



ORIGINAL ARTICLE

EFFECT OF ORGANIC EXTRACTS AND ADDING METHODS ON GROWTH AND YIELD TRAITS OF TOMATO PLANT (*SOLANUM LYCOPERSICON* L.) GROWING UNDER GREENHOUSE CONDITION

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Abstract: The experiment was conducted in a greenhouse belonging to Al-Fares agricultural company during winter season 2019- 2020. The experiment included two factors, the first factor used seven concentrations of organic extracts (control, Sheep manure extract (50g.L⁻¹), Sheep manure extract (100g.L⁻¹), Licorice roots extract (15 g.L⁻¹), Licorice roots extract (30 g.L⁻¹), Seaweed extract (tecamin) 1.5 ml.L⁻¹ and Seaweed extract (tecamin) 7.5 ml.L⁻¹) which are symbolized by (A0, A1, A2, A3, A4, A5, A6) . The second factor included the adding method of organic extracts (foliar spraying on the vegetative growth of plant and ground fertilization) which are symbolized by (B1, B2). The experiment was conducted according to the Randomized Complete Block Design (RCBD) with three replicates. The results showed that the treatment of sheep manure extract 100g.L⁻¹ significantly excelled and gave the highest values for the traits of plant height 176.35 cm, leave area 353.0 cm², leaves numbers 25.88 leaf.plant⁻¹, plant yield 3.27 kg.plant⁻¹, early yield 4.10 Kg m⁻² and total yield 10.68 Kg m⁻², while the treatment of seaweed extract (tecamin) at a concentration of 1.5 ml.L⁻¹ excelled in traits chlorophyll content in leaves 53.65 ml.100g⁻¹ fresh weight, percentage of N, P and K in leaves 4.82,0.48,3.83%, respectively). The foliar spraying method significantly excelled in most of the studied traits. The interaction treatment (ground fertilization and sheep manure extract 100g.L⁻¹) significantly excelled and gave the highest values for the traits of plant height 179.50 cm, leaves numbers 26.33 leaf.plant⁻¹, flower number 7.79 flower .plant⁻¹, plant yield 3.32 kg.plant⁻¹, early yield 4.25 Kg m⁻² and total yield 11.05 Kg.m⁻².

Keywords: Organic matter, Growth productions, Tomato, Randomized complete block design (RCBD).

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1. Introduction

Tomato (*Solanum lycopersicon* L.) is a vegetable crop that belongs to the Solanaceae family. It is ranked first among vegetable crops in terms of annual cultivated area, production and consumption. It is consumed either fresh or processed and using the correct scientific recommendations starting from choosing the right variety with providing the best conditions and treatments. Increasing the productivity of the unit area, which reduces the cost of production and increases the return. The nutritional importance of the tomato in fact is that it contains carbohydrates in

addition to containing small amounts of vitamins C, B, A and salts of iron, phosphorous, calcium and lycopene. The process of fertilizing or adding nutrients to plants is a basic process to obtain the highest yield and the best quality at the lowest costs by increasing the efficiency of the composting process by choosing the appropriate type of fertilizer for a particular plant, in a specific soil, at the right time, in the appropriate quantity and the appropriate method used to add it, which would achieve the best response by the plant for this fertilizer. Organic fertiliser extract is one of the best ways to use organic fertilisers since it contains several healthy

elements, and organic acids can benefit and useful to encourage plants for good growth [Chitgupekar *et al.* (2014)]. Al-Naamey and Najm (1990) mentioned that organic extract foliar spraying on vegetative growth or by ground fertilization can be the best and efficient methods to uptake nutrients by plants. Organic extracts also play an important role in building the soil from an agricultural point of view, as it is a reserve source for plant nutrients, especially nitrogen, as the high acidity of organic acids increases the efficiency of soil with positive cations [Kok *et al.* (2010), Hussain and Najla (2014)], reduces nitrogen volatilization in the form of ammonia gas, and increases the efficiency of ammonium representation. The aim is to determine the impact of organic extracts and the methods for adding them to tomato plants grown in greenhouses on their growth and yield

2. Materials and Methods

The experiment was conducted in a greenhouse belonging to Al-Fares agricultural company during winter season 2019-2020. The experiment included two factors, the first factor used seven concentrations of organic extracts (control, Sheep manure extract (50g.L⁻¹), Sheep manure extract (100g.L⁻¹), Licorice roots extract (15 g.L⁻¹), Licorice roots extract (30 g.L⁻¹). Seaweed extract (tecamin) 1.5 ml.L⁻¹ and Seaweed extract (tecamin) 7.5 ml.L⁻¹) which are symbolized by (A0, A1, A2, A3, A4, A5, A6). The second factor

Table 1: Some physical and chemical properties of soil for the growing season 2019-2020.

Type of analysis	Unit	The value	References
EC	ds.m ⁻¹	3.13	Page <i>et al.</i> , (1982)
pH	-	7.11	
Total nitrogen	g.kg ⁻¹	22.12	
Ready phosphorous	g.kg ⁻¹	0.021	
Ready Potassium	g.kg ⁻¹	1.15	Black, 1965
Organic matter	%	0.64	
The proportion of clay	%	40.13	
Silt ratio	%	45.6	
Sand ratio	%	14.21	
Soil tissue	-	Silty clay	
Humidity at field capacity	%	30.13	

Table 2: Some chemical properties of sheep manure.

Mg	Ca	k	p	C:N Ratio	Total N	Total C	PH	EC
1.0	0.5	2.5	2.1	18.2	19.8	322.4	7.8	17

included the adding method of organic extracts (foliar spraying on the vegetative growth of plant and ground fertilization) which are symbolized by (B1, B2) to study the effect on growth and yield of hybrid tomato cultivar (Norra). The chemical and physical properties of the experiment greenhouse soil are shown in Table 1. Sheep manures fertilizer and Licorice roots powder were soaked in water for one week to make sure to dissolve a maximum quantity of powder and until the organic extracts is obtained [Al-Abdali (2002)]. Tables 2 and 3 show some chemical and physical properties of Sheep manures and Licorice roots extract used in the experiment while Seaweed extract (tecamin) produced in Egypt used depend on fertilization recommendation at 1.5 and 7.5 ml L⁻¹ (Table 4). The soil of Lath house was tillaged three times, smoothed and divided into 6 lines, the distance between line and other was 1.25m, length of each line 38m was divided into 7 experiment units, the drip irrigation system was used to irrigated plants in lines. The seedlings of unlimited growth of hybrid tomato (Nora) plants were produced under Lath house conditions. The seeds were cultivated in cork trays, and after they reached the age of 45 days, they were transferred to the greenhouse on 1/10/2019 and the plants were sprayed with treatments 5 times throughout the experiment period.

The factorial experiment was conducted as a split plots system according to Randomized Complete Block Design (RCBD) with three replicates. The adding method considered as main-plot, while the concentration of organic extract as a sub - plot [Al-Rawi and Khalf alah (1980)].

Table 3: Some components of licorice root.

Chemical compound	Percentage%
glycerin	24-4
Reducing sugars	3-15
starch	3-2
flavonoids	1
Volatile oils	0.04
Amino acids	1-2
mephalonic	10.55
humidity	7.8-5
other materials and compounds	12-26

Table 4: Some components of algae extract Tecamin.

Composite	The ratio
Organic matter	45-55%
Potassiumk20	6%
Total nitrogen	0.5-1.5%
Phosphorous p2o5	18-22%
magnesium	0.42-0.60%
copper	20-45%
iron	0.15-0.3%
iodine	300-600
sulfur	1.5-2.5%
calcium	0.4-1.6%
Alganic acid	10-12%

Studied traits

Plant height (cm), Leaf area (cm²), leaves number (leave plant⁻¹), Number of inflorescence (inflorescence plant⁻¹), Total number of flowers (flower plant⁻¹), Leaves total chlorophyll content (ml.100g⁻¹ fresh weight). The percentage of N, P, K in leaves (%), Plant yield (Kg plant⁻¹), Early yield (Kg plant⁻¹), Total yield (Kg m⁻²) were studied.

3. Results and Discussion

Plant height

Table 5 showed a significant effect of organic extracts, where the treatment Sheep manure extract (100g.L⁻¹) significantly excelled and gave the highest values for plant height reached 176.35cm, while the control treatment gave the lowest value amounted to

118.25cm.

The ground fertilization method significantly excelled on the foliar spraying and gave the highest values for plant height amounting to 151.89cm, while there are no significant differences between bi-interaction.

Leaf area (cm²)

Table 6 showed a significant effect of organic extracts, where the treatment Sheep manure extract (100g.L⁻¹) significantly excelled and gave the highest values for Leaf area reached 394.0cm², while the control treatment gave the lowest value amounted to 241.6cm².

The ground fertilization method significantly excelled on the foliar spraying and gave the highest values for Leaf area amounting to 308.4cm², while the interaction treatment Sheep manure extract (100g.L⁻¹) and foliar spraying excelled and gave the highest values for Leaf area reached 396.1cm².

Leaves number (leaf.plant⁻¹)

Table 7 showed a significant effect of organic extracts, where the treatment Sheep manure extract (100g.L⁻¹) significantly excelled and gave the highest values for number of leaves(leave.plant⁻¹) reached 25.88 leave.plant⁻¹, while the control treatment gave the lowest value amounted to 23.31 leave.plant⁻¹

The ground fertilization method significantly excelled on the foliar spraying and gave the highest values for number of leaves amounting to 23.31 leave.plant⁻¹, while the interaction treatment Sheep

Table 5: The effect of organic extracts and method of addition and the interaction between them on plant height (cm).

The effect of organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	114.00	122.50	118.25
Sheep manure extract(50g.L ⁻¹)	164.23	172.23	168.23
Sheep manure extract(100g.L ⁻¹)	173.20	179.50	176.35
Licorice root extract(15g.L ⁻¹)	118.43	129.17	123.80
Licorice root extract(30 g.L ⁻¹)	129.23	143.83	136.53
Seaweed extract(7.5ml.L ⁻¹)	142.17	151.43	146.80
Seaweed extract(1.5ml.L ⁻¹)	158.47	164.53	161.50
Average effect of addition method	142.82	151.89	
L.S.D(0.05)	Extract	addition method	Interaction
	4.41	8.34	n.s

manure extract (100g.L⁻¹) and foliar spraying excelled and gave the highest values for number of leaves reached 26.33 leave.plant⁻¹ while the control treatment gave the lowest value amounted to 15.87 leave.plant⁻¹.

Inflorescence number

Table 8 showed a significant effect of organic extracts on Inflorescence number, where the treatment Licorice root extract (30 g.L⁻¹) significantly excelled and gave the highest values for Inflorescence number reached 8.95 Inflorescence.plant⁻¹, while the control treatment gave the lowest value amounted to 5.59 Inflorescence.plant⁻¹.

The ground fertilization method significantly excelled on the foliar spraying and gave the highest values for number of Inflorescence amounting to 7.81

Inflorescence.plant⁻¹, while the interaction treatment Licorice root extract (30 g.L⁻¹) and foliar spraying excelled and gave the highest values for number of Inflorescence reached 8.96 Inflorescence.plant⁻¹ while the control treatment gave the lowest value amounted to 4.92 Inflorescence.plant⁻¹.

Total number of flowers

Table 9 showed a significant effect of organic extracts on Total flowers number, where the treatment Licorice root extract (30 g.L⁻¹) significantly excelled and gave the highest values for Total flowers number reached 7.85 flowers.plant⁻¹, while the control treatment gave the lowest value amounted to 4.16 flowers.plant⁻¹

The ground fertilization method significantly

Table 6: The effect of organic extracts and method of addition and the interaction between them on the leaves area (cm).

The effect of organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	235.5	247.8	241.6
Sheep manure extract(50g.L ⁻¹)	396.1	393.1	394.0
Sheep manure extract(100g.L ⁻¹)	322.6	383.5	353.0
Licorice root extract(15g.L ⁻¹)	272.6	284.1	278.4
Licorice root extract(30 g.L ⁻¹)	299.6	301.1	300.4
Seaweed extract(7.5ml.L ⁻¹)	296.5	286.9	291.7
Seaweed extract(1.5ml.L ⁻¹)	253.2	262.2	257.7
Control	296.6	308.4	
L.S.D(0.05)	Extract	addition method	Interaction
	12.9	21.77	n.s

Table 7: The effect of organic extracts and method of addition and the interaction between them on the total number of leaves (leave.plant⁻¹).

The effect of organic extracts	effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	15.87	19.19	17.53
Sheep manure extract(50g.L ⁻¹)	24.43	25.00	24.71
Sheep manure extract(100g.L ⁻¹)	25.43	26.33	25.88
Licorice root extract(15g.L ⁻¹)	20.54	21.13	20.83
Licorice root extract(30 g.L ⁻¹)	22.98	23.99	23.48
Seaweed extract(7.5ml.L ⁻¹)	21.34	24.65	22.99
Seaweed extract(1.5ml.L ⁻¹)	20.65	22.87	21.90
Average effect of addition method	21.60	23.31	
L.S.D(0.05)	Extract	addition method	Interaction
	0.56	1.23	n.s

excelled on the foliar spraying and gave the highest values for number of flowers amounting to 6.71 flowers.plant⁻¹, while the interaction treatment Licorice root extract (30 g.L⁻¹) and foliar spraying excelled and gave the highest values for number of flowers reached 7.87 flowers.plant⁻¹ while the control treatment gave the lowest value amounted to 3.86 flowers.plant⁻¹.

Leaves content of total chlorophyll (ml.100g⁻¹ fresh weight)

Table 10 showed a significant effect of organic extracts on chlorophyll content, where the treatment Seaweed extract (7.5ml.L⁻¹) significantly excelled and gave the highest values for chlorophyll content reached 53.65 ml.100g⁻¹ fresh weight, while the control

treatment gave the lowest value amounted to 40.28 ml.100g⁻¹ fresh weight.

The foliar spraying significantly excelled on the ground fertilization method and gave the highest values for chlorophyll content amounting to 46.83, while the interaction treatment Seaweed extract (7.5ml.L⁻¹) and foliar spraying excelled and gave the highest values for chlorophyll content reached 53.93 ml.100g⁻¹ fresh weight while the control treatment gave the lowest value amounted to 40.73 ml.100g⁻¹ fresh weight.

Total N percentage (%)

Table 11 showed a significant effect of organic extracts on N percentage (%), where the treatment Seaweed extract (7.5ml.L⁻¹) significantly excelled and

Table 8: The effect of organic extracts and method of addition and the interaction between them on number of flowering inflorescences.

The effect of organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	4.92	6.25	5.59
Sheep manure extract(50g.L ⁻¹)	6.80	6.50	6.65
Sheep manure extract(100g.L ⁻¹)	7.80	7.55	7.68
Licorice root extract(15g.L ⁻¹)	8.84	8.87	8.86
Licorice root extract(30 g.L ⁻¹)	8.95	8.96	8.95
Seaweed extract(7.5ml.L ⁻¹)	6.93	7.59	7.26
Seaweed extract(1.5ml.L ⁻¹)	8.32	8.92	8.62
Average effect of addition method	7.50	7.81	
L.S.D(0.05)	Extract	addition method	Interaction
	0.43	0.24	0.57

Table 9: The effect of organic extracts and method of addition and the interaction between them on the total number of flowers (flower.plant⁻¹).

The effect of Organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	3.86	4.46	4.16
Sheep manure extract(50g.L ⁻¹)	5.71	6.77	6.24
Sheep manure extract(100g.L ⁻¹)	6.73	7.79	7.27
Licorice root extract(15g.L ⁻¹)	7.77	7.87	7.82
Licorice root extract(30 g.L ⁻¹)	7.87	7.84	7.85
Seaweed extract(7.5ml.L ⁻¹)	4.73	5.51	5.12
Seaweed extract(1.5ml.L ⁻¹)	6.19	6.78	6.49
Average effect of addition method	6.12	6.71	
L.S.D(0.05)	Extract	addition method	interaction
	0.35	0.38	0.49

gave the highest values for chlorophyll content reached 4.82 (%), while the control treatment gave the lowest value amounted to 2.37%. The foliar spraying significantly excelled on the ground fertilization method and gave the highest values for N percentage amounting to 5.72%, while the interaction treatment Seaweed extract (7.5ml.L⁻¹) and ground fertilization methods excelled and gave the highest values for N percentage reached 4.83 % while the control treatment gave the lowest value amounted to 2.41%.

Total P percentage (%)

Table 12 showed a significant effect of organic extracts on P percentage (%), where the treatment Seaweed extract (7.5ml.L⁻¹) significantly excelled and gave the highest values for P percentage reached 0.48%, while the control treatment gave the lowest value amounted to 0.21%. The foliar spraying significantly excelled on the ground fertilization method and gave the highest values for P percentage amounting to 0.38%, while the interaction treatment Seaweed extract (7.5ml.L⁻¹) and foliar spraying excelled and gave the highest values for N percentage (%) reached 0.57% while the control treatment and ground fertilization method gave the lowest value amounted to 0.19%.

Total K percentage (%)

Table 13 showed a significant effect of organic extracts on K percentage (%), where the treatment Seaweed extract (7.5ml.L⁻¹) significantly excelled and gave the highest values for K percentage reached 3.85%, while the control treatment gave the lowest value amounted to 1.37%. The treatments of the

addition method did not show any significant differences between them while the interaction treatment Seaweed extract (1.5ml.L⁻¹) and foliar spraying excelled and gave the highest values for K percentage (%) reached 3.87% while the control treatment and ground fertilization method gave the lowest value amounted to 1.35%.

Plant yield (Kg plant⁻¹)

Table 14 showed a significant effect of organic extracts on Plant yield (Kg plant⁻¹), where the treatment Sheep manure extract (100g.L⁻¹) significantly excelled and gave the highest values for Plant yield reached 3.09 (Kg plant⁻¹), while the control treatment gave the lowest value amounted to 1.33 Kg plant⁻¹. The ground fertilization method significantly excelled on the ground fertilization method and gave the highest values for Plant yield amounting to 2.57 Kg plant⁻¹, while the interaction treatment Sheep manure extract (100g.L⁻¹) and foliar spraying excelled and gave the highest values for Plant yield reached 3.32 Kg plant⁻¹ while the control treatment and ground fertilization method gave the lowest value amounted to 1.28 Kg plant⁻¹.

Early yield (Kg plant⁻¹)

Table 15 showed a significant effect of organic extracts on Early yield (Kg plant⁻¹), where the treatment Sheep manure extract (100g.L⁻¹) significantly excelled and gave the highest values for Early yield reached 4.10 (Kg plant⁻¹), while the control treatment gave the lowest value amounted to 2.31 Kg plant⁻¹. The ground fertilization method significantly excelled on the ground fertilization method and gave the highest values for Early yield amounting to 3.64 Kg plant⁻¹, while the interaction

Table 10: The effect of organic extracts and method of addition and the interaction between them on the total chlorophyll concentration in the leaves (ml.100g⁻¹ fresh weight).

The effect of Organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	40.73	39.83	40.28
Sheep manure extract(50g.L ⁻¹)	42.27	41.03	41.65
Sheep manure extract(100g.L ⁻¹)	44.30	45.07	44.68
Licorice root extract(15g.L ⁻¹)	50.43	42.67	46.55
Licorice root extract(30 g.L ⁻¹)	46.90	46.80	46.85
Seaweed extract(7.5ml.L ⁻¹)	49.23	49.40	49.26
Seaweed extract(1.5ml.L ⁻¹)	53.93	53.37	53.65
Average effect of addition method	46.83	45.45	
L.S.D(0.05)	Extract	addition method	Interaction
	1.07	0.44	1.41

treatment Sheep manure extract (100g.L⁻¹) and foliar spraying excelled and gave the highest values for Early yield reached 4.25 Kg plant⁻¹ while the control treatment and foliar spraying method gave the lowest value amounted to 2.10 Kg plant⁻¹.

Total yield (Kg m⁻²)

Table 16 showed a significant effect of organic extracts on Total yield (Kgm⁻²), where the treatment Sheep manure extract (100g.L⁻¹) significantly excelled and gave the highest values for Total yield reached 10.88 (Kgm⁻²), while the control treatment gave the lowest value amounted to 4.43 Kgm⁻². The ground fertilization method significantly excelled on the ground

fertilization method and gave the highest values for Total yield amounting to 8.54 Kgm⁻², while the interaction treatment Sheep manure extract (100g.L⁻¹) and foliar spraying excelled and gave the highest values for Total yield reached 11.05 Kgm⁻² while the control treatment and foliar spraying adding method gave the lowest value amounted to 4.25 Kgm⁻².

The results in Tables 15 and 16 showed that the organic extract excelled in all studies traits may be due to containing high amount of nutrients such as N, P, K, Fe, Cu, Zn, Mg and these mineral nutrients affect significantly on increased photosynthesis and increased plant growth because this nutrients inter on plant metabolism and finally increased plant growth or may

Table 11: The effect of organic extracts and method of addition and the interaction between them on the total nitrogen concentration in leaves (%).

The effect of Organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	2.41	2.34	2.37
Sheep manure extract(50g.L ⁻¹)	2.38	2.26	2.32
Sheep manure extract(100g.L ⁻¹)	3.38	2.39	2.84
Licorice root extract(15g.L ⁻¹)	4.54	4.47	4.50
Licorice root extract(30 g.L ⁻¹)	4.53	3.95	4.04
Seaweed extract(7.5ml.L ⁻¹)	4.13	3.95	4.81
Seaweed extract(1.5ml.L ⁻¹)	4.81	4.83	4.82
Average effect of addition method	5.72	3.43	
L.S.D(0.05)	Extract	addition method	interaction
	0.22	n.s	n.s

Table 12: The effect of organic extracts and method of addition and the interaction between them on the total phosphorus concentration in leaves (%).

The effect of Organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	0.22	0.19	0.21
Sheep manure extract(50g.L ⁻¹)	0.27	0.20	0.24
Sheep manure extract(100g.L ⁻¹)	0.33	0.22	0.27
Licorice root extract(15g.L ⁻¹)	0.36	0.32	0.34
Licorice root extract(30 g.L ⁻¹)	0.36	0.34	0.35
Seaweed extract(7.5ml.L ⁻¹)	0.58	0.36	0.47
Seaweed extract(1.5ml.L ⁻¹)	0.57	0.39	0.48
Average effect of addition method	0.38	0.28	
L.S.D(0.05)	Extract	addition method	interaction
	0.38	0.28	n.s

be due to stimulating physiological functions in tomato plant because the high content of macronutrients in organic extract and different encouraging growth materials and increasing the activity of Protease and Phosphatase enzymes in organically composted soils compared to conventional farming soils. On the other hand, organic extracts contain natural growth regulators such as auxin, amino acids, humic and fulvic, which affect plant growth, and organic matter is a major store of ions necessary for growth [Singh *et al.* (2012)]. It is a source of ready-made ammonium, increases the mobility and readiness of phosphorous and micro-nutrients, and increases the ability of the soil to retain moisture that lead increased the studies traits [Hegab *et al.* (2005)]. As for the method of adding organic

extracts where foliar spraying is one of the successful methods to treat the lack of elements, especially the smaller ones, Because many nutrients provided to the soil are only utilised in small amounts by the plant, their readiness is reduced as a result of their deposition or fixation, which negatively affects the growth of the plant. The use of foliar spraying is economical compared to ground fertilization by reducing the amount of ground fertilizer, which is expensive, as well as ensuring the rapid response of the plant to foliar spraying [Al-Amiri *et al.* (2014)], then increase the absorption of nutrients, especially nitrogen and potassium, which have an important role in increasing plant growth through their role in the process of photosynthesis and the transport of carbohydrates, and that the deficiency of these two

Table 13: The effect of organic extracts and method of addition and the interaction between them on the total potassium concentration inleaves (%).

The effect of Organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	1.40	1.35	1.37
Sheep manure extract(50g.L ⁻¹)	1.45	1.40	1.42
Sheep manure extract(100g.L ⁻¹)	3.29	2.41	2.85
Licorice root extract(15g.L ⁻¹)	3.36	3.16	3.26
Licorice root extract(30 g.L ⁻¹)	3.48	3.37	3.42
Seaweed extract(7.5ml.L ⁻¹)	3.87	3.83	3.83
Seaweed extract(1.5ml.L ⁻¹)	3.83	3.83	3.85
Average effect of addition method	2.96	2.96	
L.S.D(0.05)	Extract	addition method	interaction
	2.76	2.96	0.36

Table 14: The effect of organic extracts and method of addition and the interaction between them on per plant yield (gm.plant⁻¹).

The effect of Organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	1.28	1.38	1.33
Sheep manure extract(50g.L ⁻¹)	3.13	3.15	3.14
Sheep manure extract(100g.L ⁻¹)	3.22	3.32	3.27
Licorice root extract(15g.L ⁻¹)	2.65	2.68	2.67
Licorice root extract(30 g.L ⁻¹)	3.07	3.12	3.09
Seaweed extract(7.5ml.L ⁻¹)	1.95	2.03	1.99
Seaweed extract(1.5ml.L ⁻¹)	2.24	2.26	2.25
Average effect of addition method	2.50	2.57	
L.S.D(0.05)	Extract	addition method	interaction
	0.10	0.01	n.s

Table 15: The effect of organic extracts and method of addition and the interaction between them on early plant yield (gm.plant⁻¹).

The effect of Organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	2.10	2.51	2.31
Sheep manure extract(50g.L ⁻¹)	3.95	4.25	4.10
Sheep manure extract(100g.L ⁻¹)	3.95	4.18	4.06
Licorice root extract(15g.L ⁻¹)	2.93	3.21	3.10
Licorice root extract(30 g.L ⁻¹)	3.55	3.74	3.64
Seaweed extract(7.5ml.L ⁻¹)	3.92	3.94	3.93
Seaweed extract(1.5ml.L ⁻¹)	3.66	3.81	3.73
Average effect of addition method	3.46	3.64	
L.S.D(0.05)	Extract	addition method	interaction
	1.07	n.s	n.s

Table 16: The effect of organic extracts and method of addition and the interaction between them on total plant yield (plant.m²).

The effect of Organic extracts	Effect of addition method		Average effect of Organic extract
	Fertilization	Foliar	
Control	4.25	4.61	4.43
Sheep manure extract(50g.L ⁻¹)	10.42	10.49	10.46
Sheep manure extract(100g.L ⁻¹)	10.71	11.05	10.88
Licorice root extract(15g.L ⁻¹)	6.50	6.77	6.63
Licorice root extract(30 g.L ⁻¹)	7.46	7.53	7.49
Seaweed extract(7.5ml.L ⁻¹)	10.22	10.38	10.30
Seaweed extract(1.5ml.L ⁻¹)	8.84	8.92	8.88
Average effect of addition method	8.34	8.54	
L.S.D(0.05)	Extract	addition method	interaction
	0.33	0.04	n.s

elements (N, K) leads to a decrease in growth and yield [Al-Saad (2000)]. These results agreed with results of Al-Zeridi and Hoda (2017), Al-Amery *et al.* (2014) on tomato plant and Abd AL-Hseen and Manea (2020) on Cauliflower plant

4. Conclusion

It is concluded from the study that there are significant differences between the adding methods where the ground fertilization method excelled in most of the traits of vegetative, flowering and yield. The sheep manure extract 100 g.L⁻¹ and the licorice root extract 30g.L⁻¹ significantly excelled in most of the studied traits.

5. Recommendations

1. It is recommended to use the ground fertilization a method to obtain the best traits of vegetative, flowering growth and yield.
2. It is recommended to adopt organic extracts as a substitute for chemical fertilizer that pollute soil and plants.
3. It is also recommended that more studies be done on other types of organic extracts and applied to other plants.

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