4. RESULTS AND DISCUSSION

I. Varietal differences on:

1. Growth characters and growth analysis:

Results in Table (2) show that Misr-1 and Giza 429 varieties did not differ significantly in plant height, number of branches/plant, number of leaves and leaf area/plant, as well as dry weight/plant at 80 and 100 day after sowing (DAP) and (NAR) in both seasons.

Misr-1 variety was superior to Giza 429 in plant height (in the second season). While, Giza 429 variety was superior to Misr-1 in dry weight of leaves, CGR and RGR at 100 DAP (in the first season). Such difference may be due to the gentical differences among Misr1 and Giza 429. These results are in harmony with those obtained by **Mohamed (2000) and Bakhit, *et al.* (2001).**

Table (2): Varietal differences on growth characters in 2003/04 and 2004/05 seasons.

Character / Variety	Growth parameters at 100 DAS				Dry weight (g)				Growth analysis		
	Plant height (cm)	No. of Branch/ plant	No. of leaves/ plant	Leaf area (cm^2)	80 days		100 days		CGR gm/m^2/ week	RGR gm/gm/ week	NAR gm/gm/ week
					Leaves	Plant	Leaves	Plant			
2003/04 season											
Misr-1	101.32	2.86	34.75	1506.0	4.46	7.14	6.91	11.85	0.235	0.025	0.008
Giza-429	105.83	2.91	37.54	1648.8	4.47	7.15	7.53	12.13	0.250	0.027	0.008
F-test	ns	ns	ns	ns	ns	ns	**	ns	**	**	ns
2004/05 season											
Misr -1	91.37	2.45	34.39	1059.4	4.09	8.18	4.81	9.73	0.096	0.011	0.004
Giza-429	89.64	2.77	30.99	1091.8	4.29	8.71	4.94	9.79	0.076	0.008	0.002
F-test	**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

2. Yield and yield components:

Data presented in Table (3) indicate that there were no significant differences among Misr-1 and Giza 429 verieties on number of pods/ plant in both seasons, number of seeds/plant in the 1st season, seeds weight/plant and seed yield/fed in the 2nd season, (Fig 1) straw and biological yields/fed in both seasons (Fig 2 and 3). However, Misr-1 significantly recorded the highest seed yield per plant and per fed.(19.75 gm. and 1.03 ton) respectively in the first season and 100 seeds weight (61.68 and 70.00 gm.) in the two successive seasons .

On the other side Giza 429 variety significantly increased number of seeds/plant (53.31) comparing with other variety Misr-1 in the second season.

Such difference may be due to the gentical differences among the faba bean varieties. These results are in accordance with those obtained by **Hafiz and Abdel-Mottaleb (1998)** who found that the differences among the three faba bean cultivars, (Giza 3, Giza 461 and Giza 716) were not significant differences among the three studied cultivars on pods yield/ plant, number of seeds/ pod, seed yield/ plant, shelling percentage and 100- seed weight

The differences in seed, straw and biological yields/fed, seed protein content and protein yield were significant among the three studied varieties. Giza 3 recorded the highest seed yield/ fad, while the highest value in straw and biological yields/ fad were recorded by Giza 461.

3.Seeds chemical analysis :

Results in Table (4) demonstrate that there were no significant differences between Misr-1 and Giza 429 varieties on N, P, K and seed protein percentage in the second seasons.

These results are not in agreement with those reported by **Sharaan *et al.* (2003)** who found that tested cultivars significantly differed for all studied characters. **Ahmed and El-Abagy (2007).**They found that Giza Blanka cultivar significantly surpassed Giza 3 cultivar in protein yield/fed, mean while, Giza 483 cultivar significantly exceeded Giza Blanca in protein% /seeds

Table (4): Varietal differences on some chemical composition of faba bean (*Vicia faba L.*) .

Character / Varieties	Seeds chemical analysis %			
	N	P	K	Protein
Misr -1	4.41	0.48	2.05	27.54
Giza-429	4.71	0.51	2.18	29.43
F-test	N.S	N.S	N.S	N.S

II. Effect of plant density on:

1. Growth characters and growth analysis:

Results in Table (5) show that plant height after 100 days from sowing was significantly decreased by increasing planting space up to 25 cm between hills (112000 plants/fed) as compared with the lowest planting space was 20 cm between

hills (140000 plants/fed) in the first growing seasons only. The shortest plants were resulted at 30 cm between hills (93333 plants/fed) while the tallest plants were at 20 cm between hills. However, the difference between 25 and 30 cm between hills not significant. Such results are in agreement with those obtained by **Noeaman, (1989)** who reported that plant height after 130 days from sowing was significantly increased by increasing plant density from 35000 to 104000 plants/ fed. This result is expected since dense planting led to more competition among plants for light.

The effect of plant density on the number of branches/ plant after 100 days from sowing was insignificant in both seasons. Similar results were also reported by **Ashmawy, et al (1998), Hassan and Hafiz (1998), El- Douby et al. (2000), El-Murshedy et al (2002).**

The results illustrated in Table (5) show that the number of leaves/ plants was increased significantly by decreasing hill spacing up to 30 cm. in the two successive seasons. It is clear that 30 cm between hills produced the highest number of leaves / plant (38.92 and 34.99) in the two respective growing seasons. On the other hand, sowing at 20 cm between hills gave the lowest number of leaves/ plants (33.01 and 30.18) in the 1st and 2nd seasons, respectively. These results are in agreement with those obtained by **Abdel Aziz, and Shalaby (1999).** Who showed that plant population of 22 plant /m^2 highly significant increase in number of leaves/plant compared with 33 plants.

With regard to the leaf area / plant the results indicate clearly that it was significantly increased by increasing plant

density from 63333 to 140000 plants/fed. in 1st season. It is obvious that 20cm planting spaces produced the highest leaf area/ plant which was 1432.2. The difference between the three plant densities were insignificant in the 2nd seasons.

Differences in leaves and plant dry weight due to plant densities were significant (Table 5) at 80 day after planting in both seasons. Plants grown at lower densities / unit area (30 cm planting spaces) always had higher means of plant dry weight. These results could be due to less competition for light, nutrients or water between plants. Moreover, plants grown at lower population densities appeared capale for giving more branches than those grown at higher density. Thus, the dry weight of plant increase with decreased plant density. These results are in accordance with those of **AbdEl Aziz and Shalaby (1999)** and **Ben Mohamed 2003** who reported that sowing more number of plants/m^2 decreased total plant dry weight.

With regard to the growth analysis. It is obvious from the results in table (5) that CGR, RGR and NAR for faba bean plants were not significant effect by plant density at the period 80 – 100 day after planting in both growth seasons. These results are not agreement with these obtained by **Abd El Aziz and Shalaby (1999)** who showed that plant population of 22 plant/m^2 gave highly significant increase in CGR, RGR and NAR compared with 33 plants .

Table (5): Effect of plant density on growth characters in 2003/04 and 2004/05 seasons.

Character / hill spacing.	Growth parameters at 100 DAS				Dry weight (g)				Growth analysis		
	Plant height (cm)	No. of Branches/ plant	No. of leaves/ plant	Leaf area (cm^2)	80 days		100 days		CGR gm/m^2 / week	RGR gm/gm/ week	NAR gm/gm/ week
					Leaves	Plant	Leaves	Plant			
	2003/04 season										
20cm	106.00	2.88	33.01	1888.6	4.07	6.87	6.96	11.58	0.236	0.026	0.006
25cm	102.94	2.83	36.51	1432.2	4.32	7.06	7.13	11.92	0.243	0.026	0.008
30cm	101.78	2.94	38.92	1411.6	5.01	7.51	7.58	12.46	0.249	0.025	0.008
LSD at 5%	3.32	ns	1.63	9.94	0.42	0.48	ns	ns	ns	ns	ns
	2004/05 season										
20cm	91.26	2.57	30.18	1254.0	3.86	7.32	4.60	8.84	0.090	0.011	0.004
25cm	90.63	2.61	32.91	953.6	4.28	8.77	4.68	9.57	0.075	0.008	0.002
30cm	89.64	2.64	34.99	1019.4	4.42	9.25	5.34	10.86	0.093	0.009	0.004
LSD at 5%	N.S	N.S	3.51	N.S	0.47	0.92	N.S	1.14	N.S	N.S	N.S

2. Yield and yield components:

Results in Table (6) show that decreasing hill spacing led to decreased No. of pods/ plant. The highest number of pods / plant (13.55 and 11.53 in the first and second seasons, respectively) was recorded for faba bean plants grown in lower plant densities (30 cm between hills). While, the higher plant density, depressed number of pods / plant (10.84 and 8.59 in the 1^{st} and 2^{nd} seasons, respectively). The reduction in number of pods / plant results from increasing population density may be

due to the greater competition for the light and other resources and few number of fruiting branches. It could be concluded that high plant densities reduced number of branches and consequently number of pods / unit area decreased. These finding are in accordance with those obtained by **Ashmawy *et al.* (1998), Hassan and Hafiz (1998), El-Refay *et al.* (1999), Hussein *et al.*(2002), El-Deeb *et al.* (2006), Kozak *et al.* (2007).** Also, **Idris (2008)** who showed that increasing plant spacing up to 30 cm), between hills increased the number of pods / plant, pods / main stem and consequently gave the highest seed yield.

Table (6): Effect of plant density on yield and yield components of faba bean (*Vicia faba L*) in 2003/04 and 2004/05 seasons.

Character / Hill spacing	Yield components at harvest				Yields (ton/fed)		
	No. of pods /plant	No. of seeds /Plant	Seed wt. /plant (g)	100-seed wt. (g)	Seed	Straw	Biological
	2003/04 season						
20cm	10.84	48.34	16.58	56.88	1.07	2.07	3.13
25cm	11.63	52.39	18.51	59.35	0.93	1.91	2.84
30cm	13.55	56.18	22.61	60.87	0.85	1.74	2.59
LSD at 5%	**1.86**	**18.12**	**2.92**	**NS**	**0.12**	**0.14**	**0.17**
	2004/05 season						
20cm	8.59	47.68	11.62	63.87	1.51	2.14	3.65
25cm	9.82	48.46	12.86	66.86	1.41	1.94	3.35
30cm	11.53	56.69	13.70	67.38	1.38	1.80	3.18
LSD at 5%	**1.92**	**4.52**	**1.25**	**1.21**	**0.06**	**0.08**	**0.09**

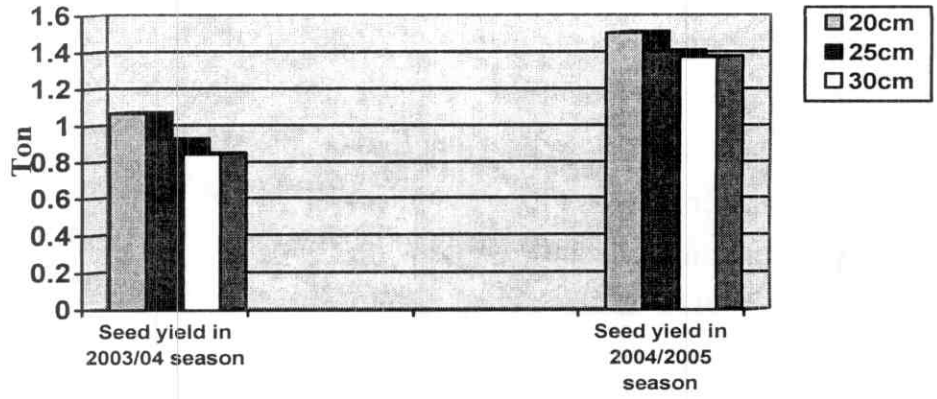


Fig (4): Effect of plant density on seed yield/fed of faba bean (*Vicia faba* L) in 2003/2004 and 2004/2005 seasons.

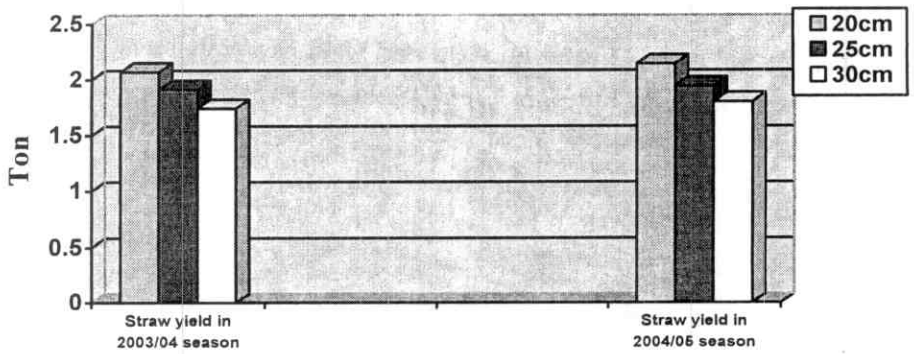


Fig (5): Effect of plant density on straw yield/fed of faba bean (*Vicia faba L*) in 2003/2004 and 2004/2005 seasons.

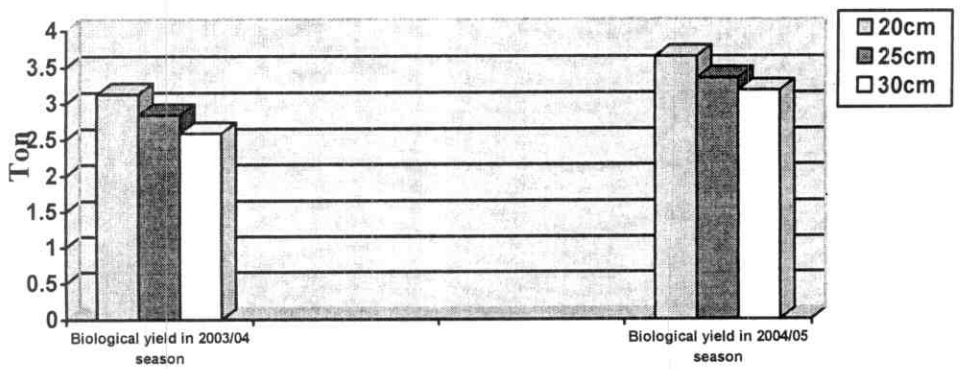


Fig (6): Effect of plant density on biological yield/fed of faba bean (*Vicia faba L*) in 2003/2004 and 2004/2005 seasons.

As shown in Table (6), seed index (100-seed weight) was significantly affected by hill spacing in the 2nd seasons only. Seed index increased with increasing hill spacing from 20 to 30 cm between hills. The greatest seed index (67.38 g) was obtained from sowing on 30 cm between hills (93333 plants/fed.). However, the lowest 100- seed weight observed from 20 between hills (140000 plants/fed.). These results are in line with those obtained by **Ashmawy *et al.* (1998), Mohamed (2000), Bakheit *et al.* (2001) and Munir and Abdel-Rahman (2002).** With respected the seed weight / plant. The results in (Table 6) indicate clearly that the difference among three densities were significant and take the same trend of number of pods / plant. The heaviest seed yield were obtained by growing at 30 cm between hills (22.61 and 13.70 gm / plant) as compared with the two other spacing (20 and 25 cm) (16.58 and 11.62) and (18.51 and 12.86 gm / plant) in the two growing seasons respectively. These results were accompanied by **El-Murshedy *et al.* (2002), Ben Mohamed (2003), Kozak *et al.* (2007).**

On the other hand, **Abdel Aziz and Shalaby (1999)** indicated that plant densities did not have significant effect on 100- seed weight.

With regard to number of seeds/ plant is a reflection of number of pods/ plant and number of seeds / plants sown with low density (30 cm between hills) significantly exceeded those sown with of higher densities (20 cm between hills in number of seeds / plant. The lowest number of seeds / plant (48.34 and 47.68 in the, 1st and 2nd season, respectively) was produced from planting are 20 cm between hills (Table 6). These results are in

harmony with those obtained by **Abdel Aziz and shalaby (1999), Hussein *et al.* (1999), El-Douby *et al.* (2000), Ben Mohamed (2003), El-Deeb *et al.* (2006) and Kozak *et al.* (2007).**

As shown in Table 6 and Fig 4,5 and 6 seed, straw and biological yields/fed were significantly increased as planting distance 20 cm which surpassed 25 and 30 cm planting spaces in seed yield / fed by 15.05 and 25.88 % in 1st season, 7.09 and 9.42 % in the 2nd season, respectively. The respective increments percentage for straw yield were 8.37 and 18.96 % in the 1st season , 10.30 and 18.88 % in the 2nd seasons, respectively. Also the biological yield / fed. take the same trend .

It is aforementioned that the narrow planting space 20 cm affected negatively the growth and yield of individual plants but the increased number of plants / unit area compensated that negative effect resulted higher straw and seed yield / fed. Similar results were obtained by **Ibrahem (2000), Hussein *et al.* (2002), Lopez – Belliod *et al.* (2005), AbdEl-Latif (2004) and Hashabdi and Sedaghathoor (2006).**

3. Seeds chemical analysis:

Data presented in Table (7) show that there were a significant increasing in N, P, K and protein % in faba bean seeds as a result to the increase of hill spacing up to 25cm between hills. These results are in agreement with those obtained by **Abdel-Aziz and Shalaby (1999) and Ahmed and Al-Abagy (2007).**

Table (7): Effect of plant density on some chemical composition in seeds of faba bean (*Vicia faba L*) .

Character / Hill spacing	Seeds chemical analysis %			
	N	P	K	Protein
20cm	4.27	0.43	2.00	26.71
25cm	4.62	0.52	2.09	28.85
30cm	4.78	0.54	2.26	29.90
LSD at 5%	0.23	0.03	0.10	1.41

III. Effect of phosphorus fertilizers:

1. Growth characters and growth analysis:

Results presented in Table (8) revealed that plant height, number of branches/plant, number of leaves/plant, leaf area/plant, dry weight of leaves and plant at 80 and 100 day after planting, CGR, RGR and NAR were improved by phosphrous fertilization mixed with phosphorein®. The highest values of these characters were obtained by using the mixed of phosphorus fertilization with phosphorein® the growing seasons while the lowest values for forenamed traits were obtained in the unfertilized plots (control). It is known that phosphorus is essential for cell division development of root nodules and stimulation of nitrogen fixation as well as improvements in forenamed traits may be attributed to the beneficial effect of inoculation with phosphate dissolving bacteria (*B. megaterium*) on faba bean growth. The latter researcher obtained marked increments in growth characters with each increment in P_2O_5

rate/fed from 0 to 15 and to 30 kg P_2O_5/fed These results are in agreement with those obtained by **Hamed (2003), Ahmed et at.(2007),El-Gizawy and Mehasen, 2009** they found that adding 30 kg P_2O_5 / fed Mixed with phosphate dissolving bacteria (PDB) markedly increased plant height and number of branches.

Table (8): Effect of phosphorus fertilizers on growth characters of faba bean (*Vicia faba L.*) in 2003/04 and 2004/05 seasons.

Characters / Phosphorous fertilizers	Growth parameters at 100 DAS				Dry weight (g)				Growth analysis		
	Plant height (cm)	No. of Branches/ plant	No. of leaves/ plant	Leaf area (cm^2)	80 days		100 days		CGR gm/m^2/ week	RGR gm/gm/ week	NAR gm/gm/ week
					Leaves	Plant	Leaves	Plant			
	2003/04 season										
0 kg P_2O_5/fed	95.47	2.49	32.87	1379.0	3.10	5.09	4.74	7.79	0.137	0.022	0.004
15 kg P_2O_5/fed	100.74	2.76	35.17	1700.0	3.73	6.05	6.68	10.66	0.231	0.028	0.006
30 kg P_2O_5/fed	101.96	2.82	36.17	1584.2	4.26	6.73	6.91	11.28	0.228	0.026	0.006
Phosphoreine	104.88	2.91	35.89	1474.0	4.69	7.43	7.52	12.53	0.255	0.026	0.008
Phos. + 15 kg P_2O_5/fed	106.12	3.08	37.63	1620.6	5.16	8.12	8.28	13.86	0.287	0.027	0.008
Phos. + 30 kg P_2O_5/fed	112.27	3.23	39.14	1707.0	5.85	9.45	9.21	15.81	0.318	0.025	0.008
LSD at 5%	2.01	0.13	1.92	19.82	0.24	0.36	0.51	0.81	0.042	0.001	0.002
	2004/05 season										
0 kg P_2O_5/fed	82.81	1.98	25.89	1074.8	2.60	6.60	3.69	6.48	0.036	0.006	0.002
15 kg P_2O_5/fed	86.57	2.29	29.89	1049.8	3.40	7.35	4.17	8.01	0.069	0.008	0.002
30 kg P_2O_5/fed	89.36	2.60	31.11	1066.2	3.89	8.22	4.64	9.31	0.078	0.010	0.004
Phosphoreine	91.16	2.69	33.23	1006.0	4.37	8.91	5.07	10.44	0.091	0.010	0.004
Phos. + 15 kg P_2O_5/fed	93.62	2.89	35.91	1118.0	4.98	9.56	5.60	11.63	0.107	0.010	0.004
Phos. + 30 kg P_2O_5/fed	99.54	3.21	40.12	1139.0	5.88	10.04	6.09	12.67	0.136	0.012	0.004
LSD at 5%	2.15	0.20	1.40	N.S	0.26	0.32	0.25	0.43	0.021	0.001	0.002

2. Yield and yield components:

The results of applying phosphorus fertilizer levels mixed with phosphorein® significantly affected on yield and yield components characters as shown in table 9 and Fig 7,8,9. The results show that adding 30 kg P_2O_5/fed, mixed with phosphorein® markedly increased number of pods/plant, number of seeds/plant, seed weight/plant, 100-seed weight as well as seed, straw and biological yields/fed in both seasons (Fig,7,8 and 9) as compared with all other treatments. The seed yield/fed increased as applied P_2O_5 rate was increased up to the highest level i.e. 30 kg/fed mixed with phosphorein®. The increases were 100 and 38.01% in the 1st and 2nd seasons, respectively, compared with control. This may be due to that phosphorus fertilization encouraged the vegetative growth plant, flowering and fruiting of faba bean.

The improvements in number of pods and number of seeds/plant, seed weight/plant and 100-seed weight may be attributed to the beneficial effect of inoculation with phosphorein ® on faba bean growth, so seed, straw and biological yields/fed as compared with other treatments .

These results could be attributed to the higher soil contents of P. They indicated that the increasing of seed yield may be due to effect of phosphorus on increasing the percentage of flowering and setting which increased the number of pods and seeds / plant, weight of pods and seeds / plant.

The results are in accordance with those of **El-Kalla *et al.* (1999), Zedan and Abdel-Lateef (2001), Hamed (2003), Mohamed (2005), Ahmed and El-Abagy (2007) and El-**

Gizawy and Mehasen (2009) who found that adding 30 kg P_2O_5 / fed. Mixed with phosphate dissolving bacteria (PDB) markedly increased pods, 100-seed weight, seed yield/ plant, seed and straw yields / fed.

3. Seeds chemical analysis:

It is evident from data presented in Table (10) that nitrogen, phosphorus, potassium and protein% in faba bean seeds significantly affected by phosphorus fertilizers. The increasing P rates up to 30Kg P_2O_5/fed mixed with phosphorein® significantly increased seeds content of N, P, K and protein percentages. The stimulatory affect of phosphorus may also be due to its role in enhancing metaboilic processes such as photosynthesis, starch synthesis, glycolysis and synthesis of fats and proteins.

Similar results were also reported by **Ahmed *et al.* (2003), Saleh *et al.* (2008) and El-Gizawy and Mehesin (2009)** who found that adding 30 kg P_2O_5 / fed. Mixed with phosphate dissolving bacteria (PDB) markedly increased Protein %,N %,P %, in the seeds and N and Pup take.

Table (9):Effect of phosphorus fertilizers on yield and yield components of faba bean (*Vicia faba L*) in 2003/04 and 2004/05 seasons.

Character / Phosphorous fertilizers	Yield components at harvest				Yields (ton/fed)		
	No.of pods /plant	No. of seeds /Plant	Seed wt. /plant (g)	100-seed wt. (g)	Seed	Straw	Biological
	2003/04 season						
0 kg P_2O_5/fed	9.48	40.48	13.33	54.53	0.64	1.48	2.13
15 kg P_2O_5/fed	10.34	44.89	15.58	56.48	0.80	1.64	2.44
30 kg P_2O_5/fed	11.52	49.11	18.08	58.17	0.90	1.79	2.69
Phosphoreine	12.29	52.72	19.97	59.81	0.98	1.98	2.95
Phos. + 15 kg P_2O_5/fed	13.53	59.37	22.63	61.35	1.10	2.19	3.28
Phos. + 30 kg P_2O_5/fed	14.87	67.24	25.80	63.86	1.28	2.36	3.64
LSD at 5%	0.59	2.69	1.23	1.47	0.06	0.06	0.09
	2004/05 season						
0 kg P_2O_5/fed	7.22	38.33	9.28	60.74	1.21	1.54	2.75
15 kg P_2O_5/fed	8.01	44.41	10.32	63.12	1.29	1.71	3.00
30 kg P_2O_5/fed	9.28	49.69	12.18	64.87	1.38	1.88	3.26
Phosphoreine	10.32	54.09	13.18	66.88	1.48	2.04	3.52
Phos. + 15 kg P_2O_5/fed	11.56	57.26	14.59	69.04	1.57	2.20	3.77
Phos. + 30 kg P_2O_5/fed	13.47	61.91	16.81	71.56	1.67	2.40	4.08
LSD at 5%	0.76	2.44	0.80	1.25	0.04	0.05	0.06

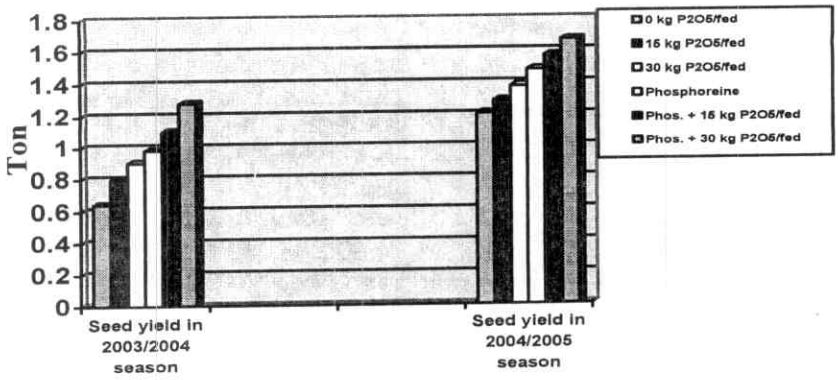


Fig (7): Effect of phosphorus fertilization on seed yield of fabaan (*Vicia faba* L) in 2003/2004 and 2004/2005 seasons.

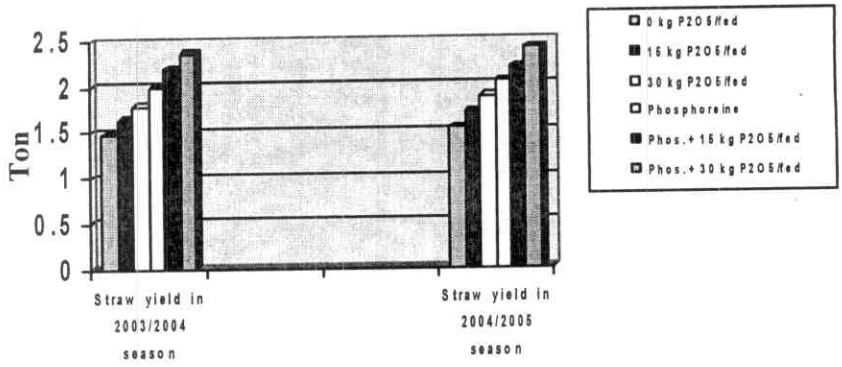


Fig (8): Effect of phosphorus fertilization on straw yield of faba bean (*Vicia faba L*) in 2003/2004 and 2004/2005 seasons.

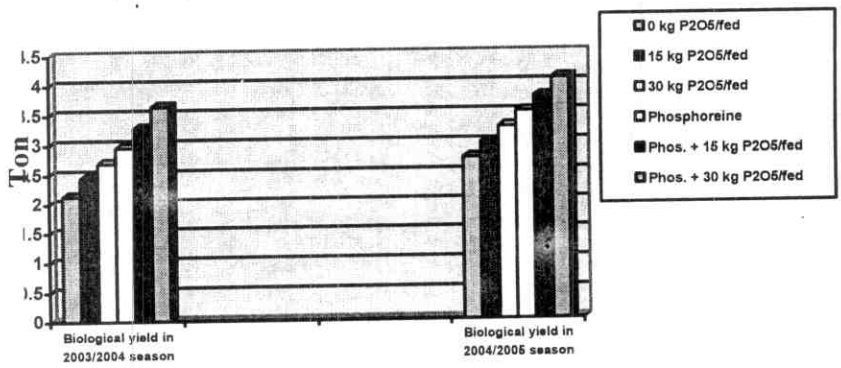


Fig (9): Effect of phosphorus fertilization on biological yield of faba bean (*Vicia faba L*) in 2003/2004 and 2004/2005 seasons.

Table (10):Effect of phosphorus fertilizers on some chemical composition in seeds .

Character / Phosphorus fertilizers	Chemical composition in seeds (%)			
	N	P	K	Protein
0 kg P_2O_5/fed	4.29	0.42	1.97	26.84
15 kg P_2O_5/fed	4.37	0.45	2.04	27.32
30 kg P_2O_5/fed	4.51	0.49	2.10	28.19
Phosphoreine	4.63	0.51	2.16	28.94
Phos. + 15 kg P_2O_5/fed	4.74	0.55	2.20	29.64
Phos. + 30 kg P_2O_5/fed	4.80	0.56	2.22	29.99
LSD at 5%	0.33	0.01	0.06	0.65

IV. Interaction effects:

a. Effect of the first order interaction:

1. Effect of the interaction between faba bean varieties and hill spacing:

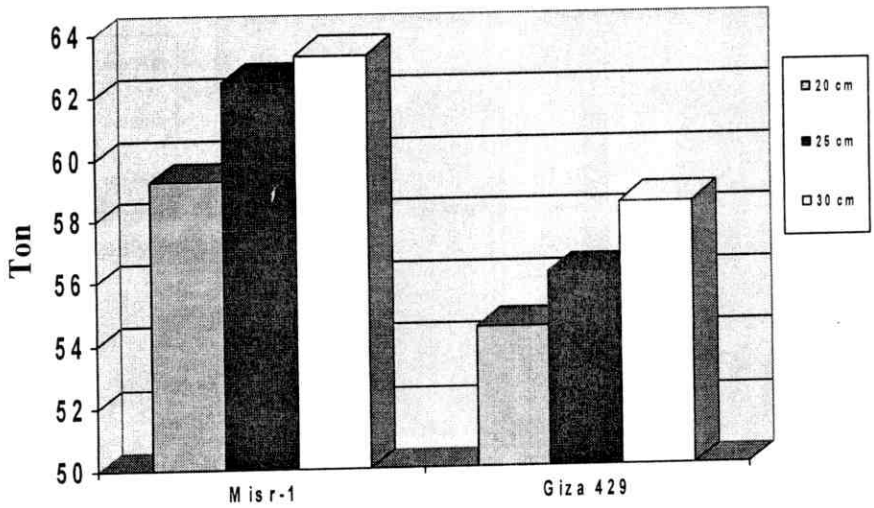
Data in Table (11) and (Fig. 10 and 11) illustrated that 100-seed weight and seed yield /fed were significantly affected by the interaction between faba bean varieties and hill spacing in 2nd season. The highest values of 100-seed weight (70.99g) was produced when Misr-1 faba bean variety was planting at 25cm between hills. On the other hand, the lowest value of this character was produced when Giza 429 variety was planting at 20cm between hills. However, the highest seed yield (1.56) ton was recorded when Misr-1 variety planting at 20cm between hills, while the lowest value of this character (1.33 ton) was obtained when Misr-1 planting at 30 cm between hills.

Table (11): **Effect of the interaction between variety and plant density on yield and yield components of faba bean (*Vicia faba L.*) in 2003/04 and 2004/05 seasons.**

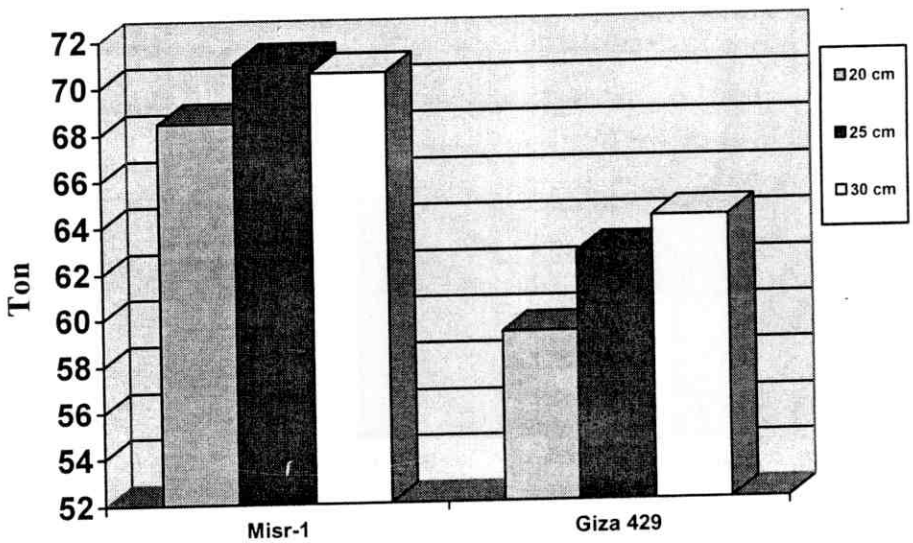
Character / Treatment		100-seed wt. (g)	Seed yield (ton/fed.)	100-seed wt. (g)	Seed yield (ton/fed.)
		2003/04 season		2004/05 season	
Misr-1	20cm	59.26	1.20	68.46	1.56
	25cm	62.49	0.97	70.99	1.42
	30cm	63.29	0.93	70.55	1.33
Giza-429	20cm	54.50	0.94	59.28	1.46
	25cm	56.20	0.89	62.72	1.41
	30cm	58.45	0.77	64.21	1.42
LSD at 5%		N.S	N.S	1.71	0.08

2. Effect of the interaction between faba bean varieties and phosphorus fertilizers:

The interaction between varieties and P fertilizers did not affected significantly in all growth characters, yield and its components and chemical content of faba bean seeds in both seasons.

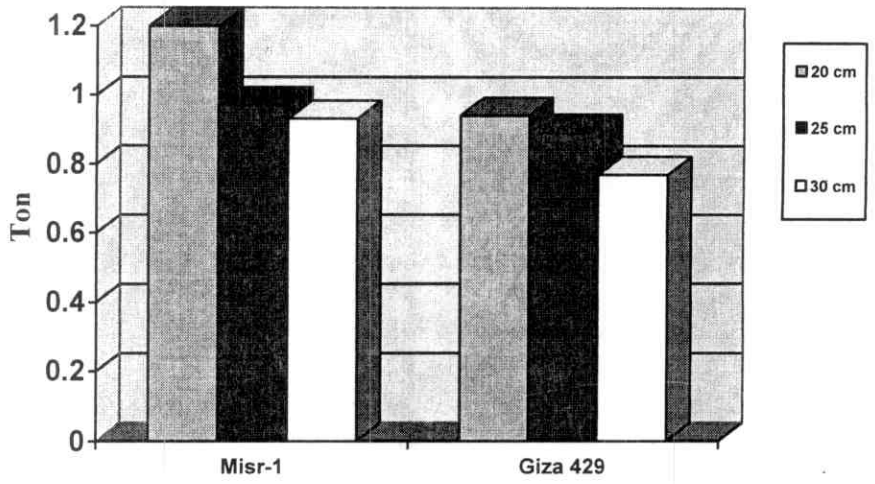


2003/2004 Season

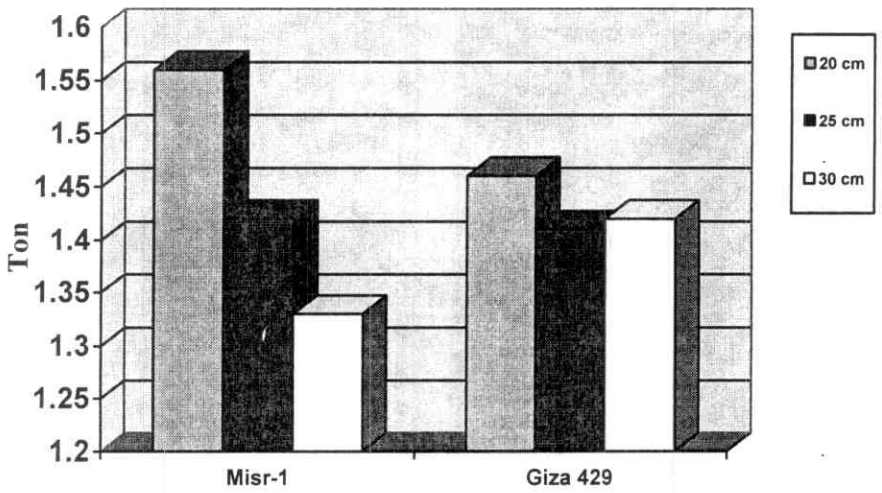


2004/2005 Season

Fig. (10):Effect of the interaction between variety and plant density on 100-seed weight (g) of faba bean (*Vicia faba L.*).



2003/2004 Season



2004/2005 Season

Fig. (11): Effect of the interaction between variety and plant density on seed yield (ton/fed) of faba bean (*Vicia faba L.*)

3. Effect of the interaction between plant density and phosphorus fertilizers:

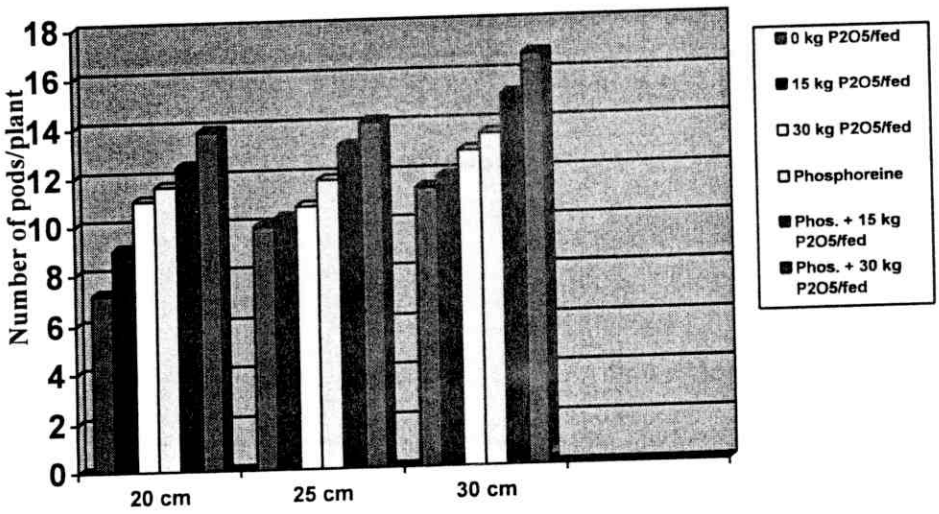
From data in Table (12) and (Fig, 12, 13, 14, 15, 16 and 17) it could be obvious that the interaction between plant density and phosphorus fertilizers had a significant effect on number of pods/plant in both seasons, number of seeds and seed yield/plant in the 1st season, as well as seed, straw and biological yields/fed in the 2nd season. It could be observed that the highest number of pods/plant 16.73 and 16.43 in the 1st and 2nd seasons, respectively were obtained when faba bean sown on 30cm between hills and received 30 Kg P_2O_5 + phosphorin ® and the lowest one resulted when faba bean planted on 20cm between hills without P fertilizer. The same trend were also found in number of seeds and seed yield/plant. Results recorded in the same Table revealed that the highest seed, straw and biological yields in the 2nd season (1.78, 2.69 and 4.47 ton/fed, respectively) were obtained when faba bean planted on 20cm between hills and 30 kg P_2O_5 fed. Mixed with phosphorin ®.

b. Effect of the second order interaction:

The interaction between variety x plant density x phosphorus fertilization had no significant affect on all characteristic under study in both seasons.

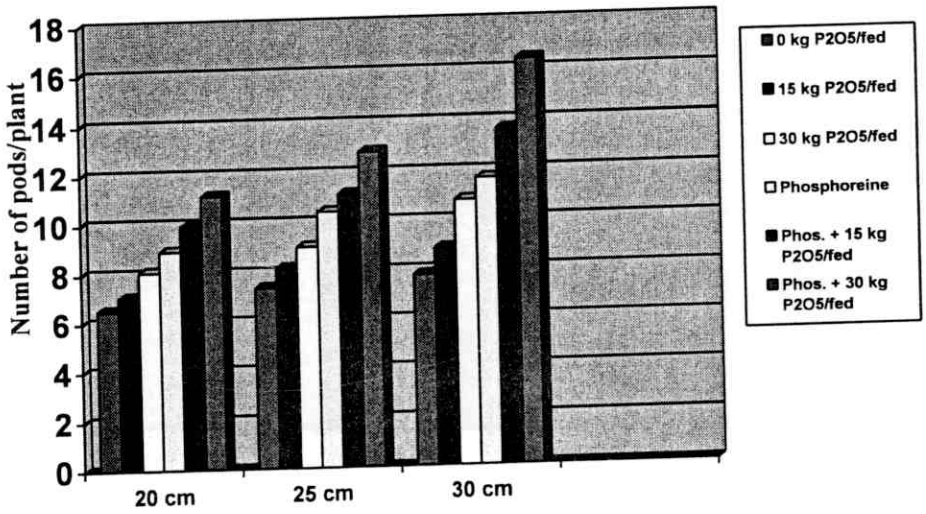
Table (12): Effect of the interaction between plant density and phosphorous fertilizers on yield and yield components of faba bean (*Vicia faba L.*) in 2003/04 and 2004/05 seasons.

Character / Treatment		Yield components at harvest			Yields (ton/fed)			Yield components at harvest			Yields (ton/fed)		
		No. of pods /plant	No. of seeds /Plant	Seed weight /plant (g)	Seed	Straw	Biological	No. of pods /plant	No. of seeds /Plant	Seed yield /plant (g)	Seed	Straw	Biological
		2003/04 season						2004/05 season					
20 cm	0 kg P_2O_5/fed	7.20	37.45	12.10	0.77	1.62	2.39	6.50	35.28	8.17	1.24	1.67	2.91
	15 kg P_2O_5/fed	9.00	43.22	13.93	0.87	1.83	2.71	7.03	40.44	9.47	1.32	1.89	3.21
	30 kg P_2O_5/fed	11.03	45.44	15.87	1.00	1.91	2.91	8.07	46.39	11.63	1.46	2.03	3.49
	Phosphoreine	11.60	49.89	17.17	1.08	2.13	3.20	8.90	51.06	11.97	1.59	2.19	3.78
	Phos. + 15 kg P_2O_5/fed	12.40	55.50	19.30	1.26	2.35	3.61	9.90	54.22	13.03	1.69	2.39	4.08
	Phos. + 30 kg P_2O_5/fed	13.80	58.56	21.10	1.42	2.57	3.98	11.13	58.72	15.47	1.78	2.69	4.47
25 cm	0 kg P_2O_5/fed	9.87	40.67	11.50	0.63	1.51	2.15	7.37	35.78	9.80	1.19	1.52	2.71
	15 kg P_2O_5/fed	10.23	42.45	14.93	0.78	1.61	2.38	8.17	39.11	10.70	1.28	1.69	2.96
	30 kg P_2O_5/fed	10.70	48.28	17.47	0.87	1.81	2.69	9.00	45.83	12.00	1.37	1.91	3.27
	Phosphoreine	11.77	52.56	19.53	0.95	1.99	2.94	10.40	52.22	13.20	1.45	2.03	3.49
	Phos. + 15 kg P_2O_5/fed	13.13	59.61	21.77	1.06	2.19	3.25	11.13	55.78	14.90	1.54	2.19	3.74
	Phos. + 30 kg P_2O_5/fed	14.07	70.78	25.83	1.28	2.35	3.63	12.83	62.06	16.53	1.65	2.31	3.96
30 cm	0 kg P_2O_5/fed	11.37	43.34	16.40	0.52	1.32	1.84	7.80	43.95	9.87	1.21	1.43	2.64
	15 kg P_2O_5/fed	11.80	49.00	17.87	0.74	1.49	2.23	8.83	53.67	10.80	1.26	1.57	2.83
	30 kg P_2O_5/fed	12.83	53.61	20.90	0.82	1.65	2.47	10.78	56.83	12.90	1.32	1.69	3.01
	Phosphoreine	13.50	55.72	23.20	0.91	1.81	2.72	11.67	59.00	14.37	1.41	1.89	3.29
	Phos. + 15 kg P_2O_5/fed	15.07	63.00	26.83	0.96	2.03	2.99	13.63	61.78	15.83	1.47	2.03	3.50
	Phos. + 30 kg P_2O_5/fed	16.73	72.39	30.47	1.15	2.16	3.31	16.43	64.94	18.43	1.59	2.21	3.80
LSD at 5%		1.02	4.66	2.12	NS	NS	NS	1.32	NS	NS	0.06	0.08	0.10



Hill space

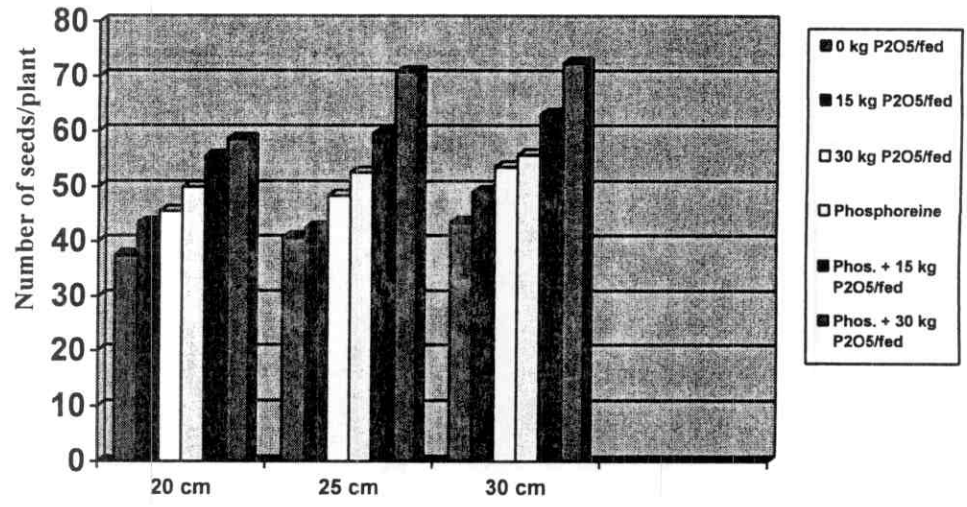
2003/2004 Season



Hill space

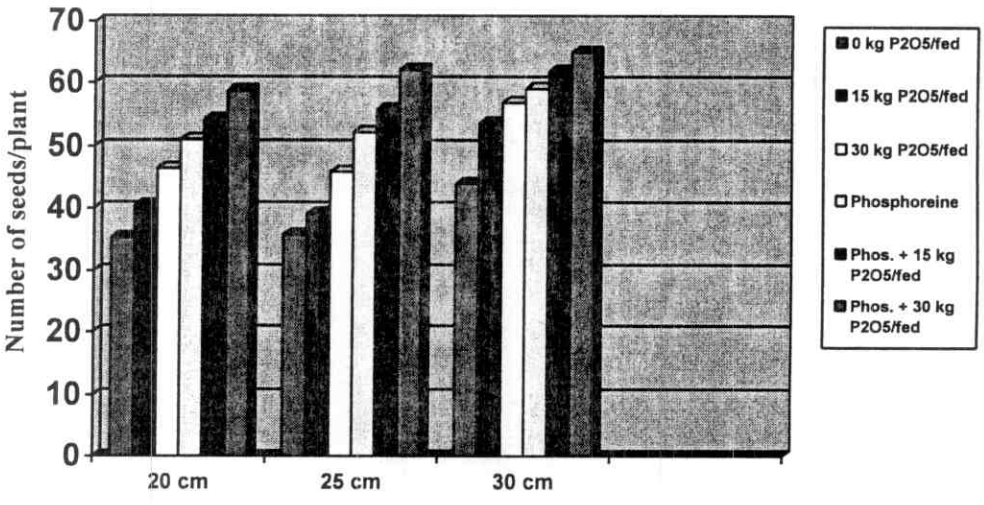
2004/2005 Season

Fig (12): Effect of the interaction between plant density and phosphorus fertilizers on number of pods/plant of faba bean (*Vicia faba L.*) in 2003/04 and 2004/05 seasons .



Hill space

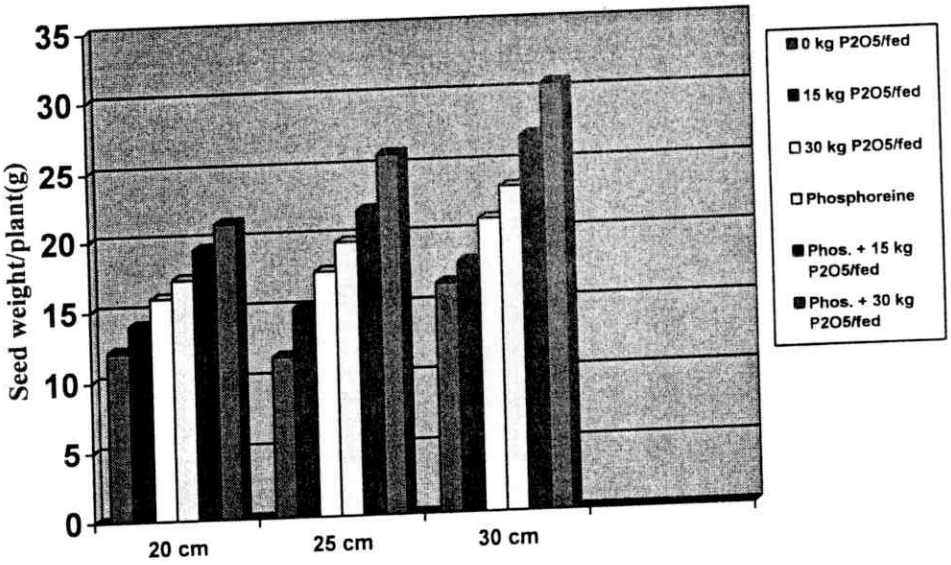
2003/2004 Season



Hill space

2004/2005 Season

Fig (13):Effect of the interaction between plant density and phosphorus fertilizers on number of seeds/plant of faba bean (*Vicia faba L.*) in 2003/04 and 2004/05 seasons .



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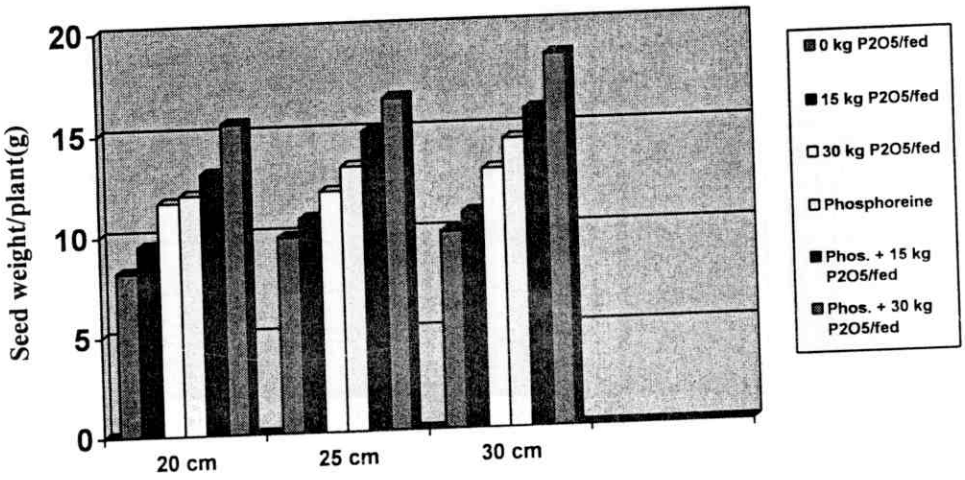
2003/2004 Season



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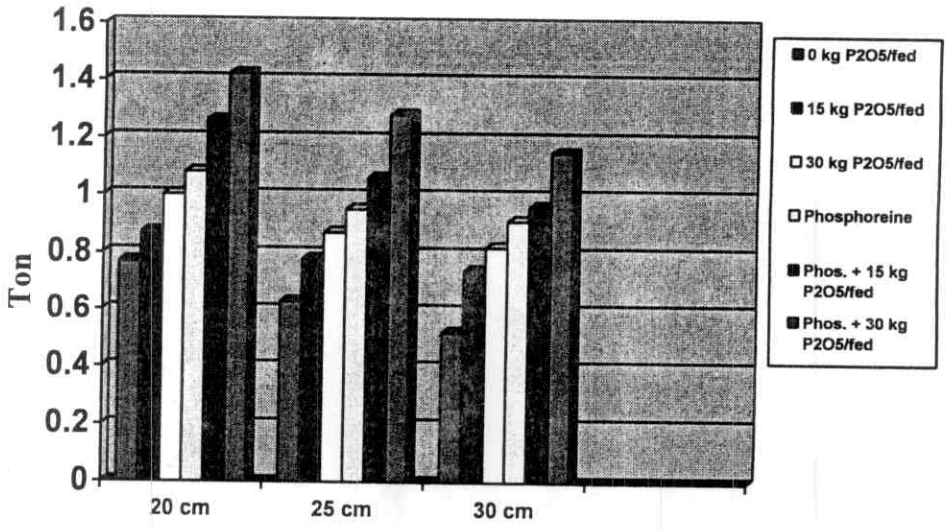
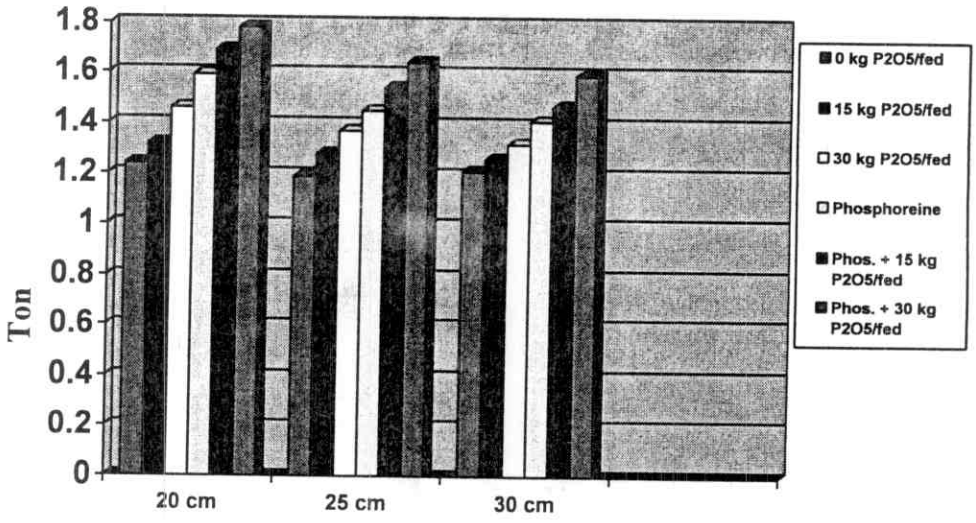
2004/2005 Season

Fig (14):Effect of the interaction between plant density and phosphorus fertilizers on seed weight/plant (g) of faba bean (*Vicia faba L.*) in 2003/04 and 2004/05 seasons .

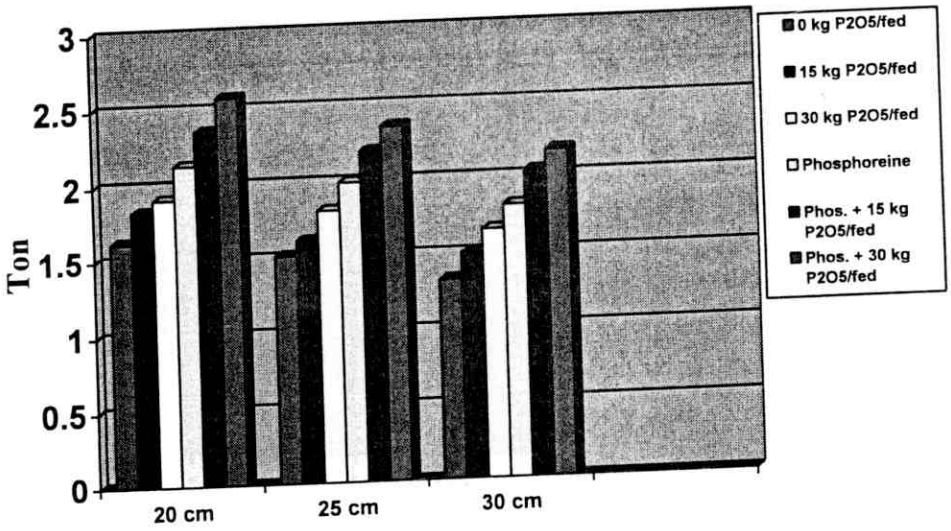


2003/2004 Season

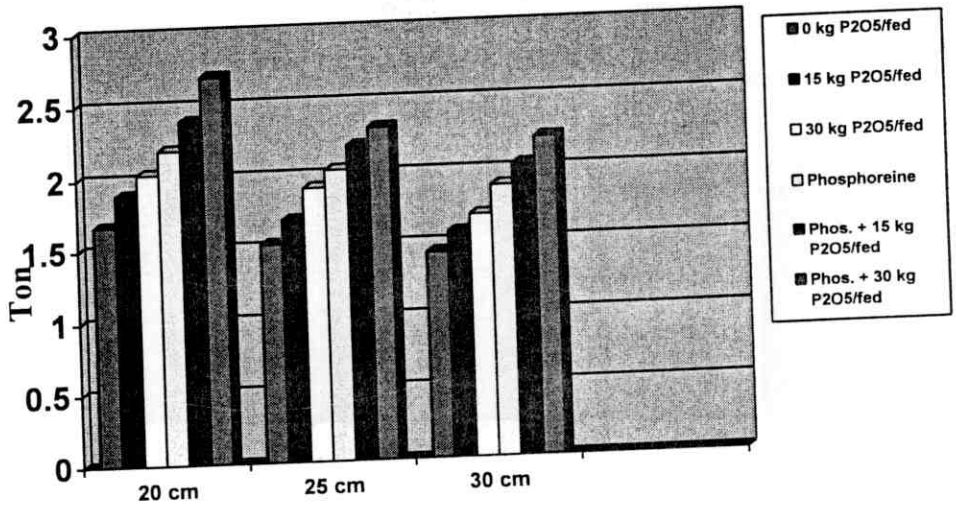


2004/2005 Season

Fig (15): Effect of the interaction between plant density and phosphorus fertilizers on seed yield (ton/fed) of faba bean (*Vicia faba L.*) in 2003/04 and 2004/05 seasons .

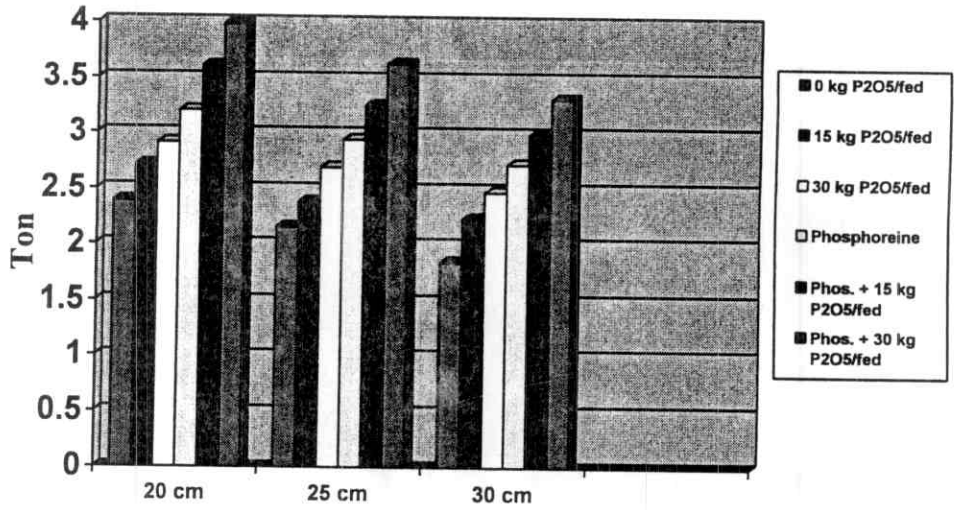


2003/2004 Season

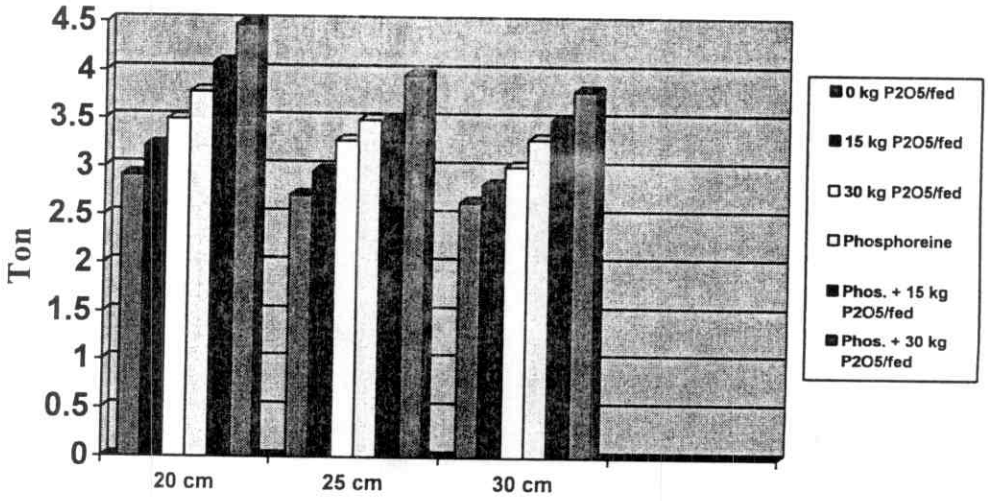


2004/2005 Season

Fig (16):Effect of the interaction between plant density and phosphorus fertilizers on straw yield (ton/fed) of faba bean (*Vicia faba L.*) in 2003/04 and 2004/05 seasons .



2003/2004 Season



2004/2005 Season

Fig (17):Effect of the interaction between plant density and phosphorus fertilizers on biological yield (ton/fed) of faba bean (*Vicia faba L.*) in 2003/04 and 2004/05 seasons .