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EFFECT OF BIO AND MINERAL PHOSPHATE FERTILIZATION ON GROWTH AND PRODUCTIVITY OF CANTALOUPE (*Cucumis melo* var. *Cantaloupensis,* L.)

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ABSTRACT

This investigation was conducted on cantaloupe plants (*Cucumis melo* var. *Cantaloupensis*, L.). Melon hybrid F_1 (Ananas) was grown on clay loam soil at Barramoon Experimental Farm (El-Dakahlia Governorate) during the two successive seasons of 1998 and 1999, to study the influence of soil dressing with mineral-P fertilizer at 0, 30, 60 and 90 kg P_2O_5/fed. either alone or in combination with P-biofertilizer (Phosphorien) at 3 kg/fed. on plant growth, total yield and its components as well as fruit traits and chemical constituents in plant leaves. The interaction between main factors was also studied.

In general, the obtained results can be summarized as follows:-

All studied characteristics of plants received mineral-P were generally better than those of unfertilized ones. Beside this, increasing the applied mineral-P rate from 30 to 90 kg P_2O_5/fed. significantly increased most parameters of plant growth, total fruit yield and its components as well as all traits of fruit and concentrations of N, P, K and Ca in leaves.

Application of P-biofertilizer (Phosphorien) exerts significant increases in most studied characteristics of plant growth, yield and its components. In addition, it markedly improved fruit traits and muchly increased P and K concentrations in leaves as compared with those of untreated plants.

The positive interactions between mineral-P and Phosphorien inoculum have often been observed. The obtained values by using Phosphorien with mineral-P levels were generally increased than those of either alone. The greatest values were achieved by using 60 kg P_2O_5/fed. in the presence of Phosphorien. These values were nearly identical for those obtained by 90 kg P_2O_5/fed alone.

From the foregoing results, it is evident that inoculation of cantaloupe seeds pre-planting with P-biofertilizer (Phosphorien) at 3 kg/fed. reduced the need for mineral-P manuring by up to 33.5%. In addition, the high costs of production and environment pollution problem could be reduced.

INTRODUCTION

For most plant species, P element is very important in metabolic processes, i.e., blooming and flower developments, because it is a main constituent of energy compounds (ATP and ADP), phospholipids, nucleic acids, nucleotides and co-enzymes (Russell, 1950). In spit of the huge additions of chemical-P fertilizers to the cultivated soil in Egypt, the available-P level for plants is usually low, since it rapidly converts to tricalcium-P, thus, becomes inaccessible by plants. This case in wide spread in the alkaline soils as a result of high calcium concentrations and insufficient amounts of added organic fertilizers (Mahmoud and Abd El-Hafez, 1982). Under such conditions, the farmers used to add considerable amounts of mineral-P fertilizers to face the shortage of organic manures and to raise crop production, but the continuous increase in the cost of chemical fertilizers prevents the farmers to use sufficient amounts. Thus, it has become essential to use untraditional fertilizers (biofertilizers) as supplemented or substitute for chemical fertilizers. It is thought that the P-biofertilizers are of the utmost importance for plant productions, soil fertility as they improve the biological, physical and chemical properties of soils (Radwan, 1983, Abdel-Moniem *et al*., 1988; El-Dahtory *et al*., 1989 and Abdel-Ati *et al*., 1996).

In the last decade, several workers indicated that soil inoculation with P-solubilizing microorganisms improved soil fertility and plant productivity by releasing. P-element from rock or tricalcium-P (Forster and Freter, 1988 and Hauka *et al*., 1990). Furthermore, under Egyptian soil conditions, El-Awag *et al*. (1993); Abo El-Nour *et al*. (1996); El-Sheekh (1997) and Ashour (1998) mentioned that utilization of P-biofertilizer (Phosphorien) with or instead of mineral-P markedly increased the available-P concentrations in soil and plants and hence plant growth and yields.

On the other hand, there were many investigators reported that plant growth, yields and chemical constituents in foliage and fruit tissues of different cucurbits were dependent not only on available-P level in the soils, but also on the applied P-rate to plants (Shukla and Gupta, 1980; Adams and Winsor, 1984 and Damarany and Farag, 1994). Moreover, there was a positive relationship between cucurbits production and the supplied P-rate to plants (Lingle and Wight, 1962; Deswal and Patil, 1984 and Mohamed, 1995).

Thus, this work was planned to study the effects of different mineral-P levels and P-biofertilizer (Phosphorien), in addition to their interactions on plant growth and productivity of cantaloupe plants under conditions of El-Dakahlia district.

MATERIALS AND METHODS

Two field trials were carried out on clay loam soil at Barramoon Experimental Farm (El-Dakahlia Governorate) during the successive summer seasons of 1998 and 1999, to investigate the influence of different mineral-P level either alone or in combination with P-biofertilizer (Phosphorien) on plant growth and productivity of cantaloupe (*Cucumis melo* var. *Cantaloupensis*, L.) melon hybrid F_1 (Ananas).

The experimental soil was analyzed by using standard method described by Page (1982). The obtained data were tabulated in Table 1.

Table 1. Physical and chemical analysis of the experimental soil.

Depth (cm)	Clay %	Silt %	Fine sand %	$CaC0_3$ %	EC mmhos/cm (25°C)	OM %	Avail. N ppm	Avail. P ppm	Avail. K ppm	TSS %	pH
0-30	63.9	19.1	13.7	1.89	1.53	0.39	21.12	11.93	419	0.15	7.7
30-60	67.3	15.6	10.7	2.33	1.40	0.31	13.19	9.37	361	0.19	7.9

A split plot design with eight treatments and four replications was used. The treatments consisted of four mineral-P levels, i.e., 0, 30, 60 and 90 kg P_2O_5/fed. either alone or with P-biofertilizer (Phosphorien[1]) at 3 kg/fed. The mineral-P levels were applied in the main plots, 50% at planting and 50% at four weeks later, whereas Phosphorien inoculum mixed with seeds directly pre-planting and assigned to the sub-plots. The sub-plot area was 37.5 m^3 (5 ridges, each 5 m long and 1.5 m width).

The planting date was during the third week of March in both seasons of this study. The seeds were sown on one side of the ridge at 50 cm apart. At soil preparation (pre-ridging), 20 m^3 farmyard manure was applied. All plants were fertilized with 60 kg N + 48 kg K_2O/fed, being applied three equal doses at 20, 40 and 60 days after sowing. Normal cultural practices for cantaloupe commercial production were used according to the recommendations of the Agriculture Ministry.

Studied characteristics:

Plant growth parameters: At 75 days after planting, a random sample (5 plants) is taken from every treatment to determine plant main stem length, number of both branches and leaves / plant as well as fresh and weight / plant.

Yield and its components: All fruits of plants (20 plants) in each plot were harvested and weighted (kg) and recorded as a total yield (ton/fed). Plant yield as number and weight of fruits as well as weight of seeds / fruit and seed index (100-seed weight) were recorded.

Fruit traits: A random sample of 10 fruits was taken from each plot to measure average weight of fruit, flesh thickness, total soluble solids (TSS), vitamin C, and acidity.

Chemical constituents: Concentrations of N, P, K and Ca in plant leaves were determined according to the method described by Black (1965), John (1970), Brown and Lilleland (1946) and Jackson (1967), respectively.

The obtained data from this study were statistically analyzed and treatment means were compared by using Least Significant Difference (L.S.D.) as reported by Gommez and Gommez (1984).

RESULTS AND DISCUSSION

1. Plant growth parameters:

1.1. Effect of mineral-P:

Data presented in Table 2 indicated that most growth parameters of plants fed on different levels of mineral-P fertilizer were generally better than those of the unrecieved plants. Plant main length, number of leaves / plant,

[1] **Phosphorien inoculum is a commercial locally produced by the Ministry of Agriculture (Egypt). It contains active bacteria which is capable to convert tricalcium phosphate to monocalcium phosphate**

fresh and dry weight / plant were increased progressively and significantly as the supplied mineral-P rate was increased from 30-90 kg P_2O_5/fed. However, there was no significant increase in number of leaves / plant in both seasons of study. The positive effect of mineral-P on plant growth characteristics might be due to the fact that P-element is an essential component of the energy transfer compounds (ATP and ADP), genetic information system, cell membranes, phospholipids, phosphorproteins and nucleic acids. In general, these compounds are considered very important to plant growth (Gardener *et al*., 1985). The obtained results are in harmony with those of Shukla and Gupta (1980), who showed that increasing the applied P-fertilizer rate to squash plants markedly increased plant height and number of leaves / plant.

1.2. Effect of Phosphorien:

It is obvious from Table 2, also that inoculation of cantaloupe seeds pre-planting with P-biofertilizer (Phosphorien) significantly increased plant main stem length, fresh and dry weight / plant in both seasons than those of the un-inoculated ones. However, number of both branches and leaves / plant was increased, but not significantly in both seasons. These increases may be attributed to the phosphate solubilizing bacteria of Phosphorien inoculum, which may have played a great role in contributing growth hormones, such as auxins, gibberellins or cytokinins, which could stimulate plant growth (El-Sheekh, 1997). The obtained results concerted with those of Abdel-Ati *et al*. (1996), who found that vegetative growth of potato plants inoculated with phosphate solubilizing bacteria was significantly higher than that of the untreated plants.

1.3. Effect of interaction between mineral-P and Phosphorien:

In Table 2, it was noticed that mean values of all studied characteristics of plant vegetative growth, except main stem length of plant were generally significant increased by using Phosphorien inoculum with mineral-P than for mineral-P alone. The highest values were obtained by 60 kg P_2O_5/fed with Phosphorien application, these values were higher than those attained by 90 kg P_2O_5/fed in the absence of Phosphorien. These results propose that Phosphorien application may increase number and activity of soil microorganisms in general and P-solubilizing bacteria in particular, consequently exert increases in the available-P and hence plant growth (El-Awag *et al*., 1993). Similar results were reported by Abo El-Nour *et al*. (1996), who indicated that inoculation of faba bean seeds with Phosphorien enhanced plant growth when combined with 50% of recommended mineral-P dose as compared with that of plant grown without Phosphorien.

2. Yield and its components:

2.1. Effect of mineral-P:

From Table 3, it is evident that total fruit yield / fed, plant yield (number and weight), weight of seeds / fruit and seed index were generally higher with than without mineral-P application. Increasing the applied rate of

mineral-P from 30 to 90 kg P_2O_5/fed significantly increased all studied attributes of total yield and its components. The increases in total fruit yield were 54.13 and 51.85% in the first and second seasons, respectively. These increases might be described to the fact that P-element is very important for certain essential steps such as accumulation and release of energy during photosynthesis process and cellular metabolism. In addition, it is a constituent of many organic compounds in plant (Russell, 1950). The obtained results agreed with those reported by Mohamoud (1995), who declared that supplying mineral-P at 50, 100 or 150 kg P_2O_5/donum (1000 m^2) gradually increased number and weight of total and marketable fruit yield of cucumber plants.

2.2. Effect of Phosphorien:

In Table 3, the data indicate that use of P-biofertilizer (Phosphorien) significantly increased total fruit yield, weight of fruits / plant, weight of seeds / fruit and seed index in both seasons of the study as compared with those of the untreated ones. The percentage increase in total fruit yield weight due to Phosphorien application was 18.91 and 15.85 in the first and second seasons, respectively. These increases may explained on the basis of P-biofertilizer Phosphorien contains active bacteria which is capable to convert tricalcium phosphate to available-P (mono-P), beside this improving the fertility via releasing the fixed-P with other elements, this in turn, increased total fruit yield and improved fruit quality (El-Dahtory *et al*., 1989). The obtained results were similar with those of Hauka *et al*. (1990), who proved that soil microorganisms can play an important role in improving plant growth and yields by releasing Phosphorus from rock or tricalcium phosphate.

2.3. Effect of interaction between mineral-P and Phosphorien:

It is clear from Table 3 that mineral-P application in the presence of Phosphorien inoculum produced more yields than for either alone. Total yield, weight of fruits / plant, weight of seeds / fruit and seed index were greatly increased by using 60 kg P_2O_5/fed with Phosphorien inoculum. These increases were roughly parallel to those achieved by using 90 kg P_2O_5/fed alone or in presence of Phosphorien. It is thought that the bacteria of P-solubilizing is very an important factor in raising phosphour efficiency in the soil due to continuous solubility during the period of plant growth (Radwan, 1983). The obtained results coincide with those of Abdel-Nasser and Makawi (1979), who found that total yields of watermelon and cucumber were significantly increased by using Phosphorien inoculum with chemical phosphorus pre-sowing.

3. Fruit traits:

3.1. Effect of mineral-P:

Data in Table 4 show that all traits of cantaloupe fruit were generally greater with than without mineral-P application. Fruit weight, flesh thickness, total soluble solids (TSS), vitamin C and acidity were increased gradually and significantly with increasing the applied mineral-P rate from 30 to 90 kg

P_2O_5/fed in both seasons. These increases may be due to the great effect of P-element on proportion of dry matter diverted to the fruits (Adams and Winsor, 1984). Similar results were reported by Damarany and Farag (1994), who denoted that pumpkin yield, fruit sizes, flesh thickness, colour intensity, dry matter, number of seed / fruit and seed index were greater with 210 than with 105 kg P_2O_5/fed.

3.2. Effect of Phosphorien:

From Table 4, it is evident that all fruit traits with exception of the acidity were generally significant increased with Phosphorien inoculum application, comparing with those of untreated ones. Apparently, it is well known that P-solubilizing bacteria might enhance the phosphorylation via increase available-P in soil and hence improved fruit traits in this study. The obtained results are in accordance with those of Abdel-Moniem *et al*. (1988), who mentioned that Phosphorien application increased yield and quality of some vegetable crops.

3.3. Effect of interaction between mineral-P and phosphorien:

As regard to the interaction effect of mineral-P with P-biofertilizer (Phosphorien) on fruit traits, data presented in Table 4 revealed that fruit weight, flesh thickness and vitamin C were significantly increased in both seasons by application of mineral-P with than without Phosphorien. However, no significant effects were found on total soluble solids (TSS) and acidity. In general, the greatest values were obtained by using 60 kg P_2O_5/fed with Phosphorien, these values were nearly identical for those obtained by 90 kg P_2O_5/fed with Phosphorien application. The positive effect of interaction treatments on fruit traits might be due to the double effect of Phosphorien and mineral-P together on photosynthesis and translocation rate of photosynthates from plant foliage to fruits. The obtained results are in agreement with those of Ashour (1998).

4. Chemical constituents:

4.1. Effect of mineral-P:

In Table 5, data clearly demonstrate that use of mineral-P at different levels to cantaloupe plants obviously increased concentrations of chemical elements in plant leaves, comparing with those of unfertilized ones. Increasing the applied-mineral-P rate from 30 to 90 kg P_2O_5/fed increased constantly and significantly P, K and Ca concentrations in plant leaves in both seasons. However, there was no significant effect on N concentration in plant leaves in both seasons. It is well known that, P-element is very important for plant growth, blooming and root development processes, which in turn, increased other nutrient uptake (Russell, 1950). The obtained results were similar with those of Lingle and Wight (1962), who showed that P-fertilization was necessary to raise dry matter in cantaloupe fruits and give the earliest possible maturity.

Table 5. Chemical constituents in plant leaves of cantaloupe as affected by different mineral-P levels, P-biofertilizer (Phosphorien) and their interactions during 1998 and 1999 seasons.

Characters	N %		P %		K %		Ca %	
Treatments	1998	1999	1998	1999	1998	1999	1998	1999
P_2O_5 level (a):								
Control	3.17	3.21	0.27	0.26	2.12	2.25	1.94	1.83
30 kg/fed	3.57	3.60	0.33	0.34	3.33	3.32	2.29	2.27
60 kg/fed	4.07	4.13	0.38	0.40	3.60	3.55	2.59	2.61
90 kg/fed	4.29	4.37	0.41	0.43	3.70	3.72	2.65	2.73
L.S.D. at 5%	NS	NS	0.02	0.01	0.14	0.08	0.09	0.12
1%	NS	NS	0.03	0.02	0.21	0.12	0.15	0.19
Phosphorien (b):								
Without	3.56	3.59	0.33	0.33	2.99	2.99	2.17	2.19
With	3.97	4.07	0.37	0.38	3.38	4.43	2.56	2.53
L.S.D. at 5%	NS	NS	0.01	0.01	0.10	0.09	NS	NS
1%	NS	NS	0.02	0.02	0.14	0.14	NS	NS
Interaction (a x b):								
P_2O_5 Phosphorien								
Control Without	2.97	3.10	0.26	0.25	2.01	2.13	1.82	1.67
With	3.36	3.32	0.29	0.27	2.21	2.37	2.05	1.98
30 kg/fed Without	3.34	3.28	0.30	0.31	3.14	3.03	2.00	2.09
With	3.80	3.92	0.36	0.37	3.51	3.61	2.58	2.44
60 kg/fed Without	3.88	3.92	0.36	0.35	3.33	3.28	2.42	2.42
With	4.26	4.45	0.40	0.44	3.87	3.82	2.76	2.81
90 kg/fed Without	4.07	4.17	0.40	0.41	3.45	3.51	2.44	2.56
With	4.48	4.58	0.42	0.45	3.94	3.92	2.85	2.89
L.S.D. at 5%	NS	NS	0.03	0.02	NS	NS	NS	NS
1%	NS	NS	0.05	0.03	NS	NS	NS	NS

4.2. Effect of phosphorien:

It is clear from Table 5, also that application of P-biofertilizer (Phosphorien) significantly increased P and K concentrations in plant leaves of cantaloupe in both seasons, but N or Ca concentrations did not affect as compared with untreated ones. These results agreed with those of Abdel-Nasser and Makawi (1979), who indicated that mineral elements contents in fruits of watermelon and cucumber were much greater by application of P-solubilizing micro-organisms.

4.3. Effect of interaction between mineral-P and Phosphorien:

The interaction effect of mineral-P with P-biofertilizer (Phosphorien) on chemical constituents in cantaloupe plant leaves is seen in Table 5. Although, P concentration in plant leaves was significantly increased in both seasons by using of Phosphorien with mineral P. The interaction did not reflect any significant variations on N, K and Ca concentrations in the two years of study. Similar results were obtained by Deswal and Patil (1984).

CONCLUSION

In general, from the results of this study, it could be concluded that cantaloupe seed inoculations pre-sowing with P-biofertilizer (Phosphorien) at 3 kg/fed with using 60 P_2O_5/fed is the recommended treatment for improvement plant growth and productivity. This treatment gave the greatest values under the conditions of this research, these values were nearly similar for those achieved by using 90 kg P_2O_5/fed. Therefore, Phosphorien inoculum application reduced the need for mineral-P fertilizer by about 33%, beside this, decreasing the production cost and environment pollution.

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تأثير التسميد الفوسفاتى الحيوى والمعدنى على نمو وإنتاجية الكنتالوب

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نفذت تجربتان حقليتان فى مزرعة بحوث البساتين بالبرامون - محافظة الدقهلية على محصول الكنتالوب (أناناس) هجين - F_1 أثناء موسمى الزراعة الصيفى 1998 و 1999 لدراسة تأثير التسميد الأرضى بمستويات مختلفة من الفوسفور المعدنى (صفر ، 30 ، 60 ، 90 كجم فو$_2$أ$_5$ للفدان) كل منها منفرداً أو مع 3 كجم من السماد الفوسفاتى الحيوى (الفوسفورين) أضيفت كملقح للبذور قبل الزراعة على نمو النباتات ومحصول الثمار ومكوناته وكذلك صفات الثمرة والمحتويات الكيماوية فى أوراق النبات ، وقد وزعت المعاملات فى قطع منشقة مرة واحدة فى أربع مكررات0 والنتائج المتحصل عليها أمكن تلخيصها فيما يلى:-

- أدى التسميد بالفوسفور المعدنى إلى حدوث زيادات ملموسة فى معظم قياسات نمو النباتات ومحصول الثمار وصفات الثمار والمحتوى الكيماوى فى أوراق النباتات وذلك بالمقارنة مع تلك المتحصل عليها من النباتات غير المسمدة0 ولقد كانت هذه الزيادات معنوية عندما زاد معدل الفوسفور المعدنى المضاف من 30 إلى 90 كجم فو$_2$أ$_5$ للفدان فى كلا الموسمين0
- أدى تلقيح البذور قبل الزراعة بالسماد الفوسفاتى الحيوى (الفوسفورين) إلى حدوث زيادات معنوية فى معظم الصفات المختبرة وذلك بالمقارنة مع تلك المتحصل عليها من النباتات غير الملقحة بالفوسفورين فى كلا موسمى الزراعة0
- التفاعلات الموجبة بين الفوسفور المعدنى وملقح الفوسفورين لوحظت فى حالات كثيرة ، ولقد كانت كل القيم المتحصل عليها بإستخدام الفوسفورين مع مستويات الفوسفور المعدنى بصفة عامة أفضل كثيراً من تلك المنتجة بإستخدام كل منهما منفرداً0 ولقد أدى إستخدام 60 كجم فو$_2$أ$_5$ للفدان فى وجود الفوسفورين إلى أعلى إنتاج0 كما كانت هذه القيم متماثلة تقريباً مع تلك المتحصل عليها بإستخدام 90 كجم فو$_2$ أ$_5$ للفدان بدون الفوسفورين0
- من نتائج هذه الدراسة وضح أن تلقيح بذور الكنتالوب قبل الزراعة بالسماد الحيوى الفوسفاتى (الفوسفورين) أنقص المعدل المطلوب من سماد الفوسفور المعدنى حوالى 33% وبذلك أمكن تخفيض تكاليف الإنتاج وتلوث البيئة0

Table 2. Vegetative growth characteristics of cantaloupe plants as affected by different mineral-P levels, P-biofertilizer (Phosphorien) and their interactions during 1998 and 1999 seasons.

Treatments / Characters	Main stem length (cm)		No. of branches / plant		No. of leaves / plant		Plant fresh weight (gm)		Plant dry weight (gm)	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
P_2O_5 level (a):										
Control	144.1	147.5	3.05	3.36	56.25	53.06	358.3	348.1	57.1	55.1
30 kg/fed	162.5	170.9	3.77	3.64	66.86	68.54	391.6	436.0	72.7	68.3
60 kg/fed	169.5	172.4	4.03	4.22	73.75	80.32	553.1	588.1	109.1	117.1
90 kg/fed	174.9	178.8	4.11	4.31	77.27	84.59	610.4	644.3	124.2	135.9
L.S.D. at 5%	7.77	7.70	NS	NS	2.17	5.04	7.00	3.19	2.44	7.59
1%	11.79	4.09	NS	NS	3.30	7.64	10.61	4.85	4.46	11.53
Phosphorien (b):										
Without	158.3	161.9	3.74	3.40	62.61	65.93	431.6	453.2	76.3	77.7
With	167.3	172.9	4.14	4.78	74.45	77.32	524.6	554.9	105.3	110.6
L.S.D. at 5%	4.13	2.28	NS	NS	NS	NS	6.81	3.87	2.51	4.13
1%	6.01	3.32	NS	NS	NS	NS	9.91	5.63	5.63	6.01
Interaction (a x b):										
P_2O_5 Phosphorien										
Control Without	140.2	143.2	3.54	3.34	52.18	48.41	350.9	335.6	51.8	46.9
With	148.1	151.7	3.56	3.28	60.32	57.71	365.7	360.5	62.5	63.2
30 kg/fed Without	158.7	166.0	3.04	3.05	62.69	64.62	380.8	410.3	65.1	57.4
With	166.4	175.9	4.50	4.23	71.02	72.45	400.5	461.7	80.4	79.3
60 kg/fed Without	163.6	164.6	3.37	3.49	65.45	72.50	450.7	480.9	80.8	85.9
With	175.4	180.3	5.98	5.56	82.06	88.14	655.5	695.1	137.4	148.3
90 kg/fed Without	170.5	173.9	3.70	3.53	70.14	78.20	544.2	585.7	107.5	120.4
With	179.2	183.6	5.52	5.05	84.41	90.98	676.5	702.3	140.9	151.5
L.S.D. at 5%	NS	NS	0.69	0.51	3.84	2.11	13.67	7.76	5.04	8.28
1%	NS	NS	1.01	0.73	NS	3.07	19.85	11.28	7.33	12.08

Table 3. Total yield and its components of cantaloupe as affected by different mineral-P levels, P-biofertilizer (Phosphorien) and their interactions during 1998 and 1999 seasons.

Characters / Treatments	Total yield / fed (ton)		No. of fruits / plant		Weight of fruits / plant (kg)		Weight of seeds / fruit (gm)		Seed index (gm)	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
P_2O_5 level (a):										
Control	5.44	4.76	2.11	1.89	1.25	1.20	13.47	13.11	3.67	3.92
30 kg/fed	8.48	8.10	2.49	2.46	1.71	1.67	16.80	16.26	4.41	4.32
60 kg/fed	11.67	11.06	2.93	2.83	2.26	2.30	20.99	20.51	5.05	4.97
90 kg/fed	13.07	12.30	3.19	2.96	2.49	2.50	22.53	21.89	5.51	5.37
L.S.D. at 5%	0.45	1.75	0.22	0.10	0.014	0.17	1.42	1.33	0.10	0.13
1%	0.68	2.66	0.34	0.15	0.002	0.25	2.15	2.01	0.14	0.19
Phosphorien (b):										
Without	8.83	8.39	2.49	2.31	1.71	1.72	17.20	16.73	4.47	4.55
With	10.50	9.72	2.87	2.76	2.15	2.11	19.70	19.15	4.86	4.75
L.S.D. at 5%	0.34	0.99	NS	NS	0.01	0.12	0.59	0.65	0.06	0.07
1%	0.50	1.44	NS	NS	0.02	0.17	0.87	0.94	0.09	0.10
Interaction (a x b):										
P_2O_5 Phosphorien										
Control Without	5.22	5.43	1.92	1.83	1.08	1.16	12.74	12.44	3.51	3.92
With	5.67	4.09	2.30	1.95	1.42	1.24	14.20	13.79	3.83	3.92
30 kg/fed Without	7.68	7.40	2.33	2.15	1.47	1.51	15.52	14.35	4.18	4.12
With	9.27	8.81	2.65	2.77	1.95	1.83	18.08	18.16	4.65	4.51
60 kg/fed Without	9.95	9.30	2.67	2.52	1.93	1.99	18.71	19.01	4.74	4.84
With	13.38	12.83	3.20	3.14	2.59	2.63	23.27	22.00	5.35	5.09
90 kg/fed Without	12.45	11.45	3.03	2.75	2.36	2.24	21.80	21.12	5.43	5.29
With	13.69	13.14	3.34	3.17	2.63	2.75	23.25	22.66	5.95	5.46
L.S.D. at 5%	0.69	1.98	NS	NS	0.015	0.24	1.19	1.30	0.13	0.13
1%	1.01	NS	NS	NS	0.022	NS	1.73	NS	0.18	0.17

Table 4. Fruit traits of cantaloupe as affected by different mineral-P levels, P-biofertilizer (Phosphorien) and their interactions during 1998 and 1999 seasons.

Treatments / Characters	Fruit weight (gm)		Flesh thickness (cm)		TSS (%)		Vitamin C (mg/100 gm)		Acidity (mg/100 gm)	
	1998	**1999**	**1998**	**1999**	**1998**	**1999**	**1998**	**1999**	**1998**	**1999**
P_2O_5 level (a):										
Control	433.2	429.9	2.03	2.02	6.87	7.01	18.68	19.97	132.7	125.8
30 kg/fed	540.5	517.8	2.67	2.81	8.43	8.59	23.18	24.24	135.1	132.1
60 kg/fed	650.2	671.8	2.78	3.07	10.03	10.18	31.63	32.27	144.4	141.9
90 kg/fed	665.7	692.5	3.00	3.14	10.36	10.81	36.83	37.25	150.9	148.6
L.S.D. at 5%	13.09	12.77	0.11	0.16	0.18	0.38	1.16	0.39	7.77	1.49
1%	19.88	19.38	0.17	0.24	0.27	0.58	1.89	0.59	2.68	2.26
Phosphorien (b):										
Without	539.3	552.1	2.54	2.65	8.31	8.67	26.72	26.81	137.9	132.9
With	605.2	603.8	2.70	2.87	9.53	9.63	28.44	30.06	143.6	141.4
L.S.D. at 5%	10.81	5.21	0.08	0.04	0.10	0.21	0.66	0.16	NS	NS
1%	15.72	7.58	0.11	0.06	0.15	0.31	0.97	0.24	NS	NS
Interaction (a x b):										
P_2O_5 Phosphorien										
Control Without	408.2	420.5	1.92	1.83	6.14	6.57	18.09	19.29	130.1	121.2
With	457.8	439.2	2.13	2.21	7.61	7.45	19.27	20.66	135.3	130.5
30 kg/fed Without	503.2	485.2	2.54	2.67	8.06	8.26	22.84	23.41	133.8	130.0
With	577.8	549.8	2.80	2.95	8.79	8.91	23.51	25.08	136.3	134.1
60 kg/fed Without	615.2	632.9	2.75	3.01	9.29	9.50	29.13	28.44	138.5	135.5
With	685.2	710.7	2.82	3.13	10.76	10.87	34.13	36.05	150.2	148.5
90 kg/fed Without	630.6	669.7	2.96	3.09	9.76	10.35	36.80	36.06	149.5	144.7
With	699.8	715.4	3.03	3.18	10.96	11.28	36.85	39.45	152.5	152.5
L.S.D. at 5%	21.67	10.45	0.16	0.09	NS	NS	1.33	0.33	NS	NS
1%	31.49	15.18	0.23	0.13	NS	NS	1.94	0.48	NS	NS