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RESPONSE OF PEANUT CROP CULTIVATED IN NEWLY RECLAIMED SOIL TO INOCULATION WITH PLANT GROWTH- PROMOTING RHIZOBACTERIA

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ABSTRACT: ***This study was carried out during the two successive summer seasons 2007 and 2008 at the Experimental Farm of Environmental Studies and Research Institute, Minufiya University, Sadat City, to study the response of two peanut cultivars (Giza-5 and Giza-6) to plant growth promoting rhizobacteria (Pseudomonas fluorescens, Serratia sp., Bacillus polymyxa and Bacillus megaterium) on effectiveness of Bradyrhizobium, root nodulation , enzyme activity in rhizosphere soil, plant growth and yield of peanut(Arachis hypogea L.) in a split-plot design of four replications.***

Mixed inoculation (PGPR plus Bradyrhizobium) led to significant increases for the all plant growth parameters in both growing seasons as compared with the uninoculated treatment or plants inoculated with Bradyrhizobium alone. Also all the bacterial strains stimulate the Bradyrhizobium effect with nodulation and other growth parameters and enzyme activity in the rhizosphere soil .

The highest values of nodular tissues, shoot and root dry weight, dehydrogenase activity(DHA), chlorophyll contents as well as yield attributes in both seasons were obtained by Giza 5 cultivar with (mixed+ 20 kg N) inoculates followed descending order : Serratia sp. Plus Br.> P. fluorescens plus Br. >B. polymyxa plus Br.> B. megaterium plus Br. > Bradyrhizobium alone. The highest values of total bacterial count and DHA in the rhizosphere soil were obtained by co-inoculation.

Peanut Giza 5 cultivar was superior than Giza 6 in shoot and root dry weights, number of branches / plant, number of pods / plant, 100-pod weight, shelling and total protein ., while Giza 5 had higher oil %.

Higher and significant correlation coefficients were found between yield components and pod yield which suggested good selection to improve peanut yield using these attributes.

The interaction between biofertilizer agents and cultivars had significant effects on pod yield / fed. the highest pod yield / fed. were produced by Giza 5 and mixed inoculations+ 20 kg N . The highest pod yield was achieved by Giza 5 variety fertilized with 40 kg chemical nitrogen without significant differences with (mixed inoculation + 20 gk N) which , hence we can obtain similar yield and saving the half recommended dose of chemical nitrogen

Key Words*: growth promoting rhizobacteria, peanut cultivars; oil seed percentage, total protein, growth, yield and yield attributes.*

INTRODUCTION

Peanut (*Arachis hypogaea* L .) is considered to be one of the most important edible oil crops in Egypt, which due to its seeds high nutritive value for human and the produced cake as well as the green leafy hay for livestock ,in addition to the seed oil importance for industrial purposes. Peanut contains about 50% oil, 25- 30% protein, 20% carbohydrates and 5% fiber (Fageria *et al*.,1997).In addition, sandy soils can be more potentially productive by using proper combination of cultivars and agronomic practices. Increasing of peanut production in order to cover the local consumption and outside export could be achieved by both introducing high productive varieties and improving the cultural practices.

Bacteria that colonize the rhizosphere and plant roots and enhance plant growth by any mechanism are referred to as plant growth-promoting rhizobacteria (PGPR). In the context of increasing international concern for food and environmental quality, the use of PGPR for reducing chemical inputs in agriculture is a potentially important issue. PGPR have been applied to various crops to enhance growth, seed emergence and crop yield, and some have been commercialized (Dey *et al*., 2004 and Herman *et al*., 2008). A PGPR *Pseudomonas fluorescens* B16 isolated from the roots of graminaceous plants has been shown to colonize the roots of various plants, and to increase the height, flower number, fruit number and total fruit weight of tomato plants (Minorsky, 2008). Under salt stress, PGPR have shown positive effects in plants on such parameters as germination rate, tolerance to drought, weight of shoots and roots, yield, and plant growth (Kloepper *et al*., 2004; Kokalis-Burelle *et al*., 2006). Another major benefit of PGPR is to produce antibacterial compounds that are effective against certain plant pathogens and pests (Dey *et al*., 2004; Herman *et al*., 2008; Minorsky, 2008).

Santos (1998) reported that BRS151 amendoim L 7 is a large seeded groundnut variety for Brazil with average pod yield of 1850 kg under rainfed and 4500 kg per hectare under irrigated condition. Gao *et al*., (1996) released Nonghua 22 for early maturity and high yield. The variety was tested at four locations with average pod yield of 4021 and 4116 kg per hectare during 1992 and 1993 against checks (3454 and 3607 kg/ha). Khan and Rahim (1998) evaluated 20 varieties of groundnut and reported that Cina (4528 kg/ha), ICGS 50 (3889 kg/ha). ICGV 86028 (3798 kg/ha) and ICGS 7326 (3611 kg/ha) produced significantly higher pod yield against check SP-96 (2409 kg/ha). Recently, there is a growing interest in PGPR due to their efficacy as biological control and growth promoting agents in many crops (Thakuria *et al*., 2004). There is very little information regarding the use of PGPR as biofertilizer in peanut cultivers.

The present study is undertaken to screen the PGPR strains that are compatible with peanut cultivers in Egypt in order to reduce the amount of chemical nitrogen in peanut production.

MATERIALS AND METHODS

Field trials with Giza-5 and Giza-6 peanuts were conducted in 2007 and 2008 seasons on sandy soil at the experimental farm of Environmental Studies and Research Institute, Minufiya University, Sadat City. The climate of this region is warm dry and the soil is sandy . The physical and chemical properties of the test soil were determined according to Page *et al*. (1982) and presented in (Table 1).

Table (1): Physical and chemical properties of experimental soil.

$CaCO_3$%	Organic matter,%	Particle size distr., %			Texture class
		Sand	Silt	Clay	
1.90	0.03	88.59	4.8	6.61	Sandy

PH*	EC** m mohs/cm	Soluble cations (meq/L)				Soluble anions (meq/L)			
		Ca^{++}	Mg^{++}	K^+	Na^+	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}
7.63	1.82	0.36	0.32	0.13	0.56	-	0.41	0.36	0.61

***In the 1:2.5 Soil: water suspension. **In the 1:5 Soil ; water then extract.**

Bacterial strains

Strains of *Pseudomonas fluorescens* (IFO,2034), *Serratia sp.* (local strain) *, Bacillus polymyxa* (local strain), *Bacillus megaterium* (local strain) and *Bradyrhizobium* sp.(strain USDA 3456) were used .All these strains were kindly supplied by Biofertilizers Production Unit, Soils, Water and Environment Research Institute, ARC, Giza, Egypt. *Pseudomonas* , *Serratia* and *Bacillus* were grown on a Kings medium B (Atlas,1995). *Bradyrhizobium* was grown on a yeast extract manitol broth (Vincent, 1970). Each bacterial culture was incubated at 28 ^{O}C for 3 days on a rotary shaker until early log phase was developed of 10^9 viable cell ml^{-1}.

Preparation of rhizobial inocula

Vermiculite supplemented with 10% peat was packed in polyethylene bags (300g carrier bag), then sealed and sterilized by gamma irradiation (5.0x 10^6 rads).Bacterial culture was injected into sterilized carrier to satisfy 60% of the maximal water holding capacity.

Peanut seeds of the commercial varieties Giza 5 and Giza 6 were kindly provided by Field Crops Research Institute, ARC, Giza ,Egypt.

Experimental treatments

The following treatments were performed:

1- Uninoculated +20 kg N/fed. (control)
2- Recommended N fer.(40kgN/fed.)
3- Inoculation with *Bradyrhizobium* +20 kgN/ fed.

4- Inoculation with *Bradyrhizobium* + *Pseudomonas fluorescens* +20 kgN/ fed.
5- Inoculation with *Bradyrhizobium* + *Bacillus polymyxa* +20 kgN/ fed.
6- Inoculation with *Bradyrhizobium* + *Serratia* +20 kgN/ fed..
7- Inoculation with *Bradyrhizobium* + *Bacillus megaterium* +20 kgN/ fed.
8- Inoculation with collective inoculum (*Bradyrhizobium* + *P. fluorescens* + *B. polymyxa*+ *Serratia* + *B. megaterium*) + 20 kgN/ fed.

The field was thoroughly prepared and fertilized with super phosphate fertilizer (15.5% P_2O_5) at the rate of 200 kg/fed. during soil preparation. Ammonium sulphate (20.5%N) was used as a source of nitrogen according to the treatments in four equal doses starting 15 days after sowing and then every 10 days intervals , while potassium sulphate (48% K_2O) at the rate of 100kg/fed. was added directly after sowing. The experiment was laid out in split plot design with four replications. The main plots included *Bradyrhizobium* inoculation and cultivars were distributed in the sub plot and a plot size of 4.5 x 3 meter, contained 6 ridges (3m length and 75 cm width). Three seeds were deposited on May 1st and 5th in both seasons, respectively in the hill depth of 2-3cm then irrigation took place immediately using drip irrigation system ,and then thinned to 2 seedlings/hill two weeks after planting. Harvest was done after 120 days after sowing. The other cultural practices were applied as recommended.

Plant growth criteria

Five peanut plants were uprooted randomly from each plot after 75 days for determination plant growth. Number of root nodules, Dry weight of nodules and shoot and root dry weights. Chlorophyll a (mg/plant) ,Chlorophyll b (mg/plant) according to (Arnon,1949), and protein content of seeds were determined according to (A.O.C. 1990).

Assay of Enzyme Activity and Bacterial counts in Soil

- Dehydrogenase of enzyme activity was determined colourimetrically, using the 2,3,5- triphenyl formazan (TPF) produced from the reduction of 2,3,5- triphenyl tetrazolium chloride (TTC), using acetone for extraction (Thalmann.,1967).

- Total bacterial numbers were determined using agar plate technique (Difco Manual, 1985).

Yield and Its components

At harvest, the following characters were recorded on ten guarded plants taken randomly from the two inner ridges of each sub plot to estimate number of pods / plant. , Pod weight (g/plant), seed weight g/plant., 100- seed weight(g), Pod yield (ardab / fed.), (ardab=75 kg) and shelling % as well as oil and protein percentage .

Statistical analysis:

Analyses of variance were computed according to (Gomez and Gomez 1984) using the least significant difference at 0.05 levels to compare the differences among means. All possible correlation coefficients were computed following the statistical technique prescribed by Sing and Chaudhary (1977). Statistical significance of phenotypic correlation was determined by T-test as described by Steel and Torrie.,(1981) .For the combined data after test of the homogeneity of the experimental error.

RESULTS AND DISCUSSION

Root Nodulation status of Peanut Plants

Nodulation formed on peanut roots as affected by Bradyrhizobium inoculation and other mixed inocula with PGPR as co- inoculation in both growing season of 2007and 2008 was recorded in Table (2). Results showed that the response of root nodulation (number and dry weight of root nodules) was positively significant. Inoculation of peanut with (*Bradyrhizobium* + 20 kg N) only led to a significant increase in the nodulation status as compared to control or the addition of recommended dose of nitrogen fertilizer without inoculation. Increases in nodule number reached (141.45 & 50.55%) and (135.23 &45.54%) above control and 40 kgN/ fed, respectively. This result confirms that *Bradyrhizobium* inoculation is very important to improve the nodulation status in reclaimed sandy soil. The highest values of nodulation aspects were due to peanut co- inoculation with all strains of PGPR and *Bradyrhizobium* with *Serratia*+20 kg N *.* Increases with co- inoculation with *Serratia* reached 62.68 &68.32 % and 23.25 & 19.46 % above inoculation with *Bradyrhizobium* only for number and weight of nodules in both seasons, respectively. These results demonstrated that the co- inoculation with PGPR may stimulate the *Bradyrhizobium* growth and enhance nodulation process via providing more nodule sites (Srinivasan *et al*., 1996).

It was obvious that Giza 5 variety was the superior in response to bio-inoculation than Giza 6 variety, where it had higher values of number of nodules and dry weight of nodules in the same manure. However, Giza 5 variety with mixed inoculation achieved the highest values of these traits. Similar tendency was noticed by (Hassanein *et al*., 2006) who found that co-inoculation of some legumes with rhizobacteria exerted beneficial effects on nodulation of soybean, pea, faba bean and chickpea under natural and artifical infection conditions and (El- Howeity 2008) reported that co-inoculation of *Phaseolus vulgaris* with *Rhizobium etli* and *Lactococcus lactis* increased nodular tissues accumulated under aseptic conditions.

Table (2)

Microbiological determination

Data presented in Table (3) demonstrated the effect of nitrogen fertilizer *Pseudomonas fluorescens*, *Serratia* sp., *Bacillus polymyxa* , *B. megaterium* and mixed inocula on dehydrogenase activity and bacterial population densities in rhizosphere soil. Dehydrogenase enzyme activity (DHA) is frequently used as a measurement of the overall microbial activity in rhizosphere soil. Results exhibited highly response of Giza 5 peanut variety to all inoculation in microbial count and DHA value compared to Giza 6. Such effect may be due to th genetic differences between both varieties. Addition of nitrogen fertilizer at rate of 40kg/fed enhanced DHA in rhizosphere soil by (144.56 &136.44%) in both seasons (2007 and 2008), respectively. Results also displayed that, co- inoculation of both peanut genotypes with *Bradyrhizobium* and abovementioned strains increased DHA compared with control and full dose of N- fertilizer. As a general trend, the potency of improving took the following descending rank: Mixed of all strains> *Br. +B.polymyxa >Br*. + *Serratia >Br*. +*B.megaterium* > *Br.* + *Pseudomonas* > *Bradyrhizobium* only.

Concerning the bacterial population densities that expressed as log number of cells g^{-1}. It was observed that, the addition of N-fertilizer and inoculation led to increases in population densities in rhizosphere soil. Similar trend was found for DHA. Higher population densities was recorded with co- inoculation with all strains of PGPR, when gave (7.35 & 7.60 log CFU g^{-1}). It is also appeared that the differences due to peanut genotypes had significant effect on dehydrogenase activity and population densities in rhizosphere soil and Giza 5 variety surpassed Giza 6 in both traits and highly responded to inoculation with these biofertilizer agents especially in case of mixed inoculation in the presence of half dose of chemical nitrogen (20 kg / fed.), which reflect the significant effect of interaction between peanut genotypes and the other inoculation process .

Chlorophyll content

Concerning the chlorophyll content (Table, 4). Data displayed that higher and significant increases were recorded by Giza 5 peanut variety in chlorophyll a and b. These increases in chlorophyll content of Giza 5 estimated by 13.9 and 17.25 and 6.64 and 91.26 mg/ plant compared to Giza 6 variety in chlorophyll a and b in both seasons, respectively. The addition of 40 kg N/fed led to significant increases in chlorophyll content a and b as compared to control treatment in both seasons reached to 191.89 % with Chlor. a and 43.15% for Chlor., b. Addition of mixture of all strains gave higher increases in chlorophyll content followed by *B. polymyxa* and *Serratia*. Increases reached 207.79 & 181.12 and 180.42 % above control with chlorophyll a in 2007.

Table (3)

Table 4

Similar trend was found in season 2008 for chlorophyll b. Superiority in chlorophyll content may be attributed to increases in N-fixation , root surface area , nutrient uptake that enhanced the overall plant growth.

In general, Giza 5 variety inoculated with mixed inoculation achieved the highest values of chlorophyll content. Many investigators showed that the prominent role of PGPR including *Serratia*, *Pseudomonas*, *B. polymyxa* is the enhancement of plant vigour and nitrogen fixation (Srinivasan *et al*., 1996, Abdel-Wahab *et al*., 2006 and El-Howeity *et al*., 2009). In this concern, (Zhang *et al*., 1996 and Dashti *et al*. 1997) found that *Serratia* induced increases in soybean photosynthesis occurred prior to the onset of nitrogen fixation. They added that *Serratia* stimulates soybean growth through the production of plant growth substances, which stimulate nitrogen fixation by stimulating overall plant vigour and growth in a subsequent increase in nitrogen fixation .

Shoot and Root Dry Matter:

Results in Table (5) revealed that the shoot and root dry matter increased significantly in both two seasons by using 40 kgN/fed and /or co inoculation. The variances between two cultivars were significant except in shoot dry weight in the first season, Giza 5 variety exceeded Giza 6 in both shoot and root dry weight in both growing seasons. Regarding the shoot dry matter, data reveled that the addition of 40 kgN/fed led to significant increases reached to 48.45 & 57 .9% compared with control, in both seasons 2007 and 2008, respectively. Also, the root dry matter increased with the addition of 40kgN /fed by 25.22 & 30 % above the control in 2007 and 2008 , respectively.

Moreover, the highest values of plant dry matter (shoot and root) were due to co- inoculation with all PGPR strains followed by *B. polymyxa*, *Serratia* and *Pseudomonas* sp. then *Bradyrhizobium*, (Table 3). Mixed inocula enhanced the shoot by 65.88 & 79.9% and root by 37.83 &40.8 % compared to the control, in both seasons, respectively. The effect of interaction between peanut varieties and biofertilizer treatments was insignificant in both traits except for root dry weight in the second season. Generally, mixed inoculation to Giza 5 variety produced the highest values of shoot and dry weight and reflected high response of Giza 5 variety to the inoculation with PGPR and other *Bradyrhizobia* which led to save apart of chemical fertilizer in peanut production. These increases in dry matter may due to a higher nitrogen accumulation per plant, enhancement of plant vigour and nitrogen fixation (Srinivasan *et al*., 1996, El-Howeity 2008 and El-Howeity *et al*.,2009).

Hameeda *et al*., (2008) observed that, inoculation of maize with *Serratia* and *Pseudomonas* increased plant biomass dry weight by 99 and 94 %, respectively.

Table (5)

2. Yield and its components

Seed weight g/plant, 100- seed weight g/plant, number of pods/plant, pod weight g/plant, pod yield ardab/fed and shelling% had significantly affected by addition of nitrogen at the rate 40 kg/fed in both seasons (Tables 6,7and 8).

Similar findings were observed by El-Fayoumy and Ramadan (2002) and Hossain *et al*. (2007) indicated that the response of groundnut plants to nitrogen fertilizer at the rate of (0, 20, 40, and 60 kg N/ha) applied to groundnut (cv. Zhingabadam) had significantly influenced number of mature pods per plant.

Also data in Tables (6, 7 and 8) showed the influence by varietal differences on seed weight g/plant, 100 seed weight g/plant, number of pods/plant. Pod weight g/plant, pod yield ardab/fed and shelling% of peanut plants during 2007 and 2008 seasons under newly reclaimed soil.

Results indicated significant differences among the tested varieties in seed weight g/plant, 100- seed weight g/plant, number of pods/plant. Pod weight g/plant, pod yield ardab/fed and shelling% in both seasons of peanut plants, where Giza 5 recorded the highest values of seed weight g/plant, 100- seed weight g/plant, number of pods/plant. Pod weight g/plant, pod yield ardab/fed and shelling% in both seasons of peanut plants. However, Giza 6 variety gave the lowest values in this respect in both seasons. The differences among peanut varieties in seed weight g/plant, 100- seed weight g/plant, number of pods/plant. Pod weight g/plant, pod yield ardab/fed and shelling% of peanut plants could be mainly due to differences in their genetic make-up. In addition, several investigators Adhikari *et al.*, (2003) and Maha, Abd-Alla (2004) showed significant differences among peanut cultivars in this respect.

On the other hand Co- inoculation of peanut genotypes with *Bradyrhizobium* with PGPR led to significant increases in pod yield reached to 16.93, 21.15, 22.39, 16.06 and 27.29% over control in season 2007 , and 19.17, 27.31, 27.79, 17.05 and 33.61% in season 2008,over control by Br.+ *Pseudomonas*, Br.+ *B. polymyxa* 20kg N , Br.+ *Serratia* 20kg N + 20kg N, Br.+ *B.megaterium*+20 kgN and Mixed inocula +20kgN, respectively. It might be deduced from these results that co- inoculation of peanut with *Bradyrhizobium* with PGPR + half dose from nitrogen fertilizer can exert a prominent superiority in increasing pod yield , In addition , co- inoculation treatments particularly in the case of *Serratia* or *B. polymyxa* in conjunction with *Bradyrhizobium* displayed significant increases in pod number , weight / plant , shelling percentage , hundred seed weight and shoot-N content, protein percentage indicating to extend their promotive effect to comprise the productivity and quality of peanut yield.

Table (6)

Table (7)

Table (8)

This synergistic effect of rhizobacteria on peanut yield may be elucidated by their ability to enhance the nodulation development, nitrogen fixation performance and nutrients availability and uptake from soil such as phosphorus and micronutrients, which resulted in various mechanisms mainly the production of substances like hormones, siderophores, phosphate volatilization and improvement of nutrient and water uptake by increasing the root perforation. Such mechanisms have been proved by many investigators (Dobbelaere *et al*., 2003; Fuentes-Ramirez and Caballero-Mellado, 2005and Tilak et al., 2005).

The interaction between plant growth promoting rhizobacteria and cultivars had significant effect. However, mixed inoculation (PGPR plus *Bradyrhizobium*)led to significant increases for the all plant growth parameters except shoot dry weight (g/plant) in both growing seasons and root dry weight (g/plant in the second seasons as compared with the uninoculated treatment with Giza 5 variety.

Seed quality

Data presented in Table (9) Presented both of oil % and protein % .Giza 5 variety recorded the highest oil % in both seasons while the differences did not in the significance level in the second season .In the other hand , no significant variation was detected between the two studied peanut varieties in seed protein % although Giza 6 variety had higher values of protein %. Peanut untreated seeds (control) gave the highest oil percentage , while the lowest oil % due to the application of *Br.+Serratia*+20kg / fed. Also, Giza 5 cultivar produced higher oil percentage compared with Giza 6 .Significant interaction effect was detected on oil %, where Giza 6 variety produced the highest oil % with untreated plants in both seasons. Mixed inoculation +20kg with Giza 6 variety produced significantly the highest protein % in the first and the second seasons. Such results indicated that the biofertilizer agent and the genotypic combination of varieties did not act independently. Sarhan (2001) , Sundaramoorthy *et al*., (2001) recorded varietal differences in seed content of oil and protein.

Correlation coefficient:

Correlation coefficients among the peanut traits and pod yield for both cultivars are presented in Table (10 and 11). Concerning peanut Giza 5 variety, all studied characters were positively and significantly correlated with seed yield / plant also with pod yield except for shelling%, Also, Positive relationships have frequently been associated between the seed yield and chlorophyll A and B ,dry weights of shoot and root , number of pods / plant and number of seeds /plant . The same results were true for Giza 6 variety . So selection for such traits are useful for yield and quality improvement., it may be recommended that cultivars having high number of pod / plant , 100 – seed weight and seed yield / plant should be criteria preferred specifically in both cultivation and selection in peanut.

Table (9)

Table (10)

Table (11)

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استجابة الفول السوداني للتلقيح ببكتيريا الجذور المشجعة للنمو تحت ظروف الأراضى المستصلحة حديثا

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الملخص العربي

تم إجراء تجربتين حقليتين بمزرعة معهد الدراسات والبحوث البيئية – جامعة المنوفية – فرع السادات خلال موسمي٢٠٠٧ و٢٠٠٨ بهدف دراسة تأثير التلقيح البكتيري بالريزوبكتيريا المشجعة للنمو (باسيدومونس فلوروسنس ، السراتيا ، باسلس بوليمكسا و باسلس ميجاتيريم) على تنشيط البرادى ريزوبيم ، و التعقيد ، النمو الخضري ، النشاط الانزيمى في منطقة الريزوسفير و كذا المحصول ومكوناته لنبات الفول السوداني صنفي جيزة ٥ وجيزة ٦، تحت ظروف الأراضي الجديدة .

أظهرت النتائج أن استخدام التلقيح المشترك للريزوبكتيريا المشجعة للنمو مع البرادى ريزوبيم أدى إلى زيادة معنوية فى النمو الخضري و تشجيع عملية تكوين العقد الجذرية وكذا النشاط الانزيمى (انزيم الديهيدروجينيز) فى منطقة الريزوسفير و كذلك زيادة معنوية للمحصول ومكوناته خلال موسمي الدراسة .

وجدت أعلى القيم لعدد ووزن العقد الجذرية، والوزن الجاف للنمو الخضري والجذري و المحتوى النيتروجينى خلال موسمي الدراسة مع استخدام خليط من جميع السلالات البكتيرية + ٢٠ كجم نيتروجين معدني تلاها لقاح السراتيا + البرادى ريزوبيم تلاها باسلس بوليمكسا + البرادى ريزوبيم ثم الباسيدومونس فلوروسنس + البرادى ريزوبيم تلاها باسلس ميجاتيريم +

البرادى ريزوبيم ثم البرادى ريزوبيم منفردا مع كلا الصنفين محل الدراسة وتفوق الصنف جيزة ٥ على الصنف جيزة ٦.

كما أشارت النتائج إلى تفوق صنف جيزة ٥ في صفات وزن البذور جم/ نبات ، ووزن ١٠٠ بذرة جم ، و عدد القرون / نبات ، ووزن القرون جم / نبات ، و محصول القرون اردب/فدان ، ونسبة التقشير عن صنف جيزة ٦ .

أوضحت النتائج إن أفضل تفاعل بين المعاملات كان بإضافة خليط من جميع السلالات البكتيرية مع صنف جيزة ٥ .لذلك توصى الدراسة في ظل ظروف التجربة او الظروف المشابهة باستخدام خليط من جميع السلالات البكتيرية مع إضافة ٤٠ كجم/فدان سماد ازوتى لصنف جيزة ٥ للحصول على أفضل القيم للصفات موضوع الدراسة وبذلك يمكن الوصول إلى أعلى إنتاجية باستخدام التسميد الحيوي مع توفير نصف كمية السماد الكيماوي الموصى به

أوضحت الدراسة وجود تلازم قوى بين صفات مكونات المحصول ومحصول القرون مما يشير إلى إمكان استخدامها كمؤشر للانتخاب لمحصول القرون.

Table (2) : Effect of rhizobacteria on nodulation of peanut plants grown in the sandy soil

Character	Number of nodules /plant						Dry wt.of nodules(mg/plant)					
Season	2007			2008			2007			2008		
Treatments	G.5	G6	Mean	G5	G6	Mean	G.5	G6	Mean	G5	G6	Mean
Control	19.33	17.67	18.50	21.00	20.67	20.83	87.93	75.73	81.83	88.07	84.20	86.13
Rec.N 40 kg/fed.	36.00	23.33	29.67	38.33	29.00	33.67	109.70	91.43	100.57	122.07	100.77	111.42
Bradyrhizobium+20kg	52.67	36.67	44.67	58.00	40.00	49.00	325.53	267.73	296.63	355.00	278.10	316.55
Br.+Ps+20kg	70.33	57.00	63.67	76.00	66.00	71.00	357.00	302.97	329.98	370.70	318.87	344.78
Br.+B.polymyxa+20kg	65.67	58.33	62.00	73.00	64.67	68.83	349.17	289.07	319.12	355.57	309.83	332.70
Br.+Serratia+20kg	77.00	68.33	72.67	85.67	76.33	81.00	409.77	321.47	365.62	417.40	338.93	378.17
Br.+B.Meg.+20kg	64.33	54.67	59.50	69.00	62.00	65.50	341.80	282.57	312.18	356.40	296.57	326.48
Mixed inocula+20kgN	85.00	73.67	79.33	91.33	81.33	86.33	428.90	349.57	389.23	438.20	362.00	400.10
Mean of varieties	58.79	48.71	53.75	64.04	55.00	59.52	301.23	247.57	274.40	312.93	261.16	287.04
LSD at 0.05 Var.			5.23			6.35			22.18			43.16
LSD at 0.05 Treat.			8.42			12			15.06			18.14
LSD at 0.05 T x V			14.12			7.14			18.51			11.41

Table (3): Effect of rhizobacteria on microbial activity in rhizosphere soil (Total bacterial count and dehydrogenase activity "DHA") of peanut plants grown in the sandy soil

Character	Total Bacterial count (CFU/ g dry soil)						DHA (µg TPF/g dry soil)					
Season	2007			2008			2007			2008		
Treatments	G.5	G6	Mean	G5	G6	Mean	G.5	G6	Mean	G5	G6	Mean
Control	5.92	5.35	5.64	6.20	5.49	5.85	32.08	29.19	30.63	35.97	34.34	35.15
Rec.N 40 kg/fed.	6.95	6.06	6.51	7.09	6.58	6.84	83.21	66.61	74.91	89.88	76.79	83.33
Bradyrhizobium+20kg	7.12	6.17	6.65	7.24	6.38	6.81	87.64	70.10	78.87	97.88	82.76	90.32
Br.+Ps+20kg	7.21	6.38	6.80	7.35	6.53	6.94	108.49	78.12	93.31	121.97	93.06	107.52
Br.+B.polymyxa+20kg	7.65	6.69	7.17	8.03	6.73	7.38	123.97	97.14	110.55	133.81	110.14	121.97
Br.+Serratia+20kg	7.76	6.74	7.25	8.05	6.76	7.41	121.41	97.96	109.69	133.08	108.82	120.95
Br.+B.Meg.+20kg	7.16	6.22	6.69	7.28	6.31	6.80	93.15	75.84	84.50	111.04	89.72	100.38
Mixed inocula+20kgN	7.90	6.80	7.35	8.18	7.01	7.60	129.58	104.04	116.81	140.70	116.85	128.78
Mean of varieties	7.21	6.30	6.76	7.43	6.47	6.95	97.44	77.37	87.41	108.04	89.06	98.55
LSD at 0.05 Var.			0.68			0.91			8.12			12.14
LSD at 0.05 Treat.			0.57			0.72			7.32			11.24
LSD at 0.05 T x V			1.03			NS			19.52			15.06

Table (4): Effect of rhizobacteria on growth parameter (chlorophyll content) of peanut plants grown in the sandy soil

Character	Chlorophyll a (mg/plant)						Chlorophyll b (mg/plant)					
Season	2007			2008			2007			2008		
Treatments	G.5	G6	Mean	G5	G6	Mean	G.5	G6	Mean	G5	G6	Mean
Control	1.53	1.34	1.43	1.88	1.19	1.54	1.17	0.53	0.85	1.52	0.58	1.05
Rec.N 40 kg/fed.	4.58	3.84	4.21	4.82	4.06	4.44	1.28	1.02	1.15	1.99	1.17	1.58
Bradyrhizobium+20kg	3.84	3.51	3.68	4.05	3.97	4.01	1.28	0.86	1.07	1.87	0.85	1.36
Br.+*Ps*+20kg	3.96	2.90	3.11	4.62	4.07	4.35	1.28	0.93	1.11	1.95	1.10	1.53
Br.+*B.polymyxa*+20kg	4.12	3.91	4.02	4.92	4.11	4.52	1.78	1.01	1.39	2.11	1.16	1.63
Br.+*Serratia*+20kg	4.15	3.87	4.01	4.97	4.13	4.55	2.06	1.09	1.58	2.17	1.19	1.68
Br.+*B.Meg*.+20kg	3.77	3.68	3.73	4.61	4.00	4.31	1.26	0.92	1.09	1.99	0.98	1.48
Mixed inocula+20kgN	4.86	4.02	4.44	4.96	4.14	4.55	2.01	1.18	1.59	2.19	1.20	1.70
Mean of varieties	3.85	3.38	3.58	4.35	3.71	4.03	1.51	0.94	1.23	1.97	1.03	1.50
LSD at 0.05 Var.			N.S			0.52			0.42			0.56
LSD at 0.05 Treat.			1.04			2.65			0.38			0.42
LSD at 0.05 T x V			2.34			N.S			0.63			0.68

Table (5): Effect of rhizobacteria on growth parameter (shoot and root dry weights) of peanut plants grown in the sandy soil

Character	Shoot dry weight (g/plant)						Root dry weight (g/plant)					
Season	2007			2008			2007			2008		
Treatments	G.5	G6	Mean	G5	G6	Mean	G.5	G6	Mean	G5	G6	Mean
Control	10.12	8.57	9.35	11.25	8.75	10.00	1.25	0.96	1.11	1.34	1.05	1.20
Rec.N 40 kg/fed.	14.07	13.71	13.89	15.75	15.82	15.79	1.52	1.25	1.39	1.80	1.32	1.56
Bradyrhizobium+20kg	13.23	12.47	12.85	15.93	14.25	15.09	1.26	1.13	1.20	1.53	1.55	1.54
Br.+*Ps*+20kg	14.07	13.51	13.79	17.29	14.69	15.99	1.42	1.23	1.32	1.60	1.28	1.44
Br.+*B.polymyxa*+20kg	15.19	14.32	14.76	19.10	15.10	17.10	1.73	1.28	1.51	1.86	1.34	1.60
Br.+*Serratia*+20kg	15.05	14.31	14.68	19.11	14.87	16.99	1.78	1.27	1.53	1.81	1.32	1.57
Br.+*B.Meg*.+20kg	14.86	13.87	14.37	17.13	14.49	15.81	1.51	1.23	1.37	1.66	1.25	1.46
Mixed inocula+20kgN	15.97	15.04	15.51	19.86	16.11	17.99	1.80	1.26	1.53	2.00	1.38	1.69
Mean of varieties	14.07	13.23	13.65	16.93	14.26	15.59	1.54	1.20	1.37	1.70	1.31	1.51
LSD at 0.05 Var.			NS			1.02			0.24			0.32
LSD at 0.05 Treat.			1.30			2.51			0.21			0.27
LSD at 0.05 T x V			NS			NS			0.43			NS

Table (6):Effect of rhizobacteria on number and weight of Pods of peanut plants grown in the sandy soil

Character	N.of Pods / plant						Pod weight (g/plant)					
Season	2007			2008			2007			2008		
Treatments	G.5	G6	Mean	G5	G6	Mean	G.5	G6	Mean	G5	G6	Mean
Control	15.33	11	13.17	14.67	11.33	13.00	23.93	22.28	23.11	25.91	22.51	24.21
Rec.N 40 kg/fed.	18.66	17.66	18.16	18.67	17.67	18.17	32.48	28.21	30.35	33.23	28.92	31.08
Bradyrhizobium+20kg	18.00	17.66	17.83	18.33	17.67	18.00	28.88	25.85	27.37	29.84	26.18	28.01
Br.+Ps+20kg	18.66	17.66	18.16	18.33	18.33	18.33	32.76	26.08	29.42	34.09	25.97	30.03
Br.+B.polymyxa+20kg	18.66	18.33	18.50	19.00	18.67	18.83	33.86	27.06	30.46	34.90	27.06	30.98
Br.+Serratia+20kg	18.66	19.66	19.16	19.67	20.67	20.17	34.16	27.81	30.99	34.99	27.51	31.25
Br.+B.Meg.+20kg	18.33	17.66	18.00	18.00	18.67	18.33	31.81	25.95	28.88	32.29	26.09	29.19
Mixed inocula+20kgN	19.00	20.33	19.67	19.67	20.67	20.17	34.69	28.36	31.53	35.62	28.91	32.26
Mean of varieties	18.16	17.50	17.83	18.29	17.96	18.13	31.57	26.45	29.01	32.61	26.64	29.63
LSD at 0.05 Var.			NS			NS			3.24			4.51
LSD at 0.05 Treat.			3.52			2.01			4.34			3.74
LSD at 0.05 T x V			5.32			3.04			5.62			NS

Table (7): Effect of rhizobacteria on yield parameter (seed weight) of peanut plants grown in the sandy soil

Character	Seed weight / plant						100 seed weight (g)					
Season	2007			2008			2007			2008		
Treatments	G.5	G6	Mean	G5	G6	Mean	G.5	G6	Mean	G5	G6	Mean
Control	12.35	11.97	12.16	12.83	12.05	12.44	72.82	72.07	72.44	73.65	72.78	73.22
Rec.N 40 kg/fed.	21.05	19.69	20.37	22.72	19.98	21.35	87.63	85.18	86.41	87.07	86.01	86.54
Bradyrhizobium+20kg	18.33	17.81	18.07	18.78	17.48	18.13	83.90	81.09	82.50	84.56	81.98	83.27
Br.+Ps+20kg	18.94	18.01	18.48	19.23	18.08	18.65	85.69	81.82	83.76	86.26	82.41	84.33
Br.+B.polymyxa+20kg	19.88	18.85	19.37	20.81	19.06	19.94	87.81	84.12	85.96	86.20	83.76	84.98
Br.+Serratia+20kg	19.91	19.01	19.46	21.24	19.55	20.40	87.93	84.04	85.98	88.36	84.85	86.61
Br.+B.Meg.+20kg	18.65	18.09	18.37	18.95	17.99	18.47	85.25	82.00	83.62	85.87	82.02	83.94
Mixed inocula+20kgN	21.58	20.05	20.82	16.13	20.43	18.28	88.40	85.06	86.73	92.08	85.95	89.02
Mean of varieties	18.84	17.94	18.39	18.84	18.08	18.46	84.93	81.92	83.42	85.51	82.47	83.99
LSD at 0.05 Var.			NS			NS			1.33			2.06
LSD at 0.05 Treat.			4.11			2.56			3.26			4.03
LSD at 0.05 T x V			3.76			4.18			3.66			5.33

Table (8): Effect of rhizobacteria on yield parameter (Pod yield and shelling) of peanut plants grown in the sandy soil

Character	Pod yield (ardab* / fed.)						Shelling %					
Season	2007			2008			2007			2008		
Treatments	G.5	G6	Mean	G5	G6	Mean	G.5	G6	Mean	G5	G6	Mean
control	16.32	15.91	16.12	16.88	16.08	16.48	51.62	53.68	52.65	49.52	53.51	51.52
Rec.N 40 kg/fed.	22.76	20.23	21.49	22.86	21.69	22.28	64.81	69.81	67.31	68.37	69.08	68.73
Bradyrhizobium+20kg	18.95	17.52	18.23	19.43	19.16	19.30	63.49	68.45	65.97	62.93	66.86	64.89
Br.+*Ps*+20kg	19.23	18.47	18.85	20.08	19.20	19.64	57.81	69.02	63.42	56.41	69.61	63.01
Br.+*B.polymyxa*+20kg	20.18	18.88	19.53	21.17	20.79	20.98	58.71	69.65	64.18	59.62	69.60	64.61
Br.+*Serratia*+20kg	20.25	19.20	19.73	21.27	20.85	21.06	58.29	68.61	63.45	60.69	71.10	65.90
Br.+*B.Meg*.+20kg	19.08	18.34	18.71	19.51	19.07	19.29	58.62	69.72	64.17	58.67	68.95	63.81
Mixed inocula+20kgN	20.55	20.49	20.52	22.08	21.96	22.02	62.00	70.72	66.36	64.03	70.67	67.35
Mean of varieties	19.66	18.63	19.15	20.41	19.85	20.13	59.42	67.46	63.44	60.03	67.42	63.73
LSD at 0.05 Var.			0.93			NS			3.17			4.61
LSD at 0.05 Treat.			2.07			2.46			2.16			3.23
LSD at 0.05 T x V			NS			3.37			7.62			5.29

*Ardab= 75 kg

Table (9): Seed oil and protein percentage as affected by biofertilizer treatments of Giza 5 and Giza 6 varieties

Characters	Oil %						Protein %					
Seasons	2007			2008			2007			2008		
Varieties / Treatments	G5	G6	Mean	G5	G6	Mean	G5	G6	Mean	G5	G6	Mean
Control	21.5	23.1	22.301	22.8	22.7	22.75	40.22	40.43	40.33	40.56	42.24	41.40
Rec.N 40 kg/fed.	22.2	19.47	20.84	19.77	19.77	19.77	42.19	40.36	41.28	40.5	43.1	41.80
Bradyrhizobium+20kg	21.2	20.6	20.90	21.695	19.6	20.65	39.77	41.71	40.74	42.93	42.5	42.72
Br.+*Ps*+20kg	22.1	18.2	20.15	22.42	20.6	21.51	41.4	40.76	41.08	43.33	41.98	42.66
Br.+*B.polymyxa*+20kg	22.6	19.17	20.89	22.4	22.31	22.36	40.92	41.15	41.04	42.96	40.09	41.53
Br.+*Serratia*+20kg	19.3	17.3	18.30	19.86	19.86	19.86	40	41.9	40.95	42.8	42.64	42.72
Br.+*B.megaterium*+20kg	23.7	17.32	20.51	22.09	20.21	21.15	41.43	40.87	41.15	41.65	41.68	41.67
Mixed inocula+20kgN	21.7	18.52	20.11	21.9	21.06	21.48	41.96	42.3	42.13	41.09	44.65	42.87
Mean of varieties	21.79	19.21	20.50	21.62	20.76	21.19	40.99	41.19	41.09	41.98	42.36	42.17
LSD at 0.05 Var			1.32			NS			NS			NS
LSD at 0.05 Bio			3.09			2.19			0.92			2.65
LSD at 0.05 B x V			3.52			3.43			2.01			2.12

Table (10): Correlation coefficient between yield attributes and pod yield / fed of peanut variety Giza

Characters	Chlorophyll *B* (mg/plant)	Shoot dry weight (g/plant)	Root dry weight (g/plant	N.of Pods / plant	Pod weight (g/plant)	Seed weight / plant	100 seed weight (g/plant)	Shelling %	Pod yield (ardab / fed.)
Chlorophyll *A* (mg/plant	0.520	0.913*	0.667	0.972*	0.914*	0.996*	0.973*	0.826*	0.874*
Chlorophyll *B* (mg/plant)		0.669*	0.903	0.508	0.676	0.551	0.573	0.134	0.368*
Shoot dry weight (g/plant)			0.827*	0.954*	0.967*	0.925*	0.951*	0.574	0.704*
Root dry weight (g/plant				0.672*	0.847*	0.714	0.734	0.236	0.870
N.of Pods / plant					0.935*	0.971*	0.989*	0.719	0.804*
Pod weight (g/plant)						0.934*	0.962*	0.534*	0.770*
Seed weight / plant							0.981*	0.798*	0.895*
100 seed weight (g/plant)								0.723*	0.845*
Shelling %									0.808

Table (11): Correlation coefficient between yield attributes and pod yield / fed of peanut variety Giza 6

Characters	Chlorophyll *B* (mg/plant)	Shoot dry weight (g/plant)	Root dry weight (g/plant	N.of Pods / plant	Pod weight (g/plant)	Seed weight / plant	100 seed weight (g/plant)	Shelling %	Pod yield (ardab / fed.)
Chlorophyll *A* (mg/plant	0.918	0.940*	0.903*	0.938*	0.928*	0.961*	0.959*	0.937*	0.837*
Chlorophyll *B* (mg/plant)		0.966*	0.933*	0.966*	0.974*	0.959*	0.961*	0.888*	0.940*
Shoot dry weight (g/plant)			0.977*	0.970*	0.930*	0.969*	0.966*	0.956*	0.879*
Root dry weight (g/plant				0.916*	0.916*	0.942*	0.959*	0.924*	0.871*
N.of Pods / plant					0.926*	0.960*	0.943*	0.940*	0.840*
Pod weight (g/plant)						0.971*	0.981*	0.885	0.963*
Seed weight / plant							0.994*	0.970*	0.913*
100 seed weight (g/plant)								0.948*	0.928*
Shelling %									0.804