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RESPONSE OF SOYBEAN (*Glycine max* L.) TO BIO AND MINERAL PHOSPHATE FERTILIZATION UNDER DIFFERENT LEVELS OF SOIL MOISTURE.

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ABSTRACT

Two field experiments were conducted at Gemmiza Agricultural Research Station , Agricultural Research Center Gharbia Governorate , Egypt , during 2000 and 2001 seasons. The aim of this investigation is to study the difference between superphosphate application and inoculation with phosphate solubilizing microorganisms (phosphobactrin and vesicular arabuscular mycorrhiza VAM) on soybean variety Giza $_{21}$grown under two levels of soil moisture (40 % and 80 % depletion from soil available water).

Increasing available soil moisture content caused significant increases in number of seeds per plant , seed weight per plant, seed yield ton per feddan , number of seeds per pod and maturity date in first season , while in second season it caused significant increases for number of pods , seeds , seed weight per plant and maturity date. So it caused significant increases for protein and phosphorus percentages. The inoculation by phosphobactrin , VAM and superphosphate application caused significant increases for all characters in both seasons except number of seeds per pod (Table 3). The inoculation by phosphobactrin solid, micorrhiza solid , phosphobactrin with superphosphate and micorrhiza with superphosphate caused significant increases for characters number of branches , pods , seeds , seed weight per plant and seed yield ton per feddan in both seasons. Inoculation by mycorrhiza with 22 $P_2 O_5$ gave the highest values of seed yield ton per feddan (1.830 – 1.850 ton/fed.) compared to (1.100 – 1.187 ton/fed. of control in the first season , while in the second season gave (1.730 – 1.747 ton/fed.) compared to (1.007 – 1.160 ton/fed.) for control. So inoculation by mycorrhiza and superphosphate caused increases of protein percentage (41.40 % compared to 37.84 % for control and increases of phosphor percentage in seeds 0.62 % compared to 0.30 % of control. The available phosphorus in soil was higher by VAM inoculation than phosphobactrin inoculation and phosphorus application at rate of 22 $P_2 O_5$ / fed.

Therefore it is recommended to inoculate the soil with VAM and phosphobactrin and decrease the phosphorus application doses or use rock phosphate to decrease the costs with soil moisture for field capacity to 40 % depletion from available soil water.

INTRODUCTION

Soybean is considered one of the relatively new crops introduced into Egyptian agriculture which contribute in reducing the food deficiency gap for the high quality ratio of protein and oil contained in its seeds reaching up to 40 % protein as well as approximately 20 % of oil.

Phosphorus is well known to be one of the most important major elements for plant nutrition and development. It plays an important role in certain essential steps such as accumulation and release of energy during cellular metabolism and inter in many organic compound. This elements is added to soils either as mineral or organic manners. Regarding inorganic phosphorus application it is clear that 22.5 P_2O_5 / fed. was adequate to meet the requirements of soybean (Jones *et al* 1977).

Under alkaline condition, the monovalent phosphate (H_2PO_4) in different phosphatic fertilizers is rapidly fixed , mainly in the form of tricalcium phosphate and becoming unavailable for plant nutrition , this process is well known in Egyptian soils , which are alkaline having high percentage of calcium carbonate. This transformation is considered as one of the most important problems in phosphorus nutrition in all Egyptian soils.

Fortunately , soil microorganisms known as phosphate solubilizing bacteria play a fundamental role in correcting the solubility problem in many soils by releasing the fixed form to soluble form ready for plant nutrition , the organisms capable of carrying out such process are known as phosphate dissolvers. P. solubilizing bacteria preparations having different commercial names are nowproduced and practiced in different countries. Biofertilizer (phosphobactrin) is now produced by the Ministry of Agric. at Dokki , Cairo. Fernandez *et al* , (1984) stated the importance of this microbial effect or role in supplying growing plants with available phosphorus.

Mycorrhizal not only improve phosphorus uptake , but also improved absorption of other nutrients such as Ca , Mg , N , K , Cu , Mn , Fe and Zn , where the VAM infection can provide channels for direct inter plant and that transfer is sufficient to significant enhancement of both growth and nutrient composition of receivers. Ishac *et al* (1986). Abdel – Rahman *et al.* (1971) concluded that increasing soil moisture from wilting percentage to field capacity resulted in significant increases in the uptake of N , P , K and Ca by soybean plants.

MATERIALS AND METHODS

Two field experiments were conducted at Gemmiza Agricultural Research station , Agricultural Research Center during two successive seasons of 2000 and 2001 . The purpose of this work to study the effect of chemical phosphorus fertilizer and biophosphorus fertilizer inoculation or with vesicular arabuscular mycorrhiza (VAM) on yield and its components by soybean plants variety Giza $_{21}$ grown under different levels of soil moisture stress. In each season a split plot design with three replications was used, water treatment occupied the main plots.

Irrigation water was applied to reach the field capacity when soil moisture was depleted to 40 % and 80 % from available water. The sub plots were devoted to nine treatments (control , 11 P_2O_5 , 22 P_2O_5 / fed. , phosphobactrin (Ph) , 11 P_2O_5 + ph , 22 P_2O_5 + ph , mycorrhiza (M) , 11 P_2O_5 + M and 22 P_2O_5 + M. Phosphorus was applied at planting and also seeds of soybean were inoculated by (Ph) and (M) at planting. The experimental plot size consisted of 6 rows , 60 cm. apart and 3.5 meter long. The experimental plots were sown on 20 and 25 may in both seasons, respectively. Urea (46 % N) was applied to the experiment as recommended by Agric. Res. Center. All treatments had the planting irrigation in equal volume of 400 m^3 / fed.

Data presented in Table 1 show some physical and chemical properties of experimental soil. Observations were recorded on 10randomly selected plants in each plot, including , plant height cm. height of first pod cm. , number of branches per plant ,number of pods , seeds , seed weight in gm. Per plant and seed index. Moreover seed yield ton per fed. was determined from an area 7.2 m2 (2.4 x 3 m long) , inaddition to number of seeds per pod, flowering and maturity date.

Nitrogen was determined using micro – Kjeldahl method as described by Hesse (1971). Phosphorus was determined colorimetrically as described by Hesse (1971). The data were statistically analyzed according to Snedecor and Cochran (1981). Treatment means were compared by L. S. D. at 0.05 level probability.

Table (1): Some physical and chemical properties of experimental site.

Particle size distribution	Depth in cm.		
	0 - 20	20 - 40	40 – 60
Clay %	43.2	45.9	46.0
Silt	39.3	37.7	39.5
F – sand %	15.0	14.0	12.5
C – sand %	0.58	0.37	0.30
Textural class	Clay 98.08	Clay 97.97	Clay 98.3
Field capacity	43.5	41.5	40.6
Wilting point %	20.4	19.7	19.0
Bulk density g / cm^3	1.10	1.02	1.31
O. M. %	1.85	1.61	1.52
$CaCo_3$ %	2.8	2.6	2.1
pH in 1:2.5 (soils water suspension)	8.2	8.1	8.1
Total P %	0.13	0.13	0.11
Avail P (PPm)	8.9	7.6	7.2

RESULTS AND DISCUSSION

Data present in Table 2 showed that the water consumptive use had significant effects on number of seeds / plant , seed weight / plant gm. Seed yield ton / fed. number of seeds / pod , flowering date , maturity date and phosphor percentage of seeds in the first season. In the second season the water consumptive use had significant effects on number of pods , seeds , seed weight /plant and maturity date. Combined analysis showed significant effects for seed yield ton / fed. , number of seeds / pod and number of days to maturity. Results indicated that seed yield ton per fed. increased by soil moisture treatment of 40 % than 80 % depletion from soil available water. The amount of total irrigation water applied were 658.932 mm at 40 % and 482.976 at 80 % depletion from soil available water. The seed yield was 1.588 and 1.561 ton / fed. in the first and second seasons respectively , this may be due to the effect of available water on increasing the activity of mycorrhiza and phosphorin microorganisms and increased nutrient solubility. This results similar to Abdel – Rahman *et al* (1971) who concluded that water stress effects growth of soybean and cotton plants. Also , Olfat et al, (1984) illustrated that the soybean growth increased by increasing soil moisture content from 25 to 100 % of soil field capacity.

Table (2) : Effect of soil moisture and mineral phosphate fertilization on yield and its components of soybean in 2000 and 2001 and average of the two seasons.

Main effects and interaction	Plant height cm.			Height of first pod cm.			No.of branches / plant		
	2000	2001	Comb	2000	2001	Comb	2000	2001	Comb
Moisture (A).									
40% moisture	81.4	79.5	80.4	8.2	7.4	7.8	1.8	1.9	1.9
80% moisture	78.8	81.4	80.1	7.3	8.5	7.9	2.0	1.6	1.8
F.test.	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
Phosphate fertilization (B).									
Control	78.6	79.5	79.0	7.0	8.0	7.5	2.1	2.2	2.2
11 P_2O_5	80.9	77.9	79.4	7.5	6.6	7.1	1.7	2.2	2.0
22 + P_2O_5	79.1	83.1	81.1	6.2	7.4	6.8	2.0	2.1	2.0
Phosphorin(p)	81.6	81.1	81.4	8.3	9.0	8.6	1.6	1.4	1.5
Ph + 11 P_2O_5	79.1	79.8	79.5	8.3	8.2	8.3	2.0	1.6	1.8
Ph + 22 P_2O_5	80.3	79.1	79.7	7.9	8.4	8.2	1.8	1.3	1.6
Mycorrhiza (M)	79.4	78.4	78.9	7.6	8.6	8.1	1.8	1.7	1.7
M + 11 P_2O_5	83.3	81.4	82.4	10.0	8.0	9.0	1.8	1.5	1.7
M + 22 P_2O_5	78.1	83.7	80.9	6.9	7.2	7.0	2.3	2.2	2.3
F.test	*	**	**	**	**	**	**	**	**
L.S.D. 0.05	2.92	2.49	1.88	0.88	0.89	0.62	0.26	0.21	0.16
Interactions									
A x B	**	N.S	**	**	**	*	**	**	**
Main effects and interaction	**No.of pods /plant**			**No.of seeds / plant**			**Seed weight/ plant(gm.)**		
	2000	2001	Comb	2000	2001	Comb	2000	2001	Comb
Moisture (A).									
40% moisture	52.7	70.3	61.5	122.1	165.6	143.8	19.44	25.51	22.48
80% moisture	58.9	59.3	59.1	142.2	139.1	140.6	22.62	21.1	21.86
F.test.	N.S	*	N.S	*	*	N.S.	*	**	N.S.
Phosphate fertilization (B).									
Control	42.0	63.2	52.6	95.6	145.5	120.5	14.64	21.47	18.05
11 P_2O_5	45.9	60.1	53.0	105.0	141.2	123.1	18.08	21.23	19.66
22 + P_2O_5	55.0	63.1	59.0	133.0	149.0	141.0	21.03	22.92	21.97
Phosphorin(p)	53.2	64.1	58.7	137.8	148.2	143.0	21.51	22.60	22.05
Ph + 11 P_2O_5	51.5	64.6	58.1	123.8	155.2	139.5	20.1	23.30	21.70
Ph + 22 P_2O_5	57.7	67.0	62.3	139.5	158.2	148.9	22.1	23.55	22.83
Mycorrhiza (M)	59.3	67.6	63.5	138.6	156.8	147.7	22.01	24.30	23.15
M + 11 P_2O_5	64.3	63.9	64.1	151.7	151.5	151.6	23.03	23.63	23.33
M + 22 P_2O_5	73.3	69.4	71.4	164.3	165.4	164.9	26.76	26.78	26.77
F.test	**	*	**	**	**	**	**	**	**
L.S.D. 0.05	7.29	4.75	4.26	11.16	16.51	7.71	1.62	1.90	1.01
Interactions									
A x B	*	*	**	**	**	**	**	**	**
Main effects and interaction	**Seed index (gm)**			**Seed yield ton / fed.**			**No.of seeds / pod**		
	2000	2001	Comb	2000	2001	Comb	2000	2001	Comb
Moisture (A).									
40% moisture	15.87	15.38	15.62	1.588	1.561	1.574	2.29	2.34	2.32
80% moisture	15.87	15.25	15.55	1.426	1.450	1.438	236	2.36	2.36
F.test.	N.S.	N.S.	N.S.	*	N.S.	**	*	N.S.	*
Phosphate fertilization (B).									
Control	18.15	14.77	14.97	1.143	1.083	1.113	2.3	2.3	2.31
11 P_2O_5	17.21	15.59	16.40	1.290	1.320	1.305	2.3	2.4	2.34
22 + P_2O_5	15.79	15.56	15.67	1.453	1.493	1.473	2.4	2.4	2.39
Phosphorin(p)	15.62	15.21	15.41	1.447	1.493	1.470	2.3	2.3	2.31
Ph + 11 P_2O_5	16.23	14.58	15.40	1.530	1.560	1.545	2.4	2.4	2.39
Ph + 22 P_2O_5	15.75	15.03	15.39	1.627	1.617	1.622	2.4	2.4	2.40
Mycorrhiza (M)	15.95	15.49	15.72	1.543	1.580	1.562	2.3	2.4	2.33
M + 11 P_2O_5	14.86	15.40	15.13	1.687	1.663	1.675	2.2	2.4	2.31
M + 22 P_2O_5	16.25	16.20	16.23	1.480	1.738	1.789	2.2	2.3	2.27
F.test	**	**	**	**	**	**	N.S.	N.S.	N.S.
L.S.D. 0.05	0.57	1.15	0.47	0.072	0.079	0.041	N.S.	N.S.	N.S.
Interactions									
A x B	N.S.	*	**	**	**	**	**	**	**

Table (2) : cont.

Main effects and interaction	50 % flowering			No. of days to maturity			Protein %	Phosphor %
	2000	2001	Comb	2000	2001	Comb		
Moisture (A).								
40% moisture	35.3	35.2	35.25	118.9	118.9	118.94	39.21	0.48
80% moisture	35.6	35.4	35.51	120.7	120.7	120.59	37.94	0.40
F.test.	N.S	N.S.	N.S.	*	*	**	*	**
Phosphate fertilization (B).								
Control	34.5	34.5	34.50	117.2	117.0	117.08	37.30	0.28
11 P_2O_5	35.5	34.8	35.17	116.8	117.3	117.08	37.81	0.32
22 + P_2O_5	35.5	35.7	35.58	118.7	118.8	118.75	38.15	0.40
Phosphorin(p)	35.3	35.5	35.42	120.5	119.7	120.08	38.24	0.39
Ph + 11 P_2O_5	35.5	35.5	35.50	120.5	120.2	120.33	37.85	0.43
Ph + 22 P_2O_5	35.5	35.7	35.58	121.3	121.3	121.33	38.54	0.44
Mycorrhiza (M)	35.7	35.5	35.58	121.7	121.5	121.58	39.35	0.55
M + 11 P_2O_5	35.8	35.7	35.75	121.5	121.7	121.75	40.12	0.56
M + 22 P_2O_5	35.9	35.2	35.38	120.0	121.0	120.50	39.82	0.57
F.test	*	**	**	**	**	**	**	**
L.S.D. 0.05	0.65	1.002	0.46	0.84	0.95	0.52	1.23	0.017
Interactions								
A x B	N.S.	N.S.	N.S.	N.S.	N.S.	*		

Data in Table 2 showed that significant increases for all characters studied in both seasons except number of seeds /pod by doses of superphosphate , phosphorin, mycorrhiza , superphosphate plus phosphorin and superphosphat plus mycorrhiza. Number of pods , seeds , seed weight / plant gm. and seed yield ton/fed. increased addition doses of superphosphate plus mycorrhiza in both seasons. The addition mycorrhiza plus 22 $P_2 O_5$ gave the highest value of number of pods/plant (73.3 , 69.4 compared to 42.0, 63.2 of control) , number of seeds/plant (164.3 , 165.4 compared to 95.6 , 145.5 of control) , seed weight/plant gm. (26.76 , 26.78 compared to 14.64 , 21.47 of control) and seed yield ton/fed. (1.840 , 1.738 compared to 1.143 , 1.083 of control) for first and second seasons , respectively. Addition superphosphate , phosphorin or microrrhiza did not influence soybean branching (Table 2), however only addition mycrorrhiza plus 22 P_2 O_5 increased soybean branching 2.3 compared to 2.1 of control. As shown in Table 2 addition of superphosphate solid or with phosphorin or mycorrhiza gave higher values than the control. Combined over two seasons Table 2 showed significant effects for all characters studied except number of days to 50 % flowering .This results similar to Sharma (1999) who decided that root nodulation , pods / plant , seeds / pod , 1000 seed weight and seed yield were greatest with 75 Kg P/ ha and Rhizobium + FYM + PSB. He concluded that seed protein increased with P and biofertilizer application.

Data presented in Tables 2 and 3 showed that the interaction between treatments of moisture and treatments of mineral fertilization and bio fertilization were significant for characters plant height , height of first pod , number of branches, pods , seeds , seed weight / plant, seed yield ton / fed. , number of seeds / pod and phosphor percentage in the first season , while it was significant for all characters studied except plant height , flowering and maturity date in the second season. El – Lateef *et al* (1998) found that significant responses to bio fertilization on most of the yield , yield component characters , seed quality , protein , oil percentages of soybean , sesame and sunflower. The inoculation with biofertilizers , phosphobactrin and superphosphate application caused an increases in number of pods , seeds , seed weight / plant ,seed yield ton /fed.and percentage of phosphorus in seeds compared to control treatments in both seasons (Tables 2 and 3). These increases were higher with inoculation by mycorrhiza plus $P_2 O_5$ treatments than inoculation by phosphobactrin and superphosphate application at rate of 22 $P_2 O_5$ / fed. This may be due to increase the concentration of all nutrients under study by mycorrhiza inoculation , while the increases of yield and its components by phosphobactrin inoculation without any addition of superphsphate were approxymately equal to the superphosphate applicationat at rate of 22 $P_2 O_5$ / fed. This may be attributed to the effect of phosphobactrin on increasing the availability of phosphorus in soil. Hence , it can achieve more soybean yield by inoculation with mycorrhiza and phosphobactrin. These results are agreement with that obtained by El – Lateef *et al* (1998) who found that biofertilization increased seed yield by 20.4 , 25.3 and 15.4 % over the control treatment for soybean , sesame and sunflower , respectively. Chandra *et al* (1995) inoculation seeds of soybean by Bradyrhizobium Japonicum with 4 Kg / ha P solubilizing bacteria (PSB) for soil or given 40 , 50 or 60 Kg $P_2 O_5$ / ha and found that seed yield per plant from these treatments were 31.35 , 31.46 , 34.50 and 34.63 gm. respectively , compared with the control (seed inoculation only) yielded of 28.50 gm./plant.

As shown in Table 3 the inoculation with mycorrhia or phosphobactrin gave number of pods , seeds , seed weight / plant gm. and seed yield ton / fed. were approxymately equal to the inoculation by mycorrhiza plus $P_2 O_5$ an d phosphobactrin plus $P_2 O_5$ at rate 22 $P_2 O_5$. Such results indicate that the great efficiency of biofertilization with mycorrhiza or phosphobactrin in reducing the phosphate fertilizer applied to this crop.As shown in Table 3 data of both seasons and combined showed significant effect for the interaction between soil moisture and bio and mineral fertilization on plant height , height of first pod , number of branches , pods , seeds , seed weight / plant , seed index , seed yield ton / fed. and number of seeds / pod.

Our results indicated that studied nutrients concentration (N P) in seeds of soybean increased significantly with inoculation by VAM plus $P_2 O_5$ compared to control treatment Table 2. The increases in P concentration may be due to the increase of available P in soil by VAM and phosphobactrin inoculation and phosphorus application as compared with the control treatment. The available phosphorus in soil was higher by VAM inoculation than phosphobactrin inoculation and phosphorus application at rate of 22 $P_2 O_5$ / fed. The increases in N and P concentration by increasing available in soil could be attributed to the increase in root growth and physiological activity of plant roots. So the increase in N concentration in seeds of soybean by increasing available phosphate may be due to increasing the activity of symbiotic N – fixation. These results agreed with El- Gharably *et al* (1980) who concluded that the concentration of N , P and K in plants was increased due to phosphorus application. Amara and Nasr (1995) found that combined

Table (3) : Seed yield and its components of soybean as affected by soil moisture , bio and mineral phosphate fertilization in 2000 and 2001 and average of two seasons.

Moisture cont.	Fertilizers	Plant height cm.			Height of first pod cm.			No.of branches/plant		
		2000	2001	Comb	2000	2001	Comb	2000	2001	Comb
40 % depletion from soil available water	Control	78.8	79.7	79.37	6.7	7.6	7.17	2.5	2.0	2.23
	11 P_2O_5	85.3	78.1	81.73	8.5	5.7	7.13	1.6	2.5	2.03
	22 + P_2O_5	80.8	80.6	80.70	7.2	5.9	6.52	1.6	2.4	2.0
	Phosphorin (ph)	81.2	79.9	80.53	8.0	8.3	8.13	1.5	1.5	1.5
	Ph + 11 P_2O_5	81.3	79.8	80.56	9.3	7.7	8.50	1.9	2.1	2.0
	Ph + 22 P_2O_5	86.3	76.8	81.53	9.3	7.1	8.23	1.5	1.3	1.40
	Mycorrhiza (M)	80.0	77.9	78.93	6.9	8.5	7.68	1.8	1.7	1.75
	M + 11 P_2O_5	80.4	79.5	79.97	10.3	8.9	9.57	1.9	1.9	1.88
	M + 22 P_2O_5	78.0	83.2	80.62	7.2	7.1	7.17	2.3	2.1	2.23
Mean		81.3	79.5	80.44	8.2	7.4	7.79	1.8	1.9	1.89
40 % depletion from soil available water	Control	78.3	79.0	78.67	7.3	8.5	7.87	1.8	2.4	2.08
	11 P_2O_5	76.5	77.7	77.13	6.5	7.5	6.97	1.9	1.9	1.90
	22 + P_2O_5	77.4	85.7	81.53	5.1	9.0	7.03	2.4	1.7	2.08
	Phosphorin(ph)	82.0	82.4	82.20	8.5	9.8	9.15	1.7	1.3	1.50
	Ph + 11 P_2O_5	76.9	79.8	78.37	7.3	8.7	8.03	2.0	1.2	1.62
	Ph + 22 P_2O_5	74.4	81.5	77.93	6.5	9.7	8.13	2.2	1.3	1.73
	Mycorrhiza (M)	78.7	78.9	78.80	8.4	8.7	8.57	1.7	1.6	1.65
	M + 11 P_2O_5	86.2	83.3	84.77	9.7	7.1	8.40	1.7	1.1	1.42
	M + 22 P_2O_5	78.2	84.1	81.15	6.7	7.2	6.92	2.3	2.2	2.27
Mean		78.7	81.4	80.06	7.3	8.5	7.89	2.0	1.6	1.81
L.S.D. 0.05		4.13	N.S.	2.67	1.25	1.26	0.87	0.37	0.30	0.23

Table (3) : cont.

Moisture cont.	Fertilizers	No.of pods / plant			No.of seeds /plant			Seed weight / plant (gm.).		
		2000	2001	Comb	2000	2001	Comb	2000	2001	Comb
40 % depletion from soil available water	Control	36.1	66.8	51.45	91.1	163.4	127.3	14.05	24.73	19.39
	11 P_2O_5	40.1	63.7	51.93	97.8	156.4	127.1	17.28	23.80	20.54
	22 + P_2O_5	46.2	71.0	58.60	110.9	169.1	140.0	17.47	26.60	22.04
	Phosphorin(ph)	51.4	70.9	61.13	133.4	172.3	152.9	21.16	26.80	23.98
	Ph + 11 P_2O_5	49.6	67.9	58.75	118.0	165.2	141.6	18.85	24.80	21.83
	Ph + 22 P_2O_5	54.3	75.0	64.62	123.4	167.2	145.3	19.55	25.40	22.48
	Mycorrhiza (M)	62.8	76.7	69.77	136.0	171.3	153.7	20.98	25.73	23.36
	M + 11 P_2O_5	65.0	69.7	67.33	141.2	157.8	149.5	21.42	24.53	22.98
	M + 22 P_2O_5	68.6	70.6	69.57	147.1	167.3	157.2	24.22	27.22	25.72
Mean		52.7	70.3	61.46	122.1	165.6	143.8	19.44	25.51	21.03
40 % depletion from soil available water	Control	48.0	59.5	53.77	100.1	127.5	113.8	15.23	18.20	16.72
	11 P_2O_5	51.7	56.5	54.07	112.3	126.0	119.1	18.88	18.67	18.78
	22 + P_2O_5	63.7	55.2	59.45	155.1	128.8	142.0	24.58	19.23	21.91
	Phosphorin (ph)	54.9	57.4	56.17	142.2	124.1	133.2	21.86	18.40	20.13
	Ph + 11 P_2O_5	53.3	61.4	57.35	129.6	145.2	137.4	21.35	21.80	21.58
	Ph + 22 P_2O_5	61.1	59.0	60.07	155.7	194.3	152.5	24.65	21.70	23.18
	Mycorrhiza (M)	55.9	58.5	57.18	141.2	142.2	141.7	23.03	22.87	22.95
	M + 11 P_2O_5	63.7	58.1	60.87	162.2	145.2	153.7	24.63	22.73	23.68
	M + 22 P_2O_5	78.0	68.3	73.13	181.5	163.6	172.6	29.31	26.34	27.83
Mean		58.9	59.3	59.12	142.2	139.1	140.6	22.60	21.10	23.31
L.S.D. 0.05		10.3	6.72	6.03	15.78	23.35	10.91	2.29	2.68	1.43

Table (3) :cont.

Moisture cont.	Fertilizers	Seed index (gm.).			Seed yield ton / fed.			No. of seeds /pod.		
		2000	2001	Comb	2000	2001	Comb	2000	2001	Comb
40 % depletion from soil available water	Control	15.16	14.83	14.99	1.187	1.160	1.173	2.5	2.4	2.48
	11 P_2O_5	17.64	16.33	16.99	1.373	1.413	1.393	2.5	2.5	2.45
	22 + P_2O_5	15.73	16.13	15.93	1.500	1.580	1.540	2.4	2.4	2.39
	Phosphorin(ph)	15.87	15.58	15.72	1.520	1.520	1.520	2.4	2.4	2.44
	Ph + 11 P_2O_5	15.98	14.13	15.06	1.693	1.647	1.670	2.4	2.4	2.37
	Ph + 22 P_2O_5	15.82	15.25	15.54	1.773	1.687	1.730	2.3	2.2	2.26
	Mycorrhiza (M)	15.88	14.88	15.38	1.600	1.607	1.603	2.1	2.3	2.19
	M + 11 P_2O_5	14.53	15.12	14.92	1.793	1.687	1.740	1.9	2.3	2.10
	M + 22 P_2O_5	16.17	16.17	16.18	1.850	1.747	1.798	2.1	2.2	2.15
Mean		15.86	15.38	15.62	1.558	1.561	1.574	2.3	2.3	2.31
40 % depletion from soil available water	Control	15.19	14.71	14.95	1.100	1.007	1.053	2.1	2.2	2.13
	11 P_2O_5	16.77	14.84	15.81	1.207	1.227	1.217	2.2	2.2	2.22
	22 + P_2O_5	15.84	14.99	15.42	1.407	1.407	1.407	2.4	2.3	2.39
	Phosphorin(ph)	15.36	14.84	15.10	1.373	1.467	1.420	2.2	2.2	2.17
	Ph + 11 P_2O_5	16.47	15.03	15.75	1.367	1.473	1.420	2.4	2.4	2.41
	Ph + 22 P_2O_5	15.67	14.81	15.24	1.480	1.547	1.513	2.6	2.5	2.54
	Mycorrhiza (M)	16.02	16.09	16.06	1.487	1.553	1.520	2.5	2.4	2.47
	M + 11 P_2O_5	15.19	15.68	15.43	1.580	1.640	1.610	2.5	2.5	2.53
	M + 22 P_2O_5	16.33	16.23	16.28	1.830	1.730	1.780	2.4	2.4	2.38
Mean		15.87	15.35	15.56	1.426	1.450	1.438	2.4	2.3	2.36
L.S.D. 0.05		N.S.	1.63	0.67	0.202	0.112	0.060	0.25	0.14	0.13

Table (3) : cont.

Moisture cont.	Fertilizers	50 % flowering			No.of days to maturity			Prote-In%	Phos-Phor%	T.I.W.a
		2000	2001	Comb	2000	2001	Comb			
40 % depletion from soil available water	Control	34.3	34.3	34.33	116.7	116.0	116.3	37.84	0.30	
	11 P_2O_5	35.3	35.0	35.17	116.7	116.7	116.7	38.43	0.34	
	22 + P_2O_5	35.3	35.3	35.33	117.7	118.0	117.8	38.90	0.43	658.932
	Phosphorin (ph)	34.7	35.3	35.0	119.7	118.7	119.2	38.52	0.42	
	Ph + 11 P_2O_5	35.7	35.3	35.5	120.0	119.7	119.8	37.70	0.48	
	Ph + 22 P_2O_5	35.3	36.0	35.7	120.0	120.3	120.2	38.86	0.49	
	Mycorrhiza (M)	35.7	35.3	35.5	120.3	121.0	120.7	40.16	0.60	
	M + 11 P_2O_5	35.7	35.3	35.5	120.3	120.3	120.3	41.03	0.61	
	M + 22 P_2O_5	35.7	35.0	35.3	119.0	120.0	119.5	41.40	0.62	
Mean		35.3	35.2	35.54	118.9	119.0	118.9	39.20	0.48	
40 % depletion from soil available water	Control	34.7	34.7	34.7	117.7	118.0	117.3	36.75	0.27	
	11 P_2O_5	35.7	34.7	35.2	117.0	118.0	117.5	37.18	0.30	
	22 + P_2O_5	35.7	36.0	35.8	119.7	119.7	119.7	37.40	0.37	
	Phosphorin (ph)	36.0	35.7	35.8	121.3	120.7	121.0	37.97	0.36	
	Ph + 11 P_2O_5	35.3	35.7	35.5	121.0	120.7	120.8	38.0	0.39	482.976
	Ph + 22 P_2O_5	35.7	35.3	35.5	122.7	122.3	122.5	38.22	0.39	
	Mycorrhiza (M)	35.7	35.7	35.7	123.0	122.0	122.5	38.53	0.49	
	M + 11 P_2O_5	36.0	36.0	36.0	122.7	123.0	122.8	39.20	0.51	
	M + 22 P_2O_5	35.5	35.3	35.4	121.0	122.0	121.5	38.25	0.53	
Mean		35.6	35.3	35.33	120.7	120.7	120.7	37.94	0.40	
L.S.D. 0.05		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.024	

T.I.W.a = Total irrigation water applied (mm).

inoculation of the N fixing and P dissolving bacteria + Fe + Zn gave the highest seed yield / plant. Solanky *et al* (1998) in India found that application of R. Japonicum by either method plus phosphate solubilizing microorganisms plus half the recommended practice (recommended rate of N P K + seed inoculation with R. Japonicum) through increased values of yield attributes and greater uptake of N , P and K , while the cost was lower as less NPK fertilizer was required. Halimark and Barber (1984) stated that increasing K content and uptake by phosphatic fertilization may be explained by greatest formation of ATP which could increase nutrient. Mba (1994) showed that soil available phosphorus increased at the five leaf stage ,while N – fixation in the soil increased by 45 or 11 % relative to control. Bar and Gautam (1991) found that basal application of 20 Kg N / ha and A. brasilense and VAM gave the highest grain yield of 2.71 t/ha followed by a basal application of 20 Kg N/ha with 20 Kg N + 20 Kg P2 O5 / ha (2.66 t / ha).

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استجابة فول الصــويا للتسميد الحيوي والمعدني الفوســفاتي تحــت مســتويات مختلفة من الرطوبة الأرضية.

محمود إبراهيم عبد المحســن ، محمد سيد على ، علاء محمد عزمي رزق
مركز البحوث الزراعية ـ معهد بحوث المحــاصيل الحقليــة ـ قسم بحوث المحــاصيل البقولية

أجري هذا البحث في محطة البحوث الزراعية بالجميزة محافظة الغربية التابعة لمركز البحــوث الزراعية خلال موسمي 2000، 2001 لدراسة استجابة فول الصويا " الصــنف جيــزة 21 " للتســميد المعدني بجرعات مختلفة من السوبر فوسفات ومقارنة ذلك بالتلقيح بواسطة الكائنات الحية الدقيقة المذيبــة للفوسفور " الفوسفوبكترين والميكروريزا " تحت مستويات مختلفة من الرطوبة الأرضية.

وقد استخدم تصميم القطع المنشقة مرة واحدة في ثلاث مكررات حيث وزعت مستويات الرطوبة في القطع

الرئيسية ومعاملات التسميد المعدني والحيوي في القطع الشقية وتتلخص أهم النتائج فيما يلي : ـ

1 ـ أدي استخدام مستوي الرطوبة 40 % الي زيادة المحصول ومكوناته معنويا وكذا زيادة نسبتي البروتين والفوسفور في البذور.

2 ـ كان للتسميد المعدني والتسميد الحيوي تأثير واضح لزيادة المحصول ومكوناته فــي كــلا الموســمين مقارنة بالكنترول.

3 ـ زاد المحصول زيادة واضحة باستخدام الفوسفوبكترين والميكروريزا.

4 ـ أعطت المعاملة 22 كجم فو 2 أ5 + الميكروريزا أعلي زيادة في المحصول ومكوناته.

5 ـ زادت نسبتي البروتين والفوسفرر في البذور باســتخدام الميكروريــزا أو الفوســفوبكترين + الســوبر فوسفات.

6 ـ تساوت معاملات اضافة السوبر فوسفات تقريبــا مــع معــاملات التلقــيح الحيــوي بالفوســفوبكترين والميكروريزا مما يدل علي أن هذه المواد المذيبة للفوسفور الموجود بالتربة ذات أهمية كبيرة في تقليــل تكلفة الأنتاجية من وحدة المساحة بالحد من استخدام الأسمدة المعدنية.