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MINERAL AND BIO-PHOSPHATIC FERRTILIZATION FOR INTERCROPPED FABA BEAN AND ONION

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Abstract

Two field experiments were conducted at the Experimental Farm, Faculty of Agriculture, Mansoura University during 1994/95 and 1995/96 winter growing seasons, to study the effect of different patterns of intercropping faba bean (*Vicia faba*, L.) and onion (*Allium cepa*, L.). as well as mineral and bio-phosphatic fertilization on growth and yield of both crops. A split-split plot design with four replications was used. The main plots were occupied with intercropping systems and pure stand of faba bean and onion, as follows: faba bean on one side of the ridge with onion on the other side (1:1), faba bean on both sides of the the ridge and onion on both sides of the next ridge (2:2) and planting onion on raised beds (wide ridges, 120 cm wide) in a four middle rows spaced 20 cm apart and faba bean in two border rows (2:4). The sub plots were devoted to four P_2O_5 levels, i.e., control (without phosphorus fertilization), 15, 30 and 45 kg P_2O_5/fad. The sub sub plots were assigned to phosphate Bio-fertilizer (Phosphorin) application, i.e. with and without the addition of phosphorin.

The results showed that faba bean plant height, number of branches/plant and seed yield/fad were higher in solid planting. The intercropping system of 2 rows of faba bean : 4 rows of onion resulted in maximum values of number of pods/plant, number of seeds/pod, seed yield/plant and 100-seed weight, compared with other intercropping systems. Raising P_2O_5 to 45 kg/fad increased faba bean plant height, number of branches/plant, number of pods/plant, number of seeds/pod, seed yield/plant, 100-seed weight, seed/fad and seed protein percentage. Application of biophosphatic fertilizer (Phosphorin) resulted in an increase in plant height, number of branches and poods/plant, number of seeds/pod, seed yield/plant, 100-seed pod, seed yield/plant, 100-seed weight, seed yield/fad as well as seed protein content.

With respect to onion, solid stand was associated with the maximum number of leaves/plant, fresh and dry weight/plant, bubing ratio, marketable yield/fad, average bulb

marketable yield/fad, average bulb weight and total soluble solids (TSS), followed by the intercropping system of 2 faba bean: 4 onion. The earlier maturity and lower culls yield/fad resulted from solid planting of onion. Higher P-level (45 kg P_2O_5/fad) resulted in marked increase in plant height, number of leaves/plant, fresh and dry weight /plant as well as bulbing ratio and earlier maturity. Adding 30 kg P_2O_5/fad increased average bulb weight, culls yield/fad, marketable yield/fad.Application of bio-phosphatic fertilizer (Phosphorin) markeadly increased fresh and dry weights/plant, marketable yield, average bulb weight, TSS and dry matter content in onion bulbs.

In genreal, it can be concluded that intercroppping faba bean with onion in a system of 2: 4 rows on raised beds, fertilized with 30 kg /fed plus bio-phosphatic fertilization (phosphorin) is recommended for raising intercropped faba bean and onion productivity under the conditions of the study.

INTRODUCTION

Intercropping appears to be useful for increasing agricultural production in Egypt, and is considered a good way to ray to raise farmers income. Ahmed et al (1986) reported no adverse effected no adverse effect on onion yield due to its interplanting with horse beans at the recommended densities of both crops. However, the yield of the horse bean was reduced to as much as 50-70%. El-Hawary, et al. (1991) found that intercropping 4 ridges of faba bean: 4 ridges of onion gave hiehger yield, plant height, number of branches/plant and 100-seed weight, compared with other intercropping patterns, whereas, the intercropping of 1 faba bean: 1 onion gave the best yield of onion. El-Kafoury, et al (1993) found that interopped onion with cotton on raised beds resulted in better yield and yield components than those grown on conventional ridges. The highest land equivalent ratio (LER) was obtained when both crops were grown on raised beds. Ghobashi and El-Aweel (1996) stated that the final seed yield of faba bean in monoculture treatment was significantly higher than that obtained from association with onion. Faba bean plants were slightly taller when grown in associiation with onion. Number of branches/plant, number of pods/plant and seed size (100-seed weight) in faba bean were higher than intercropping. Number of seeds/pod was not significantly affected by planting onion with faba bean. Results also showed that sowing faba bean with onion had no significant effect on yield of onion.

Onion and faba bean require phosphate fertilization since P is an essential macronutrient. Establishment of strong root system, development and flowering of some phases, are related to the level of available phosphorus in soil (El-Khawaga ans

Zeiton (1992), Abou El-Hassan et al (1993). Radwan and Rehab (1993) pointed out that plant height, dry weight/plant, seed yield/fad and seed index of faba bean were significantly increased as phosphorus level increased up to 90 kg P_2O_5/ha. Mwafy (1995) found that increasing phosphorus levels up to 200 kg super phosphate/fad resulted in an increase in plant height, number of branches/plant, number of pods/ plant, number of seeds/pod, 100-seed weight, seed yield/plant, straw yield/plant, seed yield/fad, straw yield/fad and seed protein content of faba bean.

Nour El-Din et al (1976), El-Kalla and El-Kassaby (1982) and Leilah and Mostafa (1993) reported that adding 30 kg P2O5/fad to onion plants resulted in marked increase in plant height, number of leaves/plant, fresh and dry weight, bulbing ratio; cull, marketable and total bulb yields, TSS (total soluble solids) in bulb and improved storability of bulbs and earlier maturity.

Recently, remarkable results have been obtained from the application of phosphorus bio-fertilizer (Phosphobacterin or phosphorin) as a source of phosphorus. In addition, the inoculation of onion seedlings or faba bean seeds before planting with phosphorin stimulates the growth and yield of onion and faba bean and may reduce mineral phosphatic fertilization by changing the fixed form of phosphate to soluble form ready for plant nutrition (Gurubatham, et al, 1989). El-Awag et al (1993) reported that phosphobacterin caused significant increases in soybean grain and straw yield as compared with the control treatment. The increases by phosphobacterin inoculation without any addition of super phosphate were equal to the addition of 22.0 kg P2O5/fad. Abo El-Nour et al (1996) found that inoculation of faba bean seeds with phosphorin alone significantly reduced shoot dry weight, number of leaves, pods green yield as well as macro and micro nutrients uptake as compared with the recommended phosphorus dose. However, the combination between seed inoculation with phosphorin and 75% or 50% of the recommended phosphorus rate, generally promoted growth and significantly increased seed yield.

MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm, Faculty of Agriculture, Mansoura University during the two winter growing seasons of 1994/ 95 and 1995/96. The aim of study was to investigate the effect of different patterns of intercropping faba bean and onion as well as mineral and bio-phosphatic fertilization (Phosphorin) on growth, yield and quality of both faba bean and onion. Faba bean variey "Rina Blanka" and onion variety "Giza 20" were used in this investigation.

A split-split plot design with four replications was used. The main plots were occupied with the following intercropping systems:

S1: Pure stand of faba bean (140, 000 plants/fad).

S2: Pure stand of onion (200, 000 plants/fad).

S3: Faba bean on one side of the ridge with onion on the other side (1:1).

S4: Faba bean on both side of the ridge and onion on both sides of the next ridge (2:2).

Accordingly, in S3 and S4, 50% of unit area was occupied with faba bean and 50% with onion (70, 000 plants of faba bean and 100, 000 plants of onion/fad).

S5: Planting onion on raised beds (wide ridges of 120 cm) in the four middle rows spaced 20 cm apart and faba bean in border rows, i.e., 70,000 plants of faba bean and 200, 000 plants of onion/fad, this means a stand of 100% onion+50% faba bean.

The sub plots were devoted to four P_2O_5 levels, i.e., control (Without phosphorus fertilization), 15, 30 and 45 kg P_2O_5/fed.

The sub sub plots were assigned to phosphate Bio-fertilizer (Phosphorin) application, i.e. with and without addition of phosphorin at a rate of 400 g/fad.

Each sub sub plot consisted of 6 ridges, 60 cm apart and 3.0 m long, occupying an area of 10.8 m2. Raised beds were 3/plot.

Faba bean was sown on 11-13 november in the first and second cropping seasons, respectively. Seeds of faba bean were planted in hills 20 cm apart, while the seedlings of onion were transplanted 5-7 cm apart on 10 and 12 December in the first and second seasons, respectively. Plots were irrigated immediately after onion transplanting.

Phosphorus fertilizer in the form of calcium super phosphate (15.5% P_2O_5) was broadcasted and incorporated during soil tillage. Phosphate biofertilizer (Phosphorin) was applied to faba bean seeds and onion seedlings as an inoculation at a rate of 400 g/fad as recommended.

Nitrogen was banded to onion plants in the form of Ammonium Nitrate (33.5% N) at the rate of 60 kg N/fad. Three hand weedings were made during the growing season. Other agricultural practices were carried out as recommended.

The experimental soil was clay loam with medium fertility. Total nitrogen was 40 ppm, available phosphorus and potassium were 18 and 157 ppm, respectively.

Studied characters:

A. Faba Bean:

At full maturity, ten guarded plants of faba bean were taken at random from each subsub plot to study the following five characters:

1. Plant height (cm).

2. Number of branches/plant.

3. Number of seeds/pod.

4. Average weight of seeds/plant (g).

5. Seed index (100-seed weight, g).

6. Seed yield in ardab/fad:seed yield/fad was determined from the whole plot.

7. Crude protein prcentage: It was determined using the improved kjeldahl's methods of the A.O.A.C. (1970).

B. Onion:

Ten plants were taken at random from the outer rides from each sub sub plot at 120 days after transplanting and the following characters were measured: Plant height (cm), number of leaves/plant, fresh and dry weight/plant (g), bulbing ratio, i.e. bulb/neck diameter (Mann, 1952), earliness (days to 50% tops down).

After harvest, onion plants were left in the field to cure for two weeks, then tops and roots were removed and the following data were recorded: Weight of total culls, marketable yield, average bulb weight, percentage of total soluble solids (TSS), dry matter % in bulbs and storability (total loss in bulbs stored for four months %.

C. Competitive relationships and yield advantage:

1. Land equivalent ratio (LER) was determined according to Willey and Osiru 1972.

2. Relative crowding coefficient K as proposed by Hall 1974.

Statistical analysis:

All data were subjected to analysis of variance for the split-split-plot design Gomez and Gomez 1984, and treatment means were compared using the New L.S.D. Waller and Duncan, 1969.

RESULTS AND DISCUSSION

a. Faba bean:

Results in Tables (1 and 2) show that number of pods/plant, seed yield/plant and seed yield/fad of faba bean were significantly affected by intercropping system, in both seasons. Plant height, number of branches/plant, number of seed/pod, and seed index were markedly affected by the intercropping system, only in one of the two seasons. Seed protein content of faba bean was not affected by intercropping in both seasons. The highest means of plant heiht, number of branches/plant and seed yield/fad were obtained in the solid planting of faba bean. The intercropping system (2 rows of faba bean: 4 rows of onion on raised beds) S5, resulted in maximum values of plant height, number of pods/plant, number of seeds/pod, seed yield/plant and 100-seed weight (seed index) as compared with the other intercropping systems. Averages of seed yield of faba bean of solid (S1), intercropping S3 (1:1), S4 (2:2) and S5 (2:4) were 10.04, 6.16, 5.90 and 6.00 ardab/fad in the first season and were 10.24, 5.86, 6.17 and 6.15 ardab/fad in the second season. The superiority of S5 among other intercropping systems may be attributed to the better distribution of faba bean plants and less competition for light, nutrition and other environmental factors. Arnon (1972) reported that more uniform plant distribution increases the proportion of radiant energy intercepted by plants and reduces that reaching the soil surface. Higher photosynthetic activity per plant may be increased hence more pods/plant due to more light penetration and reduced flower abscission, increased maturated pods and seed yield. Similar observations were reported by El-Hawary, et al (1991) and Ghobashi and El-Aweel (1996).

In both seasons, mineral phosphorus fertilizer level significantly affected all studied characters. Data in Tables (1 and 2) show that raising P_2O_5 to kg P_2O_5/fad increased plant height, number of branches/plant, number of pods/plant, number of seeds/pod, seed yield/plant, 100-seed weight, seed yield/fad and seed protein percentage.

Table 1. Average of plant height, number of branches/plant, number of pods/plant and number of seeds/pod of faba bean as affected by intercropping system as well as mineral and biophosphatic fertilization during 1994/95 (1) and 1995/96 (II) seasons.

Treatment	Plant height (cm)		No of branches/plant		No of branches/plant		No of branches/plant	
	I	II	I	II	I	II	I	II
A:Intercr.system:								
Solid	82.80	93.90	2.40	1.90	6.1	6.0	3.1	3.2
1 faba bean: 1 onion	89.80	91.40	2.30	1.80	5.7	5.4	3.1	2.9
2 faba bean: 2 onion	88.90	91.10	2.10	1.80	6.4	5.3	3.1	2.9
3 faba bean: 4 onion	91.60	92.50	2.10	2.10	6.6	6.0	3.1	3.3
NLSD (5%)	1.27	NS	0.23	NS	0.3	0.1	NS	0.07
B: P2O5 Levels:								
0 kg P2O5/fad	88.10	89.00	1.70	1.50	5.9	5.3	2.9	2.7
15 kg P2O5/fad	89.90	90.80	2.00	1.80	6.1	5.6	3.1	3.0
30 kg P2O5/fad	91.40	93.00	2.40	2.00	6.3	5.8	3.3	3.1
45 kg P2O5/fad	93.70	96.00	2.70	2.40	6.5	6.0	3.3	3.4
NLDS (5%)	0.99	2.38	0.13	0.13	0.2	0.2	0.1	0.12
C: Phosphorin:								
Without	90.40	91.50	2.10	1.90	6.2	5.7	3.1	3.00
With	91.10	93.00	2.30	2.00	6.3	5.7	3.2	3.10
F.Test	*	*	*	*	*	NS	*	*

Table 2. Average of seed yield/plant, 100-seed weight, seed yield/fad and seed protein percentage of faba bean as affected by intercropping system as well as mineral and bio-phosphatic fertilization during 1994/95 (I) and 1995/96 (II) season.

Treatment	Seed yield/ plant (g)		100-Seed weight (g)		Seed yield (Ardab/fad)@		Seed protein percentage	
	I	II	I	II	I	II	I	II
A:Intercr.system:								
Solid	21.50	20.20	117.0	116.1	10.040	10.242	14.20	13.80
1 faba bean: 1 onion	18.60	18.70	114.8	1133.1	6.163	5.859	14.30	14.00
2 faba bean: 2 onion	19.40	19.50	114.1	115.5	5.908	6.167	14.20	14.00
3 faba bean: 4 onion	22.90	21.70	117.0	116.7	6.004	6.146	14.24	14.00
NLSD (5%)	1.21	0.76	4.3	NS	0.41	0.10	NS	NS
B: P2O5 Levels:								
0 kg P2O5/fad	19.1	17.70	108.6	109.0	6.304	6.188	13.60	13.30
15 kg P2O5/fad	20.90	18.90	114.3	113.5	6.988	7.025	14.20	13.80
30 kg P2O5/fad	21.60	20.90	118.6	118.3	7.292	7.467	14.50	14.20
45 kg P2O5/fad	22.00	22.50	121.5	120.6	7.733	7.530	14.60	14.50
NLDS (5%)	0.82	0.44	2.3	4.1	0.33	0.24	0.10	0.20
C: Phosphorin:								
Without	20.50	19.77	114.6	114.3	6.990	6.985	14.20	13.80
With	21.20	20.30	116.9	116.5	7.169	7.221	14.30	14.10
F.Test	*	*	NS	*	*	NS.	*	*

@ aradab = 155 kg

Average of faba bean seed yield/fad to 0, 15, 30 and 45 kg P2O5/fad were 6.30, 6.99, 7.29 and 7.73 ardabs in the first season and 6.18, 7.02, 7.46 and 7.53 aradabs in the second season. These results may be due to that phosphorus is a constituent of all important nucleo-proteins and thus increases the efficiency of root system. Consequently, the physiological activities of the plant are enhanced leading to better yield. Similar results were reported by El-Khawaga and Zeiton (1992), Abou El-Hassan, et al (1993), Radwan and Rehab (1993) and Mwafy (1995).

Application of biophosphatic fertilizer (Phosphorin) resulted in an increase in plant height, number of branches and pods/plant, number of seeds/pod, seed yield/plant, 100-seed weight and seed yield/fad as well as seed protein content. This may be attributed to the fact that phosphate solubilizing bacteria play a fundamental role in correcting the solubility problem in soil by converting the fixed from to soluble form ready for plant nutrition. These findings are in accordance with those obtained by El-Awag, et al (1993) and Abo El-Nour, et al (1996).

Faba bean seed yield/fad was significantly affected by the interaction between intercropping system and mineral phosphorus fertilizer level in both seasons (Fig. 1). Maximum seed yield/fad (11.67 and 11.38 ardab/fad) was noticed with solid planting of faba bean and fertilizing with the higher level of phosphorus (45 kg P_2O_5/fad). The most favorable combination for intercropping system for this trait was noticed with intercropping 2 rows faba bean : 4 rows onion, on 120 cm raised beds and the application of 45 kg P_2O_5/fad. Difference between addition of 30 and 45 kg P_2O_5/fad was not significant. So, it can be reported that intercropping faba bean and onion at the system of 2: 4 and addition of 30 kg P_2O_5/fad seems most beneficial. The lowest seed yield/fad (4.60 and 5.1 In the first and second seasons, respectively) were observed with intercropping 1 row faba bean: 1 row onion.

The interaction between intercropping system and biophosphatic fertilizer (phosphorin) had a significant effect on seed yield/fad in the first season. Maximum seed yield of faba bean (10.43 ardab/fad) resulted from the solid planting of faba bean and the application of biophosphatic fertilizer (phosphorin), while the minimum seed yield (5.1 ardab/fad) was obtained with intercropping 1 row faba bean: 1 row onion without phosphorine addition (Fig. 2).

b. Onion:

Data presented in Tables (3, 4 and 5) show that onion plant height was markedly affected by different intercropping systems in both seasons. Intercropping faba

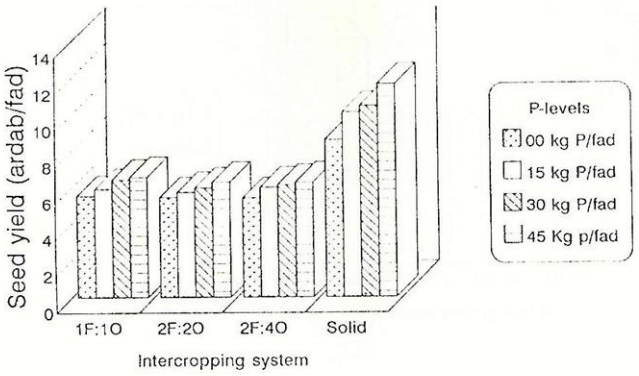

Fig. 1-a. Faba bean seed yield (ardab/fad) as affected by the interaction between intercropping system and phosphorus fertilizer levels in 1994/95 season.

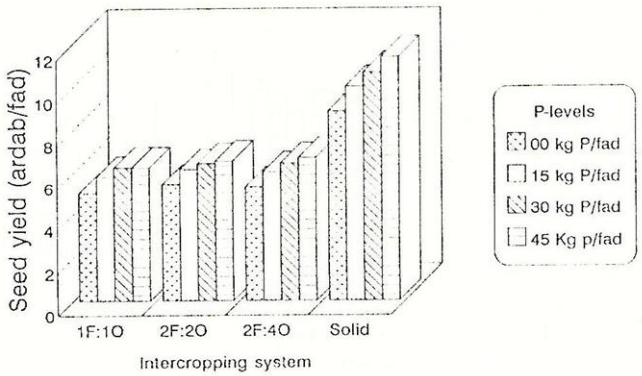

Fig. 1-b. Faba bean seed yield (ardab/fad) as affected by the interaction between intercropping system and phosphorus fertilizer levels in 1995/96 season.

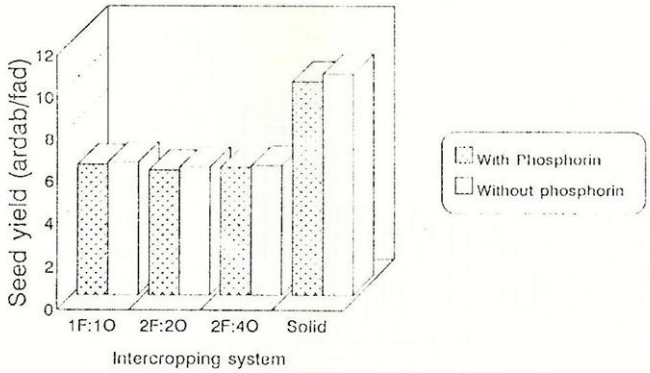

Fig. 2. Faba bean seed yield (ardab/fad) as affected by the interaction between intercropping system and phosphorus fertilizer levels in 1994/95 season.

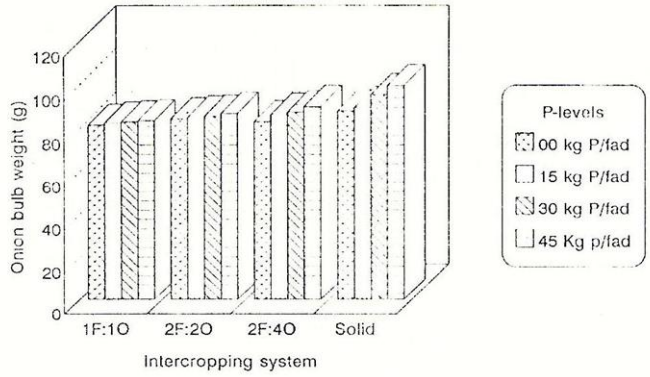

Fig. 3. Averages of onion bulb weight (g) as affected by the interaction between intercropping system and phosphorus fertilizer levels in 1995/96 season.

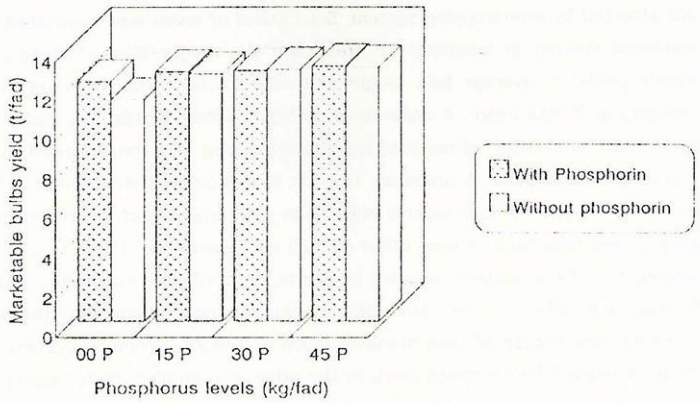

Fig. 4. Onion marketable bulbs yield (t/fad) as affected by the interact ion between mineral phosphorus levels and phosphorin application in 1995/96 season.

bean and onion in 1: 1 system resulted in the tallest onion plants. Solid stand of onion resulted in shorter ones. The increase in plant height in case of intercropping may be ascribed to more competition between onion and faba bean plants for light. El-Hawary (1991) and Ghobashi and El-aweel (1996) came to the same conclusion. Intercropping system significantly affected number of leaves/plant, fresh and dry weights/plant, bulbing ratio, days to maturity, culls, marketable yield, average bulb weight, total soluble solids (TSS) and storability. Dry matter content in bulbs was not affected by intercropping system. Solid stand of onion was associated with the maximum number of leaves/plant, fresh and dry weight/plant, bulbing ratio, marketable yield/fad, average bulb weight and total soluble solids, followed by the intercropping of 2 faba bean : 4 onion rows on 120 cm raised beds. The earlier maturity and least culls yield/fad resulted from solid planting of onion, followed by the intercropping 2 faba bean: 4 onion on 120 cm raised beds. The minimum loss in weight during storage for four months occured in solid cropping of onion and it was following 2 rows faba bean: 4 rows onion on 120 cm raised beds. These results may be ascribed to more availability of plant nutrients, light 120 cm raised beds. These results may be ascribed to more availability of plant nutrients, light and other environmental factors in case of solid stand of onion or the intercropping system of 2 faba bean: 4 onion 120 cm raised beds. In the other two studied intercropping systems onion plants began to suffer from environmental limitation. These results are in harmony with those obtained by El-Hawary, et al (1991), El-Kafoury, et al. (1993) and Ghobashi and El-Aweel (1996).

Data in Tables (3-5) show that the application of higher P-level (45 kg P_2O_5/fad) resulted in marked increase in plant height, number of leaes/plant, fresh and dry weight/plant as well as bulbing ratio. Number of days to maturity were reduced with higher P application. Adding 30 kg P_2O_5/fad increased average bulb weight, culls yield/fad, marketable yield/fad. Over both seasons, adding 15 kg P_2O_5/fad increased the marketable bulb yield by about 1.31 ton/fad, as compared with control (without phosphorus), i.e., an increase of about 87.2 kg of bulbs for each kg P_2O_5 added/fad. The second incremental of 15 kg P_2O_5/fad gave an average increase of 931 kg /fad in marketable bulb yield, representing an increase of about 26.06 kg of bulbs for each kg P_2O_5 above 15. The third increment of 15 kg P_2O_5/fad gave an average increase of about 295 kg/fad of marketable bulb yield, representing an increase of about 19.66 kg of bulbs for each kg P_2O_5 added over 30 kg P_2O_5/fad. These results are in harmony with those of El-Mofty (1966), Nour El-Din et al (1976) and El-Kalla and El-Kassaby (1982). Concerning the keeping quality of onion

Table 3. Average of plant height, number of leaves/plant, fresh and dry weight/plant of onion as affected by intercropping system, mineral and bio-phosphatic fertilization in 1994/95 (I) and 1995/96 (II) seasons.

Treatment	Plant height (cm)		No of branches/plant		No of branches/plant		No of branches/plant	
	I	II	I	II	I	II	I	II
A:Intercr.system:								
Solid	87.0	85.7	9.3	9.8	94.7	103.6	9.6	9.7
1 faba bean: 1 onion	90.3	98.4	9.4	7.7	88.0	91.2	8.5	7.8
2 faba bean: 2 onion	89.5	86.3	9.5	8.1	92.1	97.6	8.5	8.3
3 faba bean: 4 onion	91.5	86.1	9.5	9.7	92.2	101.5	9.1	8.9
NLSD (5%)	2.2	3.5	NS	0.7	1.9	2.6	0.4	0.3
B: P2O5 Levels:								
0 kg P2O5/fad	86.8	86.8	9.2	8.6	87.1	94.8	8.7	8.0
15 kg P2O5/fad	89.2	88.9	9.5	8.6	90.6	100.0	9.0	8.5
30 kg P2O5/fad	91.1	89.3	9.4	9.0	94.0	102.1	9.1	8.7
45 kg P2O5/fad	91.2	91.5	9.5	9.1	95.4	106.0	9.3	9.3
NLDS (5%)	1.2	2.0	0.2	0.4	1.3	1.26	0.2	0.2
C: Phosphorin:								
Without	89.1	88.7	9.4	8.8	91.3	99.9	9.0	8.5
With	90.1	89.5	9.4	8.9	92.2	101.6	9.1	8.8
F.Test	NS	NS	NS	NS	*	*	NS	*

Table 4. Average of bulbing ratio, earliness (days to 50% bulbs top down), culls yield/fad and marketable yield/fad of onion as affected by intercropping system as well as mineral and bio-phosphatic fertilization during 1994/95 (I) and 1995/96 (II) season.

Treatment	Bulbing ratio		Days to maturity		Culls yield (f/fad)		Marketable yield (t/fad)	
	I	II	I	II	I	II	I	II
A:Intercr.system:								
Solid	3.6	4.1	145.2	139.3	0.401	0.711	16.567	16.662
1 faba bean: 1 onion	3.3	3.0	151.5	143.8	0.903	0.802	10.208	8.305
2 faba bean: 2 onion	3.4	3.2	146.2	142.0	0.610	0.802	10.083	9.797
3 faba bean: 4 onion	3.5	3.8	143.3	141.1	0.512	0.712	15.433	15.265
NLSD (5%)	0.2	0.2	1.0	1.5	0.070	0.050	0.418	0.484
B: P2O5 Levels:								
0 kg P2O5/fad	3.4	3.4	149.1	145.0	0.600	0.804	12.595	11.710
15 kg P2O5/fad	3.4	3.5	147.8	142.3	0.601	0.715	12.996	12.617
30 kg P2O5/fad	3.4	3.6	145.3	140.4	0.602	0.714	13.237	12.767
45 kg P2O5/fad	3.5	3.6	144.1	138.6	0.604	0.711	13.363	12.936
NLDS (5%)	NS	0.1	1.6	1.2	NS	0.030	0.334	0.353
C: Phosphorin:								
Without	3.4	3.5	146.9	142.1	0.601	0.710	13.000	12.372
With	3.4	3.6	146.2	141.0	0.610	0.715	13.146	12.643
F.Test	NS	NS	NS	NS	NS	NS	NS	**

@ aradab = 155 kg

Table 5. Average of bulb weight, Total soluble solid (TSS), dry matter in bulbs and loss after four months from storage (storability) of onion as affected by intercropping system as well as mineral and biophosphatic fertilization during 1994/95 (I) and 1995/96 (II) seasons.

Treatment	Weight of bulb (g)		TSS		Dry matter %		Loss in weight after four months	
	I	II	I	II	I	II	I	II
A:Intercr.system:								
Solid	93.3	93.0	14.4	15.1	15.3	14.0	15.6	11.7
1 faba bean: 1 onion	81.8	87.6	12.5	13.2	14.2	13.4	18.6	13.8
2 faba bean: 2 onion	85.6	89.5	12.7	13.6	14.5	13.9	16.4	12.9
3 faba bean: 4 onion	87.9	91.3	13.4	14.3	15.4	14.5	16.3	13.1
NLSD (5%)	1.6	2.0	0.1	0.3	NS	NS	0.31	0.5
B: P2O5 Levels:								
0 kg P2O5/fad	84.4	86.2	13.0	13.1	14.8	13.2	17.1	12.8
15 kg P2O5/fad	87.0	89.7	13.2	14.5	14.9	13.9	16.8	12.9
30 kg P2O5/fad	88.0	92.1	13.3	14.2	14.9	14.2	16.6	12.9
45 kg P2O5/fad	89.1	92.5	13.5	14.5	14.9	14.3	16.5	12.7
NLDS (5%)	1.9	1.5	0.1	0.2	NS	0.3	0.2	NS
C: Phosphorin:								
Without	86.8	89.3	13.2	14.4	14.8	13.7	16.8	12.9
With	87.5	91.4	13.3	14.8	14.9	14.2	16.7	12.8
F.Test	*	*	NS	*	NS	*	NS	NS

Table 6. Land Equivalent ratio (LER), L faba bean (L F) and L onion (L O) as affect ed by intercropping system as well mineral and bio-phosphatic fertilization in 1994/95 (I) and 1995/96 (II).

Treatment	(I)			(II)		
	L F	L O	LER	L F	L O	LER
A:Intercr.system:						
1 faba bean: 1 onion	0.606	0.914	1.520	0.574	0.500	1.074
2 faba bean: 2 onion	0.582	0.906	1.487	0.605	0.589	1.194
3 faba bean: 4 onion	0.591	0.928	1.520	0.602	0.916	1.518
NLSD (5%)		0.050	0.055	0.032	0.032	0.043
B: P2O5 Levels:						
0 kg P2O5/fad	0.730	0.939	1.668	0.698	0.765	1.462
15 kg P2O5/fad	0.690	0.944	1.634	0.702	0.744	1.446
30 kg P2O5/fad	0.696	0.931	1.62	0.700	0.750	1.451
45 kg P2O5/fad	0.663	0.934	1.597	0.680	0.746	1.426
NLDS (5%)	0.03	NS	0.050	0.038	0.024	0.033
C: Phosphorin:						
Without	0.698	0.940	1.638	0.693	0.753	1.446
With	0.691	0.934	1.626	0.696	0.750	1.446
F.Test	NS	NS	NS	NS	NS	NS

bulbs, it is clear that adding 30 kg P_2O_5/fad increased the TSS and dry matter content in bulbs. This may be attributed to the fact that phosphorus improves the quality of onion bulbs by converting starch to sugar. These results are in harmony with those of Singh and Singh (1969), Sirry et al (1974) and El-Kalla and El-Kassaby (1982). In both seasons, bio-phosphatic fertilizer (Phosphorin) markedly affected fresh and dry weight/plant, marketable yield, average bulb weight, TSS and dry matter content in onion bulbs, which recorded the highest means with phosphorin applcation. However, it did not affect onion plant height, number of leaves/plant, bulbing ratio, days to maturity, culls yield/fad and total loss in bulbs during storage for four months (storability). The beneficial effect of phosphorin may be due to its role in releasing fixed phsophorus. According to El-Awag, et al (1993) under alkaline soil conditions, the monovalent phosphate (P_2O_5) in phosphatic fertilizer is rapidly fixed, mainly in the form of tricalcium phosphate and becomes unavailable for plant nutrition which is well known in Egyptian soils. Phosphate solubilizing bacteria (Phosphorin) plays a fundamental role in converting the fixed form to a soluble form ready for plant nutrition. In the last few years, remarkable strides have been made in the application of phosphate biofertilizer (Phosphorin). A significant effect of interaction between intercropping system and phosphorus fertilizer level was observed on average bulb weight in the second season. Maximum bulb weight (97.7 g) was noticed with solid planting of onion and fertilizing with the highest level of phosphhorus (45 kg P_2O_5/fad). It is worthy to mention that adding 30 kg or 45 kg P_2O_5/fad to the solid planting of onion gave a similar result, i.e., the difference between both rates did not reach the level of significance. The best combination was intercropping 2 rows faba bean: 4 rows onion, on raised beds 120 cm wide and the application of 30 or 45 kg P_2O_5/fad (Fig. 3).

The was a significant interaction effect between phosphorus fertilization level and phosphatic biofertilizer (phosporin) in response to the marketable bulbs yield/fad in the second season, as graphically illustrated in Fig. (4). The maximum yield of marketable bulbs (13.00 t / fad) resulted from adding 45 kg P_2O_5/fad with the application of biophosphatic fertilizer (phosphorin). Diffrence between application of 30 and 45 kg P_2O_5/fad with addition of biophosphatic fertilizer was not significant. On the other side, the minimum marketable yield (10.98 t/fad) was observed with the treatment combination of control (without both phosphorus and biophosphatic fertilizer). Gurubathan et al (1989) came to the same results.

D. Competitive relationships and yield advantages:

Data presented in Tables (6 and 7) show the land equivalent ratio (LER) and

relative crowding coefficient (K) for faba bean and onion as well as their pool per unit land area as affected by the studied intercopping systems. In both seasons, the LER of faba bean and onion showed values more than one in all intercropping systems. LER indicated that the intercropping system of 2 rows faba bean: 4 rows onion, on 120 cm raised beds, gave the highest values, compared with the other two intercropping systems. The averages of LER were 1.29, 1.45 and 1.66 in the first season and 1.01, 1.02 and 1.62 in the second season with the intercropping of 1:1, 2:2 and 2:4 (faba bean: onion, respectively).

In both seasons, relative crowding coefficient of faba bean was more than one. The same trend was noticed for onion as shown in Table (7). The highest values of K were noticed with intercropping 2 rows faba bean: 4 rows onion, on 120 cm raised beds. It is an advantage to grow two crops together than differ in their requirements in such a way that they complement each other and make better overall use of environmental resources when grown separately.

In general, it can be concluded that intercropping onion with faba bean in a system of 2 rows faba bean: 4 rows onion, on 120 cm wide ridges, fertilized with 30 kg P_2O_5/fad and the addition of bio-phosphatic fertilization (phosphorin) seems a recommended treatment for raising intercropped faba bean and onion productivity under the conditions of the study.

Table 7. Relative Crowding Coefficient (K), K faba bean (K F) and K onion (K O) as affect ed by intercropping system as well mineral and bio-phosphatic fertilization in 1994/95 (I) and 1995/96 (II).

Treatment	(I)			(II)		
	K F	K O	K	K F	K O	K
A:Intercr.system:						
1 faba bean: 1 onion	1.659	1.618	2.694	1.363	1.012	1.377
2 faba bean: 2 onion	1.498	1.566	2.341	1.555	1.448	2.250
3 faba bean: 4 onion	1.591	10.102	15.584	1.525	13.818	20.830
NLSD (5%)	0.066	1.053	1.981	0.089	2.694	4.621
B: P2O5 Levels:						
0 kg P2O5/fad	1.939	2.782	2.633	1.496	7.680	11.558
15 kg P2O5/fad	1.535	3.167	5.388	1.542	4.271	6.714
30 kg P2O5/fad	1.575	5.459	8.650	1.528	5.076	7.754
45 kg P2O5/fad	1.281	6.306	7.822	1.358	4.676	6.583
NLDS (5%)	NS	NS	NS	NS	NS	NS
C: Phosphorin:						
Without	1.617	5.023	7.863	1.476	4.573	6.850
With	1.548	3.835	5.883	1.486	6.279	9.454
F.Test	NS	NS	NS	NS	NS	NS

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تأثير التسميد الفوسفاتى المعدنى والحيوى على انتاجية الفول البلدى والبصل تحت نظم تحميل مختلفة

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تم تنفيذ هذه الدراسة بمحطة البحوث بكلية الزراعة - جامعة المنصورة وذلك خلال موسمى الزراعة ٩٤ / ٩٥، ٩٥ / ٩٦ لدراسة تأثير نظم تحميل الفول البلدى والبصل (١:١ ، ٢: ٢ على خطوط بعرض ٦٠ سم و ٢ : ٤ على مصاطب بعرض ١٢٠ سم مع زراعة الفول البلدى على جانبى المصطبة وزراعة ٤ سطور بصل فى منتصف المصطبة على مسافة ٢٠ سم بين السطور) مع مقارنة هذه النظم بالزراعة المنفرده لكلا المحصولين ومستويات التسميد الفوسفاتى المعدنى (صفر، ١٥ ، ٣٠ ، ٤٥ كجم فو ٢٥ / فدان) والتسميد الحيوى الفوسفاتى بالفوسفورين على انتاجية الفول البلدى والبصل المحملين. وقد صممت التجربة بنظام القطع المنشقة مرتين فى أربع مكررات، حيث وزعت نظم التحميل عشوائيا على القطع الرئيسية ومستويات التسميد الفوسفاتى المعدنى على القطع الشقية والتسميد الفوسفاتى الحيوى (الفوسفورين) على القطع تحت الشقية.

وتتلخص نتائج الدراسة فى الآتى:

عند زراعة الفول البلدى منفردا زاد طول النبات، عدد الأفرع / نبات ومحصول البذور/فدان، وقد أدى نظام تحميل ٢ سطر فول بلدى : ٤ سطر بصل الى زيادة واضحة فى عدد القرون / نبات، عدد البذور /قرن، محصول البذور /نبات ووزن ١٠٠ بذرة. كما أوضحت نتائج الدراسة أن زيادة مستوى التسميد الفوسفاتى المعدنى حتى ٤٥ كجم فو٢٥ / فدان أدت الى زيادة واضحة فى طول النبات، عدد أفرع، النبات، عدد القرون / نبات، عدد البذور / قرن محصول البذور/نبات وزن ١٠٠ بذرة محصول البذور / فدان ونسبة البروتين كما أدت إضافة الفوسورين منفردا الى زيادة طول النبات عدد الأفرع القرون/ نبات عدد البذور/قرن محصول البذور/نبات وزن ١٠٠ بذرة محصول البذور/فدان البذور/فدان ونسبة البروتين بالبذرة.

كما أدت زراعة البصل منفردا إلى زيادة معنوية فى عدد الأوراق/نبات، الوزن الطازج والجاف/نبات، نسبة التبصيل ونسبة وزن المحصول القابل للتسويق، متوسط وزن البصلة ونسبة المادة الصلبة الذائبة الكلية، وقد تبعها نظام التحميل ٢ سطر فول بلدى: ٤ سطر بصل. كما اظهرت النتائج أن زيادة مستوى التسميد الفوسفاتى المعدنى حتى ٤٥ كجم فو٢٥ /فدان قد أدت الى زيادة واضحة فى طول النبات الوزن الطازج الجاف / نبات، نسبة التبصيل والتبكير فى النضج. وأظهرت النتائج ان إضافة ٣٠ كجم فو٢٥/ فدان قد تسببت فى زيادة وزن البصلة والمحصول القابل للتسويق. وقد أدت إضافة الفوسفورين منفردا إلى زيادة الوزن الطازج والجاف /نبات، المحصول القابل للتسويق، متوسط وزن البصلة، نسبة المادة الصلبة الذائبة الكلية ومحتوى الآبصال من المادة الجافة.

ونستنتج من هذه الدراسة أن تحميل البصل على الفول بنظام ٢ فول : ٤ بصل على مصاطب بعرض ١٢٠ سم وإضافة السماد الفوسفاتى بمعدل ٣٠ كجم فو٢أ٥ للفدان مع إضافة السماد الفوسفاتى الحيوى قد أدت الى زيادة معنوية فى إنتاجية كلا المحصولين. كما أشارت النتائج إلى زياده معدل استغلال الارض الى اقصى حد باتباع نظام التحميل السابق.