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RESPONSE OF TOW SOYBEAN CULTIVARS TO PLANT DENSITY AND PHOSPHORUS FERTILIZATION

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ABSTRACT

Two field experiments were conducted at the experimental farm of the faculty of Agriculture, AL-Azhar University (Assuit Branch), Egypt, during 2011 and 2012 summer seasons, to study response of two soybean (Giza 22 and Giza 111) cultivars to plant density; to plant density (112,000, 140,000 and 186,000 plant/fad.) and phosphorus fertilizer rates (15.50, 23.25 and 31.00 kg P_2O_5 /fad.). The results indicated that Giza 22 surpassed Giza 111 in plant height, number of pods and seeds per plant in seasons, seed yield / fad. and oil percentage in the 1st season. While, Giza 111 surpassed Giza 22 in protein percentage in both seasons. Increasing phosphorus fertilizer levels from 15.5 to 31 kg P_2O_5 /fad. increased all studied traits except oil percentage. Increasing plant population densities from 112,000 to 186,000 plant /fad. measurably tended to increase plant height, straw yield and protein percentage, whereas reduced number of branches, pods and seeds /plant, seed yield /plant, 100 seed weight and oil percentage. While, the highest seed yield/fad. was obtained by plant density of 140,000 plant/fad. in both seasons. The interaction between soybean cultivars and phosphorus fertilizer had significant effect on number of pods and number seeds per plant in the second season and seed yield per plant, seed yield /fad., oil and protein percentages in both seasons. Interaction effect between soybean cultivars and plant density was significant on plant height, number of seeds per plant, seed yield per plant and oil percentage in both seasons, and number of branches per plant, seed yield per fad. in first season and number of pods per plant in the second season. The interaction between phosphorus rates and plant density had a significant effect on plant height in the first season and number of pods, number of seed per plant in the two seasons and seed yield per plant in the second season. The interaction among the three factors was significant on plant height, number of seeds per plant in the first and second seasons and

number of pods, straw yield per fad. in the second season. It could be concluded that the highest seed yield per fad. could be obtained by planting Giza 22 cultivar at plant density of 140,000 plant/fad. and addition of 31.0 kg P_2O_5 /fad. under Assiut Governorate conditions.

INTRODUCTION

Legume crops occupy an important position among field crops. Soybean is considered a relatively new crop in Egyptian rotation. Soybean is one of the legume crops with high protein and oil content in the seed which reach approximately to 40% and 20%, respectively.

Soybean is the most important oil seed crop in the world, its seed has high protein content> thus soybeans are used in many human food and livestock feeds. Therefore, efforts are being focused on increasing the productivity of soybean crop by growing high yielding varieties under the most favorable agricultural practices.

Plant population density and its distribution play an important role in the productivity of soybean. A marked increase in plant height, the number of pods/plant, seed index and seed yield /plant was found by increasing planting densities from 70000 to 175000 plant/ fed. (El- Attar, 1992) from 105000 to 24500 plant/ fed. (Ali, 1993), from 167000 to 333000 plant /ha. (Prasad *et al.*, 1993) and from 400000 to 800000 plant /ha. (Abbas, 1993 and Abbas *et al*. 1995).

Individual plant characters were decreased, while seed oil and protein yields per unit area were increased with increasing plant density (El-Attar, 1992, Ali, 1993; Prasad *et al.*, 1993; Abbas *et al*. 1995 and Haikel and Bassal, 1996). Increasing plant density was associated with the increase in seed yield /fed. (Abd El-Aal, 1979, Zaki, 1988 and Zeyada *et al*., 1988). In addition. Sharief and El-Bially (1992), found that each increase in plant density from 70 to 140 thousand plant/ fed. was associated with the increase in seed yield / fed. Prasad *et al.*, (1993) showed that seed yield was the highest with 333 thousand plant/ ha. and deceased with the reduction in plant density below this level.

Phosphorus application for soybean is essential since it enhances the growth of root system, maturity and increases oil percentage of soybean seeds, consequently increasing the productivity of this crop. Although, the phosphorus content in the Egyptian soil is high, the available phosphorus is too low to face the plant requirements of the element (Devlin and Witham.1983). Therefore, Attia *et al*. (1990) reported that application of phosphorus up to 30 kg P_2O_5/fed. led to a significant increase in yield and its components of soybean. Seif El-Nasr and Maani – Abo–Amou (1999) concluded that number of pods/ plant, seed weight /plant and seed yield/ fed. of soybean were significantly increased with increasing phosphorus fertilizer up to 45 kg P_2O_5/fed.

The differences between soybean cultivars were recorded in plant height

(Mahmoud 1994), number of branches, pods and seeds/plant (El-Attar and Sharaf, 1993; Ali, 1993 and Zahou *et al.*, 1994), weight of pods and seeds/ plant and weight of 100 seeds (Samia *et al*., 1993; Shams El – Din *et al.,* 1997 and Shafshak *et al.* 1997) and seed yield/ fed. (Salama and Ghonema, 1990 and Shams El-Din *et al.,* 1997). Different soybean cultivars recorded variation in seed oil and protein content (Salama and Ghonema, 1990 and Shams El- Din *et al*., 1997).

MATERIALS AND METHODS

Two field experiments were conducted during the two summer seasons of 2011 and 2012 at the experimental farm of the faculty of Agriculture, AL –Azhar University (Assuit Branch) to study the effect of three population densities (15, 20 and 25 cm between hills on both sides of the ridge with two plants per hill to each spacing) and three phosphorus fertilizer rates (15.5, 23.25 and 31.0 kg P_2O_5/fad.) in the form of calcium super phosphate (15.5 % P_2O_5) on productivity of two soybean cultivars, (Giza 22 and Giza 111).

The performed experiment was designed as randomized complete blocks in split –split plot arrangement of treatments with three replications. Soybean cultivars were assigned to the main plots, phosphorus fertilization levels were distributed randomly in the sub plots and plant densities were allocated randomly in the sub-sub plots. The experimental unit area was 10.5 m^2 (3 x 3.5 m). i. e. 1/400 faddan (one faddan = 4200 m^2). Seeds were inoculated before sowing with an effective strain of *Bradyrhizobium japonicum* and were sown on May 20 and 22 in the first and second seasons, respectively in hills. Thinning was done before the first irrigation to two plants per hill.

Calcium super phosphate (15.5% P_2O_5) fertilizer was added before the first irrigation at a rate of 100, 150 and 200 kg per faddan in the both seasons.

The examined population densities (112,000, 140,000 and 186,000/fad.) were obtained by planting both sides of ridges (60 cm apart), in hills 25, 20 and 15 cm apart, respectively. Plants were thinned to secure two plants per hill after full germination. The physical and chemical analyses of the experimental site are presented in Table (1).

At harvest samples of 10 plants were randomly pulled from each plot to estimate the following parameters: plant height (cm), number of branches / plant, number of pods/plant, number of seeds /plant, seed yield/ plant (g), 100- seed weight, protein and oil percentages.

Seed and straw yields / fad. were calculated on the basis of the three middle ridges of the experimental plots, then converted into ton per faddan.

For determination of seed oil percentage, soxhelt continuous extraction apparatus was used according to the method described in A.O.A.C (1980). However, nitrogen was determined using improved kjeldahls method as described in A.O.A.C (1980). Seed protein

percentage was calculated by multiplying total nitrogen by 6.25. The obtained data were subjected to proper statistically analysis as described by Gomez and Gomez (1984). Means were compared by using L.S.D. method at 5% level of probability.

Table (1): some physical and chemical analysis of soil field experiments

Characteristics	2011	2012	Characteristics	2011	2012
Physical analysis			Chemical analysis		
Sand (%)	25.68	26.85	Organic matter (%)	0.94	1.05
Silt (%)	39.46	38.28	Available N (ppm)	63.50	70.20
Clay (%)	34.86	34.87	Available P(ppm)	9.14	10.20
Soil texture	Clay loam		Available K (ppm)	348.30	355.00
			$_{P}H$	7.80	8.02
			E.C. (ds. m^{-1})	1.15	1.16
			Total $CaCo_3$ (%)	2.80	2.50

RESULTS AND DISCUSSION

A – Yield and yield components.

1- Performance of cultivars: The results in Tables (2, 3, 4 and 5) revealed that number of pods and seeds per plant were significantly affected by cultivars in both seasons, while, seed yield (ton/fad.) and plant height were significantly affected in the first and second seasons only, respectively. A marked increase in the previous traits was recorded for Giza 22 cultivar compared to Giza 111 cultivar. Giza 22 slightly surpassed Giza 111 cultivar for the rest of the studied traits except 100-seed weight which had the reverse trend. The differences between the tow cultivars may be due to genetic make up and its interaction with environment conditions. These results are in agreement with those obtained by Husein *et al* (2006) and Keyvan Shamsi and Soheil Kobraee (2011).

2 – Effect of phosphorus fertilizer: Data in Tables (2, 3, 4 and 5) reveled that the all studied traits were significantly affected by phosphorus in both seasons. Increasing phosphorus fertilization rate up to 31 kg P_2O_5/fad. increased gradually plant height, number of branches per plant, number of pods per plant, number of seeds per plant, seed yield per plant (g), 100 – seed weight (g), seed yield (ton / fad.) and straw yield ton/ fad. as compared with the other treatment (15.5 0r 23.25 kg P_2O_5/ fad.). in the two growing seasons. These results may be due to the well known facts that phosphorus has a major role in photosynthesis activities, energy transfer and carbohydrates metabolism of plants. Moreover, it is a part of the cells, nucleus and it is present in the cytoplasm and its role in cell division is very essential. Similar results were obtained by Seif El – Nasr and Abo – Amou (1999), Osman *et al* (2000), Allam (2005) and Jaidee *et al*. (2013).

3 – Effect of plant density: Plant population density had significant effect on all studied characters in both seasons (Tables 2, 3, 4 and 5).

Increasing plant density from 112,000 plants /fad. to 140,000 plants / fad. or 186,000 plants/fad. decreased number of branches per plant, number of pods per plant, number of seeds per plant, seed yield per plant and 100 – seed weight. While, plant height increased with increasing plant density, this may be due to increasing competition for light due to dense planting. However, seed and straw yield per fad. were significantly increased by increasing plant density in both seasons up to 186,000 plant/fad.. This mean that the density of 140,000 plants/fad. was more efficient for light interception without competition for light or light loss as well as the soil moisture and its nutrients were enough for the plant population of this treatment. Similar observation were reported by Sharief and El – Bially (1992), Galal (2003), Hussein and El – Melegy (2005) and Keyvan Shamsi and Soheil Kobraee (2011). Moreover, Seed yield per fad. reached its maximum with sowing 140,000 plant/fad.and this may be gained due to the great amount of light energy intercepted by the canopy per unit area. It is important to explain that for low density all the characters (except plant height and seed yield fad.). were in higher value because the low number of the plants per unit area had a bigger chance to get more light and different nutrients and elements, but the increase in seed yield fad. in dense planting is mainly attributed to the increase in the number of plants per unit area. These results are in line with those obtained by Abbas (1993), Haikel and Bassal (1996), Salem *et al* (2000), Galal (2003) and Hussein and El – Melegy (2005).

4 – Interaction effects: The results in Tables (2, 3, 4 and 5) showed the significant interaction effect between cultivars and phosphorus fertilizer levels on number of pods and number of seeds per plant in the second season as well as seed yield per plant and seed yield per fad. in both seasons. The highest of seed yield (1.988 and 1.813 ton/fad.) was produced by Giza 22 cultivar phosphorus fertilizer at 31 kg P_2O_5/fad. in the 1st and 2nd seasons, respectively. The interaction between cultivars and plant density had significant affected on plant height, number of seeds per plant and seed yield per plant in both seasons and number of branches per plant and seed yield per fad. in the first season and number of pods/plant in the second season only, respectively (Tables 2, 3, 4 and 5). The highest seed yield (2.239 ton/fad.) as recorded for Giza 22 cultivar with plant density of 140,000 plant/ fad. in the first season.The interaction effect between phosphorus fertilizer levels and plant density in (Tables 2, 3, 4 and 5), was significant effect on number of pods and number of seeds per plant in both seasons, plant height and seed yield per plant in the first and second seasons, respectively. The interaction among cultivars, phosphorus fertilizer levels and plant density, had significant effect on plant height and number of seeds per plant in both seasons and number of pods per plant and straw

yield ton/fad. in the second season only.

B- Seeds chemical contents: 1- Performance of cultivars: Tables (6) indicate that soybean cultivars differed significantly for oil percentage in the first season and protein percentage in both seasons. Giza 22 cultivar surpassed Giza 111 cultivar in seed oil percentage, while Giza 111 cultivar surpassed Giza 22 in protein percentage in both seasons. Similar results were obtained by El- Douby (2002).

2 – Effect of phosphorus fertilizer: Results in the Table (6) indicate that phosphorus fertilizer levels significantly affected oil and protein percentage in both seasons. It is clear that seed oil percentage was decreased by increasing phosphorus fertilizer levels. While, seed protein percentage was increased by increasing phosphorus fertilizer levels. Phosphorus has a major role in photosynthesis activities, energy transfer and carbohydrates metabolism of plants. Moreover, it is apart of the cells, nucleus and it is present in the cytoplasm and its role in cell division in very essential. Similar results were recorded by Allam (2005).

3 – Effect of plant density:

The results recorded in Table (6) indicate that the plant density had significant influence on seed oil and protein contents in both seasons. Increasing plant density from 112,000 to 140,000 or 186,000 plant/fad. decreased seed oil percentage, and increased seed protein contents in both seasons. The highest oil percentages (23.01 and 22.28 %) were obtained at density 112,000 plant / fad. in the first and second seasons, respectively. The highest seed protein percentages (41.18 and 40.69 %) were obtained with density 186,000 plant / fad. in the first and second seasons, respectively. Similar results were obtained by Shams El- Din *et al* (1997) and El-Douby *et al* (2002).

4 – Interaction effects: Results in Table (6) revealed that seed oil and protein percentages in both seasons were significantly influenced by the interaction between soybean cultivars and phosphorus fertilizer. However, the highest values of oil percentages (23.72 and 22.98 %) were obtained from Giza 22 cultivar when received the lowest phosphorus rate(15.5 kg p_2o_5/fad.), while the highest values of seed protein percentages (41.95 and 41.41 %) were recorded for Giza 111 cultivar received the highest phosphorus rate(31 kg p_2o_5) in the first and second seasons, respectively. Seed oil content in both seasons were significantly influenced by the interaction between soybean cultivars and plant density. The highest value of this trait (23.40 and 22.66%) was recorded for Giza 22 at plant density of 112,000 plants/ fad. in the first and second seasons, respectively. The effect of interaction between phosphorus levels and plant density as well as the combination among the three studied factors did not show significant effect on seed oil and protein contents in both seasons.

Table (2): Effect of plant density and phosphorus fertilizer on Plant height (cm) and number of branches/plant of two soybean cultivars in 2011 and 2012 seasons.

cultivars	P-levels (P_2O_5kg/fad.)	Plant height (cm)								Number of branches/plant							
		Plant density (1000 /fad.)															
		2011				2012				2011				2012			
		186	140	112	Mean	186	140	112	Mean	186	140	112	Mean	186	140	112	Mean
Giza(22)	15.5	96.33	90.70	84.12	90.38	92.33	86.29	76.77	85.13	2.00	2.33	2.78	2.37	1.34	2.00	2.56	1.97
	23.25	98.58	91.79	87.45	92.60	94.10	87.66	83.78	88.52	2.22	2.78	3.11	2.70	1.89	2.11	2.67	2.22
	31.0	103.70	95.32	93.44	97.49	95.00	90.43	85.45	90.30	2.44	2.89	3.44	2.93	1.89	2.34	2.67	2.30
	Mean	99.54	92.60	88.33	93.49	93.81	88.13	82.00	87.98	2.22	2.67	3.11	2.67	1.71	2.15	2.63	2.16
Giza(111)	15.5	95.89	88.11	86.30	90.10	86.55	83.03	78.23	82.60	1.33	2.11	2.78	2.08	1.56	2.11	2.44	2.04
	23.25	98.89	89.97	87.45	92.10	89.68	85.21	80.11	85.00	1.78	2.53	3.22	2.51	1.78	2.22	2.56	2.19
	31.0	104.99	94.43	89.90	96.44	93.67	88.10	82.29	88.02	1.78	2.67	3.45	5.63	1.78	2.30	2.89	2.32
	Mean	99.92	90.84	87.88	92.88	89.97	85.45	80.21	85.21	1.63	2.44	3.15	2.41	1.71	2.21	2.63	2.18
Mean for P-levels	15.5	96.11	89.40	85.21	90.24	89.44	84.66	77.50	83.87	1.67	2.22	2.78	2.22	1.45	2.05	2.50	2.00
	23.25	98.74	90.88	87.44	92.35	91.89	86.43	81.95	86.76	2.00	2.65	3.17	2.61	1.84	2.17	2.61	2.21
	31.0	104.35	94.88	91.67	96.96	94.33	89.27	83.87	89.16	2.11	2.78	3.45	2.78	1.84	2.32	2.78	2.31
	Mean	99.73	91.72	88.11		91.89	86.79	81.11		1.93	2.55	3.13		1.71	2.18	2.63	
L.S.D. at 5% for																	
Cultivars(C)		(not significant) N.S				Sig. (Significant)				N.S				N.S			
Phosphorus(P)		0.682				0.552				0.075				0.167			
Density (D)		0.691				0.726				0.145				0.148			
C X P		N.S				N.S				N.S				N.S			
CXD		0.978				1.027				0.205				N.S			
PXD		1.197				N.S				N.S				N.S			
CXPXD		1.693				1.778				N.S				N.S			

Table (3): Effect of plant density and phosphorus fertilizer on number of pods /plant and number of seeds /plant of two soybean cultivars in 2011 and 2012 seasons

cultivars	P-levels (P_2O_5kg/fad.)	Number of pods /plant								Number of seeds /plant							
		Plant density (1000 /fad.)															
		2011				2012				2011				2012			
		186	140	112	Mean	186	140	112	Mean	186	140	112	Mean	186	140	112	Mean
Giza(22)	15.5	51.43	67.47	70.44	63.12	43.44	57.44	62.10	54.33	95.33	127.56	145.44	122.78	91.33	127.22	135.44	177.99
	23.25	54.33	69.33	74.22	65.96	46.89	65.89	69.66	60.81	99.11	139.44	153.22	130.59	93.66	134.11	146.44	124.74
	31.0	57.44	74.44	81.66	71.18	50.44	71.01	75.56	65.67	104.33	146.89	157.99	136.40	98.32	136.77	148.78	127.96
	Mean	54.40	70.42	75.44	66.75	46.93	64.78	69.11	60.27	99.59	137.96	152.22	129.92	94.44	132.70	143.55	123.56
Giza(111)	15.5	38.33	55.33	58.33	50.67	34.68	49.22	52.99	45.63	78.77	106.89	124.56	103.41	81.20	110.11	123.44	104.92
	23.25	41.45	57.33	63.66	54.14	36.78	53.33	58.33	49.48	84.33	117.99	131.11	111.15	87.32	124.55	135.67	115.85
	31.0	45.33	62.00	69.32	58.89	41.56	57.33	62.44	53.78	91.22	122.77	138.21	117.40	94.55	128.77	141.45	121.59
	Mean	41.70	58.22	63.77	54.57	37.67	53.29	57.92	49.63	84.77	115.89	131.29	110.65	87.69	121.15	133.52	114.12
Mean for P-levels	15.5	44.88	61.40	64.39	56.89	39.06	53.33	57.55	49.98	87.05	117.22	134.99	113.09	86.27	118.66	129.44	111.46
	23.25	47.88	63.33	68.94	60.05	41.84	59.61	63.99	55.15	91.72	128.72	142.17	120.87	90.49	129.33	141.05	120.29
	31.0	51.39	68.22	75.49	65.03	46.00	64.17	69.00	59.72	97.77	134.83	148.10	126.90	96.44	132.77	145.11	124.77
	Mean	48.05	64.32	69.61		42.30	59.04	63.51		92.18	126.92	141.76		91.07	126.92	138.53	
L.S.D. at 5% for																	
Cultivars(C)					Sig	Sig						Sig		Sig			
Phosphorus(P)					0.879	1.069						1.051		1.719			
Density (D)					0.634	0.639						0.844		0.826			
C X P					N.S	1.512						N.S		1.516			
CXD					N.S	0.904						1.194		1.168			
PXD					1.099	1.107						1.463		1.431			
CXPXD					N.S	1.566						2.069		2.024			

Table (4): Effect of plant density and phosphorus fertilizer on Seed yield/ plant (g) and 100- seed weight (g) of two soybean cultivars in 2011 and 2012 seasons

cultivars	P-levels (P_2O_5kg/fad.)	Seed yield/ plant (g)								100- seed weight (g)							
		Plant density (1000 /fad.)															
		2011				2012				2011				2012			
		186	140	112	Mean	186	140	112	Mean	186	140	112	Mean	186	140	112	Mean
Giza(22)	15.5	18.02	25.61	28.02	23.88	17.36	24.35	27.06	22.92	16.77	18.05	18.82	17.88	16.88	17.33	18.28	17.50
	23.25	18.94	27.13	28.60	24.89	18.22	25.44	26.27	23.31	17.22	18.44	19.12	18.26	17.01	17.62	18.54	17.73
	31.0	20.44	29.45	31.76	27.22	19.89	27.04	28.97	25.30	17.55	18.51	19.94	18.67	17.12	17.81	18.84	17.92
	Mean	19.13	27.40	29.46	25.33	18.49	25.61	27.43	23.84	17.18	18.33	19.30	18.27	17.01	17.59	18.55	17.72
Giza(111)	15.5	15.64	24.73	26.30	22.22	16.43	23.90	26.01	22.12	17.35	17.90	19.23	18.16	16.69	17.82	18.73	17.74
	23.25	17.90	27.89	28.75	24.85	17.04	26.00	25.83	22.96	17.48	18.27	19.39	18.38	17.02	18.16	18.84	18.01
	31.0	19.70	30.03	31.75	27.16	19.03	28.16	28.84	25.34	17.68	18.79	19.93	18.80	17.54	18.39	18.98	18.30
	Mean	17.75	27.55	28.93	24.74	17.50	26.02	26.89	23.47	17.51	18.32	19.52	18.45	17.08	18.12	18.85	18.02
Mean for P-levels	15.5	16.83	25.17	27.16	23.05	16.89	24.13	26.54	22.52	17.06	17.98	19.03	18.02	16.79	17.57	18.50	17.62
	23.25	18.42	27.51	28.68	24.87	17.63	25.72	26.05	23.13	17.35	18.35	19.26	18.32	17.02	17.89	18.69	17.87
	310.	20.07	29.74	31.75	27.19	19.46	27.60	28.90	25.32	17.62	18.65	19.94	18.73	17.33	18.10	18.91	18.11
	Mean	18.44	27.47	29.20		18.00	25.82	27.16		17.34	18.33	19.41		17.05	17.86	18.70	
L.S.D. at 5% for																	
Cultivars(C)					N.S	N.S					N.S			N.S			
Phosphorus(P)					0.542	0.267					0.123			0.120			
Density (D)					0.551	0.469					0.233			0.189			
C X P					0.766	0.377					N.S			N.S			
CXD					0.779	0.663					N.S			N.S			
PXD					N.S	0.812					N.S			N.S			
CXPXD					N.S	N.S					N.S			N.S			

Table (5): Effect of plant density and phosphorus fertilizer on seeds yield (ton/ fad.) and straw yield (ton/ fad.)of two soybean cultivars in 2011 and 2012 seasons.

cultivars	P-levels (P_2O_5kg/fad)	Seeds yield (ton/ fad.)								Straw yield (ton/ fad.)							
		Plant density (1000 /fad.)															
		2011				2012				2011				2012			
		186	140	112	Mean	186	140	112	Mean	186	140	112	Mean	186	140	112	Mean
Giza (22)	15.5	1.700	2.103	1.417	1.740	1.6701.717	1.800	1.393	1.621	3.003	2.510	2.290	2.601	2.750	2.299	2.141	2.397
	23.25	1.817	2.260	1.473	1.850	1.823	1.860	1.477	1.684	3.081	2.613	2.444	2.713	2.954	2.432	2.195	2.527
	31.0	1.957	2.358	1.653	1.988		2.007	1.610	1.813	3.195	2.751	2.477	2.808	3.002	2.566	2.339	2.636
	Mean	1.824	2.239	1.514	1.859	1.737	1.889	1.493	1.706	3.093	2.625	2.404	2.707	2.902	2.432	2.225	2.520
Giza (111)		1.367	1.497	1.153	1.339	1.617	1.800	1.383	1.600	2.964	2.484	2.194	2.547	2.676	2.208	2.102	2.329
		1.417	1.543	1.237	1.399	1.670	1.867	1.430	1.656	3.064	2.614	2.325	2.668	2.882	2.385	2.189	2.485
		1.483	1.677	1.330	1.497	1.717	1.937	1.490	1.714	3.239	2.684	2.405	2.776	3.014	2.570	2.293	2.626
	Mean	1.422	1.572	1.240	1.411	1.668	1.868	1.434	1.657	3.089	2.594	2.308	2.664	2.857	2.388	2.195	2.480
Mean for P-levels	15.5	1.533	1.800	1.285	1.539	1.643	1.800	1.388	1.611	2.983	2.497	2.242	2.574	2.713	2.253	2.122	2.363
	23.25	1.617	1.902	1.355	1.624	1.693	1.863	1.453	1.670	3.073	2.613	2.385	2.690	2.918	2.408	2.192	2.506
	31.0	1.720	2.015	1.492	1.742	1.770	1.972	1.550	1.764	3.217	2.718	2.441	2.792	3.008	2.568	2.316	2.631
	Mean	1.623	1.906	1.377		1.702	1.878	1.464		3.091	2.609	2.356		2.880	2.410	2.210	
L.S.D. at 5% for																	
Cultivars(C)						Sig	N.S					N.S			N.S		
Phosphorus(P)						0.021	0.023					0.034			0.028		
Density (D)						0.027	0.022					0.041			0.040		
C X P						0.03	0.033					N.S			N.S		
CXD						0.027	N.S					N.S			N.S		
PXD						N.S	N.S					N.S			N.S		
CXPXD						N.S	N.S					N.S			0.0989		

Table (6): Effect of plant density and phosphorus fertilizer on seed oil and protein percentage of two soybean cultivars in 2011 and 2012 seasons.

cultivars	P-levels (P_2O_5kg/fad.)	Oil %								Protein %							
		Plant density (1000 /fad.)															
		2011				2012				2011				2012			
		186	140	112	Mean	186	140	112	Mean	186	140	112	Mean	186	140	112	Mean
Giza (22)	15.5	23.39	23.65	24.11	23.72	22.65	22.94	23.36	22.98	39.42	38.73	38.02	38.72	38.92	38.23	37.52	38.23
	23.25	22.55	22.72	23.14	22.80	21.70	22.11	22.39	22.07	40.36	39.80	38.81	39.66	39.86	39.30	38.31	39.16
	31.0	22.28	22.48	22.96	22.57	21.43	21.72	22.21	21.79	41.13	40.53	40.04	40.57	40.63	40.11	39.55	40.09
	Mean	22.74	22.95	23.40	23.03	21.93	22.25	22.66	22.28	40.30	39.69	38.96	39.65	39.80	39.21	38.46	39.16
Giza (111)	15.5	22.53	22.93	23.52	22.99	21.75	22.18	22.77	22.24	41.42	40.61	40.40	40.81	40.92	40.11	39.90	40.31
	23.25	21.36	22.16	22.38	21.97	20.72	21.41	21.76	21.30	42.17	41.39	41.05	41.53	41.67	40.89	40.55	41.04
	31.0	20.12	21.05	21.93	21.03	20.16	20.59	21.19	20.65	42.60	41.73	41.50	41.95	42.11	41.23	40.89	41.41
	Mean	21.34	22.05	22.61	22.00	20.88	21.40	21.91	21.39	42.06	41.24	40.98	41.43	41.57	40.74	40.45	39.92
Mean for P-levels	15.5	22.96	23.29	23.82	23.36	22.20	22.56	23.07	22.61	40.42	39.67	39.21	39.77	39.92	39.17	38.71	39.27
	23.25	21.96	22.44	22.76	22.39	21.21	21.76	22.08	21.68	41.26	40.59	39.93	40.60	40.77	40.10	39.43	40.10
	31.0	21.20	21.77	22.45	21.80	20.80	21.16	21.70	21.22	41.87	41.13	40.77	41.26	41.37	40.67	40.22	40.75
	Mean	22.04	22.50	23.01		21.40	21.83	22.28		41.18	40.46	39.97		40.69	39.98	39.45	
L.S.D. at 5% for																	
Cultivars(C)					Sig	N.S						Sig		Sig			
Phosphorus(P)					0.22	0.11						0.195		0.088			
Density (D)					0.157	0.07						0.083		0.132			
C X P					0.31	0.16						0.275		0.124			
CXD					0.222	0.10						N.S		N.S			
PXD					N.S	N.S						N.S		N.S			
CXPXD					N.S	N.S						N.S		N.S			

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استجابة صنفين من فول الصويا للكثافة النباتية والتسميد الفوسفاتي

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أقيمت تجربتان حقليتان خلال موسمي صيف 2011، 2012م بمزرعة كلية الزراعة جامعة الأزهر بأسيوط بهدف دراسة استجابة صنفين من فول الصويا (جيزة 22 وجيزة 111) للتسميد بمعدلات مختلفة من السماد الفوسفاتي (15.50 ، 23.25 و31.00 كجم فو$_2$أ$_5$/ فدان) تحت ثلاث كثافات نباتية (112 ، 140 و186 ألف نبات/ فدان).

وأظهرت النتائج الاتي

تفوق الصنف جيزة 22 علي الصنف جيزة 111 معنويا في صفة ارتفاع النبات ومحصول البذور للفدان بالطن ونسبة الزيت في الموسم الاول وفي عدد القرون وعدد البذور / نبات في كلا الموسمين ، بينما تفوق الصنف جيزة 111 في نسبة البروتين في كلا الموسمين .

أدى زيادة مستويات التسميد الفوسفاتى إلي زيادة معنوية في ارتفاع النبات في الموسم الثاني وعدد الأفرع والقرون والبذور ومحصول البذور/ نبات في الموسمين ، كما أدي إلي زيادة معنوية في وزن ال 100 بذرة ومحصول الفدان من البذور والقش بالطن في كلا الموسمين. أيضا زادت نسبة البروتين ونقصت نسبة الزيت في كلا الموسمين.

أدى زيادة الكثافة النباتية من 112 إلى 186 ألف نبات/ فدان إلى زيادة معنوية في إرتفاع النبات ومحصول القش بالطن/ فدان ونسبة البروتين في كلا الموسمين ، بينما نقص عدد الافرع والقرون والبذور

ومحصول البذور / نبات ووزن ال 100 بذرة والنسبة المئوية للزيت، بينما تحقق الكثافة النباتية 140 ألف نبات/فدان أعلي محصول من البذور بالطن/ فدان في كلا الموسمين.

أظهر التفاعل بين الأصناف ومستويات التسميد تأثير معنوي على صفة عدد القرون وعدد البذور / نبات في الموسم الثاني وعلي محصول النبات من البذور بالجرام والفدان بالطن ونسبة الزيت والبروتين لكلا الموسمين وكان التفاعل بين الأصناف والكثافة النباتية معنويا علي صفة ارتفاع النبات وعدد البذور ومحصول البذور /نبات ونسبة الزيت في الموسمين. بينما كان معنويا على عدد الأفرع/ نبات ومحصول البذور للفدان بالطن في الموسم الأول وعدد القرون / نبات في الموسم الثاني.

أدى التفاعل بين مستويات التسميد والكثافة النباتية إلى تأثير معنوي على صفة عدد القرون وعدد البذور/ نبات في الموسم الأول والثاني وعلى ارتفاع النبات في الموسم الأول ومحصول النبات من البذور بالجرام في الموسم الثاني . أظهر التفاعل بين عوامل الدراسة الثلاثة تأثير معنوي على كل من ارتفاع النبات وعدد البذور/ نبات في الموسمين وعدد القرون/ نبات ومحصول القش للفدان بالطن في الموسم الثاني.

وتوصى الدراسة بأنه للحصول على أفضل محصول للبذور من فول الصويا بمحافظه اسيوط بزرع الصنف جيزة 22 ويطبق التسميد الفوسفاتي بمعدل 31.00 كجم فو$_2$أ$_5$/ فدان وكثافة نباتية 140 ألف نبات / فدان (لزراعة على مسافة 20سم بين الجور علي ريشتي الخط والمسافة بين الخطوط (60سم) مع ترك نباتين بالجورة.