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EFFECT OF PHOSPHOROUS FERTILIZATION AND SOME GROWTH PROMOTERS ON GROWTH AND YIELD OF PEA (*Pisum sativum* L.).

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ABSTRACT

Two field experiments were carried out at Dekerniss distract, Dakahlia Governorate, Egypt during the two successive winter seasons of 2000/2001 and 2001/2002 to evaluate the effect of phosphorous fertilizer levels with or without phosphorien and some different growth promoters either single or in combined applications on the vegetative growth, yield and its components of pea plant (*Pisum sativum* L.) cv. Master-B.

Split-split plot system in a randomized block design with three replicates was used in both growing seasons. The foliar treatments (control, vitamin B_1, yeast extract and vitamin B_1 + yeast extract) were randomly located in the main plot whereas the sub-plots were devoted for the phosphorous fertilizer levels (100, 150 and 200 kg calcium superphosphate/fed.) and the biofertilizer treatments (with and without phosphorein) were assigned to the sub-sub plots.

The results of the following treatments (foliar application with vitamin B_1 + yeast extract, phosphorous at 200 kg/fed. calcium superphosphate and biofertilizing with phosphorein as a single factors) showed a significant increase in growth vegetative parameters, chemical content of leaves, also they reduced the number of days to the first flower. For this reason they tended to increase both total fresh and dry yield.

The interaction between (vitamin B_1 + yeast extract) combined with (200 kg/fed. calcium superphosphate) caused a significant increase in both total fresh and dry yield. Also, the combination between (vitamin B_1 + yeast extract) combined with biofertilizer gave similar results as previous ones.

Using foliar applications of yeast extract + vitamin B_1 at 200 kg/fed. calcium superphosphate plus phosphorien, caused a marked increase in pea yield and its components as compared with control (200 kg/fed. calcium superphosphate).

It was noticed that using foliar application of yeast extract at 100 kg/fed. calcium superphosphate in combination with seed inoculation with phosphorien gave yield as high as 200 kg/fed. calcium superphosphate alone and consequently decreased the environmental pollution.

Keywords: Foliar application, Vitamin B_1, Yeast extract, Phosphorous, Biofertilizer, Phosphorien, Fresh yield, Green yield, Dry yield, Seed yield, Pea (*Pisum sativum*).

INTRODUCTION

Pea (*Pisum sativum* L.) is one of the popular and important winter vegetables all over the world including Egypt. In addition, pea represents one of the most important vegetable crops for local consumption and export.

Human health has received a great attention nowadays. It was documented that artificial fertilizers have a pollutant effect in the soil and plants, in turn, on the human health. Owing to that, the scientists are looking forward to substitute the artificial fertilizers (partially) with the natural ones like biofertilizers. As for biofertilizer, several investigators indicated that soil inoculation with P solubilizing bacteria improved soil fertility and plant

productivity by releasing P element from rock phosphate or tricalcium P (Hauka et al., 1996). The results indicated that the effect of biofertilizers on pea was the most pronounced on the most parameters of vegetative growth and yield (El-Shamma, 2000; Tartoura, 2002 b).

Recently, great attention has been focused on the possibility of using natural and safety substituents, i.e., yeast, vitamin B_1 and biofertililizers in order to improve plant growth, flowering, fruit setting and total yield of horticultural plants.

Skoog and Miller (1957) mentioned that yeast via its cytokinins content improve plant growth. In this regard, Tartoura (2002 a) reported that spraying pea plants with yeast extract greatly increased the total fresh pods yield by 32.13 %.

Concerning the effect of vitamin B_1 on vegetative growth and yield parameters, El-Beheidi *et al.* (1995) stated that supplying pea plant with 50 ppm of vitamin B_1 showed significant increment in stem length and dry weight comparing with untreated plants. In this regard, Ali (2000) revealed that spraying pea plants with vitamin B_1 at 25 ppm or 50 ppm increased vegetative growth characteristics expressed as stem length, number of branches, fresh and dry weight per plant.

Phosphorous is considered the second essential nutrient element for both plants and microorganisms, respectively. In spite of the considerable addition of phosphorus to soils, the amount available for plant is usually low. Mahmoud and Abd El-Hafez (1982) reported that after fertilization with calcium superphosphate, the level of available phosphorus decreases sharply after a short period from application. They added that this case is widespread in alkaline soils, since the available phosphorus in the added fertilizer is rapidly transformed to tricalcium phosphate, thus, become unavailable to the plants.

With respect to the promoting effect of P-fertilizer on growth of plants, this may due to that phosphate regulates many enzymatic processes, the phosphorylation of adenosine diphosphate (ADP) to adenosine triphosphate (ATP), also, phosphate acts as an activator of some enzymes, leading to enhancement of the metabolism processes and formation of new cells (Dhillon, 1978), consequently, increasing the vegetative growth. Phosphorus availability can change the cytokinin level (Dhillon, 1978).

The application of phosphorous fertilizer on pea plants and its relation to vegetative growth was studied by many investigators. Bakry *et al.* (1985) indicated that increasing phosphorous rates resulted in an increase in plant height and leaf area or branch number per plant as well as dry weight of plant, the highest values were obtained by 60 kg P_2O_5/fed. Meanwhile, Ali (2000) noticed that the basal application of P_2O_5 at 120 kg/ha. resulted in a significant increase in the growth of the all plant parts.

The aim of study is reducing the use of chemicals phosphatic fertilizers and enhance the vegetative growth, yield and its quality by using natural and safety compounds such as yeast extract and vitamin B_1 as well as biofertilizer (phosphorien) of pea plants.

MATERIALS AND METHODS

Two field experiments were carried out in Dekerniss distract, Dakahlia Governorate, Egypt during the two successive winter seasons of 2000/2001 and 2001/2002 to study the effect of phosphorous fertilizer levels with or without phosphorien and some different growth promoters either single or in combined applications on the vegetative growth, yield and its components of pea plants (*Pisum sativum* L.) cv. Master-B.

Soil samples were taken before planting from experiment soil at depth of 30-50 cm to determine the physical and chemical analysis (Table1).

Table (1): Important physical and chemical parameters for the studied soil (Average of two s easons).

O.M %	Fine sand %	Coarse sand %	Silt %	Clay %	Texture class	Ec (1:2.5) dSm^{-1}	pH (1:2.5)	Available N (ppm)	Available P (ppm)	Available K (ppm)
1.90	21.17	0.95	17.79	60.09	Clayey	1.55	7.80	72.62	15.65	530

The experimental design and treatments:

The split-split plot system in a randomized block design with three replicates was used in both growing seasons. The foliar treatments were randomly located in the main plot whereas the sub-plots were devoted for the phosphorous fertilizer levels and the biofertilizer treatments were assigned to the sub-sub plots. The sub-sub plots area was 15.60 m^2, which consisted of 8 ridges, 3.25 m length and 0.60 m width. Each two adjacent plots were separated by one ridge (0.60 m).

The experiment included 24 treatments, which were the combination between four treatments of foliar applications (control, vitamin B_1, yeast extract and Vit. B_1 + yeast extract), three levels of phosphorous fertilizer (100, 150 and 200 kg calcium superphosphate/fed.) and two levels of biofertilizers (with and without phosphorein).

Planting method:

Farmyard manure (FYM) at the rate of 15 m^3 per fed. (Table 2) was added during the preparation of experimental field. Seeds were sown immediately in the moderately moist soil on November 10th and 5th in 2000/2001 and 2001/2002 seasons, respectively.

Foliar applications:

Yeast extract: Baker's yeast (soft yeast) mixed with sugar at a ratio of 1:1 and left for 3 hours at room temperature. Then it was frozen for disruption of yeast tissue and releasing their content. Preparation of yeast solution was done according to El-Ghamriny *et al.* (1999). Composition of yeast extract (According to Nagodawithana, 1991) is shown in Table (3). It was used at a concentration of 25 ml/l.

Table 2: Chemical analysis of the FYM.

Elements concentration	Macro elements (%)				Micro elements (ppm)			O.M (%)	C/N ratio
	N	P	K	Ca	Fe	Mn	Zn		
Value	0.99	0.60	1.60	23.21	1840	325	89	26.18	15.60

Table (3): Composition of yeast extract.

Constituents	Value			
Approximate composition of vitamins				
Thiamine (B_1)	60-100	µ /g		
Riboflavin (B_2)	35-50	"		
Niacin	300-500	"		
Pyridoxine HCL (B_6)	28	"		
Pantothenate (B_5)	70	"		
Biotin	1.3	"		
Cholin	4000	"		
Folic acid	5-13	"		
Vit. B_{12}	0.001	"		
Approximate composition of minerals				
Na	0.12	mg/g	Cu	8.00 µ /g
Ca	0.75	"	Se	0.10 "
Fe	0.02	"	Mn	0.02 "
Mg	1.65	"	Cr	2.20 "
K	21.00	"	Ni	3.00 "
P	13.50	"	Va	0.04 "
S	3.90	"	Mo	0.40 "
Zn	0.17	"	Sn	3.00 "
Si	0.03	"	Li	0.17 "

Vitamin B_1: It was used at a concentration of 25 ml/l as a form of thiamin hydrochloride obtained from El-Gomhoria Co.

Combination of vitamin B_1 and yeast extract was prepared by adding vitamin B_1 to the prepared yeast solution at the previous concentration, i.e., 50 ppm vit. B_1 + 25 ml/l yeast extract. Generally, all foliar treatments (Vitamin B_1, yeast extract and Vitamin B_1 + yeast extract) were applied three times at 20, 30 and 45 days after sowing.

Fertilizers applications:

a- Mineral fertilizer: phosphorous fertilizer levels were 100, 150 and 200 kg/fed. calcium superphosphate (15.5 P_2O_5). The full dose as the recommendation of the Ministry of Agriculture (30 P_2O_5 i.e. 200 kg/fed. calcium superphosphate). It was divided in two doses, the first was 75 % from the P level, it was added during the experimental field preparation and the second one (25 %) was added before the first irrigation. All treatments received 40 kg N/fed. and 50 K_2O in the form of ammonium sulphate (20.5 % N) and potassium sulphate (48-52 % K_2O), respectively. The fertilizers were divided in two equal doses, the first one was before the first irrigation and the second one was before the following irrigation. The normal agronomical practices of pea production were followed as the recommendation of Ministry of Agriculture.

b- Biofertilizer: the biofertilizer phosphorein, commercial name in Egypt, was taken from General Organization of Agriculture Equalization Fund (GOAEF), Ministry of Agriculture, Egypt. It contains live cell of efficient bacteria strain

(*Bacillus megaterium*) for phosphate dissolving in cultivated soil. Biofrtilizer activity was tested in laboratory of Microbiology Department, Faculty of Agriculture, Mansoura University. It was applied at 2 kg/fed. The inoculum was mixed with the moist seeds before planting directly.

Studied traits:

Five plants of each plot were randomly chosen at 50 days after sowing to obtain the following characteristics:

1- Vegetative characteristics:

a- Plant length. b- Number of branches/plant
c- Number of leaves/plant d- Fresh weight/plant
e- Dry weight/plant. f- Leaf area/plant:
g- Total chlorophyll: leaf chlorophyll content was determined with A-Minloti SPAD chlorophyll-meter (Yadava, 1986). The chlorophyll-meter readings were recorded on the plant standing in the field on 2nd leaf from plant top.

2- Flowering time:

Ten plants per plot were labeled to determine the flowering time, which defined as the total number of days from sowing to opening of the first fully developed flower.

3- Yield and yield components

A- Green yield

Green pods of four rows of each plot were harvested at the proper maturity stage at three times, counted and weighed in each harvest and the following parameters were calculated:

i- Average number of green pods/plant.
ii- Average pod weight (mean weight of 50 pods).
iii- Number of green seeds/pod (mean number of seed per 50 pods)
iv- Weight of 100- green seed.
v- Total green pods yield (ton/fed.).

B- Dry seed yield

Dry pods of the other four rows were harvested in one time, threshed and the following characters were calculated:

1- Total dry seeds yield (kg/fed.).
2- Seed index (1000-dry seed weight).

4- Chemical constituents:

The soil was digested as described in Jackson (1967) using a modified Kjeldahl procedure, but, the plant samples were digested using sulfuric and perchloric mixture, Jackson, 1967).

Total nitrogen was determined with micro-Kjeldahl method according to Chapman and Pratt (1961). Phosphorus was colorimetrically determined following Jackson (1967). Potassium was determined using a flame

photometer as described by Jackson (1967). The other determinations were carried out according to Jackson (1967) and Page *et al.* (1982).

A representative samples from seeds of green pods from each experimental plot were taken at random for determining the Vitamin C: it was determined by using (2, 6 dichlorophenolendophenol method).

Statistical analysis:

The obtained data were subjected to statistical analysis of variance as technique of split split plot design according to Snedecor and Cochran (1967). The treatment means were compared using the L.S.D test as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

I- Vegetative growth

1.1. Effect of foliar applications:

Spraying plants with a solution of vitamin B_1 and yeast extract significantly increased all vegetative characters expressed as plant length, number of branches and leaves per plant, fresh and dry weight and total chlorophyll in both seasons (Table 4).

Many investigators pointed out that there are many possible reasons for the stimulative effect of vit. B_1 on the vegetative growth, firstly, vit. B_1 enhances the endogenous levels of various growth hormones such as cytokines and GA (Kodandarmaiah and Rao, 1985). Secondly, it acts as a co-enzyme in the decarboxylation of α-keto acids, e.g., pyrovate and α-ketoglutarate (Oertli, 1987) and thirdly, the promotional effect of vit. B_1 upon the formotion of chlorophyll through its active role in the pathway of synthesis of α-amino lenulinic acid, the precursor of chlorophyll biosynthesis (Stroev, 1989).

The positive effect of yeast extract on the vegetative growth may be attributed to its composition as shown in Table (3) which consists of majority of macro and micro elements, in addition it contains a natural growth regulators especially, cytokinins which play an important role and had stimulative effect on cell division, enlargement, protein and nucleic acids synthesis. It have been reported that an application of yeast extract increased leaf area and chlorophyll content (Tartoura, 2002 a). The yeast also contains tryptophan which considered the precursor of IAA (Moor, 1979). Consequently, the application of yeast produced more IAA which increased plant growth.

The results reported herein agree with those obtained by El-Beheidi *et al.* (1995), Ali (2000) and Tartoura (2002 a) on pea.

1.2. Effect of phosphorous levels:

The plants received 200 kg calcium superphosphate, followed by the rate of 150 kg, tended to be the tallest, had the highest branches and leaves, heaviest fresh and dry weight, and largest leaf area (Table 4). The promoting effect of P-fertilizer on growth characters may be due to the role of phosphorous in the enzyme systems necessary for energy transform in photosynthesis and respiration as well as its essential role in division and development of meristemic tissue. In addition, phosphate leads to

0enhancing photosynthesis (Repka, 1979), consequently, increasing the vegetative growth parameters.

Such trends were noted by different workers among them El-Mansi *et al.* (1994) and Ali (2000).

1.3. Effect of biofertilizer:

Inoculation with phosphorein gave a high significant effect on the vegetative growth characters than those of un-inoculated plants in the two seasons (Table 4). The soil microorganisms release growth hormones as IAA, GA and cytokinins which stimulate plant growth and dry matter and absorption of nutrient (Frankenberger and Arshad, 1995). Also, Sherif *et al.* (1997) showed that biofertilizer (phosphorien) increase the availability of soil immobilized phosphorous by securing organic acids such as formic, acetic and lactic acids. These acids lower the pH and bring out the dissolution of bounds forms of phosphate and render them available. Consequently, the active bacteria in phosphorien which is capable to transform the tri-calcium phosphate to mono-calcium phosphate, leading to increase its concentration in plant causing stimulative plant growth and chlorophyll production (Table 4) and this in turn increased photosynthesis capacity and yield.

The obtained results are in agreement with those of El-Shamma (2000) on dry bean and Tartoura (2002 b) on pea.

1.4. Effect of interactions:

Insignificant effect was obtained as a results of all studied interaction factors on plant length, fresh weight, leaf area as well as total chlorophyll in both seasons except fresh weight which responded significantly to the interaction among foliar applications X P levels X biofertilizer in the second season only. Significant effect was reflected on dry weight as a result of all interaction factors in both seasons except the foliar applications x P levels interaction in the second season. All the interactions, gave insignificant effect on number of branches and leaves except the interaction between foliar applications X P levels on both characters and foliar applications X biofertilizer on number of branches in the first season, P levels X biofertilizer and foliar applications X P levels X biofertilizer on number of branches in the second season (Table 4).

2- Flowering time

2.1 Effect of foliar applications:

The vit. B_1 + yeast extract treatment only gave significant differences as compared with control in the first season (Table 5). Similar results were reported by Ali (2000) on pea.

2.2 Effect of P levels:

Increasing P fertilization up to 200 kg/fed. pushed plants to flower earlier compared with the other two levels, i.e., 100 kg and 150 kg/fed. The effect of P element is very important in metabolic process, blooming and flower development, because it is a main constituent of energy compounds (ATP and ADP), phospholipids, nucleic acids, nucleotides and enzymes (Dhillon, 1978). These results are in the same direction as those reported by Ali (2000) on pea.

Table 4: Effect of foliar applications, phosphorus levels, biofertilizer and their interactions on vegetative growth parameters during 2000 and 2001 seasons.

Characters	Plant Length (cm)		No. of branches /plant		No. of Leaves /plant		Fresh weight /plant (g)		Dry weight /plant (g)		Leaf area (cm^2)		Total chlorophyll (SPAD unit)	
Seasons	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
A: Foliar applications														
Control	41.56	42.53	1.77	1.68	12.16	11.38	9.50	8.80	1.19	1.17	183.48	163.98	40.04	3[illegible].63
Vit. B_1	43.16	43.90	1.95	1.89	12.20	11.44	9.75	9.24	1.25	1.25	199.70	182.27	41.93	4[illegible].61
Yeast extract	45.78	45.33	2.41	2.30	12.94	13.58	10.38	10.13	1.36	1.35	257.78	214.00	45.81	44[illegible].41
Vit.B_1+Yeast extract	43.16	46.88	2.58	2.39	12.99	13.51	11.09	10.78	1.46	1.45	267.63	216.33	46.39	45[illegible].85
L.S.D at 5%	3.02	2.40	0.05	0.02	0.06	0.13	0.37	0.19	0.01	0.001	6.14	8.97	2.27	3[illegible]65
B: Phosphorous levels (kg/fed.)														
100	42.77	43.21	2.01	1.90	11.93	11.99	9.43	8.96	1.20	1.17	212.15	180.72	41.88	41 .07
150	44.60	44.73	2.18	2.06	12.68	12.49	10.29	9.88	1.33	1.32	228.82	193.89	43.62	42 .45
200	46.03	46.04	2.36	2.24	13.10	12.95	10.82	10.44	1.42	1.42	240.47	207.82	45.13	43 .61
L.S.D at 5 %	1.11	1.75	0.02	0.02	0.04	0.06	0.56	0.10	0.02	0.04	7.50	5.49	2.56	N[illegible]S
C: Biofertilizer (Phosphorien)														
With	44.92	45.01	2.21	2.11	12.62	12.57	10..31	9.92	1.34	1.33	230.35	197.57	43.94	42[illegible]71
Without	44.02	44.31	2.15	2.03	12.52	12.39	10.05	9.60	1.29	1.27	223.95	190.72	43.14	42[illegible]05
F Test	**	**	**	**	**	**	**	**	**	**	**	**	**	*[illegible]
Interactions														
A X B	NS	NS	**	**	**	*	NS	*	*	NS	NS	NS	NS	N[illegible]S
A X C	NS	NS	*	NS	NS	NS	NS	NS	*	**	NS	NS	NS	N[illegible]S
B X C	NS	NS	NS	NS	NS	**	NS	*	**	**	NS	NS	NS	N[illegible]S
A X B X C	NS	NS	NS	**	NS	NS	NS	*	**	**	NS	NS	NS	N[illegible]S

2.3 Effect of biofertilizer:

Inoculation of pea seeds with phosphorien induced significant influence on flowering time (Table 5) in both seasons. Such obtained results are in agreement with those mentioned by Hewedy (1999) on tomato.

Table 5: Effect of foliar applications, phosphorus levels, biofertilizer and their interactions on flowering time during 2000 and 2001 seasons.

Character / Seasons	No. of days to first flower	
	2000	2001
A: Foliar applications:		
Control	35.5	33.9
Vit. B_1	35.7	33.8
Yeast extract	34.8	33.3
Vit. B_1 + Yeast extract	33.8	33.4
L.S.D at 5%	1.3	NS
B: Phosphorus levels (kg/fed.):		
100	36.1	34.8
150	34.9	33.6
200	33.8	32.3
L.S.D at 5%	1.3	1.4
C: Biofertilizer (Phosphorien):		
With	34.5	33.3
Without	35.4	34.0
F. Test	**	**
D: Interactions:		
A x B	NS	NS
A x C	*	NS
B x C	**	*
A x B x C	NS	NS

2.4. Effect of interactions:

The interaction effect of P levels X biofertilizer on flowering time gave a significant effect. Insignificant effect was detected in the other interactions except the interaction of foliar treatments X biofertilizer in the first season only (Table 5).

3- Yield and its components

3.1 Effect of foliar applications:

The combination between vit. B_1 and yeast extract had the most significant effects on physical fresh pod characteristics, i.e., average fresh pod weight, and number of seeds per pod. Also, green pod yield expressed as number of pods/plant, weight of 100-green seed, and per fed, and total dry seed yield per fed. and weight of 1000-dry seed in both seasons were highest by this treatment (Table 6).

Obtained results might be attributed to increase in the amount of metabolites synthesized by the plant, which in turn accelerated different plant growth parameters and dry weight (Table 4) and finally reflected on the total yield. It can be concluded that there is a clear relation between each of number of pods, pod weight, number of green seeds, and the total yield per fed.

Table 6: Effect of foliar applications, phosphorus levels, biofertilizer and their interactions on yield and its components during 2000 and 2001 seasons.

Characters / Seasons	No. of pods /plant		Fresh pod weight (g)		No. of seeds /pod		100-green seed weight (g)		1000-dry seed weight (g)		Total green pods yield (ton /fed.)		Total dry seeds yield (kg/fed.)	
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
A: Foliar applications														
Control	7.06	6.67	4.45	4.24	8.64	8.59	45.07	43.70	322.59	301.25	3.615	3.455	626.88	597.53
Vit. B_1	7.81	7.22	4.87	4.58	9.21	9.14	48.48	45.91	333.95	320.22	4.037	3.878	699.83	661.44
Yeast extract	8.37	8.22	5.23	5.04	9.40	9.35	50.69	48.73	348.43	332.70	4.333	4.214	743.68	706.44
Vit.B_1+Yeast extract	8.66	8.10	5.69	5.42	9.62	9.51	52.72	49.94	368.26	345.70	4.652	4.416	810.56	766.13
L.S.D at 5%	0.17	0.21	0.06	0.06	0.04	0.04	0.47	2.43	11.60	2.28	0.050	0.024	8.20	3.83
B: Phosphorous levels (kg/fed.)														
100	6.92	6.48	4.67	4.47	9.10	9.07	46.82	44.41	325.19	305.66	3.668	3.561	633.12	596.87
150	8.22	7.73	5.07	4.81	9.23	9.16	49.06	47.01	341.87	326.94	4.207	4.045	726.91	683.92
200	8.79	8.45	5.44	5.17	9.32	9.23	51.84	49.79	362.86	342.30	4.602	4.376	800.69	767.87
L.S.D at 5 %	0.11	0.16	0.05	0.05	0.06	0.05	0.28	1.40	7.00	4.88	0.044	0.017	6.92	4.06
C: Biofertilizer (Phosphorien)														
With	8.24	7.79	5.17	4.90	9.25	9.17	49.66	47.57	347.18	328.64	4.255	4.090	740.22	703.12
Without	7.72	7.32	4.95	4.74	9.19	9.13	48.82	46.57	339.43	321.29	4.064	3.891	700.26	662.65
F Test	**	**	**	**	**	**	**	**	*	**	**	**	**	**
Interactions														
A X B	NS	NS	**	**	NS	NS	**	NS	**	NS	**	**	**	**
A X C	NS	NS	**	**	NS	*	*	*	NS	NS	*	*	*	**
B X C	**	**	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	**	**
A X B X C	*	NS	*	NS	NS	NS	NS	NS	NS	NS	*	**	*	**

Yeast via its cytokinins content (Nagodawthana, 1991) and the high content of vit. B_1 and mineral might play a role in orientation and translocation of metabolites from leaves into the production organs (Saure-Sink relationship Savenkova, 1984). Also it might play a role in the synthesis of chlorophyll content and increased the dry matter and the pod characters (Tables 4 and 6). All of these occurrences and attributes might lead to the improvement of the yield of pea plant. These results are in coincidence with those reported by Ali (2000) and Tartoura (2002 a) on pea,

3.2 Effect of P levels:

All physical fresh pod characters, green and dry seed yield and weight of 1000-dry seed were affected positively by increasing the levels of calcium superphosphate up to 200 kg/fed. (Table 6). The favorable effect of phosphorous on yield was mainly due to its improving effect on plant growth (Bakry *et al.* (1985 on pea), photosynthesis process and plant nutritional status as shown at Table (8) and the superiority of total yield values scored by relatively high phosphorous level might be attributed directly to the increase number of pods per plant as well as the average of green seed weight (Table 6). Accordingly, the highest phosphorous level was found to be necessary for pea plant to produce the maximum yield. Obtained results are in agreement with those by Ali (2000) on pea.

3.3 Effect of biofertilizer:

All the studied characters of yield and its components were significantly improved by using the inoculation with phosphorien in two seasons (Table 6). The increasing in yield by phosphorien can be explained on the basis that the ability of bacteria to dissolve the precipitated form of phosphorous $Ca_3(PO_4)$ depends on its efficiency in producing inorganic, organic acids and/or CO_2 (El-Sayed, 1994), therefore the unavailable forms of phosphorous can be partially dissolved by the action of phosphate dissolving naturally accruing or inoculated in the soil.

Results obtained in the present study followed similar trend to this study by El-Shamma (2000) on dry bean and Tartoura (2002 b) on pea plants.

3.4. Effect of interactions:

The combination of vit. B_1 + yeast extract and 200 kg calcium superphosphate gave a highly significant effect on pod weight, and green and dry yield/fed in both seasons (Tables 6 and 7). Regarding this combination effect on weight of 100-green seed and 1000-dry seed, the differences were not significant in the second season.

Significant effect was obtained from the inoculation with phosphorien with the combination between vit. B_1 and yeast extract on fresh pod weight, 100-green seed weight, total green pods yield/fed. and total dry seed yield per fed. (Tables 6 and 7). Meanwhile, insignificant results were observed on number of pods, number of seed/pod, 1000-dry weight in the two seasons, except number of seed in first season only.

Table 7 : Effect of foliar applications (A), phosphorus levels (B), biofertilizer (C) and their interactions on total green pods and dry seed yield/fed. during 2000 and 2001 seasons.

Characters		Total green pods yield (ton/fed.)						Total dry seeds yield (kg/fed.)					
Treatments	Seasons	2000			2001			2000			2001		
A: Foliar applications	B: P-levels (kg/fed.)	C: Bio-fertilizer (phosphorien)		A x B Mean	C: Bio-fertilizer (phosphorien)		A x B Mean	C: Bio-fertilizer (phosphorien)		A x B Mean	C: Bio-fertilizer (phosphorien)		A x B Mean
		With	Without		With	Without		With	Without		With	Without	
Control	100	3.27	3.12	3.19	3.17	2.96	3.06	556.85	534.85	545.85	532.20	507.20	519.70
	150	3.77	3.52	3.64	3.55	3.46	3.50	639.52	620.52	630.02	614.20	589.20	601.70
	200	4.09	3.93	4.01	3.88	3.71	3.80	725.67	683.85	704.76	690.20	652.20	671.20
A x C Mean		3.71	3.52		3.53	3.38		640.68	613.07		612.20	582.87	
Vit. B_1	100	3.66	3.48	3.57	3.54	3.31	3.43	633.00	596.00	614.50	588.00	551.00	569.50
	150	4.12	3.98	4.05	4.00	3.88	3.94	730.00	685.00	707.50	685.67	636.00	660.83
	200	4.50	4.48	4.49	3.36	4.18	4.27	795.00	760.00	777.50	773.00	735.00	754.00
A x C Mean		4.09	3.98		3.97	3.79		719.33	680.33		682.22	640.67	
Yeast extract	100	4.00	3.72	3.86	3.88	3.67	3.78	688.11	656.11	672.11	641.00	611.00	626.00
	150	4.51	4.26	4.39	4.39	4.08	4.23	789.11	746.11	767.61	742.67	686.00	714.33
	200	4.79	4.72	4.75	4.69	4.58	4.63	823.00	759.67	791.33	791.00	767.00	779.00
A x C Mean		4.43	4.23		4.32	4.11		766.74	720.63		724.89	688.00	
Vit. B_1 + Yeast extract	100	4.18	3.92	4.05	4.10	3.86	3.98	711.00	689.00	700.00	687.30	657.30	672.30
	150	4.88	4.62	4.75	4.65	4.36	4.51	820.00	785.00	802.50	788.30	729.30	758.80
	200	5.30	5.01	5.15	4.88	4.65	4.77	971.33	887.00	929.17	903.97	830.63	867.30
A x C Mean		4.79	4.52		4.54	4.29		834.11	787.00		793.19	739.08	
B x C Mean	100	3.78	3.56		3.67	3.45		647.24	618.99		612.12	581.62	
	150	4.32	4.10		4.15	3.94		744.66	709.16		707.71	660.12	
	200	4.67	4.54		4.45	4.28		828.75	772.63		789.54	746.21	
LSD at 5% level													
A X B		0.09			0.03			13.83			8.12		
A X C		0.08			0.04			11.89			4.02		
B X C		NS			NS			10.30			3.48		
A X B X C		1.02			0.07			20.60			6.97		

The treatment of 200 kg calcium superphosphate plus phosphorien gave significant results in the two seasons on number of pods and dry seed yield (Tables 6 and 7). Even though insignificant difference was detected between the levels of phosphorous fertilizer and phosphorien on fresh pod weight number of seed per pod, 100-green seed, total green pods yield and 1000-dry seed weight in the two studied season except fresh pod weight in first season only.

The combination among the vit. B_1 + yeast extract + 200 kg calcium superphosphate and inoculation with phosphorien gave the best results where it gave a significant effect on number of pod per plant, fresh pod weight and total green and total dry yield per fed. In both seasons except number of pods per plant and fresh pod weight in the first season only. Meanwhile, the differences among all the studied factors did not reach to the significance level on number of seeds/pod, 100-green seed weight and 1000-dry seed weight comparing with control.

The treatment of foliar application of yeast extract at 100 kg/fed. calcium superphosphate in combination with seed inoculation with phosphorien gave yield as high as 200 kg/fed. calcium superphosphate alone (Tables 6 and 7).

4-. Chemical constituents

4.1 Effect of foliar applications:

Spraying pea plants with yeast extract and the combination between yeast and vit. B_1 solution gave an increase in N, P, K content of leaves and vit.C of green seeds compared with spraying vit. B_1 alone or control treatment in both seasons (Table 8).

Results obtained on the effect of vit. B_1 on N, P, K content of leaves were in agreement with those mentioned by Oertli (1987) on onion leaves and El-Ghamriny *et al.* (1999) on tomato leaves. It's obvious from such data that the highest elements uptake were achieved by treatments which contain yeast extract. These results were expected because yeast extract contained a lot of many macro and micro elements, carbohydrates and hormones content (Table 3) as well as to its favorable effect as reported by several investigators (Fathy *et al.*, 2000). The increase in vitamin C content of green seeds which obtained in the present study by using yeast extract may be due to its content of cytokinin and microelements, which was previously proved by or due to containing sugars, amino acids and vitamins. Such results are in agreement with these obtained by El-Ghamriny *et al.* (1999) on tomato.

4.2 Effect of P levels:

Increasing P fertilizer levels had significant effect on leaf content of N, P, K and vit.C content of green seeds. The rate of 200 kg calcium superphosphate followed by the rate of 150 kg increased N, P, K accumulation in dry leaves compared with the lowest level, i.e., 100 kg, in both seasons (Table 8). The stimulative effect of P supply on N, P and K contents of leaves in this study may be attributed to the high amount of available phosphorous in the soil and/ or the increase in absorbing efficiency of plant roots. Tashkodzhoev (1975), on potato, found that there was an increase in ascorbic acid by phosphorous fertilizer.

4.3 Effect of biofertrilizer:

Phosphorien increased significantly the N, P and K contents of pea plant leaves in the two seasons, except the N content in the first season and vit. C content of green seeds did not show any significant effect (Table 8). Inoculation with microorganisms like phosphorien increased the soil fertility and absorbing capacity of root which in turn increase the foliage contents of N, P and K. These results are in agreement with those reported by Saber *et al.* (1981) and Hauka *et al.* (1996) on pea.

4.4. Effect of interactions:

The concentrations of N, P, K in leaves and vit.C content of green seeds were not significantly affected with the interaction among all studied in the two growing seasons except the interaction between P levels and phosphorien where superior treatment was 200 kg P fertilizer/fed. alone or with phosphorien.(Table 8).

Table 8: Effect of foliar applications, phosphorus levels, biofertilizer and their interactions on some chemical constituents of leaves and green seeds during 2000 and 2001 seasons.

Characters	N %		P %		K %		Vitamin C (mg/100 g F.W.)	
Seasons	2000	2001	2000	2001	2000	2001	2000	2001
A: Foliar applications								
Control	3.167	2.853	0.414	0.401	1.413	1.367	24.37	23.89
Vit. B_1	3.388	2.952	0.431	0.423	1.546	1.472	25.09	25.32
Yeast extract	3.554	3.184	0.486	0.472	1.657	1.544	28.51	28.26
Vit.B_1+Yeast extract	3.581	3.280	0.490	0.487	1.672	1.585	28.87	28.39
L.S.D at 5%	0.107	0.120	0.007	0.013	0.036	0.062	0.92	0.71
B: Phosphorous levels (kg/fed.)								
100	3.200	2.897	0.384	0.377	1.448	1.374	26.41	25.07
150	3.456	3.093	0.463	0.457	1.594	1.498	26.49	25.83
200	3.611	3.211	0.519	0.503	1.674	1.605	27.23	28.49
L.S.D at 5 %	0.093	0.079	0.013	0.008	0.032	0.042	0.47	0.81
C: Biofertilizer (Phosphorien)								
With	3.450	3.103	0.468	0.459	1.596	1.516	26.77	26.57
Without	3.395	3.032	0.443	0.432	1.547	1.468	26.65	26.36
F Test	NS	**	**	**	**	**	NS	NS
Interactions								
A X B	NS	NS	NS	NS	NS	NS	NS	NS
A X C	NS	NS	NS	NS	NS	NS	NS	NS
B X C	NS	NS	*	**	NS	NS	NS	NS
A X B X C	NS	NS	NS	NS	NS	NS	NS	NS

CONCLUSIONS

From the economical point of view, it can be concluded that, using foliar applications of yeast extract (25 ml/l) + vitamin B_1 (50 ppm) at 200 kg/fed. calcium superphosphate plus phosphorien, caused a marked increase in pea yield and its components as compared with control (200 kg/fed. calcium superphosphate) .

It was noticed that using foliar application of yeast extract (25 ml/l) at 100 kg P fertilizer in combination with seed inoculation with phosphorien gave

a high yield similar to 200 kg/fed. calcium superphosphate alone and consequently decrease the environmental pollution.

Also, it was noticed the pea plants (Master-B) responded to phosphorous fertilizer up to 200 kg/fed. of calcium suprphosphate with phosphorien and still more research is needed to know the most effective level of P fertilizer under El-Dakahlia growing conditions.

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تأثير التسميد الفوسفاتى وبعض منشطات النمو على النمو وذذ والمحصول فى البسلة.

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اجريت هذه الدراسة بمحافظة الدقهلية بمركز دكرنس فى موسمى الزراعة ٢٠٠٠/ ٢٠٠١ ,٢٠٠١ / ٢٠٠٢ م لدراسة تاثير بعض منشطات النمو بالاضافة الى التسميد الفوسفاتى بمستويات مختلفة مع او بدون التلقيح البكتيرى بالفوسفورين على النمو والمحصول فى البسلة صنف ماستر B.

واشتملت التجربة على ٢٤ معاملة وقد تمثلت فى ٤ معاملات رش ورقى (كنترول - فيتامين ب١ بتركيز ٥٠ جزء من المليون - مستخلص الخميرة بتركيز ٢٥ مل /لتر - فيتامين ب١ + مستخلص الخميرة) واستخدمت ٣ مستويات من السماد الفوسفاتى (١٠٠ - ١٥٠ - ٢٠٠ كجم سوبر فوسفات الكالسيوم/للفدان) كل منها منفردا او مع التلقيح البكتيرى للبذور بالسماد الحيوى (الفوسفورين).

واستخدم لاجراء التجربة تصميم القطع المنشقة مرتين فى ثلاث مكررات وتم توزيع معاملات الرش فى القطع الرئيسية ومستويات التسميد الفوسفاتى فى القطع المنشقة وخصصت القطع التحت شقية للتسميد الحيوى.

واوضحت النتائج مايلى:

- ان المعاملات الفردية على حدة من كل من (فيتامين ب١ + مستخلص الخميرة), التسميد الفوسفاتى بمعدل ٢٠٠ كجم/فدان, وكذلك التلقيح بالسماد الحيوى الفوسفورين ادت الى زيادة معنوية فى كلا من صفات النمو الخضرى, والمحتوى الكيماوى للاوراق, كما قللت عدد الأيام حتى تفتح اول زهرة وبالتالى زيادة كلا من المحصولين الاخضر والجاف.
- كما اوضحت نتائج التفاعل الثنائى بين المعاملة (فيتامين ب١ + مستخلص الخميرة) مع التسميد الفوسفاتى بمعدل ٢٠٠ كجم/فدان أو مع التسميد الحيوى بالفوسفورين الى تحقيق زيادة معنوية فى المحصول الكلى / فدان سواء الاخضر اوالجاف.
- كما ان استعمال المعاملة (فيتامين ب١ + مستخلص الخميرة) مع التسميد الفوسفاتى بمعدل ٢٠٠ كجم/فدان من سوبر فوسفات الكالسيوم بالاضافة الى الملقح الحيوى الفسفورين اعطت اعلى محصول بالمقارنة بالكنترول (٢٠٠ كجم/فدان من سوبر فوسفات الكالسيوم).
- كما اعطت المعاملة بمستخلص الخميرة مع التسميد بمعدل ١٠٠ كجم من سوبر فوسفات الكالسيوم مع التلقيح بالفسفورين محصولا مقاربا للتسميد بالمعدل الاعلى من التسميد الفوسفاتى (٢٠٠ كجم سوبر فوسفات الكالسيوم), وبالتالى قللت من التلوث البيئى.