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Effect of foliar spray by some natural stimulating compounds on growth, yield and chemical composition of peas (*Pisum sativum*L.)

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Abstract

This experiment was carried out during the two successive winter seasons of 2009 /2010 and 2010 / 2011 at clay loam soil in the farm of Faculty of Agriculture, Moshtohor, Benha University, Kalubia governorate, Egypt to investigate the effect of foliar spray by some natural growth stimulating compounds as hammer, alga 600, chitosan, peptone and phosphoric acid on vegetative growth and chemical composition of plant foliage as well as green pods yield and its components and dry seeds yield of pea plants cv. Master B. Such study aimed also to reduce the amounts of mineral fertilizers used and in turn decrease the pollution resulting from using mineral fertilizers by using growth stimulating compounds.

Treatments were arranged in complete randomized blocks design with four replicates. The results revealed that mentioned characters responded to the used foliar application of Hammer at 2g /liter, Alga 600 at 0.5 g/l, chitosan at 1%, peptone at 1g/l and phosphoric acid at 1 ml/l five times during the growing season starting 21 days after complete germination and every 7 days by intervals compared with the control treatment. In this concern alga 600 and peptone were superior compared to the other tested treatments.

Key words: Pea, foliar spray, Alga 600, Hammer, Chitosan, Phosphoric acid, peptone, vegetative growth, flowering, yield production, yield quality

Introduction

Pea (*Pisum sativum* L.) is one of the most important leguminous vegetable crops grown during winter season in Egypt, which occupies a greet figure in the local consumption and export. Its nutritional value is high for its content of carbohydrates and protein mainly. It plays an important role in the nutrition of Egyptians.

The cultivated area of vegetable crops is not corresponding with population increase in Egypt. Thereafter, intensified efforts have been done during the last few years to increase the yield of unit area as well as increasing the cultivated area in order to face the needs of vegetables for local consumption, industrial purpose and along with the hope to increase vegetable exportation. That is can be achieved by using high yielding ability cultivars and improving the cultural practices i.e., sowing date, planting density, irrigation, fertilization .....etc.

It has been recognized that some native stimulants like alga 600, hammer, chitosan and peptone as well as phosphoric acid are effective means to increase the yield of vegetable crops to reduce the shortage in food supplies especially in countries with population of high density.

Seaweeds are one of the most important marine resources of the world. Seaweed extracts have been marketed for several years as fertilizer additives and beneficial results from their use have been reported (Booth, 1965). The possibilities of using seaweed in modern agriculture have been investigated by many researchers (Rathore *et al.*, 2009; Thirumaran *et al.*, 2009; Zodape *et al.*, 2010; Abo El-Yazied *et al.*, 2012). Different forms of seaweeds preparation such as LSF (Liquid Seaweed Fertilizer), SLF (Seaweed Liquid Fertilizer) LF (Liquid Fertilizer), and either whole or finally chopped powered algal manure have been used and all of them have been reported to produce beneficial effects on cereals, pulses, and flowering plants. Seaweed manure has the advantage of being free from weeds and pathogenic fungi. Liquid extracts of brown algae are being sold as bio-stimulants or bio-fertilizers in various brand names.

Humic substances (humic and fulvic acids) are the major components of soil organic matter. The humic substances in the soil might have both direct and indirect effects on plant growth (Chen and Aviad, 1990). Indirect effects involved improvement of soil properties such as aggregation, aeration, permeability, water holding capacity, ions transport and availability through pH buffering (Tan, 2003). Direct effects are those, the uptake of humic substances into the plant tissue resulting in various biochemical effects through elevate nutrient uptake and maintaining vitamins and amino acids level in plant tissues.

Chitosan is a natural polymer derived from deactivation of chitin. Chitin is readily available from shellfish waste from food processing. It is a polysaccharide called 2-Amino-2-deoxybeta-D-glucosasmine (Peniston and Johnson, 1980). Chitosan is mainly for stimulation of plant defense (Roby *et al.*, 1987; Lawton *et al.*, 1996; Siegrist *et*

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al., 1997; Ohta *et al.*, 2001; Yu and Meuhlbauer, 2001).

There has been a recent trend to use naturally-occurring compounds (including amino acids) to achieve such regulation. Davies (1982) reported that amino acids as organic nitrogenous compounds are the building blocks in the synthesis of proteins, which are formed by a process in which ribosomes catalyze the polymerization of amino acids. The possibilities of using amino acid in modern agriculture have been studied by many researchers (Fawzy *et al.*, 2010; Abdel-Mawgood *et al.*, 2011; El Awadi *et al.*, 2011; Razieh *et al.*, 2012).

Therefore, this investigation was carried out to study the effect of spraying the plants with natural growth stimulating compounds i.e., alga 600, hammer, chitosan and peptone as well as phosphoric acid on pea plant growth, chemical composition, green pod yield and its components as well as dry seed yield and seeds quality

Materials and Methods

The present experiment was conducted in the farm of Faculty of Agriculture, Moshtohor, Benha University, Egypt to study the effect of foliage spray with some safety compounds i.e., alga 600, chitosan, peptone, hammer and phosphoric acid on vegetative growth, chemical composition of plant foliage as well as green pod and dry seed yield of pea (*Pisum sativum* L*) cv. Master B.*

The soil of the experimental field was clay loam in texture (3.41% coarse sand, 16.79% fine sand, 34.85% silt and 40.90% clay) having 2.87 $CaCO_3$, 82.51 ppm available N, 2.00 ppm available P, 219.85 ppm exchangeable K with 7.2 PH. Maximum mean temperature rose up to 25.37 and 26.64 ^{o}C, while minimum mean temperature gone up to 5.01 and 5.15 ^{o}C during first and second year of crop, respectively. Relative humidity was also remained more or less similar during both years. Seeds were sown on November 1st, 2009/2010 and November 6th, 2010/2011, respectively on both sides of ridge 4 m long and 60 cm wide. Seeds were drilled at spacing averaged 7 cm apart. Each experimental plot consisted of 4 ridges. The area of each plot was 9.6m^2.

The current study was included 6 treatments as follows:

(1) Control treatment (spray with distilled water).

(2) Alga 600 at 0.5 g/l (Commercial product by Leili Agrochemistry CO., LTD). It includes 65% organic matter, 1% N, 18% K_2O, 2% S, 10% Alginic acid, 0.42% Mg, 0.30% Fe and 350 ppm I.

(3) Hammer as a source of humic and fulvic acid at 2g/l (Commercial product by. (UAD Co, Union for Agricultural Development). It includes 86% Humic acid, 6% K_2O and 7% Fulvic acid.

(4) Chitosan (Commercial product by Oxford Laboratory India). It includes 90-95% chitosan (2-Amino-2-deoxy-beta-D-glucosasmine.) at 1%. i. e., 10 g from Chitosan dissolved in 0.1 NaOH and completed to 1 liter of distilled water.

(5) Peptone 16/85 as a source of Amino acid at 0.5 g/l (Commercial product by UAD Co., Union for Agricultural Development). It includes 12 % Organic N, 5 % K_2O, 6.9% Alanine, 5.22% Arginien, 9.93% Aspartic acid, 2.25% Cystine, 7.25% Glutamic acid, 4.06% Glycine, 6.34% Histidine, 0.15% Isoleucine, 10.99% Leucine, 7.19% Lysine, 0.71% Metionine, 5.93% Phenylalanine, 3.88% Serine, 2.47% Threonine, 1% Tryptophan, 1.92% Tyrosine, 6.79% Valine and 2.84% Proline.

(6) Phosphoric acid 85% at 1ml/l (Commercial product by Tycoon Company Limited,,China).

These different amounts of foliage spray treatments were applied after complete germination (21 days from sowing and every week by in interval for 5 times through the growing season.

Data recorded.

a- Vegetative growth characters.

A random sample of five plants from each experimental plot was taken at full blooming stage i.e., after two weeks from the second addition of mineral fertilizers. The following data were recorded: Stem length. It was measured from the highest point of the plant up to the first node above the soil surface, Number of branches and leaves per plant. Fresh weight per plant, it was calculated for each of stem, leaves and total fresh weight of plant. Dry weight per plant, the above ground vegetative parts were oven dried at 70°C to a constant weight and then the dry weight per plant was calculated.

b- Flowering behavior.

Number of days from sowing till the anthesis of the first flower was determined in a representative sample of three plants which were labeled at each plot for this purpose.

c. Green pod yield and its components.

At harvest time (75 days after seed sowing), reproductive characteristics were recorded by using number and weight of green pod taken from each plot, hence, average number of green pods / plant, green pods yield / plant and total yield of green pods (ton/fed) were calculated.

d- Chemical constituents of plants foliage.

1. Chlorophyll a, b and total chlorophyll (a+b) as well as Carotenoids were colorimetrically determined as described by A.O.A.C (1970) in fresh samples from the fourth upper leaf at 7 weeks after sowing.
2. Each of N, P and K were determined in the dry matter of the different plant parts for plant foliage. Total Nitrogen, it was determined in the digested dry matter of plant leaves using

microkjeldahl method according to Pregl (1945). The Phosphorus, it was determined by using spectrophotometer method as described by John (1970). The Potassium, it was determined by using flame photometer method as described by Brown and Lilleland (1946).

e. Physical and chemical fruit quality.

In order to record the physical pod characters, random samples of 20 pods were taken from every plot and the following data were recorded: Average pod length, pod diameter and pod weight, number of seeds/pod, fresh seed weight per pod, netting percentage (total weight of green seeds/total weight of green pods X 100), weight of 100 seeds (seed index), and dry seeds yield/fed.

For chemical determination, representative sample of 100 g. of green seeds were taken from each treatment and oven dried and total nitrogen, phosphorus and potassium were determined. The previously determined total nitrogen content in dry matter of plant foliage and seeds was used for calculating total crude protein percentage in seeds by multiplying N-values by 6.25.

All the obtained data were statistically analyzed according to Gomez and Gomez (1984).

Results and Discussion

Effect of foliar spray with alga 600, hammer, chitosan, phosphoric acid and peptone on pea plants cv. Master B:

a. Vegetative growth characteristics

As for the effect of foliar spray treatments on vegetative growth characteristics during the two seasons of study (2009/2010 and 2010/2011) such data in Table 1 indicate that all measured growth traits ,i.e., plant height, leaves number, number of branches as well as fresh and dry weight per plant were significantly affected as a result of spraying plant with alga 600 at 0.5 g/l, hammer at 2 g/l, chitosan at 1% , phosphoric acid at 1ml/l and peptone at 1g/l five times during the growing season starting 21 days after complete germination and every 7 days by intervals compared with the control treatment. In this regard, spraying the plants with peptone and alga 600 exhibited the highest values for all measured growth aspects compared with other tested treatments. In this connection, such increases in morphological characteristics of plant due to spraying with peptone may be due to several alternative routes of IAA synthesis exist in plants, all starting from amino acids. In this regards, **Phillips 1971 and Russell 1982** reported that the increase in growth as a result of application of amino acids may be due to their conversion into IAA. Respecting to the growth enhancing potential of the seaweed extract might be attributed to the presence of macro and micronutrients and may be due to the presence of some growth promoting substances present in the seaweed extract **(Mooney and Van Staden, 1986; Blunden, 1991)**. Such trend was noted by different workers among them on humic acid, **EL-Ghamry *et al.* (2009), EL-Bassiony *et al.* (2010), Azarpour *et al.* (2011)** and **Saruhan *et al.* (2011).** On seaweed extract, **Thirumaran *et al.* (2009), Sridhar and Rengasamy (2010) Ramya *et al.* (2011), Abo EL-Yazied *et al.* (2012)** and **Kumar *et al.* (2012).** On chitosan, **Abd El-Mawgoud *et al.* (2010).** On pepton, **EL-Ghamry *et al.* (2009), Fawzy *et al.* (2010), Abdel- Mawgoud *et al.* (2011)** and **El-Awadi *et al.* (2011).**

Table 1. Effect of spraying with some safety compounds on morphological characters of pea plants during both seasons of study

Treatment	2009/2010					2010/2011				
	Plant height (cm)	Leaves No. /plant	No. of branches /plant	Fresh weight (g)	Dry weight /plant (g)	Plant height (cm)	Leaves number	No. of branches /plant	Fresh weight/plant (g)	Dry weight/plant (g)
Alga 600	56.82	13.60	2.55	65.74	8.90	63.94	16.49	3.38	74.25	10.51
Hammer	53.61	13.55	2.40	64.39	8.79	60.21	16.10	3.05	72.70	10.30
Chitosan	51.93	12.75	2.30	60.10	8.12	58.18	15.00	2.69	68.54	9.64
Phosphoric acid	48.83	12.75	1.58	56.98	7.60	58.93	14.65	2.11	65.74	9.29
Peptone	57.43	13.85	2.63	66.78	9.16	63.98	16.83	3.36	75.30	10.78
Control	45.84	12.10	1.38	53.46	7.27	51.72	13.80	1.65	61.58	8.49
L.S.D at 0.05	0.80	0.41	0.10	3.12	0.63	3.78	0.46	0.29	3.20	0.37

b. Flowering behavior

Regarding the effect of foliar spray treatments, data in Table 2 indicate that spraying the plants five times during the growing season with the tested growth stimulants, i.e., peptone, alga 600, hammer, chitosan and phosphoric acid at 0.5 ml/l, 0.5ml/l, 1% , 2g/l and 1 ml/l for each of them respectively, significantly increased the earliness of flowering compared to the control except the phosphoric acid. Obtained results are true during the two season of growth. In this regard, the earliness of flowering with the application of Alga 600 as a foliar spray may be due to the Seaweed extract also known to promote hormonal activity resulting in the initiation of flowers at an early stage. **Taylor and Wilkinson (1977)** reported early flowering in plants received lower dosages of seaweed extract. Obtained results are in agreement with those reported by **Kumar *et al.* (2012).**

Table 2. Effect of spraying with some safety compounds on flowering time of pea plants during both seasons of study .

Treatment	2009/2010	2010/2011
	Number of days from sowing to the first flower	Number of days from sowing to the firs flower
Alga 600	35.25	37.75
Hammer	36.50	36.50
Chitosan	37.25	37.25
Phosphoric acid	36.75	36.25
Peptone	36.5	36.25
Control	37.75	37.75
L.S.D at 0.05	0.87	0.81

c. Fruit yield and its components

Concerning the effect of spraying pea plants with alga 600, hammer, chitosan, phosphoric acid and peptone on total fruit yield and its components ,i.e., number of pods/ plant, pod weight /plant, pod weight/plot and Feddan the data in Table 3 revealed that all the forementioned yield components were significantly increased as a result of spraying the plant five times with using the different tested growth stimulants in comparison with the control treatment during both seasons of study. In addition, the highest yield and its components for both plant and faddan were obtained as a result of spraying plant with pepton and Alga 600 at 0.5ml/l for each of them. While, hammer came in the second station, chitosan in the third and phosphoric acid came in the last. Such results are similar during the two season of study. In this regard, the superiority of the total produce yield due to this safety compounds applications are connected with the highest increments in vegetative growth rate in Table1 which consequently affected on produced yield. Moreover, the highest increments in yield and its components due to using pepton may be attributed to the increase in the metabolic processes and levels of endogenous hormones, i. e., IAA and GA_3 (**Chaliakhyan 1957 and Sarhan and Abdullah, 2010**). Such trend was noted by different workers among them on humic acid, **EL-Ghamry *et al.* (2009), Ahmed *et al.* (2010), El-Bassiony *et al.* (2010)** and **Azarpour *et al.* (2011)**. On seaweed extract, **Rathore *et al.* (2009), Thirumaran *et al.* (2009), Ramya *et al.* (2011)** and **Kumar *et al.* (2012)**. On chitosan, **El-Tantawy (2009), Abd El-Mawgoud *et al.* (2010)** and **Mondal *et al.*(2012)**. On pepton, **Abo-Sedera *et al.*(2010), Fawzy *et al.* (2010), Abdel- Mawgoud *et al.* (2011)** and **El-Awadi *et al.* (2011).**

Table 3. Effect of spraying with some safety compounds on yield characters of pea plants during both seasons of study.

Treatment	2009/2010				2010/2011			
	No. of pods/ plant	Pod weight/ plant (g)	Pod weight/ plot (kg)	Pod / weight faddan (Ton)	No. of pods/ plant	Pod weight/ plant (g)	Pod weight/ plot (kg)	Pod weight/ faddan (Ton)
Alga 600	9.38	63.35	7.88	6.893	9.78	69.47	8.30	7.26
Hammer	8.75	56.06	7.17	6.276	9.15	61.91	7.57	6.626
Chitosan	8.63	49.84	6.35	5.558	8.93	54.61	6.72	5.882
Phosphoric acid	8.13	41.33	5.88	5.049	8.43	45.80	6.15	5.381
Peptone	9.20	60.49	7.61	6.657	9.65	66.41	8.02	7.015
Control	7.90	38.45	5.19	4.546	8.20	42.62	5.58	4.878
L.S.D at 0.05	0.36	3.35	0.38	0.33	0.35	3.38	0.40	0.36

d. Physical fruit quality

Regarding to the effect of foliar spray treatments on physical fruit quality, data in Table 4 indicate that spraying the plants five times during the growing season with the tested growth stimulants, i.e., peptone, alga 600, hemmer, chitosan and phosphoric acid at 0.5 ml/l, 0.5ml/l, 1% , 2g/l and 1 ml/l for each of them, respectively significantly increased all measured pod physical quality factors (average pod length, diameter, weight, No. of seeds/pod, fresh seeds weight / pod,

netting percentage and seed index) compared to the control. In this respect, using alga 600 and peptone exhibited the highest values followed by hammer, chitosan and phosphoric acid respectively in case of pod parameters. Obtained results are true during the two seasons of growth. In this regard, the increment in pod quality characteristics due to the application of Alga 600 as a foliar spray may be due to the presence of some growth promoting substances present in the seaweed extract **(Mooney and Van Staden, 1986; Blunden, 1991)**. In addition, the growth enhancing potential of the seaweed extract might be attributed to the presence of macro and micronutrients. **(Rathore *et al.* 2009)**. Obtained results are coincided with those reported by **Ahmed *et al.* (2010), El-Bassiony *et al.* (2010), Haghighi *et al.* (2011) and Azarpour *et al.* (2011)** on humic acid, **Rathore *et al.* (2009)** and **Zodape *et al.* (2010)** on seaweed extract, **Abd El-Mawgoud *et al.* (2010), Mondal *et al.* (2012)** and **Shehata *et al.* (2012)** on chitosan, **EL-Ghamry *et al.* (2009), Fawzy *et al.* (2010)** and **El-Awadi *et al.*(2011).**

Table 4. Effect of spraying with some safety compounds on physical fresh pod characteristics of pea plants during both seasons of study .

Treatment	2009 / 2010						2010 / 2011					
	Pod length (cm)	Pod diameter (cm)	Pod weight (g)	No. of seed per pod	Netting %	Seed index	Pod length (cm)	Pod diameter (cm)	Pod weight (g)	No. of seed per pod	Netting %	Seed index (g)
Alga 600	10.21	1.50	6.76	9.88	52.98	28.30	10.48	1.57	7.11	9.96	53.35	28.66
Hammar	9.64	1.45	6.40	9.50	51.01	27.19	9.52	1.53	6.76	9.82	51.37	27.54
Chitosan	8.61	1.44	5.78	9.38	50.17	26.73	8.65	1.51	6.12	9.45	50.54	27.09
Phosphoric acid	8.21	1.41	5.08	8.05	48.57	25.64	8.21	1.47	5.44	8.13	48.92	25.99
Peptone	9.83	1.48	6.52	9.60	52.95	28.09	9.83	1.56	6.88	9.68	53.32	28.46
Control	8.14	1.38	4.87	7.80	47.91	25.36	8.14	1.44	5.20	7.87	48.26	25.71
L.S.D at 0.05	0.39	0.05	0.30	0.41	0.48	0.33	0.42	0.05	0.32	0.41	0.54	0.42

e. Chemical constituents of plant foliage.

Such data indicated in Table 5 show clearly those photosynthetic pigments (chlorophyll a, b and a+b as well as carotenoids) were significantly increased as a result of foliar spray by alga 600, hammer, chitosan and peptone treatments. While the phosphoric acid did not had any significant increase in photosynthetic pigments. Also, chitosan did not had any significant increase in the carotenoids during both seasons of study. Obtained results are in agreement with those reported on humic acid **Ahmed *et al* (2010)** on snap bean, **Farouk *et al.* (2011)** on radish and **Ameri and Tehranifar (2012)** on strawberry. On seaweed extract, by **Christobel (2008)** on green gram, **Thirumaran *et al.* (2009)** and **Ramay *et al.* (2011)** on *Cyamopsis tetrogonolaba,*as well as **Abo El-Yazied *et al.* (2012)** on snap bean. On chitosan, by **Sheikha and Malki (2011)** on bean, **Farouk *et al.* (2011)** on radish and **Mondal *et al.* (2012)** on okra. On amino acid, by **EL-Ghamry *et al.* (2009)** on faba bean and **El-Awadi *et al.* (2011)** on snap bean.

Table 5. Effect of spraying with some safety compounds on pigments in leaves of pea plants during both seasons of study .

Treatment	2009/2010				2010/2011			
	Chlorophyll A (mg/100g .f.w)	Chlorophyll b (mg/100g .f.w)	Total chlorophyll (mg/ 100 g f.w)	Carotenoids (mg / 100 g f.w)	Chlorophyll A (mg/100g .f.w)	Chlorophyll b (mg/100g .f.w)	Total chlorophyll (mg/ 100 g f.w)	Carotenoids (mg / 100 g f.w)
Alga 600	75.68	46.12	121.80	66.92	78.93	48.36	127.29	69.07
Hammer	74.70	45.77	120.46	66.78	77.92	48.07	125.98	68.96
Chitosan	74.58	45.22	119.79	65.61	77.83	47.47	125.29	67.78
Phosphoric acid	70.11	41.68	111.79	65.18	73.35	43.94	117.29	67.37
Peptone	76.27	46.47	122.74	68.79	79.53	48.74	128.27	70.94
Control	69.84	41.21	111.05	63.61	73.05	43.44	116.49	65.76
L.S.D at 0.05	3.49	3.28	4.07	2.69	3.51	3.25	5.12	3.19

Such data indicated in Table 6 show clearly that total nitrogen, phosphorus, potassium and total crude protein were significantly increased as a result of foliar spray treatments. Such data in Table 6 revealed that spraying the plant with Alga 600 at 0.5 g/l., hammer at 2g/l., chitosan at 1%, phosphoric acid at 1ml/ l. and peptone at 1g/liter five times during the growing season starting 21 days after complete germination and every 7 days by intervals during the growing season increased such assayed macronutrients except the phosphoric acid treatment on N and crude proteine compared with the control

treatment during both seasons of study. In this respect, the highest concentration of N, k and crude protein were obtained in case of using peptone and alga 600 than both hammer and chitosan while using phosphoric acid reflected the highest concentration of P. Obtained results are the same during both seasons of growth. In this respect, the increments in macronutrients concentration due to the application of plant growth stimulants may be due to their content of mineral and organic constituents which affected root growth and development and consequently increased the absorption surface of root to these macronutrients and in turn increased its concentration in roots and their migration and accumulation in plant foliage. Obtained results are in agreement with those reported on humic acid, by **Ahmed *et al.*, (2010)** on snap bean, **Farouk *et al.* (2011)** on radish and **Ameri and Tehranifar (2012)** on strawberry . On seaweed extract, by **Thirumaran *et al.* (2009), Ramya *et al.* (2011)** and **Shehata *et al.* (2011).** On chitosan, by **Sheikha and Malki (2011), Farouk *et al.* (2011)** on tomato and **Mondal *et al.* (2012)** on okra. On peptone, by **EL-Ghamry *et al.* (2009)** and **El-Awadi *et al.* (2011).**

Table 6. Effect of spraying with some safety compounds on minerals contents in foliage of pea plants during both seasons of study.

Treatment	2009/2010				2010/2011			
	N%	P%	K%	Total crude protein %	N%	P%	K%	Total crude protein %
Alga 600	3.51	0.46	2.11	21.92	3.79	0.55	2.26	23.65
Hammer	3.46	0.41	2.05	21.59	3.73	0.51	2.18	23.28
Chitosan	3.37	0.37	2.03	21.03	3.64	0.45	2.15	22.76
Phosphoric acid	3.10	0.61	1.99	19.39	3.38	0.70	2.14	21.14
Peptone	3.63	0.48	2.19	22.67	3.92	0.58	2.33	24.50
Control	3.03	0.34	1.80	19.31	3.36	0.42	1.91	21.00
L.S.D at 0.05	0.16	0.05	0.15	1.01	0.14	0.07	0.16	0.92

f. Chemical fruit quality

Concerning the effect of foliar spray treatments, the same data in Table 7 show that spraying pea plants five times starting 21 days from sowing and every week by interval through the growing season with peptone, alga 600, hammer, chitosan and phosphoric acid at 0.5 ml/l, 0.5ml/l, 1% , 2g/l and 1 ml/l for each of them, respectively significantly increased mineral constituents of green seeds (N, P, K and total crude protein) compared to the control. However, no significant differences were reported between peptone, alga 600, hammer and chitosan on Nitrogen, potassium and total crude protein percentage in the two seasons of study. Such enhancing effect due to using such tested growth stimulants on measured chemical constituents may be attributed to the constituents of growth stimulants, i.e., Peptone which contain (organic nitrogen 12%, Potassium oxide 3.5%, 16% free L. amino acids and 85% total amino acids), alga 600 contain (N > 1%, K_2O > 18%, Alginic acid > 10%, Mg > 0.42 %, S > 3.1%, natural PGR, vitamin, amino acid, betaine and mannitol), Hammer which content (humic acid 86%, K_2O 6% and Fulvic acid) and chitosan content (Polysaccharides which are long carbohydrate molecules of repeated monomer units joined together by glycosidic bonds). Obtained results are in the same direction to those recorded by **Ahmed *et al.* (2010), El-Bassiony *et al.* (2010), Haghighi *et al.* (2011) and Rasaei *et al.* (2012)** on Humic acid, **Beckett *et al.* (1994), Rathore *et al.* (2009)** and **Zodape *et al.*(2010)** on seaweed extract, **Abdel-Mawgoud *et al.* (2010), Abdel-Mawgoud *et al.* (2010)** and **Shehata *et al.* (2012) on Chitosan, EL-Ghamry *et al.* (2009), El-Awadi *et al.* (2011)** and **Abdel-Mawgoud *et al.*(2011)** on Peptone.

g. Dry seed yield

Date recorded in Table 7 indicate the effect of foliar spray with alga 600, hammer, chitosan, phosphoric acid and peptone on dry seeds yield and its components during both seasons of study. In this connection, the same data in Table 7 show that spraying pea plants five times starting 21 days from sowing and every week by interval for 7 times through the growing season with pepton, alga 600, hammer, chitosan and phosphoric acid at 0.5 ml/l, 0.5ml/l, 1% , 2g/l and 1 ml/l for each of them, respectively significantly increased dry seed yield compared to the control except the phosphoric acid. However, no significant differences were reported between peptone, alga 600, while hammer came in the second place, chitosan in the third place then phosphoric acid and the control came in the last place. The increment in dry seed yield may be due to the presence of some growth promoting substances present in the seaweed extract (**Mooney and Van Staden, 1986; Blunden, 1991**). In addition, the growth enhancing potential of seaweed extract might be attributed to the presence of macro and micronutrients (**Rathore *et al.* 2009**). Also, this increment in dry seed yield caused by foliar application of humic acid may be due to increasing in number of pods/plant, seed weight/pod and 100-seed weight. These results are in line with those reported

by **Haghighi *et al.* (2011)** and **Rasaei *et al.* (2012).** Obtained results are in the same direction to those recorded by **El-Tanahy *et al.* (2012)** and **Suchada and Boonraung (2008)** on chitosan. **Razieh *et al.* (2012)** and **El-Shabasi *et al.* (2005)** on amino acid.

Table 7. Effect of spraying with some safety compounds on minerals content in seeds of pea plants during both seasons of study.

Treatment	2009/2010					2010/2011				
	N%	P%	K%	Total crude protein %	Dry seed yield / faddan (Ton)	N%	P%	K%	Total crude protein %	Dry seed yield / faddan (Ton)
Alga 600	4.41	0.75	2.40	27.56	1.38	4.59	0.85	2.92	28.70	1.45
Hammer	4.36	0.72	2.38	27.22	1.23	4.54	0.85	2.66	28.34	1.30
Chitosan	4.27	0.65	2.35	26.69	1.12	4.45	0.76	2.64	27.81	1.19
Phosphoric acid	4.14	0.81	2.35	25.88	1.02	4.32	0.91	2.62	27	1.09
Peptone	4.47	0.76	2.43	27.94	1.35	4.65	0.86	2.73	29.06	1.42
Control	3.81	0.60	2.22	23.80	0.89	3.99	0.71	2.49	24.92	0.96
L.S.D at 0.05	0.26	0.05	0.14	1.60	0.07	0.24	0.05	0.34	1.52	0.13

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الملخص العربى

تأثير الرش ببعض منشطات النمو الطبيعية على النمو و المحصول و التركيب الكيماوى فى البسله

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أجريت هذه التجربة الحقلية خلال الموسم الشتوى لعامى 2009 / 2010 و 2010 / 2011 بمزرعة كلية الزراعة بمشتهر - جامعة بنها- محافظة القليوبية بغرض دراسة تأثير الرش الورقى ببعض منشطات النمو الطبيعية مثل الهمر و ألجا 600 و الشيتوزان و البيبتون و حمض الفوسفوريك ، البيبتون كمصدر للأحماض الأمينية على النمو و التركيب الكيماوى للنمو الخضرى وكذلك أيضا محصول القرون الأخضر و مكوناته و محصول البذور الجافة لنباتات البسلة صنف ماستر بى. هذه الدراسة تهدف الى ترشيد استخدام التسميد المعدنى و بالتالى تقليل التلوث الناتج عن استخدام الأسمده المعدنية و ذلك باستخدام مركبات منشطة للنمو طبيعية. وقد اتبع في تصميم التجربة نظام القطع كاملة العشوائية فى أربع مكررات.

النتائج أظهرت أن كل الصفات التى تمت دراستها استجابت لمعملات الرش المستخدمة بالهمر بمعدل 2 جم/لتر و معاملة الألجا600 بمعدل 0,5جم/لتر و الشيتوزان بمعدل 1% و البيبتون بمعدل 1جم/لتر و حامض الفوسفوريك بمعدل 1 مللتر/لتر الرش بها 5 مرات خلال موسم النمو تبدأ بعد 21 يوم من اكتمال الانبات و كل 7 أيام مرة وذلك مقارنتها بمعاملة الكنترول. فى هذا الخصوص وجد أن الألجا600 و البيبتون أدت الى تنشيط النمو بالمقارنة بالمعاملات الأخرى.