# YIELD AND SEED QUALITY RESPONSES OF CHICKPEA TO INOCULATION WITH PHOSPHOREIN , PHOSPHOURUS FERTILIZER AND SPRAYING WITH IRON.

**El-Gizawy* N. Kh. B and S.A.S. Mehasen**

Agronomy Dept., Fac. Agric. Moshtohor , Zagazig Univ. Egypt

## ABSTRACT

Two filed experiments on chickpea were carried out during the two winter seasons of 2001/02 and 2002/03 at the Experimental Center, Faculty of Agriculture at Moshtohor, Zagazig University. Each experimental included 12 treatments which were the combination of two treatments of phosphate dissolving bacteria (*B. megatherium*) inoculation i.e. "phosphorein" (with or without), three phosphorus fertilizer levels (0, 15 and 30 kg $P_2O_5$/fed.) and two spraying treatments with Fe ( tap water and 0.5 g/L as chelated iron, 14 % Fe-EDTA).

Results showed that phosphorein treatments, inoculating chickpea seeds with phosphate dissolving bacteria (*Bacillus megatherium*) significantly surpassed the uninoculated in plant height, pods weight/plant, seed index, seed yield/plant, yields of seed, straw, biological as well as seed protein yields/fed, N and P uptake/fed. in the combined analysis of both growing seasons.

Plant height, number of branches and pods/plant, pods and seeds weight/plant,100-seed weight, seed yield/fed., seed protein % as well as of yield/fed., N and P uptake/fed were improved by phosphorus fertilization, while the lowest values for forenamed traits were obtained in the unfertilized plots.

Foliar spraying with Fe had significant effected on most studied traits in the 1st and the 2nd seasons as well as combined analysis

The studied simple correlation indicated that there were positive and high significant coefficients between each pair of plant height, pods number and weight/plant seed yield/plant, straw, biological yields/fed and seed yield/fed.

## INTRODUCTION

Chickpea (*Cicer arietinum*,L.) is one of the important grain Legumes cultivated in Egypt many year ago. It is grown as winter crop and cultivated successfully in traditional area where clay soil prevalence and in new reclaimed area having sandy soil. The need for phosphorus fertilization and inoculation with phosphate attracts the attention of agronomists under Egyption condition especially for Legume crops. It is necessary to supply Legume crops in their early stages of growth with pass the amount is the soil in not completely available for plants. Moreover, it was noticed that the Legume crops responded positively to Fe application. However, the effect of inoculation with phosphate on yield, yield components and seed quality had been studied by several investigations. Seeds or soil inoculation with phosphate dissolving bacteria had increasing seed yield and most its components of Chickpea **(Prasad and Sanoria, 1984 and Pal, 1986). Mehasen and El-Ghozoli (2003)** who reported that all growth characters, yield and yield components as well as chemical composition of

soybean seeds in both seasons were significantly increased by application of rock-phosphate (RP)+phosphate dissolving bacteria (PDB) or inoculation with PDB alone except number of branches/plant and oil percentage in the second season only**. Hamed (2003)** found that inoculating faba bean seeds with phosphate dissolving bacteria (phosphorein) surpassed the uninoculated in plant height, pods and seeds weight/plant,100-seed weight, seed and protein yields/fed. Also, positive response to addition of phosphorus is extensively reporte in the literature. These responses ranged from 15 to 50 kg $P_2O_5$/ha was reported by **Javiya *et al*.(1989) and Sarawgi and Singh (1989).** Higher responses ranging from 50 to 120 kg $P_2O_5$/ha were reported by **Kumpawat *et al*. (1990),Abd El-Gawad *et al.(*1991), Zeiton (1992) and Enania and Vyas (1995)** who indicated that all seed yield components, as well as, seed, straw and biological yields were significantly increased due to addition of P up to 45 kg $P_2O_5$ /fed. However, adding phosphorus fertilizer at a rate of 23.25 kg $P_2O_5$ /fed to chickpea plants increased significantly number of pods/plant, weight of pods/plant, seed yield/plant, seed and straw yields/fed over those fertilized by 15.5 and 31 kg $P_2O_5$/fed. On the other hand, number of seeds/pod and seed index were not affected by increasing P rate from 15.5 to 31 kg $P_2O_5$/fed **(Sawires, 2001**).

Adding Fe at a rate 15 or 30 ppm caused an increase in seed and straw yields/fed of chickpea compared with the untreated (control) were obtained by **(Sawires, 2001). Mehasen and El-Ghozoli (2003)** who demonstrated that application of Fe statistically increased number of pods/plant, weight of pods and seeds/plant, seed and protein yields/fed of soybean as compared with control treatment in the two growing seasons. This work was raised to determine the influence of inoculation with phosphate, phosphorus fertilization and spraying of Fe on yield, yield components and chemical content of chickpea.

## MATERIALS AND METHODS

Two field experiments on chickpea were carried out during the two winter seasons of 2001/02 and 2002/03 at the Agric. Res. and Exper. Cent. of the Fac.of Agric., Moshtohor, Zagazig Univ., Egypt. Each experiment included 12 treatments which were the combinations of:

- Two levels of phosphate dissolving bacteria (*B. megatherium*) inoculation, with and without. Bacteria was used in the product from of" phosphorein" seeds were inoculated by phosphorein just before sowing.
- Three phosphorus fertilizer levels ( zero, 15 and 30 kg $P_2O_5$/fed). Phosphorus levels were added before sowing as Calcium super phosphate 15 % $P_2O_5$.
- Two Fe levels (tap water and spraying with Fe at a rate 0.5 g/L as chelated iron, 14 % Fe-EDTA) Fe was sprayed twice, the first when plants aged 30 days and the second at 45 days from planting (*using hand sprayer* 1 L.). Spray solution was 400 L / fed.

The treatments were arranged in a split-plot design with four replications ,in which phosphate dissolving bacteria treatments were allocated in the main plots and the combination between phosphorus fertilizer levels and Fe treatments occupied the sub plots. The experimental unit area contained 5 ridges each of 3.5 m length and 0.60 cm

width (10.5 $m^2$). Chickpea seeds "Giza 3" cultivar were inoculated with the specific Rhizobium strain just before sowing. Seeds were planted on the two ridge sides with hills separated 20 cm, on 19 and 11 Nov., in the 1st and 2nd seasons, respectively. The preceding crop was maize in both seasons. Before the first irrigation, chickpea plants were thinned to secure two plants/hill and added 20 kg N/fed as a starter dose in the from of ammonium nitrate (33.5 % N). Soil of the experiment was clay lome in texture with pH 8.01 and contained available P 11.20 mg/kg ($NaHCO_3$-extractable) , 2.0 % organic matter and 3.6 ppm available Fe average of both seasons.

At harvest, ten guarded plants from each experimental unit were chosed and the following criteria were estimated: plant height (cm), number of branches/plant, number of pods/plant, number of seeds/pod, number of seeds/plant , weight of pods/plant (g), 100-seed weight (g) and seed yield/plant (g). Seed, straw and biological yields/fed were estimated from the whole sub-plot. Moreover, samples of chickpea seeds were dried at 70 $C^0$ for 24 hours ground wet ashed using sulphuric and perchloric acids mixture and nitrogen content (N%) in seeds was determined by micro kjldahl method according to **A.O.A.C. (1990).** Phosphorus content (P%) in seeds was determined as reported by **Frei *et al.* (1964**) using clorimetric determination with ascorbic acid. protein content was calculated by multiplying percent of N by 6.25 and Protein yield (kg/fed) was calculated by multiplying protein % in seeds by seed yield/fed While, N and P uptake in seeds (kg/fed) were calculated by multiplying N and P percentage in seeds by seed yield/fed.

All possible coefficients of the simple correlation were estimated between the following chickpea traits according to **Snedecor and Cochran (1967).** Data were statistically analyzed according to **Gomez and Gomez (1983**).Test of homogeneity of the data was applied, then combined analysis of variance was performed over the first and second seasons. For comparison between means **Duncan's** multiple range test was used **(1955).** using the MSTAT-C Statistical Software package (**Michigan State University, 1983**)

## RESULTS AND DISCUSSION

### A- Effect of growing seasons:-

Data in Table (1) showed that there were not significant seasonal effects existed for all characters studied except number of pods/plnt, weight of pods/plant, seed index, seed yield/plant, straw and biological yields/fed. Higher mean values for these traits were detected in the second season and it is may be due to earlier planting date.

**Table 1. Mean values of seasonal effect.**

| Traits | Growing seasons | | F test |
|---|---|---|---|
| | 2001 /2002 | 2002 / 2003 | |
| Plant height (cm) | 71.6 | 71.0 | n.s |
| No. of branches / plant | 3.96 | 4.30 | n.s |
| No. of pods / plant | 48.7 | 46.3 | ** |
| No. seeds / pod | 1.35 | 1.26 | n.s |
| No. of seeds / plant | 67.4 | 60.1 | n.s |
| Weight of pods/ plant | 12.02 | 13.27 | ** |
| Seed index (g) | 16.90 | 16.45 | ** |
| Seed yield / plant (g) | 9.06 | 10.02 | ** |
| Seed yield kg/fed | 778.0 | 781.9 | n.s |
| Straw yield ton/fed | 1.041 | 1.067 | ** |
| Biological yield ton/fed | 1.819 | 1.849 | * |
| Seed N content % | 2.94 | 2.97 | n.s |
| Seed protein content % | 18.32 | 18.59 | n.s |
| Protein yield kg/fed | 143.4 | 147.8 | n.s |
| N uptake kg/fed | 22.95 | 23.65 | n.s |
| Seed P content % | 0.307 | 0.314 | n.s |
| P uptake kg/fed | 2.41 | 2.49 | n.s |

*,** indicates significant at $P<0.05$ and 0.01, respectively ; n.s = non significant

**B- Effect of phosphorein.**

The presented results in Table (2) showed that the performance of Chickpea yield, yield components and seed quality under phosphorein treatments, inoculating chickpea seeds with phosphate dissolving bacteria i.e. "phosphorein" surpassed the uninoculated in plant height, number of pods/plant, weight of pods/plant, seed index, seed, straw, biological and protein yields/fed, seed N % , protein content, N and P uptake/fed in the second season and combined analysis. Also, seed index, seed yield/fed, seed P content and P uptake/fed in both seasons as well as combined analysis. On the other hand, number of branches/plant, number of seeds/pod and number of seeds/plant had no significant affected by phosphorein treatments in both seasons as well as combined analysis. The improvements in plant height, pods and seeds weight/plant and seed index may be attributed to the benefit effect of inoculation with phosphate dissolving bacteria on chickpea growth, so, pod, seed, straw, biological and protein yields/fed increased. Similar results were obtained by (**Prasad and Sanoria, 1984 and pal, 1986** on chickpea**; Mehasen and El-Ghozoli,2003** on soybean **and Hamed, 2003** on faba bean**).**

**Table 2 . Yield and its components and seed quality as affected by Phosphorein inoculation.**

| Characters | Phosphorein inoculation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2001 / 02 season | | | 2002 / 03 season | | | Combined analysis | | |
| | Non. | Inoc. | F test | Non. | Inoc. | F test | Non. | Inoc. | F test |
| Plant height (cm) | 70.6 | 72.5 | n.s | 69.1 | 72.8 | ** | 69.8 | 72.7 | ** |
| No. of branches / plant | 3.66 | 4.27 | n.s | 4.16 | 4.43 | n.s | 3.91 | 4.35 | n.s |
| No. of pods / plant | 48.25 | 49.2 | n.s | 43.8 | 48.8 | ** | 46.0 | 49.0 | ** |
| No. seeds / pod | 1.30 | 1.40 | n.s | 1.21 | 1.31 | n.s | 1.25 | 1.35 | n.s |
| No. of seeds / plant | 63.9 | 70.9 | n.s | 54.2 | 66.0 | n.s | 59.0 | 68.5 | n.s |
| Weight of pods/ plant | 11.7 | 12.3 | n.s | 12.16 | 14.38 | ** | 11.94 | 13.36 | ** |
| Seed index (g) | 16.7 | 17.1 | ** | 15.8 | 17.0 | ** | 16.2 | 17.0 | ** |
| Seed yield / plant (g) | 8.76 | 9.35 | n.s | 9.30 | 10.74 | * | 9.03 | 10.05 | * |
| Seed yield kg/fed | 758.4 | 797.5 | ** | 729.1 | 834.7 | ** | 743.8 | 816.1 | ** |
| Straw yield ton/fed | 1.034 | 1.049 | n.s | 1.033 | 1.101 | ** | 1.033 | 1.075 | * |
| Biological yield ton/fed | 1.793 | 1.846 | n.s | 1.762 | 1.935 | ** | 1.777 | 1.891 | ** |
| Seed N content % | 2.88 | 3.00 | n.s | 2.69 | 3.25 | ** | 2.78 | 3.12 | ** |
| Seed protein content % | 18.02 | 18.75 | n.s | 16.84 | 20.34 | ** | 17.43 | 19.54 | ** |
| Protein yield kg/fed | 137.1 | 149.8 | n.s | 124.4 | 171.2 | ** | 130.7 | 160.5 | * |
| N uptake kg/fed | 21.93 | 23.98 | n.s | 19.9 | 27.3 | ** | 20.9 | 25.6 | * |
| Seed P content % | 0.293 | 0.321 | ** | 0.283 | 0.344 | ** | 0.288 | 0.333 | ** |
| P uptake kg/fed | 2.24 | 2.59 | ** | 2.09 | 2.89 | ** | 2.17 | 2.74 | ** |

*,** indicates significant at $P<0.05$ and 0.01, respectively ; n.s = non significant

**C- Effect of phosphorus fertilizer.**

Data in Table (3) indicated clearly that there were significant increase in yield, yield components and seed quality of chickpea by increasing level of phosphorus in both seasons as well as combined analysis. Supplying chickpea plants with $P_2O_5$ at the rate of 30 kg/fed, gave the highest for all studied traits of yield, yield components and seed quality as compared with those of zero and 15 kg $P_2O_5$/fed. While, the lowest values for forenamed traits were obtained in the unfertilized plots. The increase in seed yield/ fed was 19.88, 19.67 and 19.77 % in the 1st , 2nd seasons and combined, respectively, at the rate of 30 kg $P_2O_5$ /fed as compared with zero level (control). The increase in pods and seeds numbers and weight/plant may be responsible for the achieved increments in seed, straw and biological yields/fed. Protein yield may by increased due to increasing seed yield/fed and protein percentage in chickpea seeds. It is known that phosphorus is essential for cell division, development of root nodules and stimulation of nitrogen fixation **(Marschner, 1995**). The results are in accordance with those of **Javiya *et al.*(1989); Sarawgi and Singh (1989); Kumpawat *et al.*(1990); Abd El-Gawad *et al.*(1991);Zeiton (1992); Enania and Vyas (1995) and Sawires (2001).**

**Table 3 . Yield and its components and seed quality as affected by Phosphorus fertilizer.**

| Characters | Phosphorus fertilizer rates (kg / fed) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2001 / 02 season | | | 2002 / 03 season | | | Combined analysis | | |
| | control | 15 | 30 | control | 15 | 30 | control | 15 | 30 |
| Plant height (cm) | 62.2 c | 74.0 b | 78.5 a | 58.7c | 74.3 b | 79.9 a | 60.5 c | 74.1 b | 79.2 a |
| No. of branches / plant | 2.74 c | 4.09 b | 5.06 a | 3.05c | 4.50 b | 5.35 a | 2.90 c | 4.29 b | 5.20 a |
| No. of pods / plant | 37.6 c | 49.5 b | 59.0 a | 33.7c | 49.8 b | 55.4 a | 35.7 c | 49.7 b | 57.2 a |
| No. seeds / pod | 1.10 c | 1.41 a | 1.53 a | 1.03b | 1.23 b | 1.51 a | 1.06 b | 1.32 b | 1.52 a |
| No. of seeds / plant | 41.4 c | 70.1 b | 90.7 a | 34.9c | 61.4 b | 84.0 a | 38.1 c | 65.8 b | 87.3 a |
| Weight of pods/ plant | 10.7 c | 12.1 b | 13.2 a | 11.5c | 13.5 b | 14.8 a | 11.12c | 12.79b | 14.04a |
| Seed index (g) | 15.5 c | 16.9 b | 18.2 a | 14.5c | 16.8 b | 18.0 a | 15.0 c | 16.8 b | 18.1 a |
| Seed yield / plant (g) | 7.63 c | 8.80 b | 10.75a | 8.88b | 9.60 b | 11.58a | 8.25 b | 9.20 b | 11.16a |
| Seed yield kg/fed | 702.4c | 789.5b | 842.1a | 700.5c | 807.0b | 838.3a | 701.5c | 798.2b | 840.2a |
| Straw yield ton/fed | 0.961c | 1.037b | 1.126a | 0.964c | 1.066b | 1.171a | 0.962c | 1.051b | 1.149a |
| Biological yield ton/fed | 1.663c | 1.826b | 1.969a | 1.664c | 1.873b | 2.009a | 1.664c | 1.850b | 1.989a |
| Seed N content % | 2.80 a | 2.96 a | 3.05 a | 2.45 c | 2.90 b | 3.56 a | 2.62 b | 2.93ab | 3.30 a |
| Seed protein content % | 17.55a | 18.54a | 19.06a | 15.31c | 18.17b | 22.29a | 16.4 c | 18.3 b | 20.6 a |
| Protein yield kg/fed | 123.3c | 146.4b | 160.6a | 108.3c | 147.6b | 187.4a | 115.8c | 147.0b | 174.0a |
| N uptake kg/fed | 19.74c | 23.43b | 25.70a | 17.3c | 23.6 b | 29.9 a | 18.5 c | 23.5 b | 27.8 a |
| Seed P content % | 0.258c | 0.310b | 0.353a | 0.258c | 0.298b | 0.384a | 0.258c | 0.304b | 0.369a |
| P uptake kg/fed | 1.82 c | 2.44 b | 2.98 a | 1.82c | 2.42 b | 3.23 a | 1.82 c | 2.43 b | 3.10 a |

## D- Effect of Fe application.

Data in Table (4) indicated clearly that there were no significant differences in seed N content, seed protein content, protein yield/fed and N uptake/fed in the first season between Fe application treatments. Spraying chickpea plants with Fe surpassed the tap water (control) in plant height, number of seeds/plant, weight of pods/plant, seed index, seed yield/plant, seed, straw, biological and protein yields/fed, seed P content and P uptake/fed in both seasons as well as combined analysis. The effect of Fe is more clearly in both seasons. It is attitude to the improvement nitrogen fixing activity of the root nodules **(Marschner, 1995)**. Available Fe in the soil experiment was 3.6 ppm. The soil is considered poor in available Fe, so, chickpea plants responsed to Fe treatment. Confirming results were reported by **Sawires (2001**) on chickpea and **Mehasen and El-Ghozoli (2003**) on soybean.

**Table 4 . Yield and its components and seed quality as affected by spraying Fe .**

| Characters | Fe foliar application | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2001 / 02 season | | | 2002 / 03 season | | | Combined analysis | | |
| | Tap w. | Fe | F test | Tap w. | Fe | F test | Tap w. | Fe | F test |
| Plant height (cm) | 70.2 | 72.9 | ** | 69.7 | 72.2 | * | 70.0 | 72.6 | ** |
| No. of branches / plant | 3.72 | 4.21 | ** | 4.13 | 4.46 | * | 3.93 | 4.33 | ** |
| No. of pods / plant | 47.8 | 49.8 | ** | 45.8 | 46.8 | n.s | 46.7 | 48.3 | * |
| No. seed / pod | 1.24 | 1.45 | * | 1.16 | 1.35 | n.s | 1.20 | 1.40 | ** |
| No. of seed / plant | 59.9 | 74.9 | ** | 54.8 | 65.4 | * | 57.4 | 70.1 | ** |
| Weight of pods/ plant | 11.6 | 12.4 | * | 12.88 | 13.66 | * | 12.25 | 13.05 | ** |
| Seed index (g) | 16.6 | 17.1 | * | 16.1 | 16.7 | * | 16.3 | 16.9 | ** |
| Seed yield / plant (g) | 8.60 | 9.52 | ** | 9.58 | 10.45 | * | 9.09 | 9.98 | ** |
| Seed yield kg/fed | 764.8 | 791.1 | ** | 769.0 | 794.8 | * | 766.9 | 793.0 | ** |
| Straw yield ton/fed | 1.025 | 1.058 | ** | 1.048 | 1.086 | ** | 1.036 | 1.072 | ** |
| Biological yield ton/fed | 1.790 | 1.849 | ** | 1.817 | 1.880 | ** | 1.803 | 1.865 | ** |
| Seed N content % | 2.90 | 2.97 | n.s | 2.86 | 3.08 | * | 2.88 | 3.03 | * |
| Seed protein content % | 18.16 | 18.61 | n.s | 17.88 | 19.30 | * | 18.0 | 18.9 | * |
| Protein yield (kg/fed) | 139.4 | 147.5 | n.s | 140.1 | 155.5 | * | 139.7 | 151.5 | * |
| N uptake (kg/fed) | 22.31 | 23.60 | n.s | 22.4 | 24.8 | * | 22.3 | 24.2 | * |
| Seed P content % | 0.292 | 0.322 | ** | 0.301 | 0.326 | ** | 0.297 | 0.324 | ** |
| P uptake kg/fed | 2.25 | 2.57 | ** | 2.35 | 2.63 | ** | 2.30 | 2.60 | ** |

*,** indicates significant at $P<0.05$ and 0.01, respectively ; n.s = non significant

**E-Interaction effects:**

Significant interaction effects were found between phosphorein and phosphorus fertilizer rates on plant height, seed, straw and biological yields/fed and P uptake/fed in combined analysis (Table 5). Also, in combiend analysis interaction were found between phosphorein and spraying with Fe on straw yield/fed (Table 6).

Data illustrated in Table (5) indicated that the highest plant height, seed, straw and biological yields/fed and P uptake/fed were obtained from inoculated with phosphorein when fertilized with P at rate 30 kg $P_2O_5$/fed. These increase represented 34.2, 33.8, 23.0, 27.4 and 123.2 % for the previously mentioned traits, respectively, as compared to control (without phosphorein and P fertilizer).

Data illustrated in Table (6) indicated that maximum straw yield/fed was obtained from inoculated with phosphorein at spraying with Fe . This increase represented 7.5 % as compared to the control (without phosphorein and Fe).

**Table 5. chickpea criteria as affected by the interaction between phosphorein and phosphorus fertilizer rates (in combined analysis).**

| phosphorein | Phosphorus rates | Plant height (cm) | Seed yield kg/fed | Straw yield ton/fed | Biological yield ton/fed | P uptake kg/fed |
|---|---|---|---|---|---|---|
| noninoculated | Control | 59.6 D | 652.1 E | 0.968 E | 1.620 E | 1.55 D |
| | 15 | 71.6 C | 771.7 C | 1.027 D | 1.799 C | 2.21 C |
| | 30 | 78.3 AB | 807.5 B | 1.106 B | 1.914 B | 2.74 B |
| Inoculated | Control | 61.4 D | 750.9 D | 0.957 E | 1.708 D | 2.09 C |
| | 15 | 76.7 B | 824.7 B | 1.076 C | 1.900 B | 2.66 B |
| | 30 | 80.0 A | 872.8 A | 1.191 A | 2.064 A | 3.46 A |

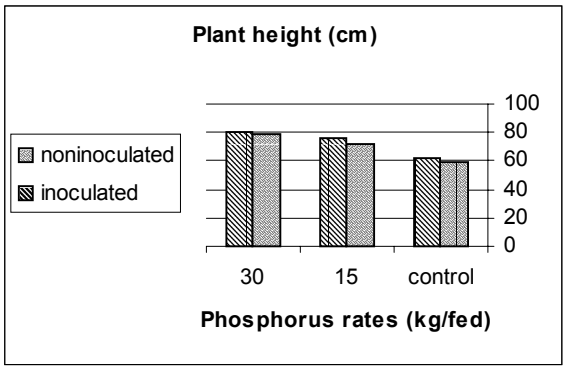
**Table 6. Straw yield (ton/fed) of chickpea as affected by the interaction between phosphorein and spraying Fe (in combined analysis).**

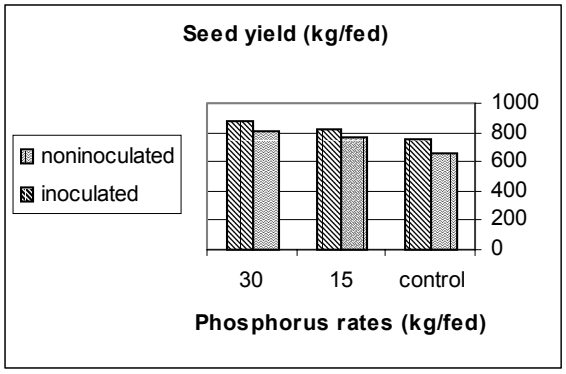
| Treatments | Noninoculated | Inoculated |
|---|---|---|
| Tap water | 1.023 C | 1.044 B |
| Spraying Fe | 1.050 B | 1.100 A |

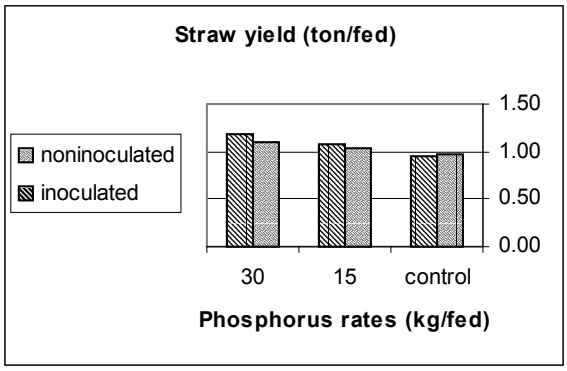
**F- Simple correlation study:**

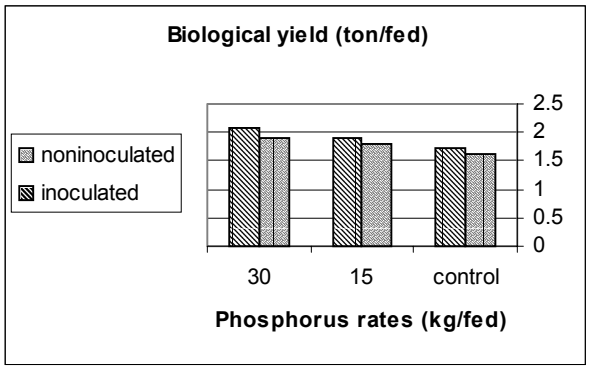
The interrelationships between seed yield of chickpea and its components in combined analysis are shown in Table (7). Seed yield/fed showed positive and highly significant correlation with all studied chickpea traits i.e., plant height, number of branches and pods/plant , number of seeds/pod, number of seeds/plant, pods weight/plant, seed yield/plant, seed index, straw and biological yields/fed. Also, highly significant and positive correlation coefficients values between biological yield/fed and each of plant height, number of branches and pods/plant, number of seeds/pod and per plant, pods and seed weight/ plant , 100-seed weight and straw yield/fed. Straw yield/fed showed positive and highly significant correlation coefficients with seed index , seed weight/plant, pods weight/plant, number of seeds/pod and per plant, number of branches/plant and plant height. Such results indicated that selection for these traits would lead to the increase in seed yield of chickpea.

## Chickpea criteria as affected by the interaction between pbosphorein and phosphorus fertilizer rates (combined analysis)

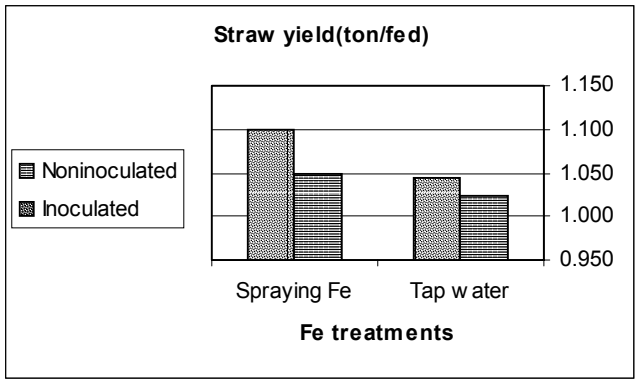



## Straw yield (ton/fed) of chickpea as affected by the interaction between phosphorein and spraying with Fe. (combined analysis)



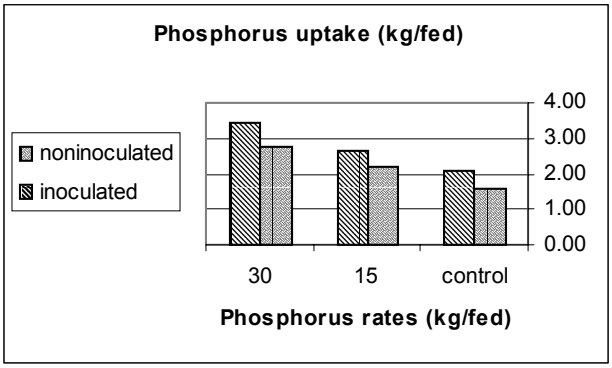



**Table 7. Simple correlation coefficients between seed yield and yield components ( combined analysis).**

| Traits | Correlation matrix | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1-Plant height (cm) | | | | | | | | | | |
| 2-Number of branches/ plant | 0.971 | | | | | | | | | |
| 3-Number of pods / plant | 0.870 | 0.902 | | | | | | | | |
| 4-Number of seeds / pod | 0.871 | 0.884 | 0.890 | | | | | | | |
| 5-Number of seeds/plant | 0.944 | 0.954 | 0.922 | 0.976 | | | | | | |
| 6-Pods weight / plant (g) | 0.884 | 0.922 | 0.843 | 0.873 | 0.912 | | | | | |
| 7-Seed yield / plant (g) | 0.849 | 0.929 | 0.918 | 0.905 | 0.934 | 0.915 | | | | |
| 8-Seed index (g) | 0.963 | 0.977 | 0.911 | 0.934 | 0.984 | 0.951 | 0.934 | | | |
| 9-Straw yield/fed | 0.921 | 0.953 | 0.938 | 0.933 | 0.973 | 0.928 | 0.948 | 0.971 | | |
| 10-Biological yield/fed | 0.945 | 0.975 | 0.922 | 0.920 | 0.969 | 0.961 | 0.956 | 0.992 | 0.972 | |
| Y-Seed yield / fed. (kg) | 0.903 | 0.930 | 0.835 | 0.836 | 0.893 | 0.929 | 0.895 | 0.943 | 0.867 | 0.960 |

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# استجابة محصول الحمص وجودة بذوره للتلقيح بالفوسفورين، السماد الفوسفاتي والرش بالحديد

ناصر خميس بركات الجيزاوي – صديق عبد العزيز صديق محيسن
قسم المحاصيل – كلية الزراعة بمشتهر- جامعة الزقازيق (فرع بنها)

أقيمت تجربتان حقليتان علي الحمص خلال موسمي ٢٠٠١/٢٠٠٢ ، ٢٠٠٢/٢٠٠٣ بمحطة التجارب والبحوث الزراعية بكلية الزراعة بمشتهر- جامعة الزقازيق (فرع بنها). تضمنت كل تجربة ١٢ معاملة هي التوافيق بين معاملتين لتلقيح التقاوي بالبكتريا المذيبة للفوسفات (باسيلاس ميجاثيرم) علي الصورة التجارية "فوسفورين" (بدون ، ملقح) ، ثلاث مستويات من السماد الفوسفاتي ( صفر، ١٥ ، ٣٠كجم $P_2O_5$ /فدان ) ومستويين للرش بالحديد المخلبي ١٤% (رش بالماء و ٠,٥ جم/لتر).

- أظهرت نتائج التحليل التجميعي للموسمين ان التلقيح بالبكتريا المذيبة للفوسفات (فوسفورين) قد تفوقت معنويا معاملة التلقيح عن بدون التلقيح في طول النبات ، وزن بذور/نبات، وزن ١٠٠ بذرة، محصول بذور/نبات، محصول البذور والقش والبيولوجي والبروتين/فدان وكذلك الممتص من النتروجين والفوسفور.

- أدى السماد الفوسفاتي إلى زيادة ارتفاع النبات، عدد الفروع والقرون/نبات، وزن قرون وبذور/نبات، وزن ١٠٠ بذرة ، محصول البذور/فدان ، نسبة البروتين ومحصوله والممتص من النتروجين والفوسفور/فدان في حين تسبب عدم التسميد الفوسفاتي إلى الحصول علي اقل القيم للصفات السابقة.

- رش المجموع الخضري بالحديد المخلبي اثر معنويا علي معظم الصفات المدروسة في الموسمين والتخليل التجميعي لهما.

-أظهرت النتائج وجود ارتباط موجب وعالي المعنوية بين كل زوج من صفات مكونات المحصول المدروسة ومحصول البذور و البيولوجي والقش/فدان .