J. Plant Production, Mansoura Univ., Vol. 9 (4): 339- 344, 2018

Response of some Soybean Cultivars to Different Systems of Phosphorus Fertilizers in North Delta Region

Iman M. Soltan[1] ; Rania F. El Mantawy[1] and Th. M. Abosen[2]
[1] Crop Physiology Res. Dep. - Field Crops Research Institute- Agric. Res. Center,Egypt.
[2] Crop Legumes Res. Dep. - Field Crops Research Institute- Agric. Res. Center,Egypt.

ABSTRACT

An experiment was carried out at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt during the two successive seasons of 2015 and 2016 to investigate the effect of different systems of phosphorus fertilizer, either alone or in combination with biofertilizer (biofertal) on growth, yield, yield components and seed quality of four cultivars of soybean. The experimental design was split plot design with four replications, the main plots were devoted to soybean cultivars (Giza 21, Giza 35, Giza 111 and Crawford). While, the sub-plots were occupied with different sources of phosphorus fertilizer ; application of 150 kg super phosphate fed.$^{-1}$., 100 kg super phosphate fed.$^{-1}$ + biofertal, 100 kg super phosphate fed.$^{-1}$ + spraying of super phosphate at 4%, 100kg super phosphate fed.$^{-1}$+ biofertal+ spraying of super phosphate at 4%, 50 kg super phosphate fed.$^{-1}$+ biofertal, 50 kg super phosphate fed.$^{-1}$ + spraying of super phosphate at 4%, 50 kg super phosphate fed.$^{-1}$+ biofertal+ spraying of super phosphate at 4%. The results showed marked difference of soybean cultivars were observed, among these cultivars, Giza 121 *cv.* recorded the highest seed yield followed by Giza 21 and Giza 35 while, the lowest seed yield was recorded with Crawford *cv.* at the two growing seasons. On the other hand, application of 100 kg P_2O_5 fed^{-1} combined with inoculation with biofertal and foliar spray with 4% P_2O_5 fed.$^{-1}$ recorded the highest values of photosynthetic pigments, dry weight plant^{-1}, plant height, number of pods plant^{-1}, 100-seed weight, seed yield and seed oil percentage at the two growing seasons. The recommendation of the obtained results is application of 100 kg P_2O_5 fed.$^{-1}$ combined with inoculation with biofertal and foliar spray with 4 % P_2O_5 fed.$^{-1}$ with soybean Giza 111 *cv.* under the same conditions in the study.

Keywords: Phosphorus sources, Bio-fertilizers ,Soybean cultivars quality, productivity.

INTRODUCTION

Soybean (*Glycine max* L.) is one of the most important oil seeds in the world. It can substitute for meat and to some extent for milk, owing to containing about 18 to 22% cholesterol free oil with 85% unsaturated fatty acids and 38 to 42% protein. The beans contain significant amounts of phytic acid, dietary minerals and B vitamins but poor sources of vitamins A and C and of starch. (Ali *et al*., 2009). It is a versatile food plant that, used in its various forms, is capable of supplying most nutrients.

Phosphorus (P) is one of the important plant nutrient required for plant growth as it has a vital role in life processes such as photosynthesis, breakdown of sugar and starches and energy transformation . It also has a significant role in increase of crop productivity (Snyder, 2000). Only a part of the phosphorus fertilizers is utilized by the plants and a large part of it is converted into insoluble forms; the recovery efficiency of phosphorus in crops is generally 10 - 30% (Swarup, 2002). Microorganisms have vital role in nutrient recycling in soils. A group of microorganisms have the ability to release the soluble form of phosphorus viz., HPO4-2 and H2PO4-1, from the insoluble inorganic P sources and make it available to plants. This process called solubilization (Goldstein, 1986). Organic application generally do not provide sufficient P for high crop growth due to their low P concentration (Aulakh *et al*., 2003). However, addition of biofertiizers identified as an helpful tool to chemical fertilizers for improved soil fertility and crop productivity . In addition, Many researchers indicate the importance of foliar feeding of soybean plants. In this regard, Camberato *et al.* (2010) reported that foliar fertilizer applications is the most effective method for overcoming micronutrient deficiencies.

The objective of this study was studying the effect of different systems of phosphorus fertilizer on growth , yield and quality on some soybean cultivars.

MATEREALS AND METHODS

An experiment was conducted during 2015 and 2016 summer seasons at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt, to study the influence of different phosphorus fertilizer systems on four cultivars of soybean (Giza 21, Giza 35, Giza 111 and Crawford) on growth, photosynthetic pigments, yield and its components, seed oil and seed protein %. A split plot design with three replicates was used in this work where ;

I- Main plots (Cultivars): Giza 21, Giza 35, Giza 111 and Crawford.

II- Sub plots (Phosphorus fertilizer) :

- 150 kg Super phosphate fed.$^{-1}$ (P_1) .
- 100 kg Super phosphate fed.$^{-1}$ + Biofertal (P_2) .
- 100 kg Super phosphate fed.$^{-1}$ + Super phosphate spray at 4% (P_3) .
- 100 kg Super phosphate fed.$^{-1}$ + Biofertal + Super phosphate spray at 4% (P_4) .
- 50 kg Super phosphate fed.$^{-1}$ + Biofertal (P_5) .
- 50 kg Super phosphate fed.$^{-1}$ + Super phosphate spray at 4% (P_6) .
- 50 kg Super phosphate fed.$^{-1}$ + Biofertal + Super phosphate spray at 4% (P_7) . were sprayed twice at 45 and 60 days after sowing.

The seeds were sown on 15th and 11st of May in the first and second season, respectively. Each plot consisted of six ridges, 4 m long and 0.70m apart. Other agricultural practices were applied as recommended.

A detailed description of name, pedigree, maturity group and origin of the tested genotypes are presented in Table (1).

Table 1. The pedigree, maturity group, growth habit and country origin of tested soybean cultivars.

Cultivars	Pedigree	Maturity group	Growth habit	Country origin
Giza 21	Crawford x Celest iza 21 x Major	IV	Indeterminate	FCRI *
Giza 35	Crawford × Celest	III	Indeterminate	FCRI *
Giza 111	Crawford × Celest	IV	Indeterminate	FCRI *
Crawford	Williams× Columbus	IV	Indeterminate	USA**

*** FCRI = Field Crops Research Institute, Giza, Egypt. ** USA = U. S. Regional Soybean Laboratory at Urbana, Illinois, and Stoneville, Mississipi.**

Soil samples were randomly taken from the experimental site at depth of 0 to 30 cm from soil surface and were analyzed for both physical and chemical characteristics according to Klute (1986) and Page *et al*. (1982) as presented in Table (2) .

Table 2. Physical and chemical analysis of soil at the experimental sites during 2015 and 2016 seasons.

Characters	2015	2016
	Physical analysis: Soil fraction:	
Sand %	17.00	20.00
Silt %	25.10	23.30
Clay %	57.90	56.70
	Chemical analysis:	
pH	8.10	8.50
E.C. mm hos/cm	2.00	1.70
Organic matter %	1.30	1.53
Available N ppm	29.00	30.00
Available P ppm	15.00	13.00
Available K ppm	300.00	350.00

Studied characteristics:

Representative plant samples were taken randomly from each plot at flowering stage to estimate the following traits:

1- **Photosynthetic pigment content in leaves:** The total chlorophyll pigments were determined by reading the absorbance on spectrophotometer at 664 and 647 nm and concentration of photosynthetic pigments were calculated according to the equation mentioned by Moran(1982) as follow :

Chl. a= 12.7(O.D)664-2.79(O.D)647

Chl. b =20.7(O.D)647-4.62(O.D)664

Total chlorophyll = 7.04 (O.D)664 + 20.27 (O.D)647

2- **Dry matter accumulation (g m^{-2}):** Plants were dried to a constant weight in forced air oven at 70c̊ and the dry weight was recorded.

Yield and its components:

At harvest a sample of ten guarded plants were randomly taken from each to measure :

- Plant height from the soil surface to the top of the main stem (cm).
- Number of pods per plant was counted as an average of the sample.
- Seed yield was determined from the central four ridges in kilograms .
- Seed oil percentage (%): It was determined according to A.O.A.C.(2000) using soxhlet apparatus using petroleum ether as a solvent.
- Seed protein %: It was determined according to A.O.A.C.(2000) and calculated by multiplying the N by the converting factor 6.25 (Hymowitz *et al.* 1972).

Statistical analysis

The obtained data were statistically analyzed and comparison among means were performed by computer programming methods (statgraphics,v.4.2 software), as described by Snedecor and Cochran (1982). Treatment means were compared by Duncan's multiple range test (Duncan's,1955).

RESULTS AND DISCUSSION

Photosynthetic pigments:

It is evident from Table 3 that, soybean cultivars significantly differed in photosynthetic pigments in both seasons. The data indicated that the highest photosynthetic pigments and dry weight were recoded with Giza 111 *cv.*, while the lowest values were recorded with Crawford cultivar at the first season and the second season, respectively. The differences among soybeans cultivars in growth characteristics may be due to the differences in number of nodules formed on the root of the tested cultivar, consequently, the growth of each cultivar may depended mainly on nitrogen fixation Tawfic *et. al.*, (1991), also to the differences in partition and migration of photosynthate between cultivars and the endogenous hormones content Ahmed *et. al.*, (1997).

Table 3. Effect of different sources of phosphorus fertilizers on photosynthetic pigments and dry weight of some soybeans cultivars during the two seasons of 2015 and 2016.

Treatments	Chlorophyll a (mg/dm^2)		Chlorophyll b (mg/dm^2)		Total Chlorophyll (mg/dm^2)		Dry weight (g/plant)	
	2015	2016	2015	2016	2015	2016	2015	2016
Cultivars								
Giza 21	1.868 b	1.865 ab	1.529 b	1.537 b	3.397 b	3.402 b	6.88 b	6.98 b
Giza 35	1.856 b	1.854 b	1.520 c	1.530 c	3.376 b	3.385 c	6.73 c	6.82 c
Giza 111	1.892 a	1.890 a	1.536 a	1.548 a	3.428 a	3.438 a	7.52 a	8.13 a
Crawford	1.834 c	1.835b	1.514 d	1.523 d	3.349 c	3.358 c	6.70 d	6.77 d
F test	*	*	*	*	*	*	*	*
Phosphorus fertilizers								
150 P_2O_5 fed.$^{-1}$	2.017 a	2.037 a	1.622 a	1.617 b	3.629 a	3.654 a	7.67 a	7.81 a
100 kg P_2O_5 fed.$^{-1}$+Biofertal	1.901 b	1.912 b	1.573 b	1.580	3.475 b	3.493 c	7.21 c	7.42 b
100 kg P_2O_5 fed.$^{-1}$+ foliar spray with 4% P_2O_5	1.845 c	1.854 c	1.541c	1.551d	3.387 c	3.405 d	6.98 d	7.25 c
100 kg P_2O_5 fed.$^{-1}$+Biofertal + foliar spray with 4% P_2O_5	2.019 a	1.931b	1.610a	1.629a	3.630 a	3.561 b	7.65 a	7.78 a
50 kg P_2O_5 fed. $^{-1}$+Biofertal	1.746 e	1.766e	1.446e	1.456 f	3.192 e	3.223 f	6.41 f	6.66 e
50 kg P_2O_5 fed. $^{-1}$+ foliar spray with 4% P_2O_5	1.702f	1.711 f	1.432f	1.439 g	3.135 f	3.151 g	6.26 g	6.58 f
50 kg P_2O_5fed. $^{-1}$+Biofertal + foliar spray with 4% P_2O_5	1.807d	1.814 d	1.461 d	1.469 e	3.268 d	3.283 e	6.55e	6.73 d
F test	*	*	*	*	*	*	*	*
Interaction	NS	NS	**	**	NS	NS	**	**

*,** significant at 0.05 and 0.01 level of probability, respectively . Mean values designed by the same letter in each column are not significant according to Duncan's Multiple Range Test.

According to the effect of phosphorus fertilization treatments, data in Table (3) showed that the different levels and sources of phosphorus influenced significantly the photosynthetic pigments and dry weight during the two growing seasons. Application of biofertal improved photosynthetic pigments and total plant dry matter .These results may be due to microorganisms with phosphate solubilizing potential increase the availability of soluble phosphate and enhance the photosynthesis process by improving biological nitrogen fixation (Kucey, *et al.*, 1989 and Ponmurugan and Gopi, 2006).

In addition, Mekki and Ahmed (2005) showed that joint application of bio-fertilizers plus inorganic fertilizers resulted in increased more dry weight (g $plant^{-1}$) after 60 day from seedling of soybean plants in comparison to the treatments received inorganic fertilizers only. This could be attributed to the plant growth promoting substances produced by the bio-fertilizer, which convert the insoluble organic phosphorus to soluble form and make it available to plants. These results are in agreement with Shakori and sharifi (2016) who reported that, application of phosphorus fertilizers combined with 100 kg P ha^{-1} chemical phosphorus increased dry matter accumulation. Many researches recorded similar results as Shahid *et al.* (2009), Demissie *et. al*., (2013) and Abitew and Kibret (2017) .

Yield and yield components :

Results in Table 4 clearly showed that, significant difference existing among all cultivars where, Giza 21 cultivar recorded the tallest plants (89.71 & 91.04 cm) followed by Giza 111 (85.50 & 86.61 cm), then Giza 35 (77.23 & 78.14 cm) while the shortest plants were observed with Crawford (66.74 & 67.57cm) at the first and second season, respectively. In addition the highest values of pods plant-1(122.33 &124.66), 100-seed weight (17.32& 17.44 g) and seed yield (1899.38&1905.14 kg fed.-1)were recorded with Giza 111 cv. during the two growing seasons. The difference in the results might be due to the difference in genetic constitution of breeding material and environmental condition El-Mohsen *et al.* (2013). The results are in line with Iqbal *et al.* (2010) and Sharief *et al.* (2010) who recorded a wide range of variability on cultivars under study.

The data in Table 4 revealed that, different levels and sources of phosphorus affected significantly yield and its components. As shown in Table 4 the highest yield and yield components were recorded with the treatment 150 kg P_2O_5 $fed.^{-1}$ without significant difference with plants treated by 100 kg P_2O_5 fed^{-1}. and inoculated with biofertal and sprayed with 4% P_2O_5 $fed.^{-1}$. This may be attributed to the effect of nutrients mobilizing microorganisms which help in availability of metals and increased levels of extractable mineral El-Kramany *et. al.*, (2000) . The obtained results agreed with those of Sherif *et. al.*, (1997) who mentioned that phosphate dissolving bacteria presses the ability to bring a soluble phosphate in soluble from excreting organic acids which lower the pH and bring about the dissolution of bonds forms of phosphate and render then available for growing plants.

Table 4. Effect of different sources of phosphorus fertilizers on yield and yield attributes of some soybeans cultivars during the two seasons 2015 and 2016.

Treatments	Plant height (cm)		No. of Pods $plant^{-1}$		100-seed weight (g)		Seed yield (kg fed^{-1})	
	2015	2016	2015	2016	2015	2016	2015	2016
Cultivars								
Giza 21	89.71 a	91.04 a	97.80 b	99.09 b	15.90 b	16.65 b	1722.33 b	1727.80 b
Giza 35	77.23 c	78.14 c	74.57 d	75.95 d	15.08 c	15.19 c	1413.80 c	1418.23 c
Giza 111	85.50 b	86.61 b	122.33 a	124.66 a	17.32 a	17.57 a	1899.38 a	1905.14 a
Crawford	66.74 d	67.57 d	86.19 c	88.28 c	13.27 d	13.38 d	1394.38 d	1399.90 d
F test	*	*	**	*	*	*	*	*
Phosphorus fertilizers								
150 P_2O_5 $fed.^{-1}$	84.80 a	85.79a	106.04 a	107.5 a	17.27 a	17.52 a	1681.16 a	1686.66 a
100 kg P_2O_5 $fed.^{-1}$+Biofertal	82.41 b	83.50 b	98.87 b	100.75 b	15.98 c	16.35 b	1648.75 b	1654.91 b
100 kg P_2O_5 $fed.^{-1}$+ foliar spray with 4% P_2O_5	80.90 c	81.50c	95.25 c	97.58 c	15.50 d	15.81 c	1630.33 c	1636.08 c
100 kg P_2O_5 $fed.^{-1}$ +Biofertal + foliar spray with 4% P_2O_5	84.43 a	85.70a	105.83a	107.16 a	16.90 b	17.40 a	1679.75 a	1683.66 a
50 kg P_2O_5 $fed.^{-1}$+Biofertal	75.33 e	76.50e	86.87e	88.58 e	14.07 f	14.30 e	1539.58 e	1544.41 e
50 kg P_2O_5 $fed.^{-1}$+ foliar spray with 4% P_2O_5	73.00 f	74.25f	83.41 f	85.25 f	13.66 g	13.78 f	1519.66 f	1525.00 f
50 kg P_2O_5 $fed.^{-1}$+Biofertal + foliar spray with 4% P_2O_5	77.87 d	78.66d	90.29d	92.16 d	14.37 e	14.74 d	1553.08 d	1558.66 d
F test	*	*	**	**	**	*	**	**
Interaction	**	**	**	**	**	**	**	**

***,** significant at 0.05 and 0.01 level of probability, respectively . Mean values designed by the same letter in each column are not significant according to Duncan's Multiple Range Test.**

Also, Ali *et al*., (2012) reported that seed inoculation with B. *japonicum*, phosphate-solubilizing and application of 50 % triple super phosphate provided the best conditions for achieving maximum grain yield and oil yield in soybean. Similar results were observed by Attia *et. al.*, (2015) who showed that inoculation of seeds for different cultivars of soybean gave the highest values of seed yield, weight of pods, protein and oil percentage and low proline content in comparison to untreated seeds. The positive effect of phosphorus fertilizer on growth attributes, may be due to the physiological role of P. on the meristematic activity of plant tissues and consequently increasing plant growth, also, its function as a part of enzyme system having a vital role of synthesis of other foods from carbohydrates Ahmed *et.al.*(2010).

In response to the interaction between soybean cultivars and phosphorus fertilizers, the data in Table(5) clearly showed that the highest values of plant height, number of pods/plant, 100-seed weight and seed yield were recorded by Giza 111 treated with 150 kg P_2O_5 fed.$^{-1}$ and/ or 100 kg P_2O_5 fed.$^{-1}$ with biofertal and sprayed with 4% P_2O_5 fed.$^{-1}$ at the first and second season, respectively.

Table 5. Effect of interaction between soybean cultivars and different phosphorus fertilizer on seed yield and its components at the 2015 and 2016 seasons.

Cultivars	Phosphorus fertilizers	Plant height (cm)		No. of Pods plant^{-1}		100-seed weight (g)		Seed yield (kg fed^{-1})	
		2015	2016	2015	2016	2015	2016	2015	2016
Giza 21	P1	95.5	96.5	110.0	110.06	18.76	19.40	1823.0	1829.0
	P2	93.0	94.3	103.0	104.3	16.61	17.75	1796.6	1806.0
	P3	91.0	93.0	100.0	102.6	15.88	16.71	1762.3	1767.0
	P4	95.5	96.5	109.6	110.3	18.53	19.39	1821.6	1827.3
	P5	84.0	85.6	87.0	87.6	13.73	14.52	1611.6	1616.3
	P6	82.0	83.3	84.0	85.0	13.52	13.66	1606.0	1608.3
	P7	87.0	88.0	91.0	93.0	14.27	15.12	1635.0	1640.6
Giza 35	P1	81.9	83.3	85.0	86.0	16.22	16.44	1504.3	1510.0
	P2	79.8	80.6	76.0	77.0	15.53	15.73	1474.0	1478.6
	P3	78.4	78.3	73.0	74.6	15.31	15.54	1451.0	1454.6
	P4	81.5	83.0	84.6	85.6	16.18	16.07	1503.6	1509.0
	P5	73.0	74.0	67.8	68.3	14.16	14.28	1285.0	1291.6
	P6	71.0	72.3	65.0	67.6	13.69	13.65	1232.0	1239.0
	P7	75.0	75.3	70.5	72.3	14.46	14.66	1310.6	1316.3
Giza 111	P1	90.33	91.0	134.0	136.3	19.48	19.50	1951.3	1956.3
	P2	87.8	89.0	126.6	130.0	17.96	18.08	1908.6	1915.0
	P3	86.3	87.3	121.0	124.3	17.48	17.59	1901.0	1909.3
	P4	90.0	91.0	134.0	135.6	18.28	19.41	1948.6	1952.3
	P5	81.6	82.6	113.6	116.0	16.21	16.06	1869.3	1873.3
	P6	80.0	81.3	110.0	111.6	15.59	15.79	1851.6	1858.3
	P7	83.0	84.0	117.0	118.6	16.27	16.58	1865.0	1871.3
Crawford	P1	71.5	72.3	95.1	97.0	14.65	14.75	1446.0	1451.3
	P2	69.0	70.0	89.8	91.6	13.81	13.86	1415.6	1420.0
	P3	67.8	67.3	87.0	88.6	13.34	13.40	1407.0	1413.0
	P4	70.7	72.3	95.0	97.0	14.61	14.72	1445.0	1446.0
	P5	62.6	63.6	79.0	82.3	12.17	12.33	1392.3	1396.3
	P6	59.0	60.0	74.6	76.6	11.85	12.01	1389.0	1394.3
	P7	66.5	67.3	82.6	84.6	12.48	12.60	1401.6	1406.3
LSD		1.578	1.194	2.231	2.028	0.271	0.256	24.943	23.616

***,** significant at 0.05 and 0.01 level of probability, respectively . Mean values designed by the same letter in each column are not significant according to Duncan's Multiple Range Test.**

Seeds quality

With respect to seed quality, the data in Table (6) revealed that oil and protein percentages have significant response in all cultivars of soybean in the two seasons. So, it can be noted that both Giza 35 and Giza 111 recorded the highest percentage of seed oil at the first season while, during the second season the highest values of seed oil recoded with Giza 111 followed by Giza 35, Crawford and Giza 21, respectively. These results are in line with Morsy *et al.* (2016).

Table 6. Effect of different sources of phosphorus fertilizers on seed oil and seed protein (%) of some soybeans cultivars during the two seasons 2015 and 2016.

Treatments	Seed oil (%)		Seed protein (%)	
	2015	2016	2015	2016
Cultivars				
Giza 21	20.33 c	20.37 d	35.83 a	35.83 a
Giza 35	20.95 a	20.98 b	35.42 b	35.45 b
Giza 111	20.96 a	21.01 a	34.27 d	34.38 d
Crawford	20.48 b	20.52 c	34.35 c	35.11 c
F test	**	**	*	*
Phosphorus fertilizers				
150 P_2O_5 fed.$^{-1}$	20.94 a	20.97 a	35.64 b	35.35 b
100 kg P_2O_5 fed.$^{-1}$+Biofertal	20.75 b	20.80 b	34.97 g	35.01 c
100 kg P_2O_5 fed.$^{-1}$+ foliar spray with 4% P_2O_5	20.65 c	20.67 c	35.01 f	35.04 c
100 kg P_2O_5 fed.-1 +Biofertal + foliar spray with 4% P_2O_5	20.94 a	20.96 a	35.67 a	35.71 a
50 kg P_2O_5 fed. $^{-1}$+Biofertal	20.49 e	20.54 d	35.08 d	35.08 c
50 kg P_2O_5 fed. $^{-1}$+ foliar spray with 4% P_2O_5	20.44 f	20.48 e	35.11 c	35.11 c
50 kg P_2O_5fed. $^{-1}$+Biofertal + foliar spray with 4% P_2O_5	20.56 d	20.60 d	35.05 e	35.06 c
F test	**	**	*	*
Interaction	**	**	NS	NS

***,** significant at 0.05 and 0.01 level of probability, respectively . Mean values designed by the same letter in each column are not significant according to Duncan's Multiple Range Test.**

In addition, the percentage of seed protein were differed significantly among the different cultivars as noticed from the table that Giza 21 recorded the highest values of seed protein(35.83&35.83%) followed by Giza 35 (35.42 &35.45%) and Crawford (34.35&35.11%) while the lowest values of seed protein were recorded by Giza 111(34.27&34.38%) during the first season and second season, respectively. These results are in agreement with Morsy *et. al*., (2016).

In regard to the effect of different types of phosphorus fertilizers, the tabulated data clearly showed that, the highest stimulatory effect and the maximum enhancement were observed with plants treated with application of 150kg P_2O_5 fed.$^{-1}$ and treatment with both biofertilizers and foliar spray with super phosphate at 4% . These results are in agreements with (Malik *et al*., 2006) who found that, significant effects on oil and protein content were noted in different levels of P and seed inoculation. Several researchers are in the line as Zarei *et. al*., (2012).

Additionally, the effect of interaction between soybean cultivars and phosphorus fertilizers, Fig.(1&2) showed that the highest percentage of seed oil was recorded by Giza 111 cv. treated with 150 kg P_2O_5 fed.$^{-1}$ and/or treatment with both biofertal and foliar spray with super phosphate at 4% .

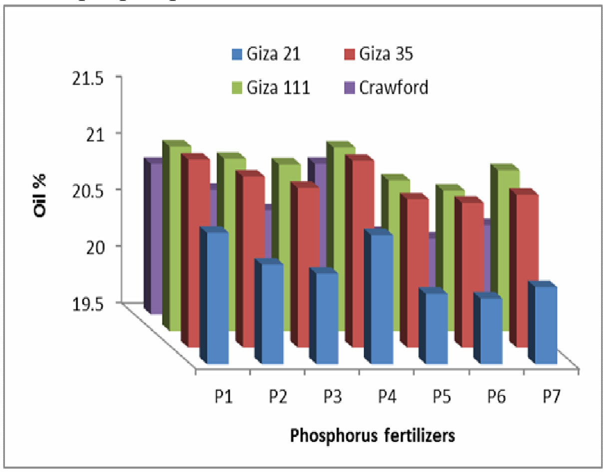

Fig. 1. Effect of interaction between soybean cultivars and different phosphorus fertilizers on oil % at the 2015 season.

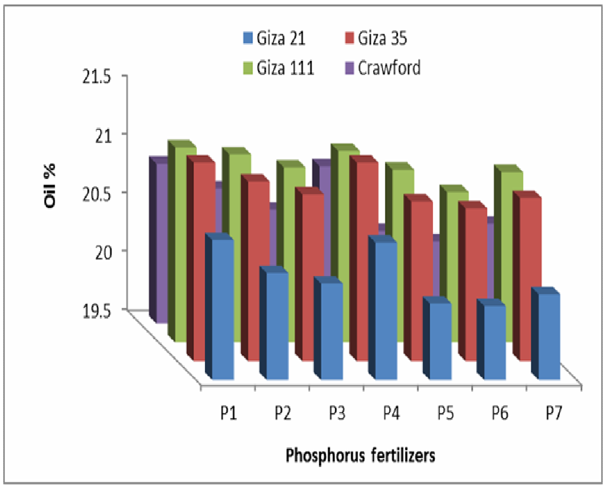

Fig. 2. Effect of interaction between soybean cultivars and different phosphorus fertilizers on oil % at the 2016 season.

CONCLUSION

It is inferred from this investigation that co-inoculation of P-solubilizing microorganisms in the presence of P_2O_5 is very effective in increasing grain yield of soybean. Thus, according to this research we recommended application of 100 kg P_2O_5 fed^{-1} with inoculation with biofertal and foliar spray with P_2O_5 at 4% with Giza 111 cv. of soybean.

REFERENCES

Abitew, T. A. and Kibret, K.(2017). Effects of Rhizobium, Nitrogen and Phosphorus Fertilizers on Growth, Nodulation, Yield and Yield Attributes of Soybean at Pawe Northwestern Ethiopia Masresha. World Sci. News 67 (2) : 201-2 18.

Ahmed, M.A. and EL-Abagy, H.M.H. (2007). Effect of bio-and mineral Phosphorus fertilizer on the growth, productivity and nutritional value of some faba bean (*Vicia faba* L.) cultivars in newly cultivated land. J. of Appl. Sci. Res.,3(6),408-420.

Ahmed, M.A., Ibrahim, O.M. and Badr, E.A. (2010). Effect of Bio and Mineral Phosphorus Fertilizer on the Growth, Productivity and Nutritional Value of Fenugreek (*Trigonella foenum graecum* L.) in Newly Cultivated Land. J. .Agric. and Biolo. Sci., 6(3): 339-348.

Ali A.; Tahir M.; Deem M.A., Tanveer, A. ; Asif, M. ; Wasaya, A. ; Rehman, J. (2009). Effect of different irrigation management strategies on growth and yield of soybean. Pak. J. Life Soc. Sci. 7(2):181-184.

Ali, A.M. ; El Tinay A.H.; Elkhalifa, A.O. ; Limya, O.M.; Babiker E.E. (2012). Effect of different supplementation levels of soybean flour on Pearl Millet Functional Properties. Food Nutr. Sci. 3:1-6.

A.O.A.C. (2000). Official Methods of Analysis of Association of Official Agricultural Chemists. Washington 25, D.C.: The Association of Official Analytical Chemists.

Attia, M.A.; Sayed, D.A. and Abdel-Rahma, L.A. (2015). Evaluation of Bio-and Mineral Phosphorus Fertilizers companied with Foliar Application of Micronutrients on Quantity and Quality of Soybean (*Glycin max* L.). Egypt. J. Soil Sci, :1-17.

Aulakh, M.S.; Pasricha, N.S.; Bahl, G.S. (2003). Phosphorus fertilizer response in an irrigated soybean-wheat production system on a subtropical, semiarid soil. Field Crops Res., 80: 99–1 09.

Camberato, J.; Wise, K. and Johnson, B. (2010). Glyphosate – manganese interactions and impacts on crop production: the controversy. Purdue University Extension News and Notes [Online]. http://www.btny. purdue.edu /weedscience /2010/ Glyphosate Mn.pdf.

Demissie S.; Muleta D. and Berecha, G. (2013). Effect of phosphate solubilizing bacteria on seed germination and seedling growth of faba bean (*Vicia fabae* L.).Inter J Agric. Res.8: 123-136.

Duncan, D.B.(1955). Multiple range and multiple F.test Biometrics,11:1-24.

El-Kramany, M.F. ; Ahmed, M.K.; A.A. and Kabesh, M.O. (2000). Utilization of bio fertilizers in field crop production. Egypt. J. Appl. Sci., 15: 137.

El-Mohsen, A.; Mahmoud, G.O. and Safina, S. A. (2013). Agronomical evaluation of six soybean cultivars using correlation and regression analysis under different irrigation regime conditions. J. Plant Breeding and Crop Sci., Vol. 5(5), pp. 91-102.

Goldstein, A.H. (1986). Bacterial solubilization of mineral phosphates: historical perspectives and future prospects. Am.J. Agric. 1, 51-57.

Hymowitz, T. F.; Collins, P. and Walker, W. M.(1972). Relationship between the content of oil, protein and sugar in soybean seed. Agronomy J. 64: 613 – 616.

Iqbal, Z.; Arshad, M.; Ashraf, M.; Naeem, R.; Malik, M.F.; Wahead, A. (2010). Genotypic divergence and correlation studies of soybean (Glycine max L. Merrile) genotypes. Pak. J. Bot. 42(2):971-976.

Klute, A. (1986) Methods of Soil Analysis, (second ed.) American Society of Agronomy, Inc. Soil Science Society of America. Madison, Wisconsin. USA.

Kucey, R.M.N., Janzen, H.H. and Leggett, M.E. (1989). Microbially mediated increases in plant-available phosphorus, Adv. Agron. 42, 199–228.

Malik, M. A.; Cheema, M. A.; Khan, H. Z. and Wahid, M. A. (2006). Growth and yield response of soybean (*Glycine max* L.) to seed inoculation and varying phosphorus levels. J. Agric. Res.44(1), 47-53.

Mekki, B.B. and Amal, G. A. (2005). Growth, Yield and Seed Quality of Soybean (*Glycine max* L.) As Affected by Organic, Biofertilizer and Yeast Application. Res. J. of Agric. and Bio. Sci. 1(4): 320-324.

Moran, R. (1982):Formula determination of chlorophylls pigments extracted with N-N dimethyl-frmamide. Plant Physiol., 69: 1376 – 1381.

Morsy, A. R.; Alaa, M. E. A. Shahein and Selim, T.A. (2016). Stability of Seed Yield and Seed Quality of Some Soybean Genotypes under Different Planting Dates. Alex. J. Agric. Sci.Vol.61, No.6, pp.635-648.

Page, A.L.; Miller, R.H. and Keeney, D.R. (1982). Methods of Soil Analysis. Part 2: Chemical and Microbiological Properties. Second edition. Agronomy J. 9, 2, Am. Soc. Agron. Inc., Soil Sci. Soc. Am. Inc. Pub. Madison, Wisconsin, USA.

Ponmurugan, P. and Gopi, C. (2006). Distribution pattern and screening of phosphate solubilizing bacteria isolated from different food and storage crops. J. Agron., 5, 600-604. http://dx.doi.org/10.3923/ ja. 2006. 600.604

Shahid,M.Q.; Saleem, M. F.; Haroon, Z. Kh. and Shakeel, A. and Anjum, Sh.A.(2009). Performance of soybean (*Glycine max* L.) under different phosphorus levels and inoculation. Pak. J. Agri. Sci., Vol. 46(4):237-241.

Shakori, Sh. and Sharifi, P. (2016). Effect of Phosphate Biofertilizer and Chemical Phosphorus on Growth and Yield of *Vicia faba* L. Electronic Journal of Biology,2016, Vol.S1: 47-52.

Sharief, A.E.M.; El-Kalla, S.E.; Salama, A.M.; Mostafa, E.I (2010). Influence of organic and inorganic fertilization on the productivity of some soybean cultivars. Crop Environ. 1(1):6-12.

Sherif, F.A.; Hegazy, M.H.; and Abdel- Fattah, F.K.(1997). Lentil yield and its components as affected by bio-fertilization and phosphorus application. J. Agric. Sci., Mansoura Univ., 22-32.

Snedecor, G.W. and Cochran, W.G.(1982).Statistical Methods 6th addition , Iowa state college press .Ams .Iowa, U.S.A.

Snyder, C. S. (2000). Raise soybean yields and profit potential with phosphorus and potassium fertilization. PPI.

Swarup, A. (2002). Lessons from long-term fertilizer experiments in improving fertilizer use efficiency and crop yields. Fertilizer News 47(12): 59–73.

Tawfic, M.M.; Azzazy, M.A. and Mohamed, M.A. (1991). Discrepancy response of some soybean cultivars to rhizobial inoculation under newly reclaimed soils. Egypt. J. Agron., 16: 95-105.

Zarei, I.; Yousef, S.; Gholam, R.H.; Ali, J. and Mohammadi, K. (2012). Effect of biofertilizer on grain yield and protein content of two soybean (*Glycin max* L.) cultivars. African J. of Biotech.11(27), 028-7037.

استجابة بعض أصناف فول الصويا لنظم مختلفة من السماد الفوسفاتى فى منطقة شمال الدلتا

ايمان محمد سلطان[1] ، رانيا فاروق المنطاوى[1] و ثروت محب أبو سن[2]

[1] قسم بحوث فسيولوجيا المحاصيل – معهد بحوث المحاصيل الحقليه – مركز البحوث الزراعيه

[2] قسم بحوث المحاصيل البقوليه - معهد بحوث المحاصيل الحقليه – مركز البحوث الزراعيه

أجريت تجربة حقلية بمزرعة محطة البحوث الزراعية بسخا خلال موسمين 2016/2015م لدراسة تأثير مستويات مختلفة من مصادرالسماد الفوسفاتى على النمو و المحصول ومكوناته وجودة البذور لأربعة أصناف من فول الصويا. كان التصميم الاحصائي المستخدم هى القطع المنشقه مرة واحدة فى أربعة مكررات ، حيث تم تخصيص القطع الرئيسية لأصناف فول الصويا الأربعة وهى (جيزة 21 ، جيزة 35 ، جيزة 111 وكروفورد) بينما خصصت القطع الشقيه لنظم السماد الفوسفاتى المختلفة وهى اضافة 150 كجم سوبر فوسفات / فدان ، 100 كجم سوبر فوسفات/ فدان + بيوفيرتال ، كجم 100 سوبر فوسفات / فدان + رش سوبر فوسفات بتركيز 4٪ ، 100 كجم سوبر فوسفات / فدان + بيوفرتال + رش سوبر فوسفات بتركيز 4 ٪ ، 50 كجم سوبر فوسفات / فدان + بيوفيرتال ، 50 كجم سوبر فوسفات / فدان + رش سوبر فوسفات بتركيز 4٪ ، 50 كجم سوبرفوسفات / فدان + بيوفرتال + رش سوبرفوسفات بتركيز 4٪. وقد أوضحت النتائج أنه هناك اختلاف واضح بين الاصناف المختبرة حيث سجل صنف جيزة 121 أعلى إنتاجية للبذور في موسمي النمو بينما أعطى صنف كروفورد أقل انتاجيه للمحصول . كما أوضحت النتائج أن استخدام 100 كجم من السوبر فوسفات مع التلقيح بالسماد الحيوى البيوفيرتال والرش الورقى بسوبر الفوسفات بتركيز 4% قد سجل أعلى القيم من صبغات البناء الضوئي ، وزن النبات الجاف ، ارتفاع النبات ، عدد القرون للنبات ، وزن 100 بذرة ، محصول البذور ونسبة زيت البذور في موسمي النمو. من النتائج السابقة يمكن التوصية باضافة 100 كجم من سوبر الفوسفات مع السماد الحيوى البيوفيرتال والرش الورقى ب 4% من سوبر الفوسفات مع زراعة فول الصويا صنف جيزة 111 تحت ظروف الدراسة.