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EFFECT OF BIOLOGICAL AND CHEMICAL FERTILIZATION ON GROWTH, YIELD AND YIELD COMPONENTS OF PEANUTS (*Arachis hypogaea* L.)

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ABSTRACT: *Two field experiments were carried out during 2010 and 2011 summer season at the experimental Farm "Demo", Fac. of Agric. Fayoum Univ., Egypt. Peanut cultivar, Giza 6, exposed to different types of inoculants such as Bradyrhizobium (BR) and phosphate dissolving bacteria, Bacillus megatherium (PDB) and/or nitrogen fertilization as well as phosphorus sources i.e. single super phosphate (SSP) and triple super phosphate (TSP). Results revealed that BR inoculation+15 kg N/feddan as starter dose promoted higher rates and values for peanut growth (i.e. Plant height, number of primary and secondary branches per plant, stem, leaf, root, nodules dry weight per plant and number of nodules per plant) and yield traits (i.e. No. of seed/plant, weight of seed/plant (g), straw yield ton/ feddan, pod yield ardab/feddan, seed yield kg/feddan, shelling % and 100 seed weigh) as compared to uninoculated treatment. BR inoculation alone and 75 kg N/feddan did not significantly differ from each other for most traits such as plant height, number of primary and secondary branches/plant, root, stem, leaf, pod and total dry weight/plant, straw, pod and seed yield/feddan, shelling % as well as 100-seed weight. BR inoculation gave significantly higher number and dry weight of nodules/plant than those of to control or 75 kg N/feddan. PDB+SSP or TSP significantly surpassed control or PDB alone, for all studied traits. The treatment of BR+15 kg N/feddan with PDB+TSP gave the highest significant 100-seed weight and pod and seed yields/feddan.*

Key word: *Peanut, Bradyrhizobium, Phosphate dissolving bacteria, nitrogen, Phosphorus sources.*

INTRODUCTON

Leguminous crops are essential components of any agricultural systems throughout the world. They play a unique role due to their ability to fix atmospheric nitrogen. One of the well knows, N_2-fixing plant-microorganism interaction, is the legume-rhizobia symbiosis, which is considered the most efficient and important process in crop production, so as to improve soil fertility and farming system flexibility. Peanut is one of the most important leguminous crop, peanut seeds contains about 25-30 % protein, 45-50 % oil, 20% carbohydrate and 5 % fiber and ash which make a substantial contribution to human (Pendashteh *et al*. 2011). Moreover, the peanut green leafy organs are another advantage characterized the crop as a good fodder for livestock. In Egypt, during the last three decades, a significant progress has occurred in land reclamation. These newly areas should be cultivated with appropriate crops enable to overcome its poor features and improving its productivity. Peanut crop is a good choice where it has a good ability for growing in this new lightly soils and thrives in improving the characteristics of the newly reclaimed sandy soil.

Phosphorus plays an important role in nodulation of legume crops. Phosphorin, a phosphate dissolving bacteria, able to convert the phosphate present in the soil from unavailable to an available form to the plant, has an indirect but definite effect on the nodulation and yield of legume crops like peanut. Under the newly reclaimed soil which mostly deficient in one or more of the essential nutrient, it should be search for the adequate perfect nutrients supplement in balanced manner. Many practices and efforts are directed to improve the growth, yield and yield components were desirable.

Application of *Bradyrhizobium* (BR) and/or phosphate dissolving bacteria (PDB)

inoculation with or without NP fertilization significantly surpassed the control treatment on peanut growth traits such as plant height (Ball *et al*., 1983; Jakhro, 1984; Khan *et al.,* 2009 and Pendashteh *et al*., 2011), number of branches/plant (Migawer and Soliman, 2001; Badawi *et al*., 2011) and dry matter accumulation (Prasad *et al*., 2001; Atayese, 2007; Badawi *et al*., 2011 and Basu, 2011).

Number and dry weight of nodules/plant were significantly affected by BR or PDB inoculants alone or with NP fertilization. Generally, BR or PDB inoculants surpassed the control treatment or NP mineral fertilization (Ball *et al*., 1983; Jakhro, 1984; Badawi *et al*., 2011 and Basu, 2011 on peanut plant and Vara *et al.,* 1994 and Dwivedi, 2003 on soybean plants).

Crop production can be increased by application of biological, organic and chemical fertilization. Efforts are directed towards improving the yield and yield components such as number and dry weight of seed/plant, straw, pod and seed yields as well as shelling percentage and 100-seed weight. Many researchers found that BR+starter nitrogen dose and/or PDB+P sources gave higher yield and yield components than control or chemical fertilization alone (Ball *et al*., 1983; Jakhro, 1984; Prasad *et al*., 2001; Vinh, 2003; Atayese, 2007; Basu *et al*., 2008; Badawi *et al*., 2011; Basu, 2011 and Pendashteh *et al*., 2011 on peanut, also, Osman *et al.*, 2010 on faba bean and Elsoni and Osman, 2011 on pigeon pea).

MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm "Demo," Faculty of Agriculture, Fayoum University, Egypt, during two successive seasons of 2010 and 2011, to evaluate the effect of inoculation with *Bradyrhizobium* (BR) and/or phosphate dissolving bacteria (PDB) under nitrogen and phosphorus fertilization on peanut root nodulation, plant growth, yield and yield components.

The soil of the experiment site was sandy loam in texture. Representative soil sample were collected from the top 30 cm layer of the experimental field, air-dried and sieved through a 2 mm screen. Physical and chemical properties of the soil are shown in Table (1).

Table (1): Physical and chemical analysis of the experimental sites.

Component	2010 season	2011 season
Particle size distributions %		
Sand	35.35	35.36
Fine sand	40.77	40.76
Silt	8.08	8.05
Clay	15.80	15.83
Soil texture	Sandy loam	Sandy loam
Chemical analysis		
pH	7.80	7.97
ECe dS/m	3.72	3.21
Organic matter %	1.03	1.10
Available N (ppm)	25.1	24.6
Available P (ppm)	5.26	5.41
Available K (ppm)	142	143

The experimental arrangement was split-plot in randomized complete block design with three replicates. The land was prepared by deep ploughing, harrowing and leveling. Then the area ridged divided into plots. The sub-plot area was 10.5 m^2 (1/400 feddan) contains 5 rows, with 3.5 m long and 60 cm apart. Treatments used were as follows:

A- Main plot treatments

a_1. Control (uninoculated).

a_2.*Bradyrhizobium* inoculation (BR) alone.

a_3. BR +15 kg N/feddan.

a_4. 75 kg N/feddan

B-Sub-plot treatments:

b_1. Control (uninoculated).

b_2. Phosphate dissolving bacteria (PDB) inoculation alone.

b_3. PDB + single super phosphate (SSP).

b_4. PDB + triple super phosphate (TSP).

Sixteen treatments were set up with three replicates (a total of 48 plots). Peanut seeds, Giza 6, were provided by the Oil Crops Res. Dept., Field Crop Res. Inst., Agric. Res. Center, Giza, Egypt. The strain of *Bradyrhizobium sp* (BR) and phosphate dissolving bacteria (PDB) *Bacillus megatherium* (Phosphorin) were kindly obtained from Biofertilizers Production Unit, Agric, Microbiology Dept., Soil, Water and Environ. Res. Inst., Agric. Res. Center, Giza, Egypt. Ammonium sulfate (20.5 %N) was added in one dose with the treatment of BR+15 kg N/feddan at 10 days after sowing (DAS) and in three equal doses in the treatment of 75 kg N/feddan at 10, 20 and 30 DAS. Phosphorus fertilization was added before sowing at the rate of 200 kg/feddan from single super phosphate (15.5 % P_2O_5) or triple super phosphate (37.5 % P_2O_5). The preceding crop was wheat and barley in the first and second seasons, respectively. Peanut seeds were sown on May 15 and May 14 in the first and second seasons, respectively in hills spaced 20 cm apart within the rows. Each plot was irrigated separately. All other recommended agricultural practices were adopted throughout both growth seasons.

At 75 DAS, the number and dry weight of nodules/plant were recorded. At harvest time, random sample of 10 guarded plants were taken from each sub-plot to determine the plant traits averages, i.e. plant height, number of primary, secondary branches and seeds/plant, dry weight of root, stem, leaves, pods and seeds as well as total dry weight/plant. After pod drying, straw, pods and seed yield /feddan as well as 100-seed weight were determined using inner two rows per plot. Shelling % was calculated according to the equation:

$$\text{Shelling\%} = \frac{\text{Seed yield/plant}}{\text{Pod yield/plant}} \times 100$$

Analysis of variance (ANOVA) was done according to Gomez and Gomez (1983). The least significant differences (LSD) test at 5 % level was used for assigning differences among treatment means.

RESULTS AND DISCUSSION

I- Growth traits

I-1- Effect of BR inoculation and/or N fertilizer:

Table (2) shows that peanut growth traits such as Plant height, number of primary, secondary branches and nodules per plant, stem, leaf, root, nodules and total dry weight per plant were high significantly or significantly affected by seed inoculation with BR and/or nitrogen fertilization in both seasons as compared to the control treatment. While, no significant effect was observed among all treatments on number of primary branches, stem dry weight only in the second season and pod dry weight in both seasons. The treatment of BR+15 kg N/feddan or application of 75 kg N/feddan which did not significantly differ from each other gave the highest growth traits values, while the application of 75 kg N/feddan significantly surpassed BR inoculation alone on plant height in the second season. Such increase may be attributed to the increase in number of internodes and/or internode length since nitrogen increase the meristematic activity of plant. These results are in agreement with those obtained by ball *et al.*, (1983), Jakhro (1984), Khan *et al.,* (2009) and Pendashteh *et al.,* (2011) for plant height, Basu (2011) for number of braches/plant and Prasad *et al.,* (2001), Atayese (2007), Badawi *et al.* (2011) and Basu (2011) for dry matter accumulation.

Table (2): Effect of biological and/or chemical fertilization on some peanut growth traits

Characters / Treatments	Plant height (cm)	No. of primary branches /plant	No. of secondary branches /plant	stem dry weight/ plant (g)	Leaf dry weight/ plant (g)	Root dry weight/ plant (g)	Pod dry weight /plant (g)	Total dry weight/ plant (g)	No of nodules /plant	Nodules dry weight /plant (mg)
2010 Season										
Main-treatments										
1-Control	41.64	3.60	15.89	16.64	18.90	1.34	13.96	50.84	11.28	18.82
2- BR. alone	51.77	5.16	21.85	23.81	26.14	1.81	21.43	73.19	140.49	259.24
3-BR+15Kg N	52.72	5.65	23.25	27.05	25.34	1.96	19.01	73.36	160.15	296.66
4- 75 Kg N/fed	53.47	5.25	23.61	25.32	29.12	1.82	22.51	78.77	17.62	27.70
LSD 0.05	4.66**	0.68**	3.71**	6.90*	6.75*	0.38*	*NS*	16.51*	37.33**	66.54**
Sub-treatments										
1-Control	44.02	3.61	13.88	15.78	15.95	1.24	10.54	43.51	58.43	102.94
2- PDB alone	47.88	4.80	19.25	21.40	23.51	1.62	17.14	63.67	72.22	127.44
3-PDB+SSP	53.93	5.53	26.22	27.75	30.05	2.02	24.78	84.60	98.82	183.10
4-PDB+TSP	53.78	5.72	25.25	27.89	29.98	2.05	24.46	84.38	100.07	188.93
LSD 0.05	3.03**	0.39**	1.95**	2.19**	2.48**	0.20**	2.93**	5.01**	13.56**	23.83**
Interaction	*NS*	*NS*	*NS*	*	*NS*	*NS*	*NS*	*	*	**
2011 Season										
Main-treatments										
1-Control	42.67	6.35	18.17	18.05	19.56	1.35	16.78	55.73	15.94	24.03
2- BR. alone	48.47	6.40	24.52	23.82	26.44	1.87	22.69	74.82	146.88	257.47
3-BR+15Kg N	53.76	7.39	27.83	26.97	26.63	1.93	22.32	77.85	161.97	290.99
4- 75 Kg N/fed	56.78	7.52	26.75	27.69	31.50	1.90	25.70	86.78	21.13	33.11
LSD 0.05	5.78**	*NS*	5.06*	*NS*	7.07*	0.37*	*NS*	17.61*	32.54**	56.63**
Sub-treatments										
1-Control	43.42	4.52	17.87	17.97	17.64	1.31	13.46	50.37	60.39	98.85
2- PDB alone	49.34	6.50	23.34	22.39	24.93	1.69	19.49	68.49	76.54	136.89
3-PDB+SSP	54.98	8.08	27.99	28.21	30.83	1.99	27.22	88.25	105.02	185.60
4-PDB+TSP	53.93	8.58	28.07	27.95	30.72	2.07	27.32	88.07	103.97	184.26
LSD 0.05	2.43**	1.08**	1.91**	2.48**	2.45**	0.22**	2.65**	4.26**	15.12**	28.19**
Interaction	*	*NS*	*NS*	*	*	*NS*	*NS*	**	*	*

BR : Bradyrhizobium, PDB: Phosphate dissolving bacteria. SSP: Single super phosphate, TSP: Triple super phosphate, *$P < 0.05$ ** $P < 0.01$ NS: not significant

Regarding number and dry weight of nodules/plant, the analysis of variance indicated that BR inoculation showed a highly significant effect on this traits. Treated peanut seeds with BR inoculation alone or with addition 15 N/feddan as starter dose (which in par from each other) produced the highest significant values of number and dry weight of nodules/plant. The treatment of uninoculation control and 75 kg N/feddan did not significantly differ from each other which produced the lowest number and dry weight of nodules/plant in both seasons. These results were agree with those mentioned by Basu *et al.,* (2008) who found that increasing NPK fertilization significantly decreased number of nodules/peanut plant. Also, Vara *et al.*, (1994) and Dwivedi (2003)

on soybean and Prasad *et al.* (2008), Badawi *et al.,* (2011) and Basu (2011) on peanut found an inverse relationship between the amount of adding N fertilizer and nodules formed on root of plants.

I-2- Effect of (PDB) inoculation and/or (P) sources:

The response of growth traits to PDB and/or P fertilization sources can be observed in data presented in Table (2). Results clearly indicated that all studied growth traits were highly significantly differed due to exposing peanut plants to PDB inoculation and/or P sources. The two P sources, which insignificantly varied to each other, gave significantly higher values for all studied growth traits in both seasons than the other two treatments (control and PDB alone). In addition, inoculation by PDB alone significantly surpassed the uninoculated control in both seasons. These results are in line with those of Khan *et al.,* (2009) who reported that NP fertilization significantly increased plant height compared with control treatment. In addition, Basu (2011) found that phosphobacterium inoculation significantly surpassed the control treatment on shoot length, number of branches/plant, dry matter accumulation, number and dry weight of nodules/plant.

I-3- Effect of the interaction:

Data in Tables (3 and 4) show that the effect of interaction between the two tested factors was significant for plant height and leaf dry weight, in the second season, and stem and total dry weight/plant and number and dry weight of nodules/plant in both seasons. Data in Table (3) revealed that the tallest plant and the heaviest leaf dry weight per plant were significantly recorded under the interaction of 75 kg N/feddan with PDB+SSP. The differences between 75 kg N/feddan with PDB +SSP or TSP did not significant on leaf dry weight/plant. However, the untreated plants (control treatment) gave the lowest significant values. The same trend was observed on stem and total dry weight/plant (Table 4), where BR+15 kg N/feddan as starter dose and 75 kg N/feddan, which did not significantly differed from each other, significantly gave the heaviest stem and total dry weight/plant under PDB+TSP and PDB+SSP, respectively compared to the other tested treatments. On the other hand, BR alone or +15 kg N/feddan with PDB+P sources interaction significantly gave higher number and dry weight of nodules/plant than the other interactions (untreated control or 75 kg N/feddan with PDB+P sources). Data revealed that the highest number and dry weight of nodules/plant were obtained by the interaction between BR+15 kg N/feddan with PDB+TSP. The lowest values were obtained by uninoculated plants with PDB (control) and fertilized with 75 kg N/feddan. The present findings are in general agreement with those obtained by Badawi *et al.,* (2011) who found that inoculation had a significant interaction on number and dry weight of nodules/plant as compared with untreated control.

Table (3): Effect of the interaction between BR/N fertilizer and PDB/P fertilizer on plant height and leaf dry weight/ plant of peanut in 2011 season.

Characters	Plant height (cm)				Leaf dry weight/plant(g)			
Treatments	Control	BR alone	BR+15kg N	75 Kg N	Control	BR alone	BR+15kg N	75 kg N
Control	38.83	42.20	45.50	47.17	14.41	16.45	19.87	19.85
PDB alone	41.33	47.47	53.90	54.67	18.67	26.95	24.50	29.59
PDB+SSP	43.03	53.50	56.83	66.53	21.51	33.16	29.18	39.48
PDB+TSP	47.50	50.70	58.80	58.73	23.64	29.21	32.98	37.07
LSD $_{0.05}$	4.86*				4.91*			

BR: Bradyrhizobium, PDB: Phosphate dissolving bacteria. SSP: Single super phosphate, TSP: Triple super phosphate, *$P < 0.05$ ** $P < 0.01$ NS: not significant

Table (4): Effect of the interaction between BR/N fertilizer and PDB/P fertilizer on some growth traits of peanut in 2010 and 2011 seasons.

Characters / Treatments	2010 season				2011 season			
	Stem dry weight /plant (g)							
	Control	BR alone	BR+15kgN	75 Kg N	Control	BR alone	BR+15 kg	75 kg N
Control	12.44	17.30	17.20	16.18	14.35	20.41	18.85	18.26
PDB alone	13.49	22.48	25.87	23.76	15.68	24.71	24.47	24.69
PDB+SSP	18.19	29.12	31.27	32.43	19.53	26.63	31.43	35.23
PDB+TSP	22.44	26.35	33.87	28.91	22.63	23.51	33.11	32.56
LSD $_{0.05}$	2.38*				4.96*			
	Total dry weight /plant (g)							
Control	33.47	49.38	45.36	45.82	40.70	52.63	54.29	53.88
PDB alone	44.79	68.10	66.17	75.63	50.77	74.19	69.28	79.72
PDB+SSP	58.88	92.40	85.85	101.27	62.22	91.03	89.20	110.56
PDB+TSP	66.21	82.89	96.08	92.36	69.25	81.44	98.61	102.98
LSD $_{0.05}$	10.01*				8.53**			
	No of nodules/plant							
Control	8.53	101.00	120.60	3.60	10.79	104.71	121.27	4.81
PDB alone	10.13	123.89	144.87	10.00	16.53	128.69	147.15	13.78
PDB+SSP	12.27	164.47	182.33	36.20	17.59	172.74	188.92	40.84
PDB+TSP	14.20	172.60	192.80	20.67	18.85	181.37	190.54	25.10
LSD 0.05	27.12*				30.24*			
	Nodules dry weight (mg)							
Control	13.07	177.48	215.75	5.45	16.09	162.59	209.09	7.61
PDB alone	15.95	209.03	269.05	15.73	24.63	238.31	261.62	22.99
PDB+SSP	20.67	313.35	342.45	55.92	25.64	309.48	345.51	61.79
PDB+TSP	25.58	337.09	359.37	33.67	29.75	319.51	347.74	40.04
LSD 0.05	47.67**				56.37*			

BR: Bradyrhizobium, PDB: Phosphate dissolving bacteria. SSP: Single super phosphate, TSP: Triple super phosphate, *$P < 0.05$ ** $P < 0.01$ NS: not significant

II- Yield and yield components

II-1- Effect of BR inoculation and/or nitrogen fertilizer:

The mean values of peanut yield and yield components as influenced by BR inoculation and/or N fertilization are presented in Table (5). Statistical analysis showed that number and weight of seeds per plant, 100-seed weight, in both seasons, and straw yield/feddan, in the first season, were high significantly affected by the tested treatments. On the other hand, this effect was significant on pod yield/feddan and shelling % only in the first season and seed yield/feddan in both seasons. The results indicated that the sole BR inoculation or BR+15 kg N/feddan significantly magnified all studied yield traits during the two seasons more than the uninoculated treatment. In addition nitrogen fertilization at 75 kg/feddan caused a significant increase in the peanut yield as compared to the uninoculated treatment. In the first season, BR inoculation+15 kg N/feddan gave 100-seed weight and seed yield/feddan

significantly higher than BR inoculation alone or fertilized with 75 kg N/feddan without significant differences from each to other. Average seed yield of peanut for BR inoculation alone or plus 15 kg N/feddan was about 28.97 and 57.98 % in the first season and 47.14 and 46.78 % in the second one higher than the uninoculated control treatment, respectively. This trend was confirmed the superiority of BR inoculation in achieving the highest values of this traits.

These results support those obtained by Ball *et al.,* (1983) who found that application of N increased fruit yield, and Jakhro (1984) who mentioned that seed yield was increased as increasing the starter N dose (with inoculation) up to 40 kg/ha. However, Khan *et al.,* (2009) reported that increasing NP fertilization up to 27:69 kg/ha significantly increased pod yield/ha. Also, Pendashteh *et al.,* (2011) found that BR or 80 kg N/ha gave significantly higher seed yield/ha than that of control treatment.

Table (5): Effect of biological and/or chemical fertilization on peanut yield and its components.

Characters / Treatments	No. of seed/ plant	weight of seed/ plant (g)	Straw yield (ton/fed)	Pod yield (ardab/fed)[a]	seed yield (kg/fed)	Shelling %	100 Seed weight (g)
			2010 Season				
Main-treatments							
1-Control	15.22	8.48	1.21	13.74	578.07	56.97	59.39
2- BR alone	23.36	14.63	1.70	14.14	745.59	69.76	68.06
3-BR+15 Kg N	24.39	16.52	1.93	16.32	913.27	73.54	73.37
4- 75 Kg N	23.42	14.90	1.78	14.46	733.36	67.69	63.76
LSD $_{0.05}$	4.04**	2.53**	0.34**	1.43*	161.44*	10.05*	4.78**
Sub-treatments							
1-Control	11.91	6.76	1.39	12.13	512.29	56.65	58.43
2- PDB alone	19.14	12.26	1.56	13.80	683.84	65.81	63.84
3-PDB+SSP	27.22	17.07	1.80	16.62	881.20	71.03	70.65
4-PDB+TSP	28.11	18.44	1.86	16.10	892.96	74.48	71.65
LSD $_{0.05}$	2.78**	2.02**	0.21**	1.42**	79.70**	3.52**	2.38**
Interaction	*NS*	*NS*	**	*NS*	*NS*	*	*
			2011 Season				
Main-treatments							
1-Control	17.23	9.87	1.55	14.27	670.15	61.61	59.39
2- B. Inoc. alone	24.60	16.17	1.98	19.43	986.04	68.49	68.76
3-B.Inoc+15Kg N	25.96	17.28	1.98	19.60	983.66	73.65	73.87
4- 75 Kg N/fed.	24.68	15.77	2.43	18.06	906.62	62.05	64.86
LSD $_{0.05}$	4.14**	2.99**	*NS*	*NS*	230.95*	*NS*	5.10**
Sub-treatments							
1-Control	13.57	7.40	1.21	13.50	590.32	58.44	59.17
2- PDB alone	21.89	14.09	1.74	15.73	786.42	66.48	63.98
3-PDB+Mono	27.57	17.98	2.50	20.85	1082.71	70.15	71.64
4-PDB+Triple	29.45	19.62	2.48	21.29	1087.01	70.72	72.08
LSD $_{0.05}$	3.03**	2.26**	0.31**	1.83**	91.42**	4.24**	2.41**
Interaction	*NS*	*NS*	**	*	*	**	*NS*

BR: Bradyrhizobium, PDB: Phosphate dissolving bacteria. SSP: Single super phosphate, TSP: Triple super phosphate, *$P < 0.05$ ** $P < 0.01$ NS: not significant

[a] One ardab =75 kg.

II-2- Effect of PDB inoculation and/or P sources:

Number and weight of seeds/plant, straw, pod and seed yields/feddan and 100-seed weight as well as shelling percent of peanut plant along the two consecutive seasons was affected by PDB and/or P sources are given in Table (5). Data illustrated that PDB inoculation + SSP or TSP, which significant in par, caused high significant increases in all peanut yield and its components as compared with PDB alone or uninoculated control. These results may be attributed to the nature of root exudates, which act as suitable substrates for the associative microorganisms, that release plant promoting substances mainly indole acetic acid, gibberllines and cytokinines. These promotive effects could stimulate plant growth, absorption of nutrients and their efficiencies, as well as the metabolism of photosynthates. These results stand in accordance with those obtained by Vinh (2003) who reported that FYM+ FMP or SSP gave significant higher pod and seed yield than control treatment. While, Atayese (2007) mentioned that either P fertilizer or mycorrhizal inoculation significantly gave higher shoot dry weight/ha, 100 seed weight, shelling percent and grain yield/ha than control treatment. In addition, the results obtained by Badawi *et al.*, (2011) and Basu (2011) revealed that BR and PDB inoculation significantly surpassed control treatment on seed weight/plant, pod and seed yield, 100 seed weight and shelling percent. Also, the same benefit effect of PDB was observed on other legume crops by Osman *et al.,* (2010) on faba bean and El soni and Osman (2011) on pigeon pea.

II-3- Effect of the interaction:

The data presented in Tables (6, 7 and 8) showed that straw yield/feddan in both seasons and shelling percent in the second one were high significantly affected by the interaction between the two factors under study. On the other hand, 100-seed weight and shelling % in the first season and pod and seed yields in the second one were significantly affected by the interaction. According to LSD test the highest straw yield/feddan was recorded from BR+15 kg N/feddan with PDB+TSP and 75 kg N/feddan with PDB +SSP interaction in the first season, while in the second one, the highest significant straw yield was recorded from 75 kg N/feddan with PDB+SSP. The differences between 75 kg with PDB+TSP and BR+15 kg N with PDB+TSP, in the second season, were not significant. The lowest straw yield was recorded by untreated control interaction in both seasons. The data showed that the reliable and valuable interaction effects were obtained from BR+15 kg N/feddan with PDB+P sources for pod and seed yield/feddan, shelling percent and 100 seed weight. On the contrary, the lowest values for all studied traits in both seasons were obtained by untreated plant with both biological and chemical fertilization. The interaction of BR+15 kg N/feddan with PDB+TSP was significantly surpassed the untreated control by 122.55 % and 183.54 % for pod and seed yield/feddan, respectively. These results are in the same line with those obtained by Basu and Bhadoria (2008) Badawi *et al.* (2011) and Basu (2011). Also, the same trend was observed by Osman *et al.* (2010) and El Soni and Osman (2011) on faba bean and pigeon pea, respectively.

Table (6): Effect of the interaction between BR/N fertilizer and PDB/P fertilizer on straw yield/feddan and shelling % of peanut in 2010 and 2011 seasons.

	2010 season				2011 season			
	Straw yield ton/feddan							
	Control	BR alone	BR+15 kg N	75 Kg N	Control	BR alone	BR+15 kg	75 kg N
Control	1.04	1.52	1.74	1.26	0.95	1.27	1.52	1.11
PDB alone	1.08	1.62	1.89	1.66	1.26	1.88	1.73	2.08
PDB+SSP	1.23	1.91	1.94	2.13	1.75	2.57	1.95	3.75
PDB+TSP	1.48	1.75	2.13	2.08	2.24	2.20	2.70	2.78
LSD $_{0.05}$	0.44**				0.63**			
	Shelling %							
Control	53.94	57.34	57.86	57.44	54.45	61.09	62.16	56.07
PDB alone	56.63	68.43	74.68	63.49	60.06	68.89	75.94	61.05
PDB+SSP	57.96	74.37	79.87	71.91	66.41	71.07	80.63	62.48
PDB+TSP	59.34	78.90	81.76	77.91	65.54	72.90	75.86	68.58
LSD $_{0.05}$	7.04*				8.49**			

BR: Bradyrhizobium, PDB: Phosphate dissolving bacteria. SSP: Single super phosphate, TSP: Triple super phosphate, *$P < 0.05$ ** $P < 0.01$ NS: not significant

Table (7): Effect of the interaction between BR/N fertilizer and PDB/P fertilizer on pod and seed yield/feddan of peanut in 2011 season.

	Pod yield (ardab/fed)[a]				Seed yield (kg/fed)			
	Control	BR alone	BR+15 kg N	75 Kg N	Control	BR alone	BR+15 kg	75 kg N
Control	11.44	15.21	12.42	14.91	473.09	697.49	574.06	616.64
PDB alone	13.40	17.74	14.85	16.93	613.85	924.47	839.94	767.44
PDB+SSP	14.73	22.56	25.70	20.41	736.23	1191.64	1179.27	1223.72
PDB+TSP	17.50	22.21	25.46	19.98	857.44	1130.56	1341.38	1018.68
LSD 0.05	3.67 *				182.85*			

BR: Bradyrhizobium, PDB: Phosphate dissolving bacteria. SSP: Single super phosphate, TSP: Triple super phosphate, *$P < 0.05$ ** $P < 0.01$ NS: not significant [a] One ardab =75 kg.

Table (8): Effect of the interaction between BR/N fertilizer and PDB/P fertilizer on 100-seed weight of peanut in 2010 season.

	100-seed weight (g)			
	Control	BR alone	BR+15 kg N	75 Kg N
Control	54.97	59.36	63.02	56.38
PDB alone	57.64	63.47	70.40	63.84
PDB+SSP	61.97	75.79	77.68	67.16
PDB+TSP	62.99	73.61	82.37	67.64
LSD $_{0.05}$	4.75 *			

BR: Bradyrhizobium, PDB: Phosphate dissolving bacteria. SSP: Single super phosphate, TSP: Triple super phosphate, *$P < 0.05$ ** $P < 0.01$ NS: not significant.

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تأثير التسميد الحيوى والكيماوى على النمو والمحصول ومكوناته للفول السوداني

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الملخص العربى

أجريت هذه الدراسة خلال الموسم الصيفى لعامى 2010 و 2011 بمزرعة كلية الزراعة "مزرعة دمو" جامعة الفيوم , لدراسة تأثير التسميد الحيوى والكيماوى على النمو والمحصول ومكونات الفول السودانى (صنف "جيزة 6). حيث تم إستخدام التلقيح البكتيرى بكلاً من البكتيريا المثبة للأزوت الجوى الريزوبيا *Bradyrhizobium* (BR) والبكتيريا المذيبة للفوسفور *Bacillus megatherium* (فوسفورين) مع التسميد النيتروجينى (15 كجرعة تنشيطية أو 75 كجم/فدان) ومصادر مختلفة من الفوسفور(سوبر فوسفات أحادى أو ثلاثى) . ويمكن إيجاز النتائج المتحصل عليها كمايلى :

1. أعطت معاملة التلقيح بالريزوبيا بالإضافة الى 15 كجم نيتروجين/فدان كجرعة تنشيطية أعلى القيم لصفات النمو مثل طول النبات ، عدد الفروع الأولية والثانوية للنبات، الوزن الجاف لكل من الجذر والسيقان والأوراق والقرون للنبات ، وقد ظهر نفس الإتجاه مع صفات المحصول ومكوناته مثل عدد ووزن بذور النبات، محصول القش والقرون للفدان ووزن المائة بذرة بالمقارنة مع الكنترول .
2. لم يكن هناك إختلافات معنوية بين المعاملة بالتلقيح بالريزوبيا وحدها والمعاملة 75 كجم نيتروجين/فدان بالنسبة لمعظم الصفات مثل طول النبات، وعدد الأفرع الرئيسية والثانوية للنبات ، والوزن الجاف للجذر والساق والأوراق والقرون والوزن الجاف الكلى/للنبات ، وكذلك محصول القش والقرون والبذور/فدان، وأيضاً وزن 100 بذرة.
3. أعطت معاملة التلقيح بالريزوبيا أكبر قيم معنوية لكل من عدد والوزن الجاف للعقد الجذرية/نبات مقارنة بمعاملة 75 كجم نيتروجين/فدان.
4. تفوقت معاملة التلقيح بالبكتيريا المذيبة للفسفور+ السوبر فوسفات الأحادى أو السوبر فوسفات الثلاثي تفوقاً معنوياً عن معاملة الكنترول ومعاملة التلقيح بالبكتيريا المذيبة للفسفور وحدها بالنسبة لجميع الصفات المدروسة.
5. أعطت معاملة التلقيح بالريزوبيا+15 كجم نيتروجين/ فدان كجرعة تنشيطية بالإضافة الى التلقيح بالبكتيريا المذيبة للفسفور+ اى من مصادر الفوسفور الأحادى أو الثلاثى أعلى محصول من القرون والبذور/فدان.