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EFFECT OF PHOSPHORUS AND BIO-FERTILIZERS ON PRODUCTIVITY OF PEANUT CROP

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ABSTRACT

Two field experiments were conducted during 2006 and 2007 summer growing seasons at Ismailia Agric. Res. Station, to study the effect of phosphorus treatments (soil at the rate of 0, 31 kg P_2O_5 and foliar application of 2% P_2O_5) as well as bio-fertilizer treatments (0, Phosphorein alone, Phosphorein + Rizobactrein, Phosphorein + Microbein and Phosphorein + Nitrobein) on yield, yield components and seed oil percentage of peanut (*Arachis hypogaea*, L.) Giza 6 cultivar. Results indicated that soil application of 31 kg P_2O_5/fad. gave the highest values for number and dry weight of nodules/plant (mg), phosphorus content, number of pods/plant, pod yield/plant (g), seed yield/plant (g), 100 – pod weight (g), 100 – seed weight(g), pod yield/fad (kg) and seed yield/fad. as well as seed oil percentage in both seasons. Also results showed that all inoculating treatments increased number, dry weight of root nodules and phosphorus content but with varying degrees compared with inoculation with phosphorein alone. In that respect bio-fertilizer treatments were descendingly arranged as follow: Phosphorein + Microbein > Phosphorein + Notrobein > Phosphorein **+** Rizobactrein. Co-inoculation with Phosphorein + Microbein exhibited superiority for the above mentioned parameters over the other co-inoculation treatments. Similar findings were obtained for yield and its components when inoculation with Phosphorein + Microbein produced pod yield/fad. higher 38.14 and 39.58% above the control treatment in both seasons. Interaction effect between phosphorus and bio-fertilizer treatments was significant for all studied attributes in both seasons, dry weight of nodules/plant, phosphorus content, seed yield/plant, 100 – seed weight and shelling percentage. It was shown that soil application of 31 kg P_2O_5 with combination of Phosphorein + Microbein gave the highest values for yield and yield attributes in both seasons.

INTRODUCTION

Peanut (*Arachis hypogaea*, L.) is considered one of the most important oil seed crops, which cultivated thrive in the newly reclaimed sandy soils. In general, under such unfavorable condition soil characterized as low fertile, low organic matter content and high leaching rate, however, it has a good ability for improving the physical structure of such soils. Consequently, nutrition is one of the most important factors that affects peanut productivity. Crop production can be improved through improving the metabolic activity and nutritional status of crop plants. Phosphorus is one of the essential elements for plant growth and production, as well as plays a major role in the energy of the metabolism, being a component of the coenzyme and energy carrier adenosine triphosphate (ATP), which is responsible for active ion uptake and synthesis of various organic compounds. An inadequate P supply causes a reduction in the synthetic activates of the plant. As respect to the effect of phosphorus application, Patel and Patil (1990) found that, by increasing phosphorus rates from 0 to 75 kg P_2O_5/ha., seed yield of peanut increased from 360 to 560 kg/ha. Ali *et al*. (1995) found that, number of

pods/plant, weight of pods/plant, pod yield/fad., and seed yield/fad. in peanut were increased by increasing phosphorus fertilizer rate from 100 to 200 kg super phosphate/fad. Number and weight of pods/plant, number and weight of seeds/plant, 100- pod weight and seed yield/fad., in peanut were significantly increased by increasing phosphorus rates up to 15 kg P_2O_5/fad. as reported by Abd El-Wahab *et al*. (1986); up to 30 kg P_2O_5/fad. (Nasr, Alla *et al*., 1998 and El-Sayed and Youssef, 2003); up to 46.5 kg P_2O_5/fad. (Gomaa *et al*., 1995) and from 15.5 to 31 kg P_2O_5/fad. (Ali and Mowafy, 2003). El-Sherbeny (1964) found that applying 4 kg P_2O_5/fad. as foliar spray of peanut decreased straw yield and did not affect pod yield in comparison with phosphorus fertilizer by soil. Abd El-Aziz *et al*. (1982) found that spraying broad bean plants with P_2O_5 at 1 and 2% resulted in an increase in seed yield of 16 and 18%, respectively, over control treatments. The increase in seed yield was more apparent in the case of foliar application than the soil one. Yadav *et al* (1991) indicated that application of phosphorus up to 10 ppm as diammonium phosphate to peanut plants increased pod yield, whereas increasing dose up to 20 ppm did not greatly affect pod yield. Hamad (1992) and Hussein *et al*. (1993) found that number of pods/plant and seed yield/fad of faba bean was significantly increased with increasing foliar application of phosphorus. Ashoub *et al*. (2003) reported that foliar application of magnesium sulphate at any age led to significant increased in the seed and straw yield/fad. of sunflower in the both seasons.

As respect to the effect of bio-fertilizer application, El-Mandoh and Abdel-Magid (1996) found that the combination of Microbein and Phosphorein gave the highest seed yield of sesame as compared with Serealein alone. Badawi and El-Moursy (1997) found that seeds inoculation with Rhizobium improved the growth characters and significantly increased the yield and its components of peanut. El-Ghandour *et al*. (1997) reported that seed inoculation of peanut showed a positive effect on growth, yield and yield components as compared with uninoculated treatment. Abd El-Lateef *et al*. (1998) observed that the number of pods, pod yield, seed yield of soybean was increased with bio-fertilizer compared to the non-biofertilized treatments. Atta Allah (1998) found that seeds inoculation treatment with Phosphorein + Microbein or with Phosphorein + Nitrobein significantly increased yield and yield components of maize. El-Akabawy *et al*. (2000) mentioned that seed cotton yield significantly increased using bio-fertilizer Nitrobein compared to Rhizobaceterein and Phosphorein as well as control. Kessel and Hartley (2000) several investigation have been conducted on the effect of biological fertilization in groundnut to improve both quality and quantity of the yield. Shahaby *et al*. (2000) found that seeds inoculation of peanut with Rhizobacterein in absence of nitrogen fertilizer produced the highest pod yield (1.92 ton/fad.), while the lowest yield (1.62 ton/fad.) was obtained by either untreated plant or these supplied with 45 kg N/fad. El-Sawy *et al.* (2006) found that seed inoculation of peanut with Bradyrhizobium + Pseudomonas exhibited superiority for the above mentioned parameters over the other co-inoculation treatments. Nasef et al. (2006) found that seeds inoculation with Rhizobium alone or combination with a bio-fertilizer showed

significant increase in all studied attributes in peanut as compared with the corresponding treatments without bio-fertilizer.

Abd El-Lateef *et al*. (1998) in soybean noticed that the highest seed yield was obtained when plants were bio-fertilized with phosphobactrein + 30 kg P_2O_5/fad. Abd El-Wahab *et al*. (1999) in soybean, reported that applying Microbein with 46.5 kg P_2O_5/fad. significantly increased number of pods/plant, number of seeds/pod and seed and pods yields/fad. Salem (2000) found that the interaction between phosphorus rates and inoculation with Biogen had significant effect on most studied characters of maize. Abd-Alla (2005) manifested that the highest values for all growth criteria, yield attributes and grain yield/fad, were achieved by application of the mixture of Nitrobein and Microbein. El-Kramany *et al*. (2007) demonstrated that application of 25% recommended chemical fertilizer NPK + 75% org. Fym. + Microbein gave the highest values for yield and yield components of peanut.

The objective of this work was to investigate the effect of phosphorus and biofertilizers on nodulation, growth and yield of peanut under sandy soil conditions.

MATERIALS AND METHODS

Two field experiments were carried out at Ismailia Agric. Res. Station during 2006 and 2007 seasons. The objective of these experiments were to evaluate the effect of phosphorus and bio-fertilizer treatments on nodulation, yield and yield components as well as seed oil percentage of peanut (*Arachis hypogeae*, L.) Giza 6 cultivar under sandy soil conditions. The mechanical and chemical analysis of the soil at experiments site according to standard methods of Page (1982) and Arnold (1986) are presented in Table (1).

Studied factors:

A – Phosphorus fertilizer treatments:

1- Control (without phosphorus fertilizer).
2- Soil application of phosphorus at the rate of 31 kg P_2O_5/fad.
3- Foliar application of phosphorus at the rate of 2% P_2O_5/fad.

Soil application of phosphorus fertilizer was applied in the form of calcium super phosphate (15.5 %P_2O_5) during soil preparation, as well as foliar application of phosphorus was sprayed in the form of calcium super phosphate (15.5% P_2O_5) after 30,40 and 50 days from sowing date.

B – Bio-fertilizer treatments:

1- Control (without bio-fertilizer).
2- Phosphorein alone (Pho).
3- Phosphorein + Rizobacterein(Pho + Rizo).
4- Phosphorein + Microbein (Pho + Micro).
5- Phosphorein + Nitrobein (Pho + Nitro).

Phosphorein. Containing free living bacteria which transform the unavailable form of Ca_3 $(PO_4)_2$ to the available from Ca $(HPO_4)_2$). Rizobacterin containing nitrogen fixing bacteria-Azotobacter chroococcum and Azospirillum brasilense. Microbein a multi strains of phosphate dissolng bacterua (Bacillus megatherium) and nitrogen fixing bacteria (Azospirillum sp,

Azotobacter chroococcum and B. polymyxa). Nitrobein containing free living nitrogen fixing microorganisms.

Table (1): Mechanical and chemical analysis of the experimental site in 2006 and 2007 seasons.

Mechanical analysis	2006 season	2007 season
Sand %	89.90	90.80
Silt	2.20	2.10
Glay	7.90	7.10
Soil texture	Sandy	Sandy
Chemical analysis		
pH (1:2.5 Soil water suspension)	7.50	7.60
E.C. (ds/m) in soil water extc (1:5)	0.35	0.32
Soluble cations meg/L.		
Ca^{++}	0.56	0.52
Mg^{++}	0.30	0.25
Na^{+}	1.90	1.62
K^{+}	0.60	0.69
Hco_3^{-}	0.00	0.00
Cl^{-}	0.95	0.80
So_4^{-}	0.50	0.59
$CaCo_3$ %	1.91	1.69
Organic matter	0.36	0.42
Available P (ppm)	7.28	6.69

Bio-fertilizers are produced and distributed commercially by the General Organization for Agriculture Equalization Fund (GOAEF) Ministry of Agriculture and Land Reclamation, Egypt.

The inoculation was performed by coating peanut seeds with each product indivially using a sticking substance (Arabic gum 5%) just before sowing. All bio-fertilizers were added to the soil mixed with peanut seeds at sowing according to the recommended doses (500 g/fad.). The experimental design was split plot with three replications, phosphorus fertilizer treatments were devoted to the main plots, while bio-fertilizers were assigned to the sub-plots. The preceding crop was faba bean in the two seasons.

The experimental unit consisted of 8 ridges each of 3.5 meters long and 60 cm in width (i.e, 1/250 faddan). Seeds of peanut were sown at the rate of 40 kg seeds/fad.. on 6th may in the two seasons. Plants were thinned to single plant per hill and the distance between hills was 10 cm apart. All the above mentioned treatments potassium at the rate of 24 kg K2O/fad., in the from of potassium sulfate (48% K_2O), added during seedbed preparation while nitrogen fertilizer was applied as ammonium sulfate (20.6%) at the rate of 40 kg N/fad., was added in two equal portions, at 15 and 45 days after sowing in the two seasons. Peanut plants were hoed twice, the first was practiced after 30 days from sowing and the second one was performed after 60 days from sowing. Normal agricultural practices of growing peanut were conducted in the usual manner followed by the recommended at the district.

Studied attributes:

At 75 days from sowing as well as at harvesting, ten individual plants were chosen at random from the middle ridge of each plot in both seasons and the following data were recorded.

A- In the first sample (At 75 days from sowing):

1- Number of nodules on root/plant.

2- Dry weight of nodules on root/plant (mg).

Root samples were collected from 0 – 40 cm depth and washed from soil particles on 1 mm sieve within 24h. The root nodules were separated from the plant roots and the number and dry weight of nodules/plant were recorded.

3- Phosphorus content was estimated according to Frie *et al.* (1964).

B- In the second sample (At harvest).

1- Number of pods/plant.

2- Pod yield/plant (g).

3- Seed yield/plant (g).

4- 100 – pod weight (g).

5- 100 – seeds weight (g).

The plants of each plot were harvested to determine.

6- Pods yield/fad. (kg).

7- Seeds yield/fad. (kg).

8- Selling percentage a random pod sample (100g) was taken from each plot, the seeds were hand separated, then selling percentage was calculated follows:

Shelling % = (seed weight/pod weight) x 100.

9- Seed oil percentage was estimated according to A.O.A.C. (1980).

Statistical analysis:

The data obtained were analyzed according to Snedecor and Cochran (1981) and the treatments were compared by the least significant difference test (L.S.D) at 5% level.

RESULTS AND DISCUSSION

Results presented in Table (2) indicated that number of nodules/plant and dry weight of nodules/plant (mg) after 75 days from sowing significantly affected by application of different phosphorus treatments. Application of 31 kg P_2O_5/fad. increased number of nodules/plant by 47.95 and 52.80% and dry weight of nodules/plant by 41.60 and 45.55% as compared with control in 2006 and 2007 seasons, respectively. Also, foliar application of 2% calcium super phosphate (15.5% P_2O_5) recorded increases in number of nodules/plant by 11.78 and 18.41% and dry weight of nodules/plant by 15.44 and 19.62% over control (without phosphorus application). This may be due to the effect of phosphorus on nodules effectiveness and growth which observed significant increase in the nodules dry weight due to the increase in number of nodules/plant. These results are in agreement with Hussein *et al*. (1997) and Abdul Galil *et al.* (2003) in faba bean, they noticed that the increase of phosphorus rate from 0 to 31 kg P_2O_5/fad.

T2

was accompanied by a significant increase in the nodulations criteria (number and dry weight of nodules/plant).

Regarding to inoculation with bio-fertilizer treatments, all bio-fertilizer treatments were significantly increased number and dry weight of nodules/plant after 75 days from sowing as compared with the uninoculated treatment (control treatment). Inoculation peanut with Phosphprein alone showed significant increases in number and dry weight of nodules/plant as compared with the uninoculated treatment. These increases reached 76.31 and 91.88 in number of nodules/plant and 39.65 and 39.96% in dry weight of nodules/plant over control treatment in both seasons, respectively. In general, seeds of peanut were inoculated with a combination of Phosphorein + Microbein recorded increases in number of nodules/plant by 53.49 and 52.43% and in dry weight of nodules/plant by 63.86 and 57.43% compared Phosphorein alone in both seasons, respectively. Mixed inoculation with Phosphorein + Nitrobein significantly increased number of nodules/plant by 41.15 and 37.80% as well as dry weight of nodules by 45.01 and 45.93% over inoculation with Phosphorein alone. Also, co-inoculation with Phosphorein + Rizobacterein significantly increased number of nodules/plant by 27.19 and 27.12% and dry weight of nodules/plant by 32.01 and 29.54% over single plants inoculated with Phosphorein. These effects were attributed to auxin, giberllin and cytokinins produced by rhizobacteria. These results are in harmony with obtained by Matiru and Dokora (2004) who reported that seed inoculation with combination between bio-fertilizer resulted in a promotion of root growth, root branching and root surface area. El-Sawy *et al*. (2006) inoculating peanut with Bradyrhizobium sp. alone showed significant increasing in number and dry weight of nodules/plant as compared with the uninoculated control. These increases reached 72.57 and 70.64% in number of nodules and 89.93 and 84.51% in dry weight of nodules in both seasons, respectively.

Results in Tables 3, 4 and 5 show the significant effect of phosphorus treatments in number of pods/plant, pod yield/plant (g), seed yield/plant (g), 100 – pod weight (g), 100 – seed weight (g), pods yield/fad (kg), seed yield/fad. (kg) and shelling percentage as well as seed oil percentage in both seasons. The highest value for number of pods/plant (28.99 and 30.13), pods yield/plant (42.93 and 44.53, g), seeds yield/plant (28.47 and 29.64, g), 100 – pod weight (181.20 and 179.33, g), 100 – seed weight (74.59 and 73.26, g), pods yield/fad. (1501.20 and 1454.20, kg), seeds yield/fad. (976.20 and 944.0. kg), shelling percentage (64.94 and 64.87, %) and seed oil percentage (49.11 and 48.70, %) were produced by soil addition of 31 kg P_2O_5/fad. in first and second seasons, respectively.

T3

T4

T5

However, the lowest values of the aforementioned attributes were recorded by control treatment. Also, foliar application of 2% calcium super phosphate (15.5% P_2O_5) recorded increases in number of pods/plant (14.86 and 17.80%), pods yield/plant (20.71 and 18.60%), seeds yield/plant (21.97 and 18.60%), 100 – pod weight (10.48 and 10.66%), 100 – seed weight (13.83 and 13.26%), pods yield/fad. (22.89 and 22.20,%), seed yield/fad. (26.64 and 24.90%), shelling percentage (3.17 and 2.26 %) as well as seed oil percentage (1.35 and 2.19 %) over control (without phosphorus fertilizer) in the both seasons, respectively. Phosphatic fertilization may increased the groundnut productivity as a result of forming vigorous roots capable for absorption of more nutrients and having active nodules, which resulted in more nitrogen fixation, hence increasing soil fertility. Consequently the different vegetative parts were more efficient in accumulating more dry matter translocated to the developed sink, i.e., pods and seed thus, the increase in pod and seed yields were due to the increase in pod number/plant, 100 – pod weight, 100 – seed weight, pod weight/plant and seed weight/plant (Tables 3, 4 and 5) many investigators mentioned an increase in pod and seed yield due to the effect of phosphorus fertilizer [Patel and Patil (1990), Ali *et al.* (1995), Ali and Mowafy (2003) and El-Sayed and Youssef (2003)].

Concerning the effect of a bio-fertilizers, results in Tables 3, 4 and 5 showed that plant inoculated with Phosphorein alone or in combination with each of the tested bacterial strains exhibited significant increases in all attributes studied as compared with the uninoculated plants (control). The uninoculated plants (control) recorded the lowest values of number of pods/plant (22.88 and 22.55), pods yield/plant (32.88 and 34.22, g), seeds yield/plant (20.25 and 21.30, g), 100 – pod weight (150.99 and 151.44, g), 100 – seed weight (59.33 and 59.886, g), pods yield/fad. (1049.00 and 1036.00, kg), seeds yield/fad. (660.33 and 648.33, kg), shelling percentage (62.79 and 62.38, %) and seed oil percentage (46.71 and 46.74, %). On the other hand, the inoculated plants with Phosphorein alone showed (7.77 and 12.81%) increases in number of pod/plant, (9.82 and 9.73%) in pods yield/plant, (17.92 and 15.58%) in seeds yield/plant, (8.39 and 7.85%) in 100 – pod weight, (8.98 and 7.61%) in 100 – seed weight, (14.42 and 15.95%) in pods yield/fad. and (14.18 and 16.40%) in seeds yield/fad. as well as (1.62 and 1.13%) in seed oil percentage over those obtained for the uninoculated plant (control) in both seasons, respectively. In all inoculation treatments, maximum pods yield 1450.66 and 1447.00, kg/fad. and seeds yield 934.00 and 927.33, kg/fad. as well as seed oil percentage 49.11 and 48.86 % were obtained for inoculation with Phosphorein + Microbein followed by that of Phosphorein + Nitrobein which recorded pods yield 1381.00 and 1366.00, kg/fad., seeds yield 880.00 and 864.33, kg/fad. and seed oil percentage 48.05 and 48.17 %, then the treatment of Phosphorein and Rhizobactrein giving pod yield of 18.15 and 17.41 ardab/fad. And seed oil percentage 48.05 and 47.24 % in both seasons, respectively. The possible of such is that the bio-fertilizer supply under combination Phosphorein + Microbein greatest helps to stimulate cell division enlarges each individual cell and generally enhance the plant growth. It is also of importance to refer here that the entire

promising peanut included in this study responded to combination of Phospharein and Microbein application, which was indicated in better performance of vegetative characters and reflected on yield and yield components. These results are in agreement with those of El-Mandoh and Abdel-Magid (1996), Atta Allah (1998), Kessel and Hartley (2000) and Nasef *et al*. (2006).

Interaction effect between phosphorus and bio-fertilizers treatments was significant for all attributes studied, except dry weight of nodules/plant, P content/plant, seed yield/plant, 100 – seed weight and shelling percentage in the two seasons. Results showed that, application of 31 kg P_2O_5/fad. combination with Phosphorein + Microbein gave the highest number of nodules/ plant(112.30 and 110.20), number of pods/plant (34.00 and 36.00), pod yield/plant (49.00 and 51.66, g), 100 – pod weight (194.00 and 200.00, g), pod yield/fad. (1715.00 and 1689.00, kg) and seed yield/fad. (1133.00 and 1108.00, kg) as well as seed oil percentage (51.52 and 51.01, %) in the two seasons, respectively, as compared with the other interactions. The increase of groundnut plants biomes and their yield parameter due to bio-fertilizer application either single or in combination with phosphorus fertilizer could be attributed to the promoting substances secreted by the different bacterial species imbedded in the used bio-fertilizer as well as improving the phosphorus availability and phosphorus supply to the growing plant all over the growing season. Many investigators mentioned effect of phosphorus fertilization and inoculation Abd El-Lateef *et al.* (1998), Abd El-Wahab *et al*. (1999), Abd-Alla (2005) and El-Kramany *et al*. (2007).

CONCLUSION

From the above metioned results it could be concluded that, phosphorus at the rate of 31kg P_2O_5 /fad. with combined inoculation of Phosphorein + Microbein gave the highest nodulation, seed yield and yield components in peanut under sandy soil conditions.

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تأثير السماد الفوسفوري والحيوي على إنتاجية محصول الفول السوداني

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أجريت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بالإسماعيلية خلال موسمي الزراعة ٢٠٠٦ و٢٠٠٧ لدراسة تأثير السماد الفوسفاتي بإضافته للتربة (بدون و ٣١ كجم بو٢أ٥) والرش على النبات ٢% حمض فوسفوريك والحيوي (بدون – فوسفورين وخليط من كل من فوسفورين + ريزوباكترين , فوسفورين + ميكروبين , فوسفورين + نيتروبين) على صفات المحصول ومكوناته ومحتوى البذور من الزيت لصنف الفول السوداني جيزة ٦.

أستخدم تصميم القطع المنشقة مرة واحدة في ثلاث مكررات حيث خصصت القطع الرئيسية لمعاملات السماد الفوسفاتي والشقية لمعاملات السماد الحيوي.

وفيما يلي أهم النتائج المتحصل عليها:-

1- أظهرت النتائج اختلافات معنوية بين معاملات السماد الفوسفاتي حيث أدى إضافة السماد الفوسفاتي بمعدل ٣١ كجم بو٢أ٥ إلى زيادة معنوية في عدد , وزن العقد على جذور النبات, وعدد قرون النبات وناتج القرون والبذور/النبات ووزن ١٠٠ قرن ، وزن ١٠٠ بذرة ، وناتج القرون و البذور /فدان ,نسبة التصافي ، ونسبة الزيت في البذور بالمقارنة بمعاملات السماد الأخرى المدروسة . وأدى إضافة ٣١ كجم بو٢أ٥ / فدان إلى زيادة في محصول قرون الفدان (٤١,١٥ ، ٣٨,٠٠ %) مقارنة بالكنترول في كلا الموسمين وأيضا أعطت أيضا معاملة الرش بـ ٢% حمض فوسفوريك إلى زيادة معنوية في ناتج القرون / فدان (٢٢,٨٤ ، ٢٥,٦٢%) مقارنة بالكنترول.

2- أظهرت النتائج اختلافات معنوية بين الأسمدة الحيوية المستخدمة وأدى استخدام معاملة اللقاح الثنائي فوسفورين + ميكروبين إلى زيادة معنوية في جميع الصفات المدروسة, ويمكن ترتيب معاملات السماد الحيوي من حيث تأثيرها على كفاءة تكوين العقد تنازلياً كالآتي:- فوسفورين + ميكروبين ثم فوسفورين + نيتروبين ثم فوسفورين + ريزوباكترين ، فوسفورين فقط .

3- أوضحت النتائج أن استخدام اللقاحات الثنائية (فوسفورين + نيتروبين ، فوسفورين + ريزوباكترين) حققت زيادة معنوية في جميع الصفات مقارنة بالمعاملة الملحقة بالفوسفورين فقط . وأعطت معاملة اللقاحات الثنائية (فوسفورين + ميكروبين) زيادة في ناتج القرون / فدان (٣٨,٤١ ، ٣٩,٥٨ %) مقارنة بالمعاملة غير الملحقة (كنترول) في الموسمين.

التوصية

أدى استخدام الفوسفور بمعدل ٣١ كجم بو٢أ٥ مع معاملة اللقاحات الثنائية (فوسفورين + ميكروبين) إلى زيادة معنوية في ناتج المحصول ومكوناته تحت ظروف التجربة.

Table (2): Effect of phosphorus and bio-fertilizer treatments on number of nodules/plant, dry weight of nodules/plant (mg) and P content in peanut after 75 days from sowing during 2006 and 2007 seasons.

Phosphorus Treatments (P)	2006 season						2007 season					
	Bio-fertilizer treatments (B)						Bio-fertilizer treatments (B)					
	Without	Pho.	Pho.+Rizo	Pho.+Micro.	Pho.+Nitro	Mean	Without	Pho.	Pho.+Rizo	Pho.+Micro	Pho.+Nitro.	Mean
Number of nodules / plant												
Without	23.30	47.25	69.14	88.20	80.68	61.71	20.66	43.75	67.00	88.50	77.38	59.45
31 Kg P_2O_5	55.38	88.30	96.40	112.30	104.13	91.30	53.33	90.70	98.66	110.20	101.33	90.84
Foliar 2% P_2O_5	30.13	56.30	78.50	94.00	86.00	68.98	27.00	59.33	80.66	96.68	88.33	70.40
Mean	36.27	63.95	81.34	98.16	90.27	73.99	33.66	64.59	82.11	98.46	89.01	73.56
L.S.D at 5% for		P		B		P x B		P		B		P x B
		4.53		6.68		7.83		4.66		5.93		8.76
Dry weight of nodules / plant (mg)												
Without	137.30	140.20	230.75	253.20	240.83	200.45	128.20	133.00	207.70	248.00	226.33	188.64
31 Kg P_2O_5	149.35	301.60	289.00	371.00	308.25	283.84	156.70	299.33	277.00	330.33	309.50	274.57
Foliar 2% P_2O_5	131.75	142.50	251.60	330.00	298.20	231.41	122.33	137.66	253.33	319.00	296.00	225.66
Mean	139.46	194.76	257.11	319.06	282.43	238.56	135.74	189.99	246.12	299.11	277.27	229.64
L.S.D at 5% for		P		B		P x B		P		B		P x B
		32.11		38.63		N.S.		34.24		37.22		N.S.
Phosphorus %												
Without	0.194	0.209	0.217	0.241	0.223	0.216	0.212	0.219	0.228	0.249	0.237	0.229
31 Kg P_2O_5	0.220	0.265	0.330	0.380	0.370	0.313	0.263	0.274	0.343	0.386	0.373	0.327
Foliar 2% P_2O_5	0.200	0.217	0.240	0.280	0.260	0.239	0223	0.234	0.256	0.301	0.285	0.259
Mean	0.204	0.230	0.262	0.300	0.287	0.256	0.232	0.242	0.275	0.312	0.298	0.271
L.S.D at 5% for		P		B		P x B		P		B		P x B
		0.197		0.032		N.S.		0.021		0.011		N.S.

Table (3): Effect of phosphorus and bio-fertilizer treatments on number of pods / plant, pods and seed yields / plant of peanut during 2006 and 2007 seasons.

Phosphorus Treatments (P)	2006 season						2007 season					
	Bio-fertilizer treatments (B)						Bio-fertilizer treatments (B)					
	Without	Pho.	Pho.+Rizo	Pho.+Micro.	Pho.+Nitro	Mean	Without	Pho.	Pho.+Rizo	Pho.+Micro	Pho.+Nitro.	Mean
Number of pods / plant												
Without	20.00	21.33	22.33	26.33	24.00	22.80	19.00	22.33	23.33	26.33	25.00	23.20
31 Kg P_2O_5	25.33	27.00	29.00	34.00	29.66	28.99	25.66	27.66	30.33	36.00	31.00	30.13
Foliar 2% P_2O_5	23.33	25.66	26.33	29.00	26.66	26.19	23.00	26.33	27.66	30.33	29.33	27.33
Mean	22.88	24.66	25.88	29.77	26.77	25.99	22.55	25.44	27.11	30.88	28.44	26.88
L.S.D at 5% for		P	B	P x B				P	B	P x B		
		1.53	1.45	2.83				1.33	1.23	2.19		
Pod yield / plant (g)												
Without	28.33	31.00	32.00	34.66	33.33	31.86	30.00	32.66	34.00	36.66	33.33	33.33
31 Kg P_2O_5	37.33	40.33	43.00	49.00	45.00	42.93	38.00	42.00	43.33	51.66	47.66	44.53
Foliar 2% P_2O_5	33.00	37.00	39.33	42.66	40.33	38.86	34.66	38.00	40.00	44.00	41.00	39.53
Mean	32.88	36.11	38.11	42.11	39.55	37.75	34.22	37.55	39.11	44.11	40.66	39.13
L.S.D at 5% for		P	B	P x B				P	B	P x B		
		1.46	1.51	3.20				2.22	2.09	4.16		
Seed yield / plant (g)												
Without	17.43	19.65	20.10	22.42	21.66	20.25	18.10	20.70	22.43	24.73	22.53	21.69
31 Kg P_2O_5	23.31	27.80	29.00	32.38	29.90	28.47	24.43	28.16	30.32	34.16	31.13	29.64
Foliar 2% P_2O_5	20.01	24.20	25.91	27.60	26.20	24.78	21.39	25.00	26.22	28.90	28.00	25.90
Mean	20.25	23.88	25.00	27.46	25.92	24.50	21.30	24.62	26.32	29.26	27.22	25.74
L.S.D at 5% for		P	B	P x B				P	B	P x B		
		2.01	1.38	N.S.				2.97	1.26	N.S.		

Table (4): Effect of phosphorus and bio-fertilizer treatments on 100 – pod weight (g), 100 – seede weight (g) and pod yield / fad. (kg) of peanut during 2006 and 2007 seasons.

Phosphorus Treatments (P)	2006 season						2007 season					
	Bio-fertilizer treatments (B)						Bio-fertilizer treatments (B)					
	Without	Pho.	Pho.+Rizo	Pho.+Micro.	Pho.+Nitro	Mean	Without	Pho.	Pho.+Rizo	Pho.+Micro	Pho.+Nitro.	Mean
100 – pod weight (g)												
Without	135.33	151.00	158.66	168.33	162.00	155.13	134.00	151.00	157.00	165.66	161.00	153.73
31 Kg P_2O_5	162.00	174.00	184.00	194.00	187.00	181.20	163.33	173.00	179.00	200.00	184.33	179.93
Foliar 2% P_2O_5	155.33	166.00	173.00	184.00	178.66	171.39	157.00	166.00	170.66	182.00	175.00	170.13
Mean	150.99	163.66	171.88	183.77	175.88	162.24	151.44	163.33	168.88	182.55	173.44	167.93
L.S.D at 5% for			P	B	P x B				P	B	P x B	
			4.90	6.88	9.20				6.73	8.24	11.13	
100 – seed weight (g)												
Without	53.66	55.33	59.00	69.00	67.00	60.79	53.66	56.33	59.33	69.00	63.33	60.33
31 Kg P_2O_5	62.33	71.66	76.00	85.00	78.00	74.59	63.33	71.66	75.33	81.33	74.66	73.26
Foliar 2% P_2O_5	62.00	67.00	70.00	75.00	72.00	69.20	62.66	65.33	68.00	74.00	71.66	68.33
Mean	59.33	64.66	68.33	76.33	72.30	68.19	59.88	64.44	67.55	74.77	69.88	67.30
L.S.D at 5% for			P	B	P x B				P	B	P x B	
			4.32	2.95	N.S.				3.69	3.62	N.S.	
Pod yield / fad. (kg)												
Without	892.00	1057.0	1087.0	1155.0	1112.0	1060.6	887.0	1042.0	1072.0	1182.0	1126.0	1061.8
31 Kg P_2O_5	1200.0	1387.0	1590.0	1715.0	1614.0	1501.2	1164.0	1382.0	1461.0	1689.0	1575.0	1454.0
Foliar 2% P_2O_5	1055.0	1157.0	1406.0	1482.0	1417.0	1303.4	1057.0	1180.0	1384.0	1470.0	1397.0	1297.6
Mean	1049.0	1200.3	1361.0	1450.6	1381.0	1288.4	1036.0	1201.3	1305.6	1447.0	1366.0	1271.2
L.S.D at 5% for		P	B	P x B				P	B	P x B		
		147.0	76.5	102.0				128.50	52.50	90.75		

Table (5): Effect of phosphorus and bio-fertilizer treatments on seed yield / fad (kg), shelling percentage and oil seed percentage of peanut during 2006 and 2007 seasons.

Phosphorus Treatments (P)	2006 season						2007 season					
	Bio-fertilizer treatments (B)						Bio-fertilizer treatments (B)					
	Without	Pho.	Pho.+Rizo	Pho.+Micro.	Pho.+Nitro	Mean	Without	Pho.	Pho.+Rizo	Pho.+Micro	Pho.+Nitro.	Mean
Seed yield / fad. (kg)												
Without	542.00	629.00	680.00	726.00	688.00	653.00	534.00	635.00	664.00	742.00	689.00	652.80
31 Kg P_2O_5	766.00	901.00	1029.00	1133.00	1052.00	976.20	752.00	983.00	944.00	1108.00	1023.00	944.00
Foliar 2% P_2O_5	673.00	732.00	887.00	943.00	900.00	827.00	659.00	736.00	869.00	932.00	881.00	815.40
Mean	660.33	754.00	865.33	934.00	880.00	818.73	648.33	754.66	825.66	927.33	864.00	804.06
L.S.D at 5% for			P	B	P x B				P	B	P x B	
			58.13	82.46	89.32				51.17	73.18	86.33	
Shelling percentage (%)												
Without	60.76	59.50	62.55	62.85	61.87	61.50	60.20	60.94	61.94	62.77	61.19	61.40
31 Kg P_2O_5	63.83	64.96	64.71	66.06	65.17	64.94	64.60	64.62	64.61	65.60	64.95	64.87
Foliar 2% P_2O_5	63.79	63.26	63.08	63.63	63.51	63.45	62.34	62.37	62.78	63.40	63.06	62.79
Mean	62.79	62.57	63.44	64.18	63.51	63.29	62.38	62.64	63.11	63.92	63..06	63.02
L.S.D at 5% for			P	B	P x B				P	B	P x B	
			1.22	0.56	N.S.				1.13	0.61	N.S.	
Seed oil percentage (%)												
Without	46.00	47.23	46.46	47.73	47.79	47.06	46.04	46.67	47.30	46.41	47.79	46.84
31 Kg P_2O_5	47.66	48.34	49.46	51.52	49.01	49.20	47.26	47.69	48.30	51.01	49.26	48.70
Foliar 2% P_2O_5	46.49	47.21	49.35	48.09	47.36	47.70	46.94	47.46	48.32	49.16	47.46	47.87
Mean	46.71	47.59	48.42	49.11	48.05	47.98	46.74	47.27	47.97	48.86	48.17	47.80
L.S.D at 5% for		P	B	P x B				P	B	P x B		
		0.26	0.41	0.72				0.49	0.47	0.81		