.923-929.

Burdman, S.;S.Sarig;J.Kigel and Y.Okon (1996). Field inoculation of common bean and chick pea with *Azospirillum brasilense* strain . Symbiosis . Rehovot, 21 (1): 41-48.

Carla, S.(1999). *Azospirillum* and *Rhizobium* inoculation of legumes. Bryan stoll (Teacher), Woodlawn High shool, Magnet program -abstracts/I. Cuirent Microbiology, 38:163-167.

Chebotar V.K., C.A.Asis and S.Akao(2001). Production of growth -promoting substances and high colonization ability of rhizobacteria enhance the nitrogen fixation of soybean when coinoculated with *Bradyrhizobium japonicum.* BioI Fertil Soils34:427-342.

Difco Manual (1985). Dehydrated culture media and reagents for microbiology .1OthEd.Difco Laboratories Defroit Michigan 4823, USA:487-623.

EI-Gizy,S.M.; A.M.shalaby and M.M.Hanna (1999). Effect of *Azospirillum* inoculation and nitrogen fertilization on the yield of some cultivars of Phasealus vulgaris. J.Agric. Mansoura Univ.,24(8): 4201-4210.

EI-Kholy,A. and M. N.A. Omar(2000). Growth response of wheat as affected by yeast and some diazotrophs inoculation under two leavels of nitrogen fertilizer. Procceding of the Intematinol Symposium on Biological Nitrogen Fixation and Crop Production, Cairo, Egypt.

EI-Komy, H.M.and A.M.Abdel Wahab(1998). Effect of simultaneous inoculation of *Azospirillum* and *Rhizobium spp.on* growth, nodulation and nitrogen fixation of two legumes using the 15_N -isotope dilution technique and the difference method. Acta Microbiologica Polonica, 47,(3): 283-296.

EI-Sayed, S.A.M.(1999). Influence of *Rhizobium* and phosphate- solubilizing bacteria on nutrient uptake and yield of lentil in the New Valley. Egypt J. Soil Sci. 39 (2):175-186.

Frankenberger, W.T.Jr. and M. Arshed, (1995). Phytohormones in Soil:Microbial production and Function. Marcel Dekker Inc. pp. 503.NY,USA:

Gallo, D.M. and P.Fabbri (1991). Effect of organic matter on chick pea inoculated with *Azospirillum brasilense* and *Rhizobium leguminosarum* bv. Ciceri. Plant and Soil, 137: 171-175.

Kloepper, J.W.; F. M.Scher; M. Laliberte, and B. Tipping(1986). Emergence-promoting rhizobacteria: description and implications for agriculture .In Iron, Siderophores and Plant Disease ed. Swinburne, T.R.pp.155-164. plenum, NY:CRC Press Inc. FL,USA:Boca Raton.

Li, D.M., and M.Alexander (1990). Factors affecting coinoculation with antibiotic producing bacteria to enhance rhizobial colonization and nodulation. Plant Soil, 129:195-201.

Massoud, A.M. (2001). Effect of molybdenum on nitrogen availability in soil and its metabolism in plant. Ph.D. Dep. Soil Sci., Fac. Agric., Minufia Univ., Egypt.

Mekhemar, G.A.A. (2001).Response of faba bean plants to co-inoculation with *Rhizobium leguminosarum* and *Bacillus megaterum* under different levels of phosphate fertilization in newly reclaimed lands. J. Agric. Sci. Mansoura Univ., 26(12): 8129-8140.

Milosev, D.; I.Molnar; G.Govedarica; N.Milosevic and M.Jarak(1996). Effect of nitrogen on wheat yield and microbiological properties of the soil. Optimization of Plant Nutration, 8-15 Sep., Prague. Czech. Republic. pp.157162.

Okon, Y. and J.Vanderleyden (1997). Root- associated *Azospirillum* species can stimulate plants. ASM News 63, 366-370.

Omar, M.N.A.; A.T.Mostafa and A.S. Ahmed (2000). Concentrated vinasse as a novel diazotrophs growth medium (Biovinasse Inoculant) and soil conditioner improveing faba bean yield under dripping irrigation. Proceeding of the Tenth Microbiology Conf., Cairo, Egypt, 11-14 Nov., pp. 100-109.

Page, A.L., RH.Miller and Keeney(1982). Methods of soil analysis. Part 2, 2 nd Am.Soc.Agronomy, Inc.Mad.Wisconsin, USA.

Pan des, A.; E. Sharma and L.S.Palni (l998). Influence of bacterial inoculation on maize in upland farming systems of the Sikkim Himalaya. Soil Bio1.Biochem, 30(3): 379-384.

Panwar, A.S. ; J.S.Balyan and V.S. Verma (2000). Yield and quality of radish *(Raphanus sativus)* seeds as affected by fertility levels and biofertilizers . Indian J. of Agron. ,45(4) :822- 826 .

Raverkar, K.P. and B.K. Konde (1988). Effect of *Rhizobium* and *Azospirillum lipoferum* inoculation on the nodulation , yield and nitrogen uptake of peanut cultivars. Plant and Soil, 106: 249-252.

Rodelas, B.;J. Gonzalz-Lopez;C.Pozo;V.Salmeron and M.V.Martinez-Toledo (1999). Response of faba bean *(Vicia faba*) to combined inoculation with *Azotobacter* and *Rhizobium leguminosarum* bV.viceae. Applied soil Ecology 12:51-59.

Singh, C.S. (1996). Arbuscular mycorrhiza (AM) in association with *Rhizobium sp.* improves nodulation, N_z- fixation and N- utilization of pigeon pea (*Cajanus cajan)* , as assessed with a 15 N technique in pots. Microbiological Res. 151, (1): 87-92.

Srinivasan M., D.J.Petersen and F.B.Holl(1996). Influence of indoleacetic acid - producing *Bacillus* isolates on the nodulation of *phaseolus vulgaris* by *Rhizobium etli* under genotobiotic conditions.Can.J.Microbio1.42: 1006-1014.

Srivastava, T.K. and I.P.S.Ahlawat (1995). Response of pea *(Pisum sativum)* to phosphors, molybdenum and biofertilizer. Indian J. Agron. 40(4) : 630-635.

Strzelczyk,E.;M.Kampert and C.Y.Li (1994). Cytokinin-like substances and ethylene production by *Azospirillum* in media with different carbon sources .Microbiol.Res.,.: 149 : 1-6.

Swelim, D. and S.M. Abdel- Wahab (2000). Co-inoculation effect with *Rhizobium* and *Azospirillum* on nodulation and nitrogenase activity of *Leucaena leucocephala.* Proceeding of the Tenth Microbiology Conf. , Cairo, Egypt. 1114 Nov., pp.1-6.

Thalmaim,A.(1967). Uber die microbiello Akivitat undihr Beziehung zu fruchtbartkeits merkmaleneiniger acherboden unter besonderer beruchsi chtigung der Dehydrogenase akativitat (TTC. Redukation). Biss Gieben Ph.D. Thesis. W.Germany.

Verma,S.;V.Kumar; N.Narula and W.Merbach (2001). Studies on in vitro production of antimicrobial substances by *Azotobacter chroococcum* isolates / mutants. Zetschrift-Fur-Pflanzenkrankheiten-und-Pflanzenscutz, 1 08 (2): 152165.

Yahalam, E.; Y.Okon and A.Dovral (1990). Possible mode of action of *Azospirillum brasilense* strain Cd on the root morphology and nodule formation in burr media (Medicago polymorpha).Can.J.Microbiol.,36:10-14.

تاثير التلقيح البكتيري والتسميد الازوتي المعدني علي العقد الجدريه
و محصول الفول السوداني

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الملخص العربي

اقيمت تجربتان احدهما اصص في الصوبه والاخري حقليه اثناء موسم نمو الفول السوداني لتقييم التلقيح البكتيري باستخدام الريزوبيا لاصناف جيزه 5 و جيزه 6 سواء منفرده او خليط مع سلالات الزوبيريللم والازوتوباكتر والبسلس مع مستويين من التسميد الازوتي المعدني .اوضحت النتائج ان هناك زياده في دلائل النمو الخضري و النشاط الميكروبي والمحصول لاصناف الفول المختبرة. اعطي التلقيح البكتيري اعلي قيم في الوزن الجاف للسيقان و الجدور مقارنا بالمعاملات الغير ملقحه .كان هناك تأثير بين السلالات المختلفه علي الوزن الجاف للجدور والسيقان كالاتي :
باسلس +ريزوبيا-- ازوسبيريللم + ريزوبيا—ازوتوباكتر + ريزوبيا ثم الريزوبيا منفرده. اعطت معامله البسالس و الريزوبيااعلي القيم في الوزن الجاف للسيقان 52 و 39.9 % و بالنسبه للجدور كانت القيم 97.26 و 103.63 % للاصناف جيزه 5 و6 علي التوالي . زادت العقد الجدريه باستخدام التلقيح البكتيري و كانت اكثر وضوحا في المعاملات ذات التلقيح المختلط.