

Research Paper

Effect of Seamino and Ascorbic Acid on Growth, Yield and Fruits Quality of Pepper (*Capsicum Annum L*)

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Abstract: *This experiment was carried out in the plastic house of Horticulture Department/ of Agriculture and Forestry / Duhok University on pepper plants during season of 2011, to study the effect of three levels of Seamino (0.0, 2, 3 ml.L⁻¹) and three levels of Ascorbic acid (0.0, 1, 2 g.L⁻¹) on pepper cv. Habanero growing inside Plastic house. The results shows that spraying Seamino or Ascorbic acid led to positive significant difference in plant height(cm), leaves chlorophyll content %, total yield as well as fruit diameter , fruit length, fruit dry weight, TSS %, Vitamin C, fruit weight, yield per plant and total yield as compared to untreated plants. The interaction between Seamino and Ascorbic acid was significantly enhanced all detected traits, Since pepper plants received 2 ml.L⁻¹ Seamino and sprayed with 1 g.L⁻¹ of Ascorbic acid were characterized by the highest values of plant height, fruit weight, fruit number/plant, yield per plant, total yield fruit diameter and fruit length.*

Keywords: Pepper, Seamino, Seaweed, Ascorbic acid, Habanero.

1. Introduction

Pepper (*Capsicum annum L.*) is one of most popular and favorite vegetable crop cultivated in Iraq. Pepper is an important agricultural crop, not only because of its economic importance, but also for the nutritional value of its fruits, mainly due to the fact that they are an excellent source of natural colours and antioxidant compounds (Howard, Talcott, Brenes, & Villalon, 2000). Seaweed extracts (Seamino) increase plant resistance to pests and diseases, plant growth, yield and quality (Verkleij, 1992). The enhanced plant resistance to diseases provided by seaweed extracts is due to the

antimicrobial activity of seaweeds against bacteria, yeast, and moulds whereas the increased plant growth, yield and quality is resulted from the influence of these extracts on cell metabolism via the induction of the synthesis of antioxidant molecules which could improve plant growth and plant resistance to stress (Cardozo *et al.*, 2007). These reports reveal that organic compounds rather than mineral elements are responsible for the effects. Kowalski *et al* (1999) describe the positive effects of Seaweed extract on plant growth and increasing yield of potato plant significantly.

Ascorbic acid as an antioxidant has auxinic action and owns a synergistic effect on flowering and production (Ahmed, *et al.* 1997). Furthermore, vitamins with their anti oxidative properties play an important role in plant defense against oxidative stress inducing by surfactants and selected pesticides (Orth *et al.*, 1993). The application of ascorbic acid can reduce the harmful effects of salt stress and may have stimulatory effects on plants, ascorbic acid is synthesized in the higher plants and improve plant growth. It is a product of D-glucose metabolism which affects some nutritional cycle activities in higher plants and plays an important role in the electron transport system (El-Kobisy *et al.*, 2005). Moreover, the application of ascorbic acid caused significant increases in growth parameters and total yield of tomato plants (Abd El- Halim, 1995). In the same respect, Talaat (2003) detected that foliar application of ascorbic acid increased the content of macronutrients (NPk) of sweet pepper fruits. Other investigators found similar results on the stimulatory effect of ascorbic acid on other plants such as potato (El-Banna *et al.*, 2006), eggplant (El-Tohamy *et al.*, 2008) and sweet pepper (Talaat 2003; Masahumi *et al.*, 2008; Khafagy *et al.*, 2009).

This study was planned to determine the effect of Seamino and Ascorbic acid on growth, yield and fruit quality of pepper *Habanero* cv. under plastic house conditions.

2. Materials and Methods

The experiment was carried out during season 2011, at the vegetative research farm, Faculty of Agriculture and Forestry, University of Duhok inside plastic house, on pepper (cv. *Habanero*). Seedlings were growing in 15th May 2011 at a distance of 40 cm between plants and 75 cm between the rows.

A completely randomized block design (RCBD) was used in this experiment. Each treatment was replicated three times with eight plants per each. The factors included the following; three concentrations of Seaweed extract (Seamino) (0.0, 2, 3 ml.L⁻¹) and Ascorbic acid at three levels (0.0, 1, 2 g.L⁻¹). All plants under taken in this study received the regular agricultural and horticultural practices that usually carried out in the vegetable crops. Spraying was done twice within ten days intervals, starting from flower initiation stage. Data were analyzed by using SAS program (SAS, 2001).

Experimental Measurements were as follows:

1–Vegetative Growth Characteristics: -

- a) Plant height (cm).
- b) Leaf chlorophyll content%.

2- Yield Characteristics:-

a- Total Yield: All fruits harvested from each treatment along the harvesting period were weighted to calculate the total yield kg/plant and Ton/Donum.

b- Fruit Number per Plant: Total fruits harvested from each treatment along the harvesting period were divided on the plants numbers of treatments to calculate the fruit number/plant.

c- Fruit weight(g)

3- Fruit Quality: Ten fruits from each treatments were randomly taken for determining average fruit character as follows:-

- a- Fruit diameter (mm).
- b- Fruit length (cm).
- c- Fruit dry weight (g)
- d- Total soluble solid (TSS) %.
- e- Vitamin C%

3. Results and Discussion:**1- Vegetative Growth Characteristics:**

Table (1) shows that spraying ascorbic acid with a concentration of 2g.L^{-1} caused significant increased in leaves chlorophyll content and 1g.L^{-1} caused significant increased in plant height compared with control treatment.

Concerning the highest average of leaves chlorophyll content and plant height resulted from spraying with a concentration of 2ml.L^{-1} Seamino, where it reached to (95.11cm and 59.67%) as compared with the lowest values (84.89 cm and 56.56%) respectively at control treatment.

For the interaction between Seamino and ascorbic acid, there is a real effect shown in table (1) from the interaction between 2ml.L^{-1} Seamino and 1g.L^{-1} ascorbic acid was significant in Plant height (cm). And the interaction between 2g.L^{-1} ascorbic acid and 3ml.L^{-1} Seamino was significant in its effect, the plants of Chlorophyll content of leaves% by the highest values of (61.00%), Increase in vegetative growth characters caused by Seaweed extracts may be due to the role of Seaweed extracts as biostimulants for plant growth and development because of presence of trace elements, organic substances like amino acids and plant growth regulators such as auxin, cytokine and gibberellins which improve nutritional status, vegetative growth (Abd El-Migeed *et. al* 2004; Abd El-Moniem and Abd-Allah 2008). Jensen (2004) showed that seaweed extract contain many of micro elements (Co, B, Mo, Zn, Cu) as well as macro elements, Auxins, Gibberellins and Cytokinins and when sprayed on plants increased root ability for growth and nutrient absorption and enhanced stem thickness and strong vegetative and root growth. Seaweeds and their extracts also increase soil health by ameliorating moisture holding capacity and by stimulating the growth of beneficial soil microbes (Moore 2004; Khan *et al.*, 2009). These increases in the above parameters by using ascorbic acid may be due to the fact that Ascorbic acid as an anti oxidant has an effect as plant growth regulators (Johnson *et al.*, 1999) and its role in activating both cell division and elongation in meristematic tissues, as well as the bio synthesis of organic foods (Nijjar, 1985).

Ascorbic acid has a well documented role in many aspects of radix control and antioxidant activity in the plant cell, this botanical briefing highlight recent development in a another aspect of Ascorbic acid metabolism (Seth *et al.*, 2007).

Wassel *et al.* (2007) assumed that the effect of ascorbic acid on the plant growth might be due to the auxinic action of Ascorbic acid as well as, its improved role in many metabolic and physiological processes and enhancing the synthesis of carbohydrates.

Table (1): Effect of Seamino and Ascorbic acid on Plant height (cm) and Chlorophyll content of leaves % on pepper (*Capsicum annum*)

Ascorbic acid(g. L ⁻¹)	Plant height (cm)			Mean effect of Ascorbic	Chlorophyll content of leaves%			Mean effect of Ascorbic
	Seamino (ml.L ⁻¹)				Seamino (ml.L ⁻¹)			
	0.0	2	3		0.0	2	3	
0.0	82.67d	91.33 b	92.00b	88.67b	54.67 c	61.00 a	59.33 ab	58.33 ab
1	86.33 c	100.67a	91.67b	92.89 a	56.33bc	58.00 a-c	56.67bc	57.00 b
2	85.67cd	93.33 b	90.00b	89.67 b	58.67a-c	60.00 ab	61.00a	59.89 a
Mean effect of Seamino	84.89 c	95.11 a	91.22b		56.56b	59.67a	59.00a	

Mean within a column, row and their interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level

2. Yields Characteristics:

Data presented in table (2 and 3) it is clearly shown that Seamino and Ascorbic acid caused significant increase in yield per plant and total yield characteristics as compared with untreated plants while caused no significant increase in fruit number. The interaction treatment between Seamino and Ascorbic acid was significant in its effect. Since pepper plants received 2 ml.L⁻¹ of Seamino and sprayed with 1 g.L⁻¹ of Ascorbic acid and were characterized by the highest value in fruit number/plant (134), Fruit weight (47.00g), Yield /Plant (6.15kg/plant) and total yield (45.07Ton/Donum) as compared with the lowest values of these traits for control which gave (86.67, 36.85 g, 3.54 kg/plant, and 25.93Ton/D.) respectively. The increase in yield characters could be due to the facts that seaweed extracts contain macro, micronutrients and organic matters like amino acids that improve nutritional status, vegetative growth and yield quality (Abd El-Migeed *et al.*, 2004; Abd El-Moniem and Abd-Allah 2008). Crouch and Vanstaden (2005) found that spraying tomato plants with concentrated seaweed extracts gave increased fruit number by 10% and fruit weight by 15%. Number of fruits per plant, fruit yield per plant and fruit yield per plot was significantly increased as a result of the application of 750 ppm of chlormequat and 1680 ppm of seaweed extract in tomato plant (Saravanan *et al.* 2003). Foliar spray of seaweed liquid extracts enhanced the yield parameters such as fruit length and fruit weight in certain vegetable crops (Sethi and Adhikary 2008).

The increase in fruits weight in pepper plants sprayed with seaweed extracts may refer to its role in enhancing the leaves numbers, leaf area and dry weight and consequently the physiological activities as photosynthesis and plant nutrition provision and these could be the reasons of increasing fruit weight (Al-Saaberi, 2005). Also indicate that the foliar spraying of Ascorbic acid improved the yield and physical characteristics, these may be due to the auxinic action of Ascorbic acid on enhancing the cell division and elongation, which were reflected positively on the leaf area (Wassel *et al.*, 2007). Which, in turn lead to improve growth, fruit weight and total yield.

Table (2): Effect of Seamino and Ascorbic acid on Fruit number/ Plant and Fruit weight (g) on pepper (Capsicum annum)

Ascorbic acid(g L ⁻¹)	Fruit number/ Plant				Fruit weight(g)			
	Seamino (ml.L ⁻¹)			Mean effect of Ascorbic acid	Seamino (ml.L ⁻¹)			Mean effect of Ascorbic acid
	0.0	2	3		0.0	2	3	
0.0	86.67 cd	101.00 cd	127.33 a	105.00 a	40.88a-c	36.85 c	40.40a-c	39.39 b
1	108.67 bc	134.00 a	95.00 cd	112.56 a	38.87 bc	47.00 a	46.60 a	44.16 a
2	119.33ab	105.33 bc	108.67bc	111.11 a	44.43 ab	46.14 a	45.29 ab	45.29 a
Mean effect of Seamino	104.89 a	113.44 a	110.33 a		41.40 a	43.33a	44.09 a	

Mean within a column, row and their interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level.

Table (3): Effect of Seamino and Ascorbic acid on Yield /Plant (kg.) and Total yield (Ton/D.) on pepper (Capsicum annum)

Ascorbic acid(g L ⁻¹)	Yield /Plant (kg.)			Total yield (Ton/D.)				
	Seamino (ml.L ⁻¹)			Mean Effect of Ascorbic acid	Seamino (ml.L ⁻¹)			Mean Effect of Ascorbic acid
	0.0	2	3		0.0	2	3	
0.0	3.54 e	3.68 e	5.15 b	4.12 b	25.93e	27.02e	37.77b	30.24b
1	4.20 d	6.15 a	4.49 cd	4.94 a	30.76d	45.07a	32.89cd	36.24a
2	5.28b	4.86bc	4.93bc	5.02 a	38.73b	35.64bc	36.15bc	36.84a
Mean effect of Seamino	4.34 b	4.90 a	4.86 a		31.81b	35.91 a	35.60 a	

Mean within a column, row and their interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level.

3. Fruit Quality Characteristics

Data in tables (4, 5, and 6) shows that Seamino and Ascorbic acid had positive effect on most quality traits as compared with control. Also the interaction between Seamino and Ascorbic acid was significant in its effect. Since pepper plants received 2 ml.L⁻¹ of Seamino and sprayed with 1 g.L⁻¹ of Ascorbic acid were characterized by the highest value in Fruit diameter (3.20mm) and fruit length (11.17 cm), as compared with the lowest values of these traits for control which gave (2.30 mm and 8.50 cm,) respectively and the interaction between 2 g.L⁻¹ of Ascorbic acid and sprayed with 2 ml.L⁻¹ of Seamino were characterized by the highest value in TSS% (7.17), vitamin C%(4.33) and Fruit dry weight (8.67g), as compared with the lowest values of these traits which gave (5.50, 2.30 and 5.94,) respectively.

The enhance in fruit quality may be due to the promoting influence of seaweed extracts on leaf area and efficiency of the photosynthesis process resulting in an increase in the percentage of the total soluble substances (Jensen, 2004). El-Aidy *et al.* (2002) demonstrated that foliar application of seaweed extracts increased plant height, leaves number, leaf area, dry weight of leaves / plant, TSS% and acidity for pepper plant. The improved fruit quality could be due to the increase in yield caused by application of seaweed extracts leading to production of better fruit quality and healthier plants as a result of enhancing plant capability to absorb nutrients from the soil (Kaizenbonsai, 2005). Masny and Zurawicz (2004) found that treating plants with seaweed extracts increased total soluble solids, vitamin C of fruits and fresh weight. The improvement in qualitative characters of cucumber could be due to the presence of carbohydrates and macro and micronutrients in seaweed extracts. also indicate that the foliar spraying of Ascorbic acid improved the yield and physical characteristics, these may be due to the auxinic action of Ascorbic acid on enhancing the cell division and elongation, which were reflected positively on the leaf area (Wassel *et al.*, 2007). Which, in turn lead to improve growth, fruit weight and total yield.

Table (4): Effect of Seamino and Ascorbic acid on Fruit diameter (mm) and Fruit length (cm) on pepper (*Capsicum annum*)

Ascorbic acid (g L ⁻¹)	Fruit diameter (mm)				Fruit length (cm.)			
	Seamino (mL.L ⁻¹)			Mean Effect of Ascorbic acid	Seamino (mL.L ⁻¹)			Mean Effect of Ascorbic acid
	0.0	2	3		0.0	2	3	
0.0	2.30 c	2.47 bc	2.43 bc	2.40 b	8.50 b	9.17 ab	10.17 ab	9.28 b
1	2.53 bc	3.20 a	2.60 bc	2.78 a	10.17 ab	11.17 a	8.83 b	10.05 ab
2	2.63 bc	2.80 ab	2.52 bc	2.65a	10.50 ab	10.50 ab	11.16 a	10.72 a
Mean effect of Seamino	2.48b	2.82a	2.52b		9.72 a	10.28 a	10.05a	

Mean within a column, row and their interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level

Table (5): Effect of Seamino and Ascorbic acid on TSS% and Vitamin C% on pepper (*Capsicum annum*)

Ascorbic acid (g L ⁻¹)	TSS%			Mean Effect of Ascorbic acid	Vitamin C%			Mean Effect of Ascorbic acid
	seamino (mL.L ⁻¹)				seamino (mL.L ⁻¹)			
	0.0	2	3	0.0	2	3		
0.0	5.83 bc	6.17 a-c	5.50 c	5.83 b	2.30 d	3.80 b	2.80 c	2.97 b
1	6.50 a-c	5.67 bc	6.67 a-c	6.28 ab	2.70 cd	2.33 d	2.70 cd	2.58 c
2	6.50 a-c	7.17 a	6.83 ab	6.83 a	2.87 c	4.33 a	2.90 c	3.37 a
Mean effect of Seamino seamino	6.28 a	6.33 a	6.33 a		2.62 b	3.49 a	2.80 b	

Mean within a column, row and their interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level

Table (6): Effect of Seamino and Ascorbic acid on Fruit dry weight (g) on pepper (*Capsicum annum*)

Ascorbic acid(g L ⁻¹)	Fruit dry weight (g)			Mean Effect of Ascorbic acid
	seamino (ml.L ⁻¹)			
	0.0	2	3	
0.0	7.73 a-c	8.18 ab	7.67 a-c	7.48 a
1	8.09 ab	8.13 ab	5.94 c	7.39 a
2	7.23 a-c	8.67 a	6.55 bc	7.86a
Mean effect of Seamino	7.69 b	8.32 a	6.72 ab	

Mean within a column, row and their interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level

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