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EFFECT OF SOME PHOSPHORUS COMPOUNDS AS SEED-SOAKING MATERIALS ON WINTER SQUASH (*Cucurbita pepo* L.) PLANTS

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ABSTRACT

Two field experiments were conducted to study the effect of squash seed soaked as a pre-sowing treatment with 1000 or 1500 ppm of Monoamonium Phosphate (MAP), Diamonium phosphate (DAP),Urea phosphate (U-P) and phosphoric acid (H_3PO_5) as phosphorous forms on vegetative and reproductive growth as well as fruit yield and quality were evaluated during winter months.

Results showed that, different phosphorus forms and levels significantly increased all vegetative and reproductive growth traits of squash compared with control. These treatments, also, altered the sex ratio to be in favour of female flowers and led to earliness of fruit production as well as total fruit yield / plant significantly was increased . The highest early and total fruit yield were existed with 1000 ppm of UP. Also, chemical composition such as minerals content, sugars, crude protein, carbohydrates and total free amino acid in leaves as well as vitamin C., total soluble solids and titratable acidity in fruits were also increased with phosphorus treatments. Therefore, the present study, was aimed to use the phosphorus treatment not only to increase earliness and total squash fruit yield but also to avoid all cautions about the inserting of green house production in the agricultural system.

Keywords: Phosphorous, growth, minerals, carbohydrates, flowering, yield, fruits quality.

INTRODUCTION

Squash, *(Cucurbita pepo L.)* is one of the important vegetables grown in Egypt. It is cultivated in Egypt all over the year, outdoor in summer and indoor either in greenhouses or in tunnels in winter. Squash is injured when exposed to nonfreezing temperatures, i.e., below 12 ℃ (Rab and Saltveit,1996)

At the present time, the cucurbit vegetables are cultivated in all major regions of the world (FAO. 1994), as well as in Egypt. Successful seedling establishment and early growth is one of the most important phases in the life cycle of any economic plant since it determines the persistence of a species in a given habitant (Sakai and Larcher. 1987). Therefore, it is important to understand how the early developmental stages of plants react and adjust to environmental stresses that can affect their growth and productivity. One of the important stress factors is the capability of a seedling to adapt to-and-tolerate frost temperatures that can occur almost in time in many locations in Egypt during winter months. Available information from the few existing studied on agricultural crops indicate that frost tolerance is generally greatest in intact seeds, decreases abruptly once the seeds have germinated and eventually increases with chronological or physiological age (Coursolle *et al,* 1998). The germination of cucurbit vegetable seeds requires relatively warm temperatures (Wien, 1997), and takes place 3 or 4 days at 25-30℃ , meanwhile germination took place in time about threshold between 5 and 10℃ and optimum germination take place between 30- 35℃ (Ne Smith and Bridges, 1992). That is because several steps of the cue seeds germination and seedling emergence process are limited by low temperatures.

Hence, there are some reports to overcome the inhibiting effects of cold soils upon cucurbit plants. In this respect, Staub (1987) tried to improve seeds germination of some cucurbits by soaking the acetone solutions of fusicoccin (0.5 m mol) or in GA (a mixture of gibberellins 4 and 7). This treatment was the most effective in stimulating germination at 12℃. Also, after four cycles of selection for cucumber seeds germination at 15℃, Nienhuis *et al.,* (1983) improved low temperature germination from 32 to 94%. In addition, Ahmed (1997) and Coursolle *et al.* (1998) enhanced seeds germination of squash and white spruce, by the temperature pre-sowing seeds treatment. Moreover, another approach being widely practiced especially in Japan and Korea is to graft cucurbits on rootstocks of species less susceptible to cold root temperatures. Using this approach; about 80% of greenhouse cucurbits allowed to be grown without heating (Lee, 1994).

Furthermore, differences in susceptibility to low soil temperature between two cucumber cultivars were particularly well related to different phosphorus uptake at those temperatures (Tachibana, 1987 and Wien, 1997). This may suggest that P uptake is one of the key processes inhibited by the low soil temperatures. That is why the idea of this research rose up for its importance to fulfill the need of achieving vigorous seedling growth accompanied with early fruited plants.

MATERIAL AND METHODS

Two field experiments were carried out during 2007 and 2008 winter seasons at the Experimental Farm of the Agricultural Botany Department, Faculty of Agriculture at Moshtohor, Benha University, Egypt. Seed of squash (*Cucurbita pepo* L.) cv Eskandarani secured from the Egyptian Agriculture Research Center,Ministry of Agric., A.R.E. Squash seeds were sown after being imbibed for 6 hours at room temperature 20 ± 2℃) either in some phosphorus forms or only in distilled water as control treatment.

Experimental design

The experiment included 9 treatments i.e., the control (distilled water), Monoamonium phosphate (MAP), Diamonium phosphate (DAP), Urea phosphate (UP) and Phosphoric acid (H_3PO_4) in two levels(1000 and 1500 ppm) for each form.. Soaked-seeds of each treatment in both seasons 2007 and 2008 were sown at 15th of January in open field in rows on one side of ridge 3.5m length and 0.6 width at 0.4m apart per experimental plot of 10.5m^2 area. The experiment was performed as a randomized complete block design in five replicates. All agricultural practices of growing squash plant including equal amounts of fertilizers and water as well as disease and pests control were followed up.

Growth parameters and chemical constituents

Forty five days after sowing (the time of flowering initiated by phosphorus treatments); samples randomly were taken following measurements and determinations:

1- The shoot system: stem length and diameter as well (at the basal part), stem dry weight, number of leaves, leaf area (according to Derieux *et al.,* 1973) and leaves dry weight as well as the photosynthetic pigments (according to Nornal, 1982) were measured or estimated.

2- The flowering and fruiting stage: number of male and female flowers were counted at two days intervals all over the season. The sex ratio was calculated as the rate of male/ female flowers. Also, number and weight of early formed fruits (as the early four pickings) and total fruits as well as the fruits dry weight were estimated. Then, the harvest index was calculated according to **Gardner *et al,* (1985)** as

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$$\text{Harvest index} = \frac{\text{economic yield (dry weight of fruits)}}{\text{Biological yield (dry weights of shoots and fruits)}} \times 100$$

4- Chemical analysis: total nitrogen, phosphorus, potassium, calcium and magnesium, iron, sugars, carbohydrates and total free amino acids (in leaves at 45 days after sowing as well as in the fresh marketable sized picked-fruits) were determined according to the methods described by Horneck and Miller (1998), Sandell (1950), Horneck and Hanson (1998), Jackson (1973),Thomas and Dutcher (1924) and Dubois et al (1956) and Rosed (1957),espectively. Also, crude protein was calculated according to A.O.A.C. (1990) using the following equation.

Crude protein = total nitrogen X 6.25

In addition, in fresh fruits, a hand refractometer and the method of A. O. A. C. (1990) were used for the total soluble solids and vitamin C and titratable acidity determinations, respectively.

5- Statistical analysis: data of growth, flowering and fruiting were statistically analyzed according to Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Growth characteristics:

Data in Table (1) indicate the growth characteristics of stems and leaves of squash grown up from pre-sowing soaked seeds in different phosphorus forms and levels compared with those developed from seeds soaked only in water.

With regard to the stem growth (length, diameter and dry weight), number of leaves, total leaf area and dry weight of leaves per plant were significantly increased with application of all phosphorus treatments compared with control. The most pronounced effect in this respect was shown with urea phosphate (UP), yet the low level of each phosphorus form being more effective than the high one.

Regarding the effect of soaking squash seeds in different phosphorus forms before sowing in such cool soil, it could be concluded that this treatment increased the ability of squash seedling to withstand the low temperature of the winter surrounding conditions. Growth data are also very useful in determining whether phosphorus forms and levels given were optimum for squash growth. This stimulatory effect of phosphorus upon squash growth could be attributed to the facts that the squash seedling is considered among the most rapidly growing vegetable plant. It owes this characteristic to several properties: a - seed size of the squash is relatively large about 150 mg/ seed (Wien, 1997). b- The decorticated seed contain an average about 49% oil, and 35% protein (Jacks *et al,* 1972), suggesting that a large store of reserve materials is available for seedling growth before the cotyledons and true leaves start to photosynthesize. Large seed size also implies large initial seedlings size, giving the plant an early start in light interception and assimilation. However, under low temperature, squash seedlings to attain their vigourous growth still require efficient supply of energy-rich phosphate (P). So, far as phosphorus (an inorganic component) involve in synthesis of ATP the main and unique energy constituent in plant tissues as well as in formation of RNA and phospholipids. Hence, by virtue of that P directly enhances and control many biosynthesis processes e.g. carbohydrate and sugar formation, nucleic acids, enzymes and hormones (Li. 1985 and Yelenosky, 1985). Such bioconstituents and metabolic changes suggested to be tightly associated with cold acclimation changes and cold tolerance status. Supporting this interpretation could be the suggestion of Tachibana (1987) that P uptake is one of the key processes inhibited by lower soil temperatures. So, allowing seeds to imbibe P solution could provide and bring favouring conditions to attain such vigorous growth that was achieved.

Photosynthetic pigments:

Data in Table (2) clearly indicate that different phosphorus forms and levels increased the photosynthetic pigments as chlorophyll a ,b and carotenoids in leaves of treated plants more than those of untreated plants. The low level of each phosphorus form was more pronounced in this respect. Also, it is clear that the highest values were obtained with UP followed by H_3PO_4 and DAP, respectively.

Effects of P on minerals and some bioconstiuents in squash leaves:

As indicated in Table (3&4) different phosphorus forms and levels considerably increased N, P, K, Ca and magnesium contents in leaves of squash plants. Also, total sugars, carbohydrates and total free amino acids as well as the crude protein contents were positively responded to the different P treatments.

Regarding the enhancement of the applied phosphorus treatments upon the minerals contents it could be considered as a direct effect of these treatments upon shoot growth (Table, 1), since, the length, diameter and dry weight of stem in plants grown up from seeds pre- soaked in different P forms were high significantly increased. Hence, the absorption of these elements being then improved.

1+2

Besides, significant increases of the leaf area (Table, 1) and increment of the photosynthetic pigments (Table,2) with different phosphorus treatments were reversed into magnitude of dry matter accumulation in different squash organs (Table,1) preceded with increasing of photosynthetic efficiency thereby increment of sugars synthesis and carbohydrates formation (Table, 4).

Reproductive growth:

a- Sex expression and fruit yields:

As illustrated in Table (5) different phosphorus forms and levels tended to affect male and female flower numbers and that was more markedly for summer squash cv. Eskandarani during 2007 and 2008 seasons. High significant reduction in the male flower number or increase in female ones were existed.

Also, the UP of phosphorus forms in the two assigned concentrations showed the highest significant increase in the female flowers number, and the lowest significant reduction in the male flowers number. On the other hand, H_3PO_4 treatment gave the lowest significant number for the male and female flowers as well. Thereby, by virtue of the reduction of the male flowers and increasing the female ones the male/female ratio was dominantly showed its high significant reduction with different P treatments compared with the control plants.

Concerning these data, it could be concluded that, under cool conditions, the production of female flowers in Eskandarani squash cultivar is favoured, since, P treatments allowed seedlings to achieve vigorous growth and to flowering earlier during the cool period of cultivation more than untreated plants. Moreover, P treatments were encouraged the carbohydrate formation (Table, 4). In this respect, Ne Smiths *et al.,* (1994) reported that in *Cucurbita pepo.* low temperature may inhibit the development of male flowers after differentiation, leading to precocious female flowers. They also demonstrated that planting date tends to affect female flowers number more markedly for some summer squash cultivars than for others. In addition, Wien (1997) concluded that conditions which enhance the building up of carbohydrates tend to favour female flower expression while factors reduce carbohydrate build-up, such as temperatures, also increase the tendency for male flower production in the cucurbit vegetables.

As for the effect of phosphorus treatments upon early and total fruits number and yield data showed that significant increase of early and total fruits number and yield during the two seasons were obtained. Also, it is clear that the highest values were obtained with UP followed by DAP and H_3PO_4,respectively.

Regarding the earliness of squash fruiting and increasing of early fruit yield percentage it could be attributed to the increasing of assimilate supply (Table. 4) under low temperatures that favour femalness and hence enhancement of fruit growth rates. In this respect, Hubbard *et al.,* (1989) and Marcelis (1993) reported that the higher assimilate levels and carbohydrates supply resulted in increased number and size of fruit cells.

3+4

Effects of P on minerals and some bioconstituents in squash fruit :

Data in Table (6) show that in the 2007 and 2008 seasons all applied phosphorus forms-in the assigned two levels-increased minerals content, crude protein %, total sugars and carbohydrates in the marketable sized squash fruits compared with the control. Also, it is clear that the highest values were obtained with UP followed by H_3PO_4 and DAP, respectively.

Economical and biological yields as well as fruit quality:

As indicated in Table (7) the MAP, DAP, UP and H_3PO_4 of phosphorus forms at 1000 and 1500 ppm levels for each significantly increased the economic fruit yield (expressed as the total dry weight of harvested fruits) and the biological yield (expressed as the dry weight of shoots and fruits) of squash plant in the two seasons of the present study. Also, the highest significant values of the both yields were obtained with 1000 ppm level of UP, whereas the lowest significant values were showed with 1000 ppm of MAP. These data were completely reversed upon the harvest index as considered the percentage of the dry matter of the economic yield divided by the dry matter of the biological one.

In this respect, it is well established that, yield production in the annual herbaceous vegetable crops of the cucurbitaceae is affected by two factors, first that influence overall plant productivity, and second those determine the partitioning of assimilates to reproductive tissues. The priority of productive structures for attracting assimilates has been reported in some cucurbitaceous as well as in other plants (Hopkins, 1995, Hendrix, 1995 and Wien, 1997).

In addition fruit quality, data in Table (7) show that in the two seasons all applied phosphorus forms-in the assigned two levels-increased vitamin C, total soluble solids (T.S.S.) and titratable acidity in the marketable sized squash fruits compared with the control. Since, the effect of phosphorus as a pre sowing seed treatments upon fruit quality of squash plant it could be noticed that this treatment provided conditions make fruits to be more favorable for marketing with good quality.

In general it could be concluded that soaking squash seeds in the assigned P forms and levels exhibited vigorous seedling growth, altered the gender of the formed flowers to be in favour of female ones. Besides, the soaking treatment also caused earliness of fruit production under low temperatures, increased the total fruit yield/plant improved fruit quality and shortened harvest periods. All of these advantages could be attributed to the increment of the canopy photosynthesis rate and, in turn, the sufficient assimilate supply. Hence, acceptable fruit yield with a great portion of early fruits and improved quality then is being achieved.

5+6

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Table (1): Effect of some phosphorus forms and levels as a seed-soaking treatments on growth characteristics of squash plants at 45 days after sowing during 2007 and 2008 seasons.

Treatments		Stem						Leaves					
		Length (cm)		Diameter (cm)		Dry weight (g/plant)		No. of leaves/plant		Leaf area/ plant (cm^2)		Dry weight (g/plant)	
P	**ppm**	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Control		7.11	6.33	1.40	1.38	0.64	o.56	12.50	11.80	812.01	766.54	5.52	5.21
MAP	**1000**	9.15	9.57	1.52	1.54	0.82	0.86	13.75	14.05	893.21	912.70	6.07	6.20
	1500	8.70	9.10	1.56	1.55	0.78	0.81	14.15	14.80	919.18	961.42	6.25	6.54
DAP	**1000**	8.44	8.95	1.71	1.75	0.76	0.80	15.30	15.75	993.90	1023.14	6.67	6.95
	1500	9.12	8.77	1.62	1.66	0.82	0.78	15.48	16.20	1005.60	1052.37	6.84	7.15
U-P	**1000**	10.42	9.38	1.77	1.79	0.93	0.84	17.58	18.00	1142.02	1169.30	7.76	7.95
	1500	8.75	9.25	1.85	1.82	0.78	0.83	16.20	17.80	1052.36	1156.31	7.15	7.86
H_3PO_4	**1000**	9.48	8.85	1.68	1.72	0.85	0.79	15.77	16.10	1024.44	1045.87	6.96	7.11
	1500	9.50	9.30	1.78	1.80	0.86	0.83	16.12	16.62	1047.17	1079.65	7.18	7.34
L.S.D. at 5%		0.74	0.82	0.17	0.20	0.04	0.07	1.11	1.25	58.87	66.24	0.75	0.87

MAP: Monoamonium phosphate U-P: urea phosphate DAP: Diamonium phosphate H_3PO_4: Phosphoric acid

Table (2): Effect of some phosphorus forms and levels as a seed-soaking treatments on photosynthetic pigments of squash leaves at 45 days after sowing during 2007 and 2008 seasons.

Treatments		Chlorophyll (mg/g F.W.)						Carotenoids (mg/g F.W.)		Total pigments (mg/g F.W.)		Chlorophyll a+b/ cartnoides	
		a		b		a+b							
P	**ppm**	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Control		0.515	0.518	0.462	0.458	0.977	0.976	0.471	0.466	1.448	1.442	2.07	2.09
MAP	**1000**	0.535	0.532	0.478	0.471	1.013	1.003	0.481	0.476	1.494	1.479	2.11	2.11
	1500	0.525	0.528	0.465	0.450	0.990	0.978	0.488	0.480	1.478	1.458	2.03	2.04
DAP	**1000**	0.611	0.642	0.482	0.462	1.093	1.104	0.520	0.515	1.613	1.619	2.10	2.14
	1500	0.557	0.620	0.479	0.435	1.036	1.055	0.538	0.527	1.574	1.582	1.93	2.00
U-P	**1000**	0.735	0.750	0.512	0.529	1.247	1.279	0.556	0.570	1.803	1.849	2.24	2.24
	1500	0.717	0.748	0.505	0.518	1.222	1.266	0.578	0.592	1.800	1.858	2.11	2.14
H_3PO_4	**1000**	0.696	0.720	0.491	0.510	1.187	1.230	0.518	0.536	1.705	1.766	2.29	2.30
	1500	0.680	0.715	0.489	0.498	1.169	1.213	0.521	0.538	1.690	1.751	2.24	2.26
L.S.D. at 5%		0.03	0.05	0.02	0.04	0.10	0.12	0.04	0.05	0.13	0.14	0.02	0.04

MAP: Monoamonium phosphate U-P: urea phosphate DAP: Diamonium phosphate H_3PO_4: Phosphoric acid

(3): Effect of some phosphorus forms and levels as a seed-soaking treatments on minerals of squash plants at 45 days after sowing during 2007 and 2008 seasons.

Treatments		Nitrogen %		Phosphorus %		Potassium %		Calcium %		Magnesium %		Iron ppm	
P	**ppm**	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Control		2.41	2.46	0.351	0.343	2.56	2.64	3.32	3.41	0.711	0.620	56.30	49.50
MAP	**1000**	2.80	0.420	0.420	0.461	2.77	2.79	3.48	3.51	0.924	0.823	75.32	73.15
	1500	2.87	0.480	0.480	0.520	2.83	2.69	3.70	3.77	0.933	0.846	77.20	81.32
DAP	**1000**	3.12	0.466	0.466	0.450	2.90	2.88	3.82	3.86	1.113	1.142	76.82	78.40
	1500	3.08	0.445	0.445	0.462	3.15	3.26	3.96	3.90	1.117	1.211	83.50	84.66
U-P	**1000**	3.75	0.474	0.474	0.482	3.46	3.53	3.88	3.94	1.363	1.281	96.18	88.70
	1500	3.60	0.476	0.476	0.464	3.77	3.80	3.92	3.89	1.225	1.182	95.13	91.33
H_3PO_4	**1000**	3.35	0.480	0.480	0.492	3.82	3.87	3.76	3.72	1.126	1.107	85.42	83.25
	1500	2.86	2.94	0.485	0.496	3.60	3.69	3.66	3.75	1.202	1.191	82.70	85.40
L.S.D. at 5%		0.08	0.07	0.02	0.03	1.12	1.13	0.05	0.07	0.14	0.12	3.12	4.22

MAP: Monoamonium phosphate U-P: urea phosphate DAP: Diamonium phosphate H_3PO_4: Phosphoric acid

Table (4): Effect of some phosphorus forms and levels as a seed-soaking treatments on some bioconstituents of squash leaves at 45 days after sowing during the two seasons.

Treatments		Sugars(mg/g F.W.) Reducing		Non-reducing		Total		Total carbohydrates (mg/g D.W.)		Total Free amino acid (mg/g F.W.)		Crude protein %	
P	**ppm**	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Control		9.17	10.22	5.13	4.66	14.30	14.88	537.3	546.7	11.15	10.92	15.06	15.38
MAP	**1000**	11.25	12.15	7.17	7.35	18.42	19.50	612.4	610.2	11.85	11.68	17.50	17.31
	1500	10.50	11.70	8.72	8.40	19.22	20.10	577.6	582.5	11.54	11.46	17.94	18.13
DAP	**1000**	13.17	12.88	9.12	9.43	22.29	22.31	628.7	632.4	12.70	12.62	19.50	19.94
	1500	13.75	14.80	8.50	8.67	22.25	23.47	618.2	622.8	12.48	12.35	19.25	19.63
U-P	**1000**	15.33	15.69	9.35	9.77	24.68	25.46	690.5	686.3	14.22	14.70	23.44	22.81
	1500	13.90	14.70	8.85	8.92	22.75	23.62	667.9	652.4	13.88	13.25	22.50	22.94
H_3PO_4	**1000**	12.55	13.40	7.44	7.87	19.99	21.27	584.7	594.6	12.80	12.86	20.94	21.88
	1500	11.85	12.72	8.17	8.59	20.02	21.31	591.8	573.5	12.20	12.66	17.88	18.38
L.S.D. at 5%		1.07	1.10	1.11	1.09	1.12	1.14	25.30	27.82	0.09	0.08	1.18	1.19

MAP: Monoamonium phosphate U-P: urea phosphate DAP: Diamonium phosphate H_3PO_4: Phosphoric acid

Table (5): Effect of some phosphorus forms and levels as a seed-soaking treatments on flowering, sex expression and fruit yield of squash plants during the two seasons.

Treatments		No. of flowers / plant						No. of fruits / plant				Yield			
		Male		Female		Male/ Female		Early		Total		Early (g)/plant		Total (kg)/ plant	
P	ppm	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Control		56.30	58.80	20.15	21.33	2.79	2.76	1.90	2.11	13.20	15.17	111.72	123.48	1.80	2.07
MAP	1000	33.15	35.25	28.50	29.79	1.16	1,18	4.55	4.60	19.44	20.52	255.62	259.55	2.60	2.72
	1500	35.40	37.42	30.12	32.55	1.18	1.15	4.35	4.40	20.60	20.75	247.32	250.73	2.78	2.83
DAP	1000	31.25	32.70	31.10	30.24	1.01	1.08	5.15	5.23	21.88	21.60	287.71	301.85	2.98	2.92
	1500	34.35	35.10	32.15	33.51	1.07	1.05	5.30	5.52	20.50	91.96	300.73	308.38	2.77	2.94
U-P	1000	29.90	30.17	31.20	30.47	0.96	0.99	5.70	5.66	22.95	23.35	320.23	317.98	3.07	3.10
	1500	30.23	31.40	29.80	30.25	1.01	1.04	5.45	5.36	20.14	20.60	306.18	299.44	2.72	2.76
H_3PO_4	1000	32.16	33.15	28.12	26.80	1.14	1.24	4.78	4.80	19.90	18.77	271.22	274.29	2.69	2.54
	1500	33.77	36.20	29.33	28.12	1.15	1.28	4.67	4.62	19.67	18.84	267.99	265.13	2.63	2.52
L.S.D. at 5%		4.11	4.21	3.12	3.24	0.17	0.19	1.15	1.21	2.72	2.86	17.42	19.22	0.18	0.21

MAP: Monoamonium phosphate U-P: urea phosphate DAP: Diamonium phosphate H_3PO_4: Phosphoric acid

Table (6): Effect of some phosphorus forms and levels as a seed-soaking treatments on some minerals and bioconstituents of squash fruits during the two seasons.

Treatments		N %		P %		K %		Crude protein %		Total sugars (mg/g F.W.)		Total carbohydrates (mg/g D.W.)	
P	ppm	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Control		1.66	1.68	0.311	0.309	1.35	1.39	10.38	10.50	32.17	36.40	620.11	614.20
MAP	1000	1.82	1.78	0.425	0.436	1.74	1.81	11.38	11.14	43.50	47.19	625.25	630.70
	1500	1.79	1.84	0.442	0.453	1.80	1.86	11.19	11.50	52.41	50.78	638.14	640.52
DAP	1000	1.88	1.95	0.450	0.456	1.90	1.92	11.75	12.19	55.36	53.80	644.28	645.66
	1500	1.94	1.96	0.474	0.466	1.88	1.83	12.13	12.25	60.22	63.25	652.70	655.25
U-P	1000	2.17	2.10	0.475	0.478	2.25	2.29	13.56	13.13	71.14	69.75	662.40	667.50
	1500	2.14	2.05	0.481	0.486	2.34	2.44	13.38	12.81	65.28	67.13	665.44	660.70
H_3PO_4	1000	1.89	1.86	0.465	0.469	2.11	2.18	11.81	11.63	58.47	61.26	672.35	677.42
	1500	1.93	1.97	0.454	0.458	2.14	2.12	12.06	12.31	56.29	57.63	636.24	661.15
L.S.D. at 5%		0.11	0.13	0.07	0.06	0.23	0.27	0.44	0.38	3.70	5.43	12.40	15.72

MAP: Monoamonium phosphate U-P: urea phosphate DAP: Diamonium phosphate H_3PO_4: Phosphoric acid

Table (7): Effect of some phosphorus forms and levels as a seed-soaking treatments on economical and biological yield of squash plants as well as fruit quality during the two seasons.

Treatments		Economical yield (g/plant)		Biological yield (g/plant)		Harvest index %		Vitamin C (mg/100g F.W)		Total soluble solids %		Titratable acidity %	
P	**ppm**	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Control		130.86	150.50	149.55	172.18	87.50	87.41	17.22	18.19	4.05	4.10	0.462	0.487
MAP	**1000**	189.03	197.76	211.00	221.79	89.56	89.17	20.40	21.15	4.22	4.30	0.524	0.518
	1500	202.12	205.49	236.68	234.46	85.40	87.64	20.66	21.23	4.28	4.26	0.526	0.532
DAP	**1000**	216.38	212.03	232.67	231.79	93.00	91.48	22.35	22.60	4.42	4.36	0.538	0.542
	1500	211.13	213.48	225.57	226.42	93.60	94.29	22.71	22.43	4.38	4.30	0.533	0.535
U-P	**1000**	222.92	225.10	234.15	237.60	95.20	94.74	21.80	22.16	4.52	4.58	0.550	0.556
	1500	197.50	200.41	218.50	224.76	90.39	89.17	22.27	22.50	4.54	4.60	0.562	0.567
H_3PO_4	**1000**	195.33	188.43	218.06	206.84	89.58	91.10	21.77	21.62	4.34	4.46	0.552	0.554
	1500	190.10	184.98	213.17	205.21	89.18	90.14	21.50	21.88	4.23	4.32	0.548	0.546
L.S.D. at 5%		14.38	16.12	13.84	16.56	1.95	2.10	1.14	1.18	0.15	0.14	0.02	0.03

*** MAP: Monoamonium phosphate** **U-P: urea phosphate**
*** DAP: Diamonium phosphate** **H_3PO_4: Phosphoric acid**