Effect of foliar spraying with Potassium humate, amino acid and seaweed extract on growth and productivity of pea plant (*Pisum sativum* L.)

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Abstract

The present study was carried out in the green houses of Al-Adawi area of the Damascus Governorate, Syria, during the period from 2024-2025, to study the effect of foliar spraying treatments with Potassium humate (0, 2, 4, 6 ml/l), amino acids (0, 2, 4, 6 ml/l) and seaweed extract(0, 50, 100, 200 g/L) on the growth and productivity of pea plant hybrid Otterloo. The study contains 10 treatments with 5 replicates for each treatment. Data was calculated using Simple Random Design. Foliar application with Potassium humate at 6 ml/l resulted in highest plant height (80.85 cm). Moreover, foliar application of seaweed extract at 200 g/l resulted in the highest values (5.20, 48.30 cm2, 19.18, 6.33, 10.56 cm, 145.89 kg/donum for number of brunches/ plant, leaf area, number of pods/ plant, number of seeds/ pod, pod length, and productivity respectively) were observed when sea weed extract was foliar sprayed at 200 g/l. The lowest values for the morphological and productivity parameters were recorded in control plant.

Keywords: Pea, Potassium humate, amino acid, seaweed extract, growth, productivity.

Introduction:

Pea (*Pisum sativum* L.) belongs to the *Fabaceae* family it is a rich source of secondary metabolites and nutrients is required for the health of humans including vitamins C and E, minerals, β-carotene, flavonoids, phenol and organic acids (Hounsome *et al*., 2008). Pea is one of the legume plants which is grown for its green and dried seeds, in addition to its importance in improving the soil. Pea growth and yield are influenced by many environmental and nutritional factors. (Yoshmoto *et al*., 2020).

Chemical fertilizers contribute a lot in fulfilling the nutrient requirement but their regular, excessive and unbalance use may lead to health and ecological, hazards depletion of physio chemical properties of the soil and ultimately poor crop yields. Hence, there is need to think of alternate source of safe fertilizers which may enhance crop yields without having adverse effects on soil properties and environment. Thus, the use of bio fertilizers and natural extracts seems to be array of hope in this direction (Hindersah *et al*., 2021). Bio fertilizers and natural extracts have been considered as a cheap, eco-friendly way of improving plant growth, productivity, quantity and quality and soil fertility status (Mishra *et al*., 2013; Al-Surhanee *et al*., 2017).

Seaweed extract is considered as natural fertilizer and used as organic source in improving growth and productivity of horticultural products and application of seaweed extract in low concentrations stimulate plant growth and development (Ismail and El-Shafay, 2015).

Seaweed extract is considered as important source of macro and micro elements, amino and organic acids, osmosis preservative, antimicrobial compounds, vitamins and plant growth promoters (Auxins, Cytokinins, Gibberellins) (Nabti and Hartmann, 2017).

Humic substances which include Potassium humate and fulvic acid, are among the most complex and biologically active organic matter compounds in the soil and are known to stimulate both plants and microbial activities (Canellas *et al*., 2014). They positively influence root growth, lateral roots emergence and root hair initiation (Puglisi *et al*., 2013).

When soils lose part of their nutrients by leaching, Potassium humate increases nutrient availability such as phosphate, calcium and trace elements. It possesses high capability in controlling soil pH against changes which might occurs from the use of chemical fertilizer (Leonard, 2008).

Humates seem to have a particular favorable effect on the nutrient supply. Therefore, the application of humates was tested as an approach to promote both, the nutrient balance of soils and plant vitality (Boehme *et al*., 2005), improve the mineral status of plants and increase the crop yield (Kolota and Osinska, 2001). Humic substances are generated through organic matter decomposition and employed as soil fertilizers in order to improve soil structure and soil microorganisms (Halime *et al*., 2011). Foliar sprays of these substances promote growth, increases yield and quality in a number of plant species (Karakurt *et al*., 2009). Likewise, humic substances have been shown to stimulate shoot and root growth and nutrient uptake of vegetable crops (Akinremi *et al*., 2000; Cimrin and Yilmaz, 2005). Boehme *et al*., (2005) found that Potassium humate promotes the uptake of N, P, Fe and Cu of tomato and other plants.

The physiological roles of amino acids in the natural extract increase the metabolic processes and levels of endogenous hormones, i.e., IAA and GA3 which promote the vegetative growth characters and increase the tubers yield, enhance the tubers quality (Sarhan and Abdullah, 2010).

Amino acids are plant growth promoter that helps plants to maintain their growth. It promotes the growth of the plant under stress conditions. It plays a role in the translocation of nutrients from the source to the targeted tissues. These nutrients are prepared in the leaves through the photosynthesis process and then are translocated to the sinks. It activates several enzymes inside plant body due to which plants continue their growth in stressful conditions. It promotes plant growth (Kowalczyk *et al*., 2008). Nutrient availability when low in the soil results in poor growth of the plants. Normal functions of plants are negatively affected by the limited nutrients in the soil. Amino acid are organic substances that enhance the nutrient uptake by plants (El-Awadi *et al*., 2011).

Amino acids play an important role that plants can uptake more deeply water from the soil and continues their normal growth activities. The process is achieved by the activation of several enzymes inside the plant body by the plant growth promotor. Every enzyme has its specific functions inside the plant body. When enzymes get activated then plants keep their normal growth and developmental activities (PandIan *et al*., 2020).

Pea is considered as one of the most important economically crops in the world. Chemical fertilizers are required for the plant to achieve the best growth and the highest productivity. Organic fertilizers are excellent alternative to chemical fertilizers and in the area of organic culture. It is a main source of plant growth regulators which promote plants growth and productivity. Due to the harmful effect of chemical fertilizers on the human health and environment, this search aimed to use the bio-fertilizers as an alternative of chemical fertilizers. Moreover, to study the effect of humic, amino acids and seaweed extract on growth and productivity of pea plants, and improving the productivity quantitatively and qualitatively.

Materials and methods:

- Pea plant hybrid Otterloo (Jas seeds company) was used as plant material. This hybrid is characterized by dark green in color, suitable for both fresh and dried consumption, vigorous growth and high productivity.
- The present study was carried out in the green houses of Al-Adawi area of the Damascus Governorate, Syria, during the period from 2024-2025 (mid-December,2024).
- The soil was plowed up to a 25 cm depth, then smoothed planted in terraces form. The seedling (resulting from planting seeds in germination trays) on lines with 50 cm distance between lines and 35 cm distance between the plants.
- During the experiment period, plants were irrigated and fertilized as recommended for pea plant. Organic fertilizer was added (3 ton/dunum) before planting, chemical fertilizer N,P,K (20:20:20 at a rate of 1 g/l) was added after two-three weeks of planting and five-six weeks of planting.

Treatments:

Humic and amino acids were separately foliar applied at four concentrations (0, 2, 4, 6 m/l). Seaweed extract was foliar applied at four concentrations (0, 50, 100, 200 mg/L).
The experiment treatments were as follows:

- Un-Treated plants (control plants).
- Treatment with Potassium humate at a concentration of 2 ml/ l.
- Treatment with Potassium humate at a concentration of 4 ml/ l.
- Treatment with Potassium humate at a concentration of 6 ml/ l.
- Treatment with amino acids at a concentration of 2 ml/ l.
- Treatment with amino acids at a concentration of 4 ml/ l.
- Treatment with amino acids at a concentration of 6 ml/ l.
- Treatment with seaweed extract at a concentration of 50 mg/l.
- Treatment with seaweed extract at a concentration of 100 mg/l.
- Treatment with seaweed extract at a concentration of 200 mg/l.

Treatments were applied after two weeks for four times (15 days, 30 days, 45 days, 60 days) after planting.
The study included 10 treatments, each treatment was repeated for five times, where, each replicate contains 10 plants. A Simple Random Design (SRD) was used (A simple experiment with one factor). Results were analyzed using the statistical analysis program (XL-STATE, 2016).
-The averages were compared according to fisher's test and calculated the least significant differences (LSD) at the level of 5 %.

Studied parameters:

- Plant hight (cm) was determined from soil surface up to top of middle leaf.
- Number of brunches per plant was calculated.
- Leaf area (cm^2): five leaves were taken randomly from each plant, leaf then scanned on A4 paper was de measured using image j programe and estimated at cm^2.
- Number of pods/ plants, number of seeds/ pods, pods length, The productivity (kg/ donum) was estimated as well.

Results and discussion:

1. *Effect of foliar application with Potassium humate, amino acid and seaweed extract on morphological Parameters:*

Data presented in Table (1) show the effect of organic fertilizers on growth parameters (plant height (cm), number of brunches/ plant and leaf area (cm²)).

All studied treatments improved studied parameters comparing with control. The gradual increase in organic fertilizers concentrations resulted in gradual improve in studied morphological characters. The highest plant height (80.85 cm) was observed when Potassium humate was added at 6 ml/l. On the other hand, the highest number of brunches/ plant (5.20) and the highest leaf area (48.30 cm^2) were observed when seaweed extracted was added at 200 g/l. The lowest values (52.20 cm, 1.86 and 32.61 cm² for the plant height, number of brunches/ plant and leaf area respectively) were recorded in non-treated control plants.

The significant effect of seaweed extract in improving the morphological parameters might be attributed to the mineral content of macro and micro elements, amino acids and growth regulators in seaweed extract (Battacharyya, *et al*., 2015).

Moreover, the important effect of organic fertilizers which promote the bio-synthesis of auxins and gibberellins, consequently, stimulate cell growth and elongation, increase plant Hight, leave area and buds number (Shokouhian, 2018). Foliar sprays of humate substances and amino acids promote growth, increases yield and quality in many of plant species (Karakurt *et al*., 2009). Likewise, humic substances have been shown to stimulate shoot and root growth and nutrient uptake of vegetable crops (Akinremi *et al*., 2000; Cimrin and Yilmaz, 2005).

Table (1): Effect of foliar application of humic, amino acids and seaweed extract on some morphological characters of Pea plant.

Treatments	Plant height (cm)	No. brunches/plant	leaf area (cm^2)
Control	52.20^{g}	1.86 ^{d}	**32.61^{i}**
Potassium humate at 2 ml L^{-1}	60.86^{cd}	2.29 cd	**35.21^{h}**
Potassium humate at 4 ml L^{-1}	66.44^{b}	2.20^{cd}	**40.55^{d}**
Potassium humate at 6 ml L^{-1}	80.85^{a}	2.53^{cd}	**44.60^{b}**
Amino acids at 2 ml L^{-1}	55.50^{f}	2.30^{cd}	**38.03^{fg}**
Amino acids at 4 ml L^{-1}	56.86^{ef}	2.53^{cd}	**39.87^{de}**
Amino acids at 6 ml L^{-1}	56.10^{ef}	2.95^{bc}	**44.51^{b}**
Seaweed extract at 50 gL^{-1}	54.70^{f}	2.86^{bc}	**39.12^{ef}**
Seaweed extract at 100 gL^{-1}	62.22^{c}	3.53^{b}	**42.59^{c}**
Seaweed extract at 200 gL^{-1}	62.85^{c}	5.20^{a}	**48.30^{a}**
LSD 5%	2.61	0.91	**1.25**

The same letters at the level of columns indicate no significant differences at the 0.05 significance level.

2. *Effect of foliar application with Potassium humate, amino acid and seaweed extract on productivity Parameters:*

The effect of organic fertilizers on number of pods/ plant, number of seeds/ pos, pod length (cm) and productivity (Kg/ donum) was presented in table (2). The lowest values (9.78, 4.60, 7.53 cm, 78.63 Kg/donum for number of pods/ plant, number of seeds/ pod, pod length (cm), and productivity (Kg/ donum) respectively) were observed in non-treated control plants. Meanwhile, the

best values (19.80, 6.33, 10.56 cm, 145.89 kg/ donum for number of pods/ plant, number of seeds/ pod, pod length (cm), and productivity (Kg/ donum) respectively) were observed when seaweed extract was added at the highest concentration (200 gm/l.). All studied treatments, however, improved productivity parameters compared with non-treated control plant.

Amino acids spraying on the vegetative plant parts helps in overcoming the nutrient a deficiency that occurs during growth (Abd El-Aal *et al*., 2010). It plays a role in the translocation of nutrients from the source to the targeted tissues. These nutrients are prepared in the leaves through the photosynthesis process. It activates several enzymes inside plant body and promotes plant growth consequently productivity (Kowalczyk *et al*., 2008). In addition, Potassium humate, positively influence root growth, lateral roots emergence and root hair initiation, promote growth and enhance productivity (Puglisi *et al*., 2013).

Seaweed extract is considered as natural fertilizer and used as organic source in improving growth and productivity of horticultural products and application of seaweed extract in low concentrations stimulate plant growth and development (Ismail and El-Shafay, 2015). In addition, Seaweed extract is considered as important source of macro and micro elements, amino and organic acids, osmosis preservative, antimicrobial compounds, vitamins and plant growth promoters (Auxins, Cytokinins, Gibberellins) (Nabti and Hartmann, 2017).

Table (2): Effect of foliar application of humic, amino acids and seaweed extract on some productivity characters of pea plant.

Treatments	Number of pods /plants	Number of seeds/ pods	pod length (cm)	productivity (Kg/ donum)
Control	9.87^{g}	4.60^{c}	7.53^{d}	**78.63^{i}**
Potassium humate at 2 ml L^{-1}	10.33^{g}	4.77^{bc}	7.67^{d}	**91.91^{h}**
Potassium humate at 4 ml L^{-1}	11.27^{fg}	5.27^{abc}	8.66^{bcd}	**103.53^{g}**
Potassium humate at 6 ml L^{-1}	13.00^{ef}	5.75^{abc}	9.50^{abc}	**123.56^{d}**
Amino acids at 2 ml L^{-1}	15.85^{ab}	4.83^{bc}	7.54^{d}	**93.42^{h}**
Amino acids at 4 ml L^{-1}	17.67^{bc}	4.83^{bc}	8.55^{cd}	**115.28^{e}**
Amino acids at 6 ml L^{-1}	19.14^{ab}	5.90^{abc}	10.00^{ab}	**134.26^{b}**
Seawead extract at 50 gL^{-1}	15.33^{d}	5.33^{abc}	9.30^{abc}	**109.88^{f}**
Seawead extract at 100 gL^{-1}	17.30^{c}	6.20^{ab}	9.70^{abc}	**127.570^{c}**
Seawead extract at 200 gL^{-1}	19.80^{a}	6.33^{a}	10.56^{a}	**145.89^{a}**
LSD 5%	1.67	1,47	1.44	**1.62**

The same letters at the level of columns indicate no significant differences at the 0.05 significance level.

Conclusions:

The treatment with Potassium humate, amino acid and seaweed extract significantly promoted morphological and productivity parameters in pea plant.

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تأثير الرش الورقي بهيومات البوتاسيوم والأحماض الأمينية ومستخلص الأعشاب البحرية في نمو وإنتاجية نبات البازلاء (*Pisum sativum* L.)

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الملخّص

أجريت هذه الدراسة في بيت بلاستيكي، منطقة العدوي، محافظة دمشق، سوريا، خلال الفترة ما بين 2024–2025 (منتصف كانون الأول، 2024) بهدف دراسة تأثير الرش الورقي بهيومات البوتاسيوم (0، 2، 4، 6 مل/ل) والأحماض الأمينية (0، 2، 4، 6 مل/ل) ومستخلص الطحالب البحرية (0، 50، 100، 200 مع/ل) في نمو وإنتاجية نبات البازلاء، الهجين أوترلو. شملت هذه الدراسة على 10 معاملات بحيث تحتوي كل معاملة على خمس مكررات. حللت النتائج باستخدام التصميم العشوائي البسيط. أدى الرش الورقي بهيومات البوتاسيوم بتركيز 6 مل/ل إلى أعلى ارتفاع للنبات (80.85 سم). إضافة إلى ذلك، أدى الرش الورقي بمستخلص الأعشاب البحرية بتركيز 200 غ/ ل إلى أعلى القيم (5.20، 48.30 سم2، 19.18، 6.33، 10.56 سم، 145.89 كغ/ دونم بالنسبة لعدد التفرعات/ النبات، المساحة الورقية، عدد القرون/ النبات، طول القرون والإنتاجية على التوالي). من جهة أخرى، تم تسجيل أقل القيم لجميع المعايير المورفولوجية والإنتاجية المدروسة في نباتات الشاهد.

الكلمات المفتاحية: بازلاء، هيومات البوتاسيوم، أحماض أمينية، مستخلص الأعشاب البحرية، نمو، إنتاجية.