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EFFECT OF SPRAYING ORGANIC AND BIOLOGICAL EXTRACTS ON SOME VEGETATIVE GROWTH CHARACTERISTICS AND YIELD OF TWO CUCUMBER VARIETIES

I. H. M. Al-Jaf [1] A. K. Alalwani [2]* Kh. Y. Kh. Al-Kubissi [2]

[1] College of Agriculture, University of Anbar.
[2] College of Sciences, University of Anbar.

***Correspondence to:** Anmar Kamil Alalwani, College of Sciences, University of Anbar, Ramadi, Iraq.
Email: anmar_kamil@uoanbar.edu.iq

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Abstract

The aim of this research was to study the effect of spraying organic extracts on the vegetative growth characteristics and yield of the Giant and Salim cucumber varieties using the randomized complete block design (RCBD) with three replicates. Fenugreek seeds, dry yeast, poultry waste, and seaweed extract were sprayed on both varieties while distilled water was sprayed as a comparison treatment. The results showed that the Giant variety was significantly superior to the Salim in all the studied characteristics, reaching 213.69 cm (length), 78.86 number of leaves plant^{-1}, 84.90 dry weight g, 105.64 g, 3.35 m^2 plant^{-1} and 28.94 number of fruits plant^{-1} and 3.07 kg, respectively. Spraying with seaweed extract was superior in terms of average length (228.33 cm), number of leaves (78.18 number of leaves plant^{-1}), and fruit weight (112.79 g). Spraying with poultry manure extract produced superior average leaf area traits, number of fruits and total plant yield at 3.49 m^2 plant^{-1}, 29.26 number of fruits plant^{-1}, and 3.24 kg, respectively. For interaction between the varieties and extracts, the treatment for the Giant variety involving seaweed extract spraying was superior in length and number of leaves traits at 251.90 cm and 84.53 number of leaves plant^{-1}, respectively. The interactive treatment

with poultry manure extract spraying for the Giant variety outperformed in leaf area, number of fruits and total yield per plant (3.69 m^2 $plant^{-1}$, 33.90 number of fruits $plant^{-1}$, and 3.68 kg) respectively. This variety outperformed in nitrogen, phosphorus and potassium content following treatment with poultry manure. The results also showed that for the poultry manure treatment, the Giant variety had the highest nitrogen content while Salim recorded the highest amounts of phosphorus and potassium.

Keywords: Cucumber, Fenugreek seed extracts, Dry yeast, Poultry waste and seaweed extract.

تأثير الرش بالمستخلصات العضوية والحيوية على بعض صفات النمو الخضري والحاصل لصنفين من الخيار

ادريس حسين ملا صالح الجاف [1] أنمار كامل العلواني [2]* خضير ياس خضير الكبيسي [2]

[1] كلية الزراعة، جامعة الأنبار.

[2] كلية العلوم، جامعة الأنبار.

***المراسلة الى:** أنمار كامل العلواني، كلية العلوم، جامعة الأنبار، الرمادي، العراق.

البريد الالكتروني: anmar_kamil@uoanbar.edu.iq

الخلاصة

نفذ البحث في مزرعة خاصة في احدى قرى مدينة الرمادي عام 2022–2023 بهدف دراسة تأثير الرش ببعض المستخلصات العضوية في صفات النمو الخضري والحاصل لصنفين من الخيار جانت GIANT وسليم SALIM وفقاً لتصميم القطاعات الكاملة العشوائية (RCBD) وبثلاثة مكررات. استعمل لهذا الدراسة مستخلصات بذور نبات الحلبة، والخميرة الجافة، ومخلفات الدواجن ومستخلص الطحلب البحري ومعاملة المقارنة الرش بالماء المقطر. اظهرت النتائج تفوق صنف جانت معنويا على صنف سليم في جميع الصفات المدروسة وبلغت (213.69 سم و78.86 عدد الأوراق نبات$^{-1}$ و84.90 وزن جاف غم و4105.6 غم و3.35 م^2 نبات$^{-1}$ و28.94 عدد الثمار نبات$^{-1}$ و3.07 كغم) على التوالي. فيما تفوقت معاملة الرش بمستخلصات البحرية في كل من صفات الطول وعدد الاوراق ووزن الثمرة واعطت (228.33 سم و78.18 عدد الأوراق نبات$^{-1}$ و9112.7 غم) على الترتيب. فيما تفوقت معاملة الرش بمستخلص سماد الدواجن في صفات مساحة الورقة وعدد الثمار والحاصل الكلي للنبات وبلغت (3.49 م^2 نبات$^{-1}$ و29.26 عدد الثمار نبات$^{-1}$ و3.24 كغم) على التوالي. وكانت للتدخل بين الاصناف والمستخلصات حيث تفوقت معاملة الصنف جانت والرش بمستخلصات البحرية في كل من صفات الطول وعدد الاوراق واعطت (251.90 سم و84.53 عدد الأوراق نبات$^{-1}$) على التوالي. فيما تفوقت معاملة الصنف جانت

والرش بمستخلص سماد الدواجن في صفات مساحة الورقة وعدد الثمار والحاصل الكلي للنبات (3.69 م^2 نبات$^{-1}$ و33.90 عدد الثمار نبات$^{-1}$ و3.68 كغم) على الترتيب. وتفوق صنف جانت تفوق في محتوى النتروجين والفسفور والبوتاسيوم، كما تفوقت معاملة سماد الدواجن في زيادة هذه العناصر. أظهرت النتائج أيضا أن صنف جانت مع سماد الدواجن حقق أعلى محتوى للنتروجين، بينما سجل صنف سليم مع السماد أعلى محتوى للفسفور والبوتاسيوم.

كلمات مفتاحية: مستخلصات بذور نبات الحلبة، الخميرة الجافة، مخلفات الدواجن ومستخلص الطحلب البحري.

Introduction

The cucumber (*Cucumis sativus* L.) is a vegetable crop in the Cucurbitaceae family that is widely cultivated around the world, including Iraq. Its original homeland is India and Africa where it has grown for thousands of years. Although water constitutes a large percentage of the weight of the fruit, it is distinguished for its nutritional and medicinal value due to its Ca, P, K, protein, carbohydrates, vitamin C, B1, B2, and niacin content (16). It is one of the most important vegetable crops grown under protected agriculture conditions due to the high financial returns resulting from the lack of competition from open crops at specific times of the year. It is available throughout the year, especially from December to the end of April. Cucumber varieties and hybrids grown under greenhouses are also distinguished by the all-female flowers they bear, with the ability to set their parthenocarpic fruits, as these varieties have high productivity, early flowering, and high resistance to diseases (4).

Common methods of growing cucumber plants under protected cultivation involve an abundance of chemical fertilizers and pesticides being added to the soil or sprayed on the plants, which have immediate or long-term negative impacts on humans and the environment. Current trends in agriculture emphasize biological controls and organic nutrition as an alternative to pesticides and chemical fertilizers (13). They also evaluate natural alternatives to natural compounds that can perform the same purpose as industrial materials but with lower or non-existent threats to humans, living organisms, and the environment (2).

According to (9), adding poultry manure and spraying with Humi Feed organic fertilizer and their interactions significantly affected the growth characteristics and yield of the plant. (17) found that cucumber plants sprayed with *Trigonella foenum–graecum*, licorice roots, and *Urtica dioica* (nettle) at 50 g L^{-1} concentration and garlic at 50 ml L^{-1} showed a significant response in the vegetative growth, early flowering, fruit number, and early and total yield characteristics of the plant.

Also, (25) reported that spraying cucumber plants with seaweed extracts such as Algean and Atonik led to a significant increase in the number of leaves plant^{-1}, leaves area plant^{-1}, number of fruits plant^{-1} and total yield. (24) noted that spraying with yeast extract increased plant height, leaf chlorophyll content, stem node numbers, and total plant yield. Natural alternatives that are non-toxic to humans and animals, non-polluting, and economical are a critical factor in cucumber cultivation. As such, this study explores the effect of various plant extracts on the growth characteristics and yield of cucumbers cultivated in greenhouses.

Materials and Methods

The research was conducted in 2022-23 at a private greenhouse farm in a village in Ramadi city. It examined the effect of spraying various organic and biological extracts on the vegetative growth characteristics and yield of the protected Giant and Salim cucumber varieties obtained from the Nong Bloco Ltd, the company licensed by BlueField, Iraq branch. This study was approved by the Ministry of Agriculture.

Five types of organic and bio-extracts were used in this study. Fenugreek seed extract (Trigonella foenum-graecum) at 25 g L^{-1} was prepared according to (23). Dry yeast extract (5 g L^{-1}) was prepared by dissolving the specified weight of dry yeast in a liter of warm water, adding the same weight of sugar (1:1 ratio), and leaving it for 12 hours for the yeast to grow and multiply, according to the specified ratio as in (24). The poultry waste extract (25 g L^{-1}) was prepared as mentioned in (11) while the jumpstart seaweed extract Alga 600 (2 g L^{-1}) was prepared as in (31). Distilled water was used for the control treatment. The plants were sprayed twice, the first at the 3-5 true leaf stage and the second two weeks after the first spraying, until they were completely wet, in the morning.

The number of searches treatment were 10 based on the two cucumber varieties and five organic extracts. They were distributed randomly within each replicate according to the randomized complete block design (RCBD) with three replicates, and the length of the experimental unit was 4 m. The number of experimental units was 30 with 15 units for each variety. The research was conducted as a factorial experiment, and all agricultural operations were carried out according to (29).

The following traits were studied: plant length (cm), leaf number (plant^{-1}), leaf area (m^2 plant^{-1}), fruit number (plant^{-1}), fruit weight (g), and total yield (kg) plant^{-1}. Nitrogen (N%) was estimated by evaporation and distillation using a micro-Kjeldahl apparatus (19) while phosphorus (P%) was estimated with a spectrophotometer at 620 nm wavelength (20). Potassium (K%) was estimated by a flame photometer, and the elements in the leaves were estimated. The results were multiplied by 10 to convert the percentage to g kg^{-1}. Statistical analysis was conducted according to the design used, and the significance of the differences between the treatments was compared using least significant difference (LSD) at the 5% probability level (8).

Results and Discussion

As shown in Tables 1, 2, and 6, the two varieties had major variations in their lengths, leaf numbers and fruit weight. The Giant variety was significantly superior to Salim in those characteristics reaching 213.69 cm, 78.86 leaf number plant^{-1}, and 105.64 g, respectively, compared to the comparison treatment that had the lowest value. The spraying treatments with seaweed extract gave the highest mean rates of plant length, leaf number and fruit weight at 228.33 cm, 78.18, leaf number plant^{-1}, and 112.79 g, respectively, compared to the lowest for the comparison at 181.64 cm, 59.53 leaf number plant^{-1}, and 106.76 g, respectively.

Also, the interactions between the two varieties and extracts significantly affected plant height and leaf numbers. The Giant variety treated with seaweed extract outperformed the others at 251.90 cm and 84.53 leaf number plant^{-1}, respectively. The

lowest rates for the same traits were in the Salim variety sprayed with distilled water in the comparison treatment reaching 179.43 cm and 49.23 leaf numbers plant^{-1}, respectively. However, there was no significant difference in fruit weights for the intervention treatments.

This may be due to the extract containing major nutrients, some minor elements, plant growth hormones (cytokines and auxins), substances similar to plant hormones, and growth-promoting substances such as amino and organic acids, vitamins, and enzymes. These elements are involved in the formation and synthesis of compounds necessary for the plant, such as DNA and RNA, while proteins are essential for plant growth and development, such as photosynthesis and respiration, which increases cell division and elongation (30). This enhances the vegetative and fruit growth of the plant as seen in the longer stem lengths, and higher number of leaves and fruit weight. Seaweed extract also has a fundamental role in improving and increasing the vegetative growth of the plant by facilitating the absorption of nutrients (21, 12, 14 and 32), as was also noted by (7, 28 and 33) in cucumber plants.

Table 1: Effect of the extracts and their interaction on the length of the two cucumber varieties (cm).

Varieties / Extract	Giant	Salim	Mean
Control	183.86	179.43	181.64
Trigonella foenum-graecum	207.20	185.23	196.21
Dry yeast	217.60	179.70	198.65
Poultry waste	207.90	181.10	194.50
Seaweed	251.90	204.76	228.33
Mean	213.69	186.04	181.64
LSD at 5%	Vari = 5.84 Inter = 12.74	Ext = 9.24	

Table 2: Effect of the extracts and their interaction on leaf numbers of the two cucumber varieties (leaf number plant^{-1}).

Varieties / Extract	Giant	Salim	Mean
Control	69.83	49.23	59.53
Trigonella foenum–graecum	87.66	51.60	69.63
Dry yeast	72.36	51.63	61.99
Poultry waste	79.93	62.40	71.16
Seaweed	84.53	71.83	78.18
Mean	78.86	57.33	
LSD at 5%	Vari = 2.23 Inter = 4.87	Ext = 3.53	

Table 3: Effect of the extracts and their interaction on leaf area (m^2 $plant^{-1}$) of the two cucumber varieties.

Varieties / Extract	Giant	Salim	Mean
Control	2.93	2.89	2.91
Trigonella foenum–graecum	3.44	3.24	3.34
Dry yeast	3.32	2.90	3.11
Poultry waste	3.69	3.30	3.49
Seaweed	3.41	3.23	3.32
Mean	3.35	3.11	
LSD at 5%	Vari = 0.13	Ext = 0.13	
	Inter = 0.31		

Tables 3, 4, 5, and 7 indicate the effect of the two cultivars on these traits. The Giant cultivar was significantly superior to the Salim in leaf area, dry weight, number of fruits, and yield, which reached 3.35 m^2 $plant^{-1}$, 84.90 g, 28.94 number of fruits $plant^{-1}$, and 3.07 kg, respectively. Spraying with poultry waste extract produced the highest rate for leaf area, dry weight, number of fruits and yield at 3.49 m^2 $plant^{-1}$, 91.66 g, 29.26 number of fruits $plant^{-1}$ and 3.24 kg, respectively. The comparison treatment had the lowest outcomes at 2.91 m^2 $plant^{-1}$, 72.55 g, 17.18 number of fruits $plant^{-1}$ and 1.80 kg, respectively. The data also showed that the interaction between the two cucumber varieties and the extracts had a significant effect on leaf area, dry weight, number of fruits, and yield. The Giant variety and the poultry manure extract treatment at 3.69 m^2 $plant^{-1}$, 96.55 g, 33.90 number of fruits $plant^{-1}$, and 3.68 kg outperformed the Salim variety sprayed with distilled water in the comparison at 2.89 m^2 $plant^{-1}$, 68.87 g, 12.16 number of fruits $plant^{-1}$ and 1.35 kg, respectively.

The superiority of the poultry manure treatment may be attributed to the ample amount of nitrogen in the organic fertilizer which helps in improving the vegetative group and increasing the size of the root group for enhanced nutrient absorption in the plant's growth and development (1,and 5). It could also be because poultry waste is a concentrated organic fertilizer that rapidly provides the plant with many and large amounts important nutrients such as N (1.5%), P (1.8%), and K (0.9%) of fresh weight (2, 18, 27 and 22). These results are consistent with those of (6, 10, 15, 24, and 29) on cucumber plants.

Table 4: Effect of the extracts and their interaction on dry weight (g $plant^{-1}$) of the two cucumber varieties.

Varieties / Extract	Giant	Salim	Mean
Control	76.23	68.87	72.55
Trigonella foenum–graecum	88.10	80.43	84.61
Dry yeast	76.25	79.87	78.06
Poultry waste	96.55	86.78	91.66
Seaweed	87.41	83.43	85.42
Mean	84.90	79.87	
LSD at 5%	Vari = 1.22	Ext = 1.94	Inter = 4.80

Table 5: Effect of the extracts and their interaction on number of fruits plant^{-1} of the two cucumber varieties.

Varieties / Extract	Giant	Salim	Mean
Control	22.20	12.16	17.18
Trigonella foenum–graecum	29.90	23.50	26.70
Dry yeast	30.33	20.93	25.63
Poultry waste	33.90	24.63	29.26
Seaweed	28.40	23.40	25.90
Mean	28.94	20.92	
LSD at 5%	Vari = 0.83	Ext = 1.31	
	Inter = 13.41		

Table 6: Effect of extracts and their interaction on fruit weight (g) of the two varieties of cucumber.

Varieties / Extract	Giant	Salim	Mean
Control	102.00	111.53	106.76
Trigonella foenum–graecum	104.66	112.66	108.66
Dry yeast	105.30	111.00	108.15
Poultry waste	108.60	114.33	111.46
Seaweed	109.66	115.93	112.79
Mean	105.64	113.09	
LSD at 5%	Vari = 2.53	Ext = 4.00	
	Inter = NS		

Table 7: Effect of extracts and their interaction on plant yield (kg) of the two cucumber varieties.

Varieties / Extract	Giant	Salim	Mean
Control	2.26	1.35	1.80
Trigonella foenum–graecum	3.12	2.64	2.88
Dry yeast	3.19	2.32	2.75
Poultry waste	3.68	2.81	3.24
Seaweed	3.11	2.71	2.91
Mean	3.07	2.36	
LSD at 5%	Vari = 0.10	Ext = 0.16	
	Inter = 0.22		

Tables 8, 9 and 10 show the effects of the two cultivars on some chemical elements. The Giant cultivar was significantly superior to Salim in nitrogen, phosphorus, and potassium content in the leaves, reaching 35.90, 3.62, and 32.60 g kg^{-1}, respectively. The extract spraying treatments had a significant effect with poultry waste extract offering the highest content of the mentioned elements at 40.90, 4.90, and 36.15 g kg^{-1} compared to the lowest at 31.65, 3.25, and 27.65 g kg^{-1}, respectively for the comparison treatment. Also, the interaction between the two varieties and the extracts had a significant effect on the leaf content of nitrogen, phosphorus, and potassium.

The Giant variety cucumber plants treated with poultry manure extract were superior in leaf nitrogen content (41.20 g kg^{-1}) compared to the those sprayed with distilled water (31.40 g kg^{-1}), while the Salim variety were superior in phosphorus and

potassium content (5.60 and 37.10 g kg^{-1}) over the distilled water treatment (3.20 and 23.20 g kg^{-1}), respectively. This is attributed to the high content of those nutrients in the manure thereby providing the necessary elements for absorption and overall development of the plant. The large amounts of sugar which accumulate from this process increase the speed of cell division and thus the yield of the plant (3, and 26).

Table 8: Effect of extracts and their interaction on nitrogen content (g kg^{-1}) in the leaves of the two cucumber varieties.

Varieties / Extract	Giant	Salim	Mean
Control	31.40	31.90	31.65
Trigonella foenum–graecum	33.70	32.50	33.10
Dry yeast	37.30	36.50	36.90
Poultry waste	41.20	40.60	40.9
Seaweed	35.90	36.70	36.30
Mean	35.90	35.64	
LSD at 5%	Vari = NS Inter =2.7	Ext = 1.9	

Table 9: Effect of extracts and their interaction on phosphorus content (g kg^{-1}) in the leaves of the two cucumber varieties.

Varieties / Extract	GIANT	SALIM	Mean
Control	3.20	3.30	3.25
Trigonella foenum–graecum	3.50	4.70	4.10
Dry yeast	3.50	3.40	3.45
Poultry waste	4.40	5.60	4.90
Seaweed	3.50	4.10	3.80
Mean	3.62	4.22	
LSD at 5%	Vari = 0.2 Inter = 0.5	Ext = 0.3	

Table 10: Effect of extracts and their interaction on potassium content (g kg^{-1}) in the leaves of the two cucumber varieties.

Varieties / Extract	Giant	Salim	Mean
Control	23.20	32.10	27.65
Trigonella foenum–graecum	34.10	33.20	33.65
Dry yeast	34.90	36.30	35.60
Poultry waste	36.00	37.10	36.55
Seaweed	34.80	34.70	34.75
Mean	32.60	34.68	
LSD at 5%	Vari = 0.2	Ext = 1.9	Inter = 2.8

Conclusions

Based on the above it can be concluded that Giant cucumber variety was superior to the Salim variety in most of the studied traits. Spraying with the extract of either poultry waste or seaweed had a positive effect on vegetative growth and yield, but the former treatment achieved better results than the others in increasing yield. In terms of nutrient

content, the Giant variety with poultry manure achieved the highest nitrogen content, while the Salim type recorded the highest phosphorus and potassium content.

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Author Contributions:

Author 1: methodology, writing—preparation of the first draft, and writing—review and editing. All authors have read and agreed to the published version of the manuscript.

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