

## Effect of foliar spraying with a mixture of seaweed extract and amino acids on the yield of two varieties of cucumber (*Cucumis melo var. flexuosus*)

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### Abstract

This study was conducted in an agricultural field in the Al-Shuaiba area / Al-Zubair district, Basra Governorate, with the aim of studying the effect of foliar spraying of Armenian cucumbers with a mixture of amino acids and seaweed extract at concentrations of (0, 1.5, and 3) ml L<sup>-1</sup> in two varieties of Armenian cucumbers (hybrid and local), as well as the effect of the interaction between the variety and spray treatments on vegetative growth and yield. The randomized complete block design (RCBD) was used. The experiment was a two-twice split experiment with three replicates. The first factor was two varieties of cucumber, namely the Indian hybrid variety and the local variety (Khneisri). The second factor was the application of a foliar fertilizer spray with a mixture of amino acids and seaweed at three concentrations (3.0, 1.5, 0.0) ml L<sup>-1</sup>. The results showed that both the variety and the spray treatment significantly affected fruit weight, fruit length, number of fruits per plant, early yield, and estimated productivity in tons per hectare. The interaction between the two study factors also had a significant effect on all studied traits.

The results showed that the hybrid variety significantly outperformed the others in number of fruits, early yield, and total yield, producing 36.41

fruits per plant. 3.56 tons per hectare - 1 and (35.25) tons per hectare - 1 respectively, while the local variety excelled in fruit length and fruit weight, giving the highest average of (39.48) cm fruit - 1 and (119.36) g fruit - 1 respectively. As for spraying with a mixture of amino acids and seaweed, the concentration of (3) ml liter - 1 was lost in fruit length, fruit weight, number of fruits, early yield and total yield at the highest average of (38.44) cm fruit - 1, (113.67) g fruit - 1, (35.83) fruit per plant - 1, (3.64) tons per hectare - 1 and (35) tons per hectare - 1 respectively.

**Keywords:** Armenian cucumber, varieties, amino acids and seaweed extract, yield

fiber, 1.5-2g sugars, 2-5mg vitamin C, 15-20mcg vitamin K, 50-100 IU vitamin A, 180mg potassium, 15mg magnesium, 20mg calcium, and 0.5mg iron (22).

From a medical perspective, cucumber acts as a hydrator and nutritional supplement due to its high water content and low calorie count, making it ideal for low-calorie diets.

### Introduction

The cucumber (*Cucumis melo var. flexuosus*) is classified as a major summer vegetable crop in Iraq and belongs to the subfamily Cucurbitaceae. Its native habitat is the Mediterranean basin. It is in high consumer demand thanks to its rich nutritional value and versatility. Every 100g of its fruit contains 94-96g water, 12-16 calories, 0.6-0.8g protein, 0.1-0.2g fat, 2.5-3.5g carbohydrates, 0.5-1g

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Spraying with seaweed extract showed a significant advantage in plant height and leaf count, registering the highest values compared to lower concentrations (20). Foliar spraying with a mixture of amino acids and seaweed extract on the two eggplant varieties "Barcelona" and "Jawaher" showed the superiority of "Barcelona" at 2 ml/L with a significant interaction compared to the control (2).

### **Materials and Methods**

The experiment was carried out in a private farm in the Al-Shuaiba area of Al-Zubair district / Basra Governorate during the summer growing season of 2025/2026 to study the effect of spraying with a foliar fertilizer consisting of a mixture of amino acids and seaweed on the growth and

production of two types of cucumber (*Cucumis melo* var *flexuosus*): the hybrid variety (Indian) and the local variety (Khneisri). A randomized complete block design (RCBD) was used, a split experiment with two replications and three replicates.

The length of the experimental unit was (3m), the distance between plants was 0.5m, and between lines was 2m. Nine longitudinal lines were opened, each repeating three lines, and each line had six experimental units. Thus, the number of plants in the experimental unit was (6 plants), and the number of experimental units was (54 experimental units).

The experiment included three factors. The first factor was the irrigation periods, which were three irrigations of 24 hours, two irrigations of 16 hours, and one irrigation of 8 hours.

It also contains antioxidants such as flavonoids and polyphenols, and its fiber content contributes to improved digestion. Furthermore, its diuretic properties aid in detoxification. Studies have shown its effectiveness in lowering blood pressure and blood sugar levels, while also supporting overall health (6).

Its cultivation is widespread across Iraq, particularly in the northern and central regions, where the cultivated area reached 21,018.7 hectares with a total yield of 185,484 tons during the 2025 season (Central Statistical Center Annual Bulletin). In Basra Governorate, the cultivated area reached 900 dunams with an average yield of 500 kg/dunam, while neighboring countries recorded higher yields, such as 188,000 tons in Saudi Arabia and 153,600 tons in Syria for the same season.

Crop productivity is affected by multiple factors, most notably the selection of the appropriate variety and advanced agricultural practices such as foliar spraying with biostimulants (5). Variety selection is a crucial factor in promoting growth, productivity, and fruit quality, as varieties differ in growth rate, ripening time, disease resistance, and tolerance to environmental conditions, in addition to morphological and chemical characteristics (9) and (16).

Foliar spraying with effective mixtures plays a crucial role in promoting vegetative growth, productivity, and quality by providing nutrients and protecting plants from pests and diseases.

Seaweed extract showed a significant increase in the number of nodules and total yield of watermelon, and the interplay between irrigation and spraying periods positively affected growth and yield characteristics in zucchini (1). Seaweed extract acts as a natural stimulant that improves micronutrient absorption and fruit quality (10).

until October 15, 2025. Harvesting is still ongoing.

The second factor was the two varieties of cucumbers, which were the Indian hybrid variety and the local variety (Khneisri). The third factor was the application of foliar fertilizer spraying with a mixture of amino acids and seaweed at three concentrations (3.0, 1.5, 0.0) ml L<sup>-1</sup>.

The plants were planted on 2025 1 7 1 26. Irrigation periods were applied two weeks after planting the seeds, i.e., after the appearance of the true leaves of the plant on 2025 1 8 1 10.

The plants were sprayed at dusk and sunset. The first spraying occurred two weeks after planting during the vegetative growth period. The second spraying took place 10 days after the first, at the beginning of flowering. The third spraying occurred 10 days after the second, at the beginning of fruit set. The fourth spraying took place 10 days after the third, during the fruiting stage. The spraying process involved preparing a mixture of amino acids and seaweed at concentrations of 1.5 and 3, with the addition of a few drops of bleach and a control treatment.

The plants were sprayed with distilled water using a foliar sprayer with a 16-liter capacity, ensuring complete saturation. Harvesting began on August 27, 2025, and continued

<b>A liquid mixture of amino acids and seaweed extract</b>	<b>Equilibrium</b>
<b>Composition</b>	Free amino acids 15% w/w Algae extract ( <i>Fucus zegiani</i> ) 10% w/w Alginic acid 1.5% w/w  Menthol 0.5% w/w Total nitrogen 3.5% w/w Potassium oxide 2.5% w/w
<b>country of origin</b>	Spain / Barcelona
<b>Dose</b>	3 -1.5 ml L <sup>-1</sup>

selected plants from the line per experimental unit, and included the following:

1. Fruit weight (g/fruit): This characteristic was calculated by dividing the total fruit weight per experimental unit across all

**studied characteristics**

The studied traits were calculated on a per-plant basis, as an average of five randomly

average yield per plant by the number of plants in the field, as in the following equation:

**Total yield of the field (kg) = Average yield of the plant × Number of plants in the field.**

#### Statistical Analysis: -

Analysis of variance was performed for each of the studied traits according to the Randomized Complete Block Design (R.C.B.D.), with three replicates using the Gestated statistical analysis program version 2007.

The results were tested according to the least significant difference (L.S.D.) to compare the arithmetic means at a probability level of 5% (Al-Rawi and Khalaf Allah, 2000).

harvests by the number of fruits per experimental unit, then calculating the average.

2. Fruit length (cm/fruit): This was measured using a measuring tape as the average for the fruit of 5 plants per experimental unit.

3. Number of fruits per plant: - Based on the number of fruits per experimental unit divided by the number of plants in the experimental unit, according to the following equation:

**Average number of fruits per plant** =  $\frac{\text{Number of fruits in the experimental unit}}{\text{Number of plants in the experimental unit}}$

4. Early Yield (tons per hectare) This trait was calculated by multiplying the

yield per plant for the first eight harvests by the number of plants in the field.

5. Productivity (tons per hectare) The total field yield was calculated by multiplying the

#### • Table (1): Physical and chemical properties of soil and irrigation water

The attribute	Value	Unit —
pH	7.88	$\text{g kg}^{-1}$
Total nitrogen (N)	26.40	$\text{g kg}^{-1}$
Phosphorus (P)	9.40	$\text{g kg}^{-1}$
Potassium (K)	29.60	$\text{g kg}^{-1}$
Calcium Carbonate ( $\text{CaCO}_3$ )	201.60	$\text{g kg}^{-1}$
Organic Matter	0.86	$\text{g kg}^{-1}$
Total Organic Carbon	0.80	$\text{g kg}^{-1}$
Electrical Conductivity (EC)	2.86	$\text{g kg}^{-1}$
Carbonate ( $\text{CO}_3^{2-}$ )	0.00	$\text{dc}^1$
Bicarbonate ( $\text{HCO}_3^-$ )	2.08	$\text{m}^1$
Calcium ( $\text{Ca}^{2+}$ )	25.76	milliequivalents $\text{L}^{-1}$
Magnesium ( $\text{Mg}^{2+}$ )	21.00	milliequivalent to liter $^{-1}$
Available Sulfur	13.28	$\text{g kg}^{-1}$
Soil Component		
Sand	72.15	%

Silkenage	16.01	%
Clay	13.86	%
Soil Texture	Sandy silt	
Irrigation Water		
Electrical Conductivity (EC)	4.50	Deciesemens $m^{-1}$
PH	7.67	—
Calcium ( $Ca^{2+}$ )	16.40	$mmol L^{-1}$
Magnesium ( $Mg^{2+}$ )	11.40	$mmol L^{-1}$
Sodium ( $Na^{+}$ )	9.60	$mmol L^{-1}$
Chloride ( $Cl^{-}$ )	14.01	$mmol L^{-1}$
Sulfate ( $SO_4^{2-}$ )	15.50	$mmol L^{-1}$

treatment. The interaction was significant, with plants of the local variety treated with a concentration of  $3 ml L^{-1}$  exhibiting the longest fruit length of 46.33 cm (fruit-1), compared to the shortest fruit length of 25.56 g (fruit-1) for the hybrid variety treated with distilled water.

Table (4) shows that both varieties and the treatments of spraying with amino acid solution and seaweed extract had a significant effect on the early yield of the plant. The hybrid variety outperformed the local variety, and plants treated with concentrations of  $1.5 ml/L^{-1}$  outperformed the control treatment, although no significant differences were found between these two concentrations.

The interaction was significant, with hybrid varieties treated with a concentration of  $1.5 ml/L^{-1}$  exhibiting the highest early yield weight of  $5.17 kg plant^{-1}$ , compared to the lowest early yield weight resulting from the treatment of the local variety with distilled water, which was  $0.994 kg plant^{-1}$ .

Table (5) also shows that the variety had a significant effect on overall productivity, with the hybrid variety exhibiting the highest yield of 35.25 tons per hectare ( $t/h^1$ ) compared to the local variety, which recorded  $28.53 t/h^1$ . Spraying with amino acid solution and seaweed extract also had a significant effect on productivity. Furthermore, the interaction was significant, with hybrid varieties treated with a concentration of  $3 ml/L$  ( $t/h^1$ ) achieving the highest yield of  $36.32 t/h^1$  compared to the

\* The analysis was conducted at the Marine Science Center/University of Basra

Table (2) shows that both varieties and the treatment with

spraying with amino acid solution and seaweed extract had

a significant effect on fruit weight. Plants treated with a concentration of  $3 ml L^{-1}$  outperformed those treated with a concentration of  $1.5 ml L^{-1}$  and the control treatment. The interaction between the two study factors was also significant; plants of the local variety treated with spraying at a concentration of  $3 ml L^{-1}$  produced the highest fruit weight of 127.04 g, compared to the lowest weight of 125.79 g, resulting from the hybrid variety treated with distilled water.

Table (3) shows that both varieties and spraying with the amino acid solution and seaweed extract significantly affected fruit length. Plants treated with a concentration of  $3 ml L^{-1}$  outperformed the control treatment, with no significant differences between them and plants treated with a concentration of  $1.5 ml L^{-1}$ . Plants treated with a concentration of  $1.5 ml L^{-1}$  also outperformed the control

lowest yield of the local variety treated with distilled water, which reached 25.91 t/h<sup>1</sup>. Table (6) shows that both varieties and spraying with the amino acid mixture and seaweed extract had a significant effect on the number of fruits. Plants treated with concentrations of 1.5 and 3 ml L<sup>-1</sup> outperformed the control treatment, although no significant differences were found between them. The interaction was significant, with hybrid varieties treated with a concentration of 1.5 ml L<sup>-1</sup> producing the highest average number of fruits (40.89 fruits per plant), compared to the lowest number of fruits (19.78 fruits per plant) for the local variety treated with distilled water.

**Table (2): Effect of variety and spraying with amino acid solution + seaweed extract and the interaction between them on the weight of the cucumber fruit**

Variety	Medium-grade spray solution			Medium-grade spray solution
	0	1.5	0	
Local Hybrid	97.08	105.25	97.08	104.17
Moderate	125.79	122.09	125.79	119.36
Spray Effect				
Variety	110.19	111.43	110.19	—
<b>LSD (0.05 )</b>				
Variety interaction and spray solution		spray solution		Category
3.047		2.159		2.113

**Table (3): Effect of variety, spraying with amino acid solution and seaweed extract, and the interaction between them on the length of the cucumber fruit.**

Variety	Medium-grade spray solution			Medium-grade spray solution
	0	1.5	3	
Local Hybrid	25.56	26.11	30.89	33.56
Moderate	44.22	46.00	46.33	39.48
Spray Effect				
Variety	35.17	35.94	38.44	—
<b>LSD (0.05 )</b>				
Variety interaction and spray solution		spray solution		Category
3.02		2.12		2.13

**Table (4): Effect of variety, spraying with amino acid solution and seaweed extract, and the interaction between them on the early yield of cucumber plants**

Variety	Medium-grade spray solution			Medium-grade spray solution
	0	1.5	3	
Local Hybrid	2.61	5.17	2.91	3.56
Moderate Spray Effect	0.994	1.64	4.37	2.33
Variety	2.13	3.08	3.64	—
<b>LSD (0.05 )</b>				
Variety interaction and spray solution		spray solution		Category
0.43		0.32		0.26

**Table (5): Effect of variety and spraying with amino acid solution + seaweed extract and the interaction between them on productivity (ton hectare<sup>-1</sup>) of cucumber.**

Variety	Medium-grade spray solution			Medium-grade spray solution
	0	1.5	3	
Local Hybrid	30.33	40.89	38.00	36.41
Moderate Spray Effect	19.78	17.67	33.67	23.70
Variety	25.06	29.28	35.83	—
<b>LSD (0.05 )</b>				
Variety interaction and spray solution		spray solution		Category
3.11		4.139		3.434

## Discussion

### Generation characteristics of cucumbers:

The results in Tables (2, 3, 4, 5, and 6) showed statistically significant differences between the local variety (Khneisri) and the hybrid variety (Indian) in most productive characteristics, such as early yield (ton hectare<sup>-1</sup>), fruit weight (g fruit<sup>-1</sup>), fruit length (cm fruit<sup>-1</sup>), number of fruits (fruit per plant<sup>-1</sup>), and total yield (ton hectare<sup>-1</sup>). This significant difference is explained by the distinct genetic characteristics of the two varieties, which are strongly correlated with vegetative and floral traits, thus influencing their different physiological and genetic responses. The hybrid variety's superiority in these traits

stems from enhanced floral development, including a higher number of female flowers, earlier flowering, and a higher fertilization rate, leading to increased fruit production and overall yield.

This interpretation is supported by the findings of (7) in their study on potatoes, and (9) on cucumbers. The local variety exhibited the lowest productivity rates, attributed to its genetic traits of fewer female flowers and more male flowers, resulting in lower fertilization rates and a negative impact on the number of fruits and the individual and total

yields. This view aligns with that of (15). The hybrid variety, on the other hand, was characterized by a high C:N ratio throughout its growth stages, accompanied by greater carbohydrate accumulation—a key physiological condition that supports the transition from vegetative to flowering and then fruiting.

The dominance of vegetative growth at the expense of flowering and fruiting resulted in a limited yield.

These findings highlight the importance of key physiological processes, nutrient and dry matter distribution, and floral development. In conclusion, the superior yield characteristics of some varieties are attributed to their genetic traits, which grant them greater efficiency in nutrient utilization and better adaptation to surrounding environmental conditions, a finding consistent with the observations of (16). These observations underscore the importance of key physiological processes, nutrient and dry matter distribution, and floral development. In conclusion, the superior yield characteristics of some varieties are attributed to their genetic traits, which enable them to utilize nutrients more efficiently and adapt optimally to surrounding environmental conditions, a finding consistent with the findings of (16).

Regarding the effect of spraying with the mixture (amino acids and seaweed extracts), the significant improvement in yield characteristics is attributed to their effective role in promoting vegetative and flowering

### Conclusions:

- 1- This study concludes that the most suitable variety for cultivation was selected, as the hybrid (Indian) variety outperformed others in the number of fruits, early yield, and total yield. It was well-suited to desert cultivation in Basra Governorate and positively impacted floral characteristics, yield, and overall production.
- 2- Cultivating the hybrid variety and applying a mixture of amino acids and seaweed as a foliar spray significantly improved yield characteristics, leading to an increase in total production.
- 3- The results showed that spraying with the mixture at a concentration of 3 ml L<sup>-1</sup> resulted in a significant improvement in

growth. This indicates a positive physiological effect of the mixture on increasing overall growth and productivity, which is consistent with the results of (18) on eggplant.

The superiority of this treatment is partly due to the improvement in biological processes, particularly the carbon-to-nitrogen (C:N) ratio. Amino acids provide a readily absorbable source of organic nitrogen, which promotes the synthesis of proteins and key growth enzymes, improves the

plant's nutritional status, and reduces environmental stress. As a result, the number and weight of fruits increased, positively impacting the overall yield; this is supported by the findings of (13) on cucumber plants. Seaweed extracts also contributed to improved yield characteristics due to their content of natural growth regulators and macro- and micronutrients, which stimulate cell division, increase photosynthetic efficiency, and direct metabolic byproducts towards the fruits. This led to an increase in the number of fruits and the yield, as confirmed by (17) on pepper plants.

In addition, spraying with the mixture resulted in a decrease in the C:N ratio due to increased nitrogen content and uptake efficiency, reflecting enhanced vegetative and flowering activity. Overall, the mixture promotes photosynthesis, nutrient uptake, and a better carbon-nitrogen balance, leading to increased fruit number, weight, and overall yield. This is consistent with the findings of Al-. (3) on eggplant and (10) on cucumber.

all traits compared to the control treatment, which positively impacted the yield.

- 4- The hybrid variety treatment combined with spraying with the amino acid and seaweed

#### Recommendations:

1

- We recommend implementing foliar fertilization programs using biostimulants, including amino acid mixtures and seaweed, within the fertilization plans for summer and winter vegetables in general, and for cucumber plants in particular, as these have proven effective in improving productive characteristics such as the number and weight of fruits and total yield.

mixture at a concentration of 3 ml L<sup>-1</sup> resulted in the highest yield traits compared to the control treatment at a concentration of 1.5 ml L<sup>-1</sup>.

2- It is advisable to conduct multiple field studies under the conditions of different regions of Iraq, applying the fertilization program to additional crops and varieties in field crops or open fields, to determine the response level of other varieties.

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