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Article

Influence of variety and hornwort extract on growth and yield of tomato plant

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Abstract: An experimental trial was conducted at Al-Haidariya district, Najaf governorate, Iraq, for the spring season of 2019-2020. The experiment included two factors. The first factor included three cultivars of the tomato plant *Solanum lycopersicum* (Jawahiri, Al-Ibrahimi and Al-Asili). The second factor included spraying three concentrations of *Ceratophyllum demersum (*hornwort**)** extract, which are (0,5,10) ml $^{-l}$, on vegetative growth. Randomized complete block design (R. C. B. D.) was used as a factorial experiment in a split-plot design with three replicates for each treatment. Duncan's multiple range test was adopted to compare the mean with a probability of 0.05% level of significance. The results appear of the variety on the vegetative growth indicators, as the Al-Asili variety outperformed in increasing the plant height, the number of plant leaves, the number of main branches, leaf area, dry weight, chlorophyll percentage, and the amount of yield, which amounted to 54.43cm, 97.63 leaves. plant^{-1} and 6.66 branches. plant^{-1}, and it reached 73.86 cm^2. and 125 % for dry weight percentage, while the total chlorophyll content was 1.23 mg.gm^{-1} and 10.1Km, compared to the Al-Jawhari cultivar, which had the least effect on plant height on reaching 37.43cm, 68.76 leaves. plant$^{-1,}$ and the number of papers was 62.06 cm^2. Leaf $^{-1}$, while the dry weight decreased and the chlorophyll the variety Al-Ibrahimi 83.33 g and 1.04 mg.gm^{-1}. Spraying at a concentration of 10 ml.l^{-1} increased the vegetative growth characteristics significantly, as the plant height reached 54.46 cm and the number of leaves was 100.76. Plant $^{-1}$, and the number of branches is 6.3 branches. Plant^{-1} leaf area amounted to 73.53 cm^2, the dry weight of the shoot was 133.33%, and the percentage of total chlorophyll was 1.22 mg.gm^{-1}

Keywords: *Ceratophyllum demersum*, hornwort, *Solanum lycopersicum*, vegetative parameters

Introduction

Sustainable agriculture encourages the wise use of natural resources, including vegetation, water and land, as it adopts healthy ecosystems to maintain a healthy environment and sustainable management and to ensure increased food security. There is a need for sustainable agricultural innovations to provide the need for food in the future[1]. Accordingly, new agricultural systems will need to evolve to improve the productivity and efficient use of vegetable crops to ensure human

nutrition and food security while ensuring agricultural production's sustainability. [2].

Integration contributes to sustainable agriculture by sharing alternatives and natural products that promote the growth and production of field crops away from chemical fertilizers and achieve the goals of increasing the growth and productivity of tomato plant varieties. It significantly reduces the costs of agricultural operations and can produce food year-round at the lowest costs. [3]. The tomato (Lycopersicon esculent mill) is one of the primary and essential vegetable crops that enter human nutrition directly or indirectly, and it belongs to the Solanaceae family. The tomato crop is considered one of the soil-stressful crops. Tomato responds well to fertilizing, as it consumes large quantities of fertilizer because it is an unlimited growth variety due to the length of its growing season; adding fertilizers in the form of batches and during the growing season of the crop, Either chemical or organic [4].

Among the problems of underdevelopment of these plants' growth and productivity curve is the lack, depletion or absence of the nutritional element, which leads to adverse effects on the various vital activities. Washing and fixing when adding it to the soil, despite its importance, is necessary to search for sources that contain its components in order for the plant to benefit from it by spraying, which is essential in its nutrition and is positively reflected in the characteristics of vegetative and flowering growth and the components and quality of the yield through the availability of these elements to the plant efficiently and quickly through foliar application [5]. The researchers found that foliar feeding is the best fertilization technique due to the high utilization of nutrients and less environmental pollution than direct soil fertilization. Moreover, foliar feeding is more efficient for adding nutrients in small quantities [6] and foliar feeding is not a substitute for ground fertilization. However, it supplements it as nutrients flow through the leaves through the symplast and apoplast pathways 7.

Ceratophyllum demersum L. is considered one of the dicotyledonous aquatic submersible plants. It belongs to the family Ceratophyllacea. This plant is spread in different regions, as found in the United States of America, New Zealand, Japan, Germany and other countries [8]. However, in Iraq, it is found in most governorates of Iraq. Its growth and density are increasing in the Tigris and Euphrates rivers, especially in the central and southern regions, especially in the governorates of Najaf, Babylon, Qadisiyah, and the marsh areas and Abu al-Khasib in Basra due to the availability of the appropriate environment for its growth from a warm climate and clear water.

Materials and Methods

The experiment was conducted in the Al-Haidariya area of Najaf governorate for the spring of 2019-2020 to test three varieties of tomato for spraying with hornwort extract. The field soil was prepared by plowing it twice and in an orthogonal manner, and then it was smoothed and leveled. Soil analysis tests were conducted before planting and fertilization. Ten soil samples were taken randomly from the field in different places with a depth ranging from 0-30 cm. The samples were mixed homogeneously and exposed to UV rays of the sunlight for 24 hours; then, it was ground and sieved with a sieve with diameter holes of 2 mm. Then, the samples were analyzed in the laboratory of the Department of Soil and Water Resources at the College of Agriculture / University of Kufa, as shown in Table 1.

After that, Farming land was Divided into experiment units (3'1.9 m). Seedlings of three cultivars of tomato were planted on March 15 on both sides of the unit, and the distance between one seedling and another was 40 cm. Each experimental unit contained 14 plants. Nitrogen fertilizer was added to 40 kg—acre a month after planting. As for phosphate fertilization was added at 40 kg P. 1 acres immediately after plowing and before dividing. Crop service operations were carried out after planting, including irrigation, weeding and control.

Physical analysis		**Chemical analysis**			
Sand	200 gm.kg^{-1}	Ph	7.4	Mg^{++} (m.equ.L^{-1})	**15.50**
Silt	350 gm.kg^{-1}	EC months/cm	0.98	Na^{+} (m.equ.L^{-1})	**9.24**
Clay	450 gm.kg^{-1}	Total N%	0.04	$HCO3^{-}$ (m.equ.L^{-1})	**2.00**
Soil texture	Clay loam	Total P%	0.06	Cl^{-} (m.equ.L^{-1})	**21.44**
Organic matter (OM)	4.9 gm.kg^{-1}	Total K%	0.34	$SO4^{--}$ (m.equ.L^{-1})	**19.72**
field capacity %	**28.32 %**	**Ca^{++} (m.equ.L^{-1})**	**19.36**	**Fe (mg.L^{-1})**	**0.40**

Table 1. Physical and chemical properties of the experimental soil.

The experiment included two factors: The first factor included three varieties of tomato (Jawahiri, Al-Ibrahimi and Al-Asili), and it was given V1, V2, and V3. The second factor included spraying three concentrations of hornwort extract, which are (0,5,10) ml.liter-1. Its symbols are N0, N1, and N2. The first spray was carried out in the seedling stage, after 10 days of seedling, when 4 true leaves were formed, and another workshop before the flowering stage. With

watering the experimental field a day before the spraying process to help open and close the stomata and increase the absorption process.

The experiment was implemented as a factorial by designing randomized complete blocks design (RCBD) according to the split-plot system and with three replications, with (14) plants for each replicate, so that the total number of plants in the experiment was (42) plants, as the treatment of the variety was distributed in the panels Main Plot and spray coefficients with Chambalan extract in the sub-plot. The averages were compared using Duncan's polynomial test at a probability level 0.05 [9] to show the significant differences between the means using the Genest program**.**

The studied traits were measured according to the following:

1. Plant height (cm). Plant height was measured at the end of the season, starting from the site of plant contact with the soil surface to the growing top, for ten plants for each treatment.

2. The number of leaves was calculated before the appearance of the flower cluster for ten plants and each concentration and according to the average

3. Number of vegetative branches/ The number of vegetative branches for ten plants was calculated randomly for each concentration, and the average was calculated.

4. Paper space

5. Root length (cm) The lengths of the roots were measured with a measuring ruler for ten plants and each concentration according to the average.

6. Chlorophyll content of leaves (mg.100gm-1 fresh weight)

7. The wet and dry weight of the vegetative group (gm), the plants were uprooted with their roots at the end of the season, randomly for ten plants for each variety,

and washed well, then the vegetative total was taken. Its wet weight was calculated with a scale, and the plants were dried aerobically. Then, the dry weight of one plant was calculated according to the average.

Hornwort content		
N	3.146	**%**
P	0.524	
K	0.907	
Ca	0.727	
IAA	311.5	**Ppm**
GA3	75.7	
Cytokinin	452.5	
Glutamic acid	102.82	
Serine	4301.57	
Glycine	528.16	
Threonine	9266.15	
Valine	898.86	
Tryptophane	151.37	
Phenylalanine	654.72	
Vitamin (C)	**445.5**	

Table 2. shows the Hornwort extract content of some chemicals.

Results

It is clear from the results of Table 3 the moral effect of the variety on the vegetative growth indicators, as the Al-Asili variety outperformed in increasing the plant height (cm), the number of plant leaves, the number of primary branches, leaf area, dry weight, chlorophyll percentage, and the amount of yield, which amounted to 54.43cm, 97.63 leaves. plant^{-1} and 6.66 branches. plant^{-1}, and it reached 73.86 cm^2. and 125 % for dry weight percentage, while the total chlorophyll content was 1.23 mg.gm^{-1} and 10.1Km, compared to the Al-Jawhari cultivar, which had a minor effect on plant height on reaching 37.43cm, 68.76 leaves. plant$^{-1,}$ and the number of papers was 62.06 cm^2. Leaf $^{-1}$, while the dry weight decreased and the chlorophyll the variety Al-Ibrahimi 83.33 gm and 1.04 mg.gm^{-1}

As for spraying hornwort extract, it was superior to spraying at a concentration of 10 ml.l^{-1} in increasing the vegetative growth characteristics significantly, as the plant height reached 54.46 cm and the number of leaves was 100.76 leaf. Plant $^{-1}$, and the number of branches is 6.3 branches. Plant^{-1} leaf area amounted to 73.53 cm2, the dry weight of the shoot was 133.33%, and the percentage of total chlorophyll was 1.22 mg.gm^{-1}

As the results showed, The treatment V3N2 of the overlap was superior in giving the highest value for plant height, which reached 64.0 cm; also, it was significantly superior to the number of leaves, as it reached 134. Plant^{-1} compared to the lowest number of leaves by the effect of the two treatments V1N1, which decreased to 51. plant^{-1}.

There was no significant difference between the treatments V3N2 and V3N1 by giving them the highest average number of primary branches in the plant, which amounted to 7 branches.plant^{-1} for each, compared with the lowest number of branches by the effect of the treatment V2N0, which amounted to 4 branches.plant^{-1}.

The results of the same table also showed that the treatment of V3N2 was significantly superior to the leaf area, as it reached 85 cm^2. Compared with the most minor area with the effect of the two treatments V1N0, it decreased to 57.3 cm^2. The interaction in the V3N2 treatment was significantly superior to the dry weight of the plant, as it reached 150% compared with the lowest weight by the effect of V1A0 treatment, as it decreased to 50% in a row.

It is clear from the review of the results that the foliar spraying treatments with aqueous Chambalan extract achieved a significant increase in the characteristics of vegetative growth by increasing the number of leaves, the number of branches, the area of one leaf, the dry weight of the plant and the percentage of chlorophyll. The primary hormones for plant growth and some amino acids and vitamins Table 1 crucial for plant growth, and the method of adding a spray to the leaves was suitable for the transfer of nutrients directly inside the plant, where the leaves are the center of many vital activities (Al-Sahhaf, 1989), and that it contains nitrogen, which is essential In influencing many physiological and biological processes within the plant, it constitutes the basic base for building amino acids, proteins, plant hormones and enzymes that are extremely important in the process of building protoplasm, stimulating growth and increasing the numbers and size of cells.

Discussion

Acid (IAA), which in turn stimulates the process of cell division and elongation, thus increasing Branches [10.] Also, phosphorous has an important role in plant growth, as it contributes to the formation of energy-rich compounds that the plant needs to form other compounds, such as phospholipids, carbohydrates and enzymatic compounds that contribute to activating the vital activities of the plant, which leads to an increase in vegetative growth, as the increase in The height of the plant may be attributed to the significant role that this element plays in plant growth (Al-Sahaf, 1989). These two elements (P and N) are included in the composition of proteins, enzymatic attachments, nucleic acids, DNA and RNA, which caused an increase in the rates of photosynthesis, which ultimately reflects on the increase in the length of the plant. In addition, it contains a high percentage of potassium Table 1, which is an osmotic-regulating element that has an influential role in the process of opening and closing stomata, which is reflected in an increase in the absorption of water and nutrients that activate the photosynthesis process and increase its products and effects. In cell elongation and division, which leads to an increase in growth indicators, it also contains plant hormones such as auxins, gibberellins and cytokinins, which may contribute to an increase in Cell division and the formation of leaf principles, and this is reflected in the increase in the yield of one plant when sprayed with hornwort extract, especially the concentration of 10 ml. this result matches with [11]—also reached [12] satisfactory results to increase the growth and yield of the Obia plant by using organic fertilizers. hornwort extract has provided enough nutrients for plant growth, especially nitrogen phosphorous and potassium, as well as hormones Plant and amino acids [13]|.

Conclusion

The study concludes with the possibility of benefiting from natural resources to meet the need of the tomato crop of nutrients as a safe alternative to chemical fertilizers and the extent of the response of three varieties of tomato to different concentrations of the extract of Chambalan rich in elements in the conditions of the cultivated area (Al-Haidariya - Najaf governorate, which is a semi-desert area).

Variety		Characteristics						
	Extract concen-tration	Plant height	No. of leaf (leaf. plant^{-1})	No. of main Branches	Leaf area cm^2	Dry weight %	Chloro	Produc-tion Km.plant
(V1)	N0	32.3 d	61.0 f	5.3c	57.3e	75d	1.0d	9.3 d
	N1	34.0 d	51 g	6b	65.3c	100c	1.14c	10.8 b
	N2	46.0 c	73.3 e	6.3b	63.6c	125b	1.22b	10.4 c
(V2)	N0	35.3 d	71.0e	4e	61cd	50e	0.98e	7.3e
	N1	50.0 b	81 d	5d	72.6b	75d	1.00d	9.5 d
	N2	53.4 b	85.6c	5.6c	72b	125b	1.13c	10.2c
(V3)	N0	45.3 c	74.3 e	6b	64.3c	100c	1.11c	8.6 e
	N1	54.0 b	94 b	7a	72.3b	125b	1.25b	11.4 a
	N2	64.0a	134a	7a	85a	150a	1.33a	10.3c
Mean of Variety	(V1)	37.43 c	68.76 c	5.86b	62.06c	100b	1.12 b	10.1 a
	(V2)	46.23 b	75.33 b	4.86c	68.53b	83.33c	1.04 c	9.00 b
	(V3)	54.43 a	97.63 a	6.66 a	73.86a	125a	1.23 a	10.1 a
Mean of extract	N0	37.63 c	61.76 c	5.1b	60.86c	75 c	1.03 c	8.4 b
	N1	46.00 b	79.2 b	6.0 a	70.06b	100 b	1.13 b	10.5 a
	N2	**54.46 a**	**100.76 a**	**6.3a**	**73.53a**	**133.33 a**	**1.22 a**	**10.3 a**

Table 3. The effect of the Variety and Extract on some Characteristics of vegetative growth and yield tomato crop.

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