Response of apple seedlings, Sharabi cultivar, to some organic plant residues, biofertilizers, and foliar spraying with seaweed extract

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Abstract

This study was conducted in the Najaf Specialized Nursery of the Ministry of Agriculture / Najaf province for the period from September 2021 to June 2022. To study the effect of plant residues, biofertilizers and foliar spraying with seaweed extract on some vegetative, root and leaf content of growth regulators for apple seedlings, Sharabi cultivar, one and a half years age, which were planted in the nursery ground. 324 seedlings were selected with homogeneous growth and size as much as possible and it was implemented as a factorial experiment (4 * 3 * 3) by designing randomized complete block design with three replications. Each replicate includes 108 seedlings, with 3 seedlings for each experimental unit and with three factors if the first factor includes: Four ground additions of organic plant residues, which included (palm fronds residues at an average of 1 kg. seedlings^{-1}, rice residues at an average of 1 kg. seedlings^{-1}, a mixture of palm fronds residues and rice residues at a rate of 1 kg. seedlings^{-1} in addition to the control treatment (no addition) .As for the second factor, it is the ground addition of biofertilizers and with three additions (the control treatment (non-addition), a mixture of three types of bacteria (Azotobacter, Bacillus and Pseudomonas at a rate of 10 ml. seedlings $^{-1}$, Mycorrhiza 10 g. seedlings $^{-1}$). While the third factor included three concentrations of foliar spray with seaweed extract (0, 2, 4 ml. L^{-1}), and the service operations were conducted equally for all treatments. The results were as follows: The results of the statistical analysis for the least significant difference (L.S.D) at the probability level of 0.05 showed that the triple intervention treatment was significantly superior to all treatments between (ground application of palm frond waste with rice at average of 1 kg. seedling-1 and ground application between mycorrhizae at a rate of 10 g. seedling-1). Foliar spraying with seaweed extract at a concentration of 4 ml.L-1 in all the studied traits represented by (leaf chlorophyll content, percentage of carbohydrates in leaves, leaf nutrient content (nitrogen, phosphorus, potassium, boron and iron). Which gave (49.37 SPAD, 34.74%, 2.300%, 0.650%, 2.290%, 38.31 mg.kg-1, 88.00 mg.kg-1) respectively compared to the control treatment, which recorded the lowest rate for these traits amounting to (31.20 SPAD, 11.41%). , 0.800%, 0.180%, 1.070%, 20.50 mg.kg-1, 40.05 mg.kg-1), respectively.

Keywords: Seaweed extract, apples, bacteria, mycorrhiza, foliar spray
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ancient times. It is believed that its original home is the Caucasus, Central Asia and western China (Al-Halabi et al., 2009). In Mesopotamia, its cultivation has been known since the beginning of human settlement at the end of the fifth

Introduction:

The apple (Malus domestica (Apple) is one of the deciduous fruit trees, and its cultivation is one of the oldest existing crops in the world. It has been known to man since

fungi, which are obtained from isolation and multiplication of microorganisms in suitable farms, then they are kept in suitable conditions until they are used to pollute the roots or the soil (Mahmoud et al., 1997). In another study, Al-Taie (2020) noticed when adding Mycorrhiza and Azotobacter bacteria to the roots of orange seedlings, a significant increase in the rate of the studied and represented traits, and seaweed extracts are considered important additions to plant nutrition because these extracts contain macro and micro elements in addition to auxins, cytokines and gibberellins and when sprayed On plants, it increases the vegetative and root system (Craigie, 2011), It also works to increase the efficiency of the photosynthesis process, and these extracts contain betaine, which is a good and important source of nitrogen in its low concentrations, in addition to being a regulator of osmosis in high concentrations, which increases the plant's resistance to salinity and drought. Among these extracts is the extract of aljarayn, which contains macro and micro nutrients, auxins, cytokines and amino acids, which are available and easily absorbed by the plant (Stirk et al., 2003), In a study, Al-Janabi et al. (2017) found a significant increase in the studied traits when spraying fig seedlings of Aswed Diyala cultivar with Algazone seaweed extract at three concentrations (8,6,4 ml. l-1.(Given the importance of these factors and their important role in plant growth and development, this study came with the aim of knowing the response of apple cultivar Sharabi seedlings to some biofertilizers, organic plant residues and foliar fertilization with seaweed extract.

Materials and methods:

The study was conducted in Al-Najaf Al-Ashraf Governorate (Al-Najaf Model Nursery) affiliated to the Ministry of Agriculture during the growing season 2021-2022. The experiment was conducted on seedlings of apple cultivar Al-Sharabi planted in the nursery at the age of one and a half years and planted in the soil of the field, 324 seedlings were selected of homogeneous growth and size as much as

millennium BC and during successive generations, and it was not given importance in its cultivation except in the sixties of the last century. As some foreign varieties were imported and multiplied in the country (Al-Nuaimi and Youssef Hanna, 1980), The apple occupies an advanced rank in the global ranking in fruit production, as its fruits are of high nutritional value, where they are rich in carbohydrates, protein and minerals. The fruits are used fresh or in the food industry, (Bal 2005). Fertilizers are added to plants naturally or synthetically to the soil or directly in order to provide the plant with one or more nutrients necessary for the growth and development of the plant. Plant waste is among the most important waste that has received wide attention in recent research because it is cheap and environmentally friendly compared to mineral fertilizers. It plays an important role in feeding the plant and supplying it with the important elements for the growth and development of the plant. The organic matter in the soil acts as a source of nutrients, improves the structure of the soil, and provides a source of food for microorganisms. It provides them with the energy and materials needed to build their bodies (Maerere et al., 2001 and Al-Shater et al., 2011). Adding organic matter to the soil improves its ability to hold water and increases the efficiency of the microorganisms present in it. Over time, the organic matter will provide the soil with the nutrients necessary for the plant's needs. Thus, it will reduce the need for fertilizing (Bell et al., 2008, Weil and Brady, 2003), In a study, Hadi (2017) found that by adding palm and wheat fronds residues to Helwani cultivar grape trees a significant increase in the studied traits represented by (plant height, leaf area, leaf content of regulators (auxins, cytokines, gibberellins). As for bio-fertilizers, they play a fundamental and important role in stabilizing some nutrients important for plant growth and development, including nitrogen, as well as increasing the absorption of phosphorous from the soil. These fertilizers are Azotobacter, Bacillus and Pseudomonas bacteria, as well as mycorrhiza

palm fronds residues at a rate of 1 kg. seedling^{-1}, rice residues at a rate of 1 kg. seedlings^{-1}, a mixture of palm fronds residues and rice residues at a rate of 1 kg. seedlings^{-1}.As for the second factor, it included biological fertilization with fungi and bacteria, which included three ground additives: (the control treatment.

A bacterial mixture that includes three types of bacteria: Azotobacter, Bacillus and Pseudomonas at a rate of 10 ml. 1 seedlings

, Biofertilization with MYCORRHIZA fungus at a rate of 10 g. seedlings $^{-1}$). As for the third factor, it included:. Spraying with seaweed extract in three concentrations: (The comparison treatment, 2 ml. L^{-1}., 4 ml. L^{-1}).

possible. The service operations were conducted equally for all transactions, and the soil was analyzed in Table (1), A factorial experiment with three factors (4 * 3 * 3) was carried out by designing randomized complete block design and with three replications, as each iterator includes 108 seedlings with 3 seedlings for each experimental unit, and the first factor included organic plant residues (palm fronds and rice residues). The rice residues were obtained from the Organic Agriculture Center in Najaf, affiliated to the Ministry of Agriculture. As for the remnants of palm fronds, they were obtained from the Organic Agriculture Center in Babylon and were analyzed in Table (2), which included four ground additions: (comparison treatment,

Table (1): Some chemical and physical characteristics of the soil in which seedlings grow

values	units	separated
740	g.kg^{-1} soil	sand
180	g.kg^{-1} soil	silt
80	g.kg^{-1} soil	Clay
sandy	--------	texture
2.24	Ds.m^{-1}	Electrical conductivity (Ec)
7.12	---------	pH
	mg.kg^{-1}	available nitrogen
	mg.kg^{-1}	available phosphorous
	mg.kg^{-1}	available potassium

Table (2): Some traits of the plant organic residues used in the experiment

units	rice residue	Palm fronds	traits
dSm-1	3.24	2.97	EC . electrical conductivity
-----	6.33	5.87	pH
gm kg-1			nitrogen
gm kg-1			phosphorous
gm kg-1			potassium
gm kg-1			organic carbon
gm kg-1			Organic matter
-----			N/C . ratio
-----			P/C . ratio

Table (3) shows the symbols used in the experiment

Treatments	Treatments symbol	Type of treatments
Organic waste (plant(	E0	control treatment (without adding ground)
	E1	Rice residues at an average of 1 kg. Seedlings -1
	E2	Palm fronds residues at an average of 1 kg. seedlings -1
	E3	Rice residues with palm fronds at an average of 1 kg. seedlings -1
biofertilizers	B0	control treatment (without adding ground)
	B1	Add bacteria at an average of 10 ml. seedlings-1
	B2	Add mycorrhiza at an average of 10 g. seedlings -1
Foliar spray with seaweed extract	A0	control treatment (without foliar spray)
	A1	Foliar spray at a concentration of 2 ml. L-1.
	A2	Foliar spray at a concentration of 4 ml. L-1.

efficiency of the plants in absorbing the sprayed substance. Moisture has a role in the process of swelling the guard cells and opening stomata, in addition to the fact that watering before spraying reduces the concentration of solutes in the leaf cells, thus increasing the penetration of the ions of the spray solution into the leaf cells (Al-Sahhaf, 1988).

Studied traits:

1- The chlorophyll content of the leaves (SPAD). The chlorophyll content of the leaves was estimated using a Soil Plant Analysis Device 502 (Chlorophyll Meter) equipped by the Japanese company Minolta Co.LTD. The reading was taken for three leaves from different places for each seedling and the average was calculated for each seedling. Then calculate the average for each experimental unit (Jemison and Williams, 2006)

2-Percentage of carbohydrates in leaves:. It was estimated according to the method (Joslyn, 1970)

3-Nitrogen content of leaves (%):. Total nitrogen was estimated using a Microkieldahl device (Paesons and Cresser, 1979)

4- Phosphorus content of leaves (%): Phosphorus was determined using the ammonium molybdate method, and after color development, the

The mycorrhizal fungus (G. mosseae) inoculum 50×10-8 was used, which was obtained from (Biofertilizers Laboratory in the Agricultural Research Department), which consisted of (spores + infected mycorrhizal roots + dry soil),The inoculum was tested to ensure the presence of pure spores by wet sieving and decanting, and it was added to the soil after placing it near the roots of the apple seedlings, according to the method suggested by (Gerdmann and Nicolson, 1963).As for the bacterial vaccine, a vaccine of three types was used: Azotobacter, Bacillus and Pseudomonas in liquid form, which was obtained from the (Bio-Fertilizer Laboratory in the Agricultural Research Department). It was added to the soil after placing it near the roots of apple seedlings. As for the spraying process with seaweed extract, it was sprayed with three times, where the first spray was tried on 3/15/2022, the second spray was on 1/4/2022 and the third spray was applied on 4/15/2022. Compared to distilled water only, A 20-liter hand sprayer was used, and the spraying process was carried out in the morning until the seedlings were completely wet. The watering process was conducted for the seedlings one day before the spraying process to increase the

treatment with seaweed extract, it was recorded. Treatment A2 with a rate of 4 ml.L^{-1} had the highest rate of 41.22 SPAD compared to the control treatment A0, which recorded the lowest rate of 39.90 SPAD. As for the bi- interaction treatments, the bi- interaction treatment between plant residues and bio fertilizers gave a significant effect to the treatment (E3 B2) by giving it the highest rate of chlorophyll content in the leaves, amounting to 47.99 SPAD, compared to the control treatment (E0B0), which recorded the lowest rate for the same trait, amounting to 32.83 SPAD. For the bi- interaction between biofertilizers and foliar spraying with seaweed extract, the treatment (B2A2) recorded the highest rate of 42.85 SPAD, while the control treatment (B0A0) recorded a clear decrease of 38.68 SPAD. We note from the same table that the bi- interaction between plant residues and foliar spraying with seaweed extract had an effective effect. In the same respect, the treatment (E3A2) gave a significantly excelled of 47.45 SPAD compared to the control treatment (E0A0), which gave the lowest rate of 33.71 SPAD. As for the triple interaction between the experimental treatments (E*A*B), the treatment gave (E3B2A2) The highest average chlorophyll content in leaves was 49.37 SPAD, while the control treatment (E0B0A0) recorded the lowest value, amounting to 31.20 SPAD.

sample was read in a spectrophotometer at a wavelength of 620 nm (Paesons and Cresser, 1979)

5-Potassium content of leaves (%). Potassium was estimated using a flame photometer according to the recommendations of (Paesons and Cresser, 1979)

6- The boron content of the leaves was estimated using an Atomic Absorption Spectrophotometer according to the method (Chapman and Pratt, 1961)

7- The iron content of the leaves was estimated using an Atomic Absorption Spectrophotometer according to the method (Chapman and Pratt, 1961)

Results:

1- Leaves' chlorophyll content (SPAD)

It is noted from the results of Table (2) that there are significant differences between the treatments, as it is noted that organic fertilization led to an increase in the chlorophyll content of the leaves, where treatment 3E (a mixture between palm frond waste and rice at a rate of 1 kg. Seedling^{-1}) gave a significant effect for this trait it was given a higher A value of 46.82 SPAD, while the control treatment E0 gave the lowest rate of 34.52 SPAD. As for bio fertilizers, the ground addition treatment with mycorrhiza B2 over the rest of the treatments gave 42.16 SPAD compared to the control treatment B0, which recorded 39.25 SPAD. As for the foliar spraying

Table (2) The effect of organic fertilization with plant residues, biofertilization with some biofertilizers, and foliar spraying with seaweed extract and the interaction between them on the chlorophyll (SPAD) content of leaves for apple seedlings, Sharabi cultivar.

treatments						
	(Organic fertilizers (E					
B x A	E3	E2	E1	E0	Fertilization A	Bio fertilizers B
38.68	45.69	41.07	36.77	31.20	A0	B0
39.43	45.82	41.53	36.92	33.44	A1	
39.65	46.17	41.77	36.82	33.86	A2	
39.57	46.33	42.27	35.51	34.17	A0	B1
40.62	46.53	42.66	39.02	34.29	A1	

41.15	46.82	43.00	39.27	35.52	A2	
41.45	47.09	43.20	39.76	35.76	A0	B2
42.17	47.52	45.13	40.00	36.02	A1	
42.85	49.37	45.31	40.29	36.43	A2	
	46.82	42.88	38.26	34.52	E effect	
effect B						
39.25	45.89	41.46	36.84	32.83	B0	B x E
40.45	46.56	42.64	37.93	34.66	B1	
42.16	47.99 99999	44.55	40.02	36.07	B2	
effect A						
39.90	46.37	42.18	37.35	33.71	A0	A x E
40.74	46.62	43.11	38.65	34.58	A1	
41.22	47.45	43.66	38.79	35.27	A2	

B x A x E	B x A	A x E	B x E	A	B	E	LSD 0.05
7.982	3.991	4.608	4.608	2.304	2.304	2.661	

leaves, amounting to 33.66%, compared to the control treatment (E0B0), which recorded the lowest rate for the same trait, amounting to 12.14%. As for the bi- interaction between fertilizers Biodiversity and foliar spraying with seaweed extract. Treatment (B2A2) recorded the highest rate of 25.72%, while the control treatment (B0A0) recorded a clear decrease of 20.68%. We note from the same table that the bi-interaction between plant residues and foliar spraying with seaweed extract had a significant effect on the same trait. The treatment (E3A2) gave a significant superiority of 33.17% compared to the control treatment (E0A0), which gave the lowest rate of 13.49%. As for the triple interaction between the experimental treatments (BEA), a significant effect was found for the interaction of these factors, as the treatment (E3B2A2) gave the highest rate. The carbohydrate content of the leaves reached 34.74%, while the control treatment (E0B0A0) recorded the lowest value, amounting to 11.41%.

Carbohydrate content of leaves.:(%)

It is noted from the results of Table (3) that there are significant differences between the organic fertilization treatments for the carbohydrate content of the leaves, as treatment 3E (a mixture of palm fronds and rice at a average of 1 kg. seedling-1) gave a significant effect for this trait, amounting to 32.52%, while the control treatment E0 gave the lowest rate for this trait. It reached 14.34%. As for the effect of ground addition with biofertilizers, the treatment with mycorrhiza B2 recorded the highest significant effect on the rest of the treatments, which gave 25.02% compared to the control treatment B0, which recorded 21.52%. As for the foliar spray treatment with seaweed extract, treatment A2 was recorded at a concentration of 4 ml. L-1 had the highest rate of 24.05%, while the control treatment A0 recorded a clear decrease of 22.74%. As for the bi- interaction between plant residues and bio fertilizers, there was a significant effect of the treatment (E3B2) by giving it the highest average of carbohydrate content of

Table (3) The effect of organic fertilization with plant residues, biofertilization with some biofertilizers, and foliar spraying with seaweed extract and their interaction on the percentage of carbohydrates in the leaves of apple seedlings.

						treatments
B x A	(Organic fertilizers (E				Fertilization A	Bio fertilizers B
	E3	E2	E1	E0		
20.68	30.79	22.57	17.94	11.41	A0	B0
21.67	31.34	24.97	18.05	12.30	A1	
22.23	31.86	25.42	18.91	12.72	A2	
22.95	32.07	27.45	19.02	13.25	A0	B1
23.73	32.76	28.14	19.17	14.85	A1	
24.19	32.92	28.60	19.91	15.33	A2	
24.60	33.07	29.37	20.14	15.82	A0	B2
24.74	33.16	29.60	20.21	16.00	A1	
25.72	34.74	30.22	20.54	17.37	A2	
	32.52	27.37	19.32	14.34		E effect
effect B						
21.52	31.33	24.32	18.30	12.14	B0	B x E
23.62	32.58	28.06	19.37	14.48	B1	
25.02	33.66	29.73	20.30	16.40	B2	
effect A						
22.74	31.98	26.46	19.03	13.49	A0	A x E
23.38	32.42	27.57	19.14	14.38	A1	
24.05	33.17	28.08	19.79	15.14	A2	

B x A x E	B xA	A x E	B x E	A	B	E	
7.489	3.744	4.324	4.324	2.162	2.162	2.496	LSD 0.05

treatment with seaweed extract, treatment A2 was recorded at a concentration of 4 ml. L^{-1}, the highest rate for the same trait was 1.624% compared to the control treatment A0, which recorded the lowest rate of 1.537%. As for the bi-interaction treatments between plant residues and biofertilizers, an effect was found for the same trait. The results of the same table indicate that there is a significantly excelled for the treatment (E3B2) by giving it the highest rate of nitrogen content in the leaves, amounting to 2.233% compared to the control treatment (E0B0), which recorded the lowest rate of 0.880%. As for the bi- interaction between

3- Nitrogen content of leaves (%):

The results of Table (4) show that there are significant differences between the organic fertilization treatments with plant residues in the nitrogen content of the leaves, where treatment 3E (a mixture between palm frond waste and rice waste at a rate of 1 kg. seedling-1) recorded a clear significant effect for this trait, as the highest value was recorded. 2.103%, while the control treatment E0 gave the lowest rate, amounting to 1.032%. As for biofertilizers, the mycorrhizal treatment B2 gave the highest value, amounting to 1.716%, compared to the control treatment B0, which recorded 1.451%. As for the foliar spray

to the control treatment (E0A0), which gave the lowest rate of 33.71%.

As for the triple interaction between the experimental treatments (E*A*B), a significant effect was found for the interaction of these factors, as the treatment (E3B2A2) gave the highest rate of nitrogen content in the leaves, amounting to 49.37%, while the control treatment (E0B0A0) recorded the lowest value, amounting to 31.20%.

biofertilizers and foliar spraying with seaweed extract, the treatment (B2A2) recorded the highest rate of 42.85%, while the control treatment (B0A0) recorded a clear decrease of 38.68%. We note from the same table that the bi-interaction between plant residues and spraying The leaves with seaweed extract had a significant effect on the same trait. The treatment (E3A2) gave a significantly excelled of 47.45% compared

Table (4) The effect of organic fertilization with plant residues, biofertilization with some biofertilizers, and foliar spraying with seaweed extract) and the interaction between them on the nitrogen content of the leaves (%) of apple seedlings.

						treatments
	(Organic fertilizers (E					
B x A	E3	E2	E1	E0	Fertilization A	Bio fertilizers B
1.407	1.940	1.640	1.250	0.800	A0	
1.457	1.980	1.670	1.280	0.900	A1	
1.487	2.020	1.690	1.300	0.940	A2	B0
1.532	2.040	1.730	1.370	0.990	A0	
1.573	2.110	1.750	1.390	1.040	A1	B1
1.623	2.140	1.790	1.470	1.090	A2	
1.672	2.170	1.840	1.540	1.140	A0	
1.712	2.230	1.870	1.580	1.170	A1	B2
1.762	2.300	1.930	1.600	1.220	A2	
	2.103	1.768	1.420	1.032		E effect
effect B						
1.451	1.980	1.667	1.277	0.880	B0	
1.576	2.097	1.757	1.410	1.040	B1	B x E
1.716	2.233	1.880	1.573	1.177	B2	
effect A						
1.537	2.050	1.737	1.3871	0.977	A0	
1.581	2.107	1.763	1.417	1.037	A1	A x E
1.624	2.153	1.803	1.457	1.083	A2	

B x A x E	B xA	A x E	B x E	A	B	E	
0.250	0.125.	0.144	0.144	0.072	0.072	0.083	LSD 0.05

treatments in the phosphorus content of the leaves, as treatment 3E recorded a clear significant superiority for this trait, amounting to

4- Phosphorus content of leaves (%):

It is noted from the results of Table (5) that there are significant differences between the

0.190%. As for the bi- interaction between biofertilizers In foliar spraying with seaweed extract, the treatment (B2A2) recorded the highest rate of 0.433%, while the control treatment (B0A0) recorded a clear decrease of 0.325%. We note from the same table that the bi-interaction between plant residues and foliar spraying with seaweed extract had a significant effect on the same trait. The treatment (E3A2) gave a significant superiority of 0.587% compared to the control treatment (E0A0), which gave the lowest rate of 0.210%. As for the three-way interaction between the experimental treatments (E*A*B), a significant effect was found for the interaction of these factors, as the treatment gave (E3B2A2 The highest rate of phosphorus content of leaves was 0.650%, while the control treatment (E0B0A0) recorded the lowest rate of 0.180%.

0.418%, while the control treatment E0 gave the lowest rate, amounting to 0.032%. As for the role of biofertilizers, the results of the same table may indicate The treatment with mycorrhizal B2 gave a significant superiority over the rest of the treatments, which gave 0.415% compared to the control treatment B0, which recorded the lowest rate of 0.335%. As for the foliar spraying treatment with seaweed extract, treatment A2, at a concentration of 4 ml.l-1, recorded the highest rate of 0.389%. Compared to the control treatment, it was A0, which recorded the lowest rate of 0.362%. As for the bi- interaction between plant residues and bio fertilizers, the treatment (E3B2) recorded a significant effect by giving it the highest rate of phosphorus content in the leaves, amounting to 0.587%, compared to the control treatment (E0B0), which recorded the lowest rate for the same trait, amounting to

Table (5) The effect of organic fertilization with plant residues, biofertilization with some biofertilizers, and foliar spraying with seaweed extract and the interaction between them on the phosphorus content (%) of apple seedlings in the leaves.

						treatments
	(Organic fertilizers (E				Fertilization A	Bio fertilizers B
B x A	E3	E2	E1	E0		
0.325	0.520	0.340	0.260	0.180	A0	B0
0.335	0.520	0.370	0.270	0.180	A1	
0.344	0.530	0.370	0.267	0.210	A2	
0.360	0.550	0.400	0.280	0.210	A0	B1
0.375	0.560	0.420	0.300	0.220	A1	
0.390	0.580	0.440	0.310	0.230	A2	
0.400	0.600	0.450	0.310	0.240	A0	B2
0.413	0.600	0.470	0.330	0.250	A1	
0.433	0.650	0.500	0.330	0.250	A2	
	0.418	0.295	0.219	0.032	E effect	
effect B						
0.335	0.557	0.397	0.266	0.190	B0	B x E
0.375	0.560	0.420	0.297	0.220	B1	
0.415	0.587	0.437	0.323	0.247	B2	
effect A						
0.362	0.557	0.397	0.283	0.210	A0	A x E
0.374	0.560	0.420	0.300	0.217	A1	

0.389	**0.587**	**0.437**	**0.302 22 14 2**	**0.230**	**A2**		
B x A x E	**B xA**	**A x E**	**B x E**	**A**	**B**	**E**	**LSD 0.05**
0.182	**0.091**	**0.105**	**0.105**	**0.052**	**0.052 6**	**0.060 .**	

amounting to 2.237% compared to the control treatment (E0B0), which recorded the lowest rate for the same trait, amounting to 1.123%. As for the bi- interaction between Biofertilizers and foliar spraying with seaweed extract. Treatment (B2A2) recorded the highest rate of 1.830%, while the control treatment (B0A0) recorded the lowest rate of 1.545%. We note from the same table that the bi- interaction between plant residues and foliar spraying of seaweed extract gave a significant effect on content The leaves contain potassium. The treatment (E3A2) gave a significantly excelled of 2.180% compared to the control treatment (E0A0), which gave the lowest rate of 1.190%.

As for the triple interaction between the experimental treatments (E*A*B), a significant effect was found for the interaction of these factors, as the treatment (E3B2A2) gave the highest rate of potassium content in the leaves, amounting to 2.290%, while the control treatment (E0B0A0) recorded the lowest value, amounting to 1.070%.

5- The potassium content of the leaves

The results of Table (6) indicate that there are significant differences between the treatments regarding organic fertilization in the potassium content of the leaves, as treatment 3E (a mixture of palm fronds and rice at a rate of 1 kg. seedling-1) gave a clear significant effect for this trait amounting to 2.140%, while the control treatment E0 gave less The average for this trait was 1.234%. As for the effect of ground addition with biofertilizers, the treatment with mycorrhizal B2 recorded a significant effect over the rest of the treatments, which recorded 1.793% compared to the control treatment B0, which recorded a decrease of 1.588%. As for the foliar spraying treatment with seaweed extract, the treatment A2 was recorded. The highest rate was 1.728% compared to the control treatment A0, which recorded the lowest rate of 1.655%. As for the bi- interaction treatments between plant residues and bio fertilizers, there was a significant effect of the treatment (E3B2) by giving it the highest rate of potassium content in the leaves,

Table (6) The effect of organic fertilization with plant residues, biofertilization with some bio fertilizers, and foliar spraying with seaweed extract and the interaction between them on the potassium content of leaves (%) of apple seedlings.

						treatments
				(Organic fertilizers (E		
B x A	**E3**	**E2**	**E1**	**E0**	**Fertilization A**	**Bio fertilizers B**
1.545	**1.990**	**1.700**	**1.420**	**1.070**	**A0**	**B0**
1.588	**2.030**	**1.740**	**1.460**	**1.120**	**A1**	
1.630	**2.070**	**1.780**	**1.490**	**1.180**	**A2**	
1.665	**2.130**	**1.800**	**1.540**	**1.190**	**A0**	**B1**
1.698	**2.150**	**1.840**	**1.560**	**1.240**	**A1**	
1.725	**2.180**	**1.860**	**1.590**	**1.270**	**A2**	

1.755	2.200	1.890	1.620	1.310	A0	B2
1.793	2.220	1.920	1.670	1.360	A1	
1.830	2.290	1.970	1.690	1.370	A2	
	2.140	1.833	1.560	1.234	E effect	
effect B						
1.588	2.030	1.740	1.457	1.123	B0	B x E
1.696	2.153	1.833	1.563	1.233	B1	
1.793	2.237	1.927	1.660	1.347	B2	
effect A						
1.655	2.107	1.797	1.527	1.190	A0	A x E
1.693	2.133	1.833	1.563	1.240	A1	
1.728	2.180	1.870	1.590	1.273	A2	

B x A x E	B x A	A x E	B x E	A	B	E	
0.230	0.115	0.133	0.133	0.066	0.066	0.077	LSD 0.05

lowest rate for the same trait, amounting to 21.80 mg.kg-1. As for the dual interaction between biofertilizers and foliar spraying with seaweed extract, the treatment (B2A2) recorded the highest rate of 29.60 mg.kg-1, while the control treatment (B0A0) recorded a clear decrease of 25.38 mg.kg-1. We note from the same table that The bi- interaction between plant residues and foliar spraying with seaweed extract had a significant effect on the same trait. The treatment (E3A2) gave a significantly excelled of 33.74 mg.kg-1 compared to the control treatment (E0A0), which gave the lowest rate of 22.25 mg.kg-1.

As for the triple interaction between the experimental treatments (E*A*B), a significant effect was found for the interaction of these factors, where the treatment (E3B2A2) gave the highest average boron content of leaves, amounting to 38.31 mg.kg-1, while the control treatment (E0B0A0) recorded the lowest value. It amounted to 20.50 mg kg-1.

3- Boron content of leaves (mg.kg-1):

It is noted from the results of Table (7) that there are significant differences between the organic fertilization treatments in the boron content of leaves, as treatment 3E recorded a significant effect on this trait, amounting to 26.91 mg.kg-1, while the control treatment E0 gave the lowest rate, amounting to 34.52 mg.kg-1. As for As for biofertilizers, the ground addition treatment with mycorrhiza B2 was applied to the rest of the treatments, which gave 28.81 mg.kg-1 compared to the control treatment B0, which recorded the lowest rate of 25.87 mg.kg-1. As for the foliar spray treatment with seaweed extract, treatment A2 recorded a rate of 4 ml. The highest rate was 27.83 mg.kg-1 compared to the control treatment A0, which recorded the lowest rate of 26.79 mg.kg-1. As for the bi- interaction between plant residues and bio fertilizers, a significant effect was found for the treatment (E3B2) by giving it the highest rate of boron content in the leaves, amounting to 36.12 mg.kg-1, compared to the control treatment (E0B0), which recorded the

Table (7) The effect of organic and biofertilization with some biofertilizers and foliar spraying with seaweed extract and their interaction on the boron content of leaves (mg.kg-1) of apple seedlings.

treatments						
B x A	(Organic fertilizers (E				Fertilization A	Bio fertilizers B
	E3	E2	E1	E0		

25.38	**29.57**	**26.87**	**24.56**	**20.50**	**A0**	**B0**
25.84	**29.82**	**27.13**	**24.68**	**21.71**	**A1**	
26.39	**30.15**	**27.31**	**24.93**	**23.18**	**A2**	
26.72	**31.40**	**27.87**	**25.00**	**22.62**	**A0**	**B1**
24.37	**31.72**	**17.44**	**25.12**	**23.18**	**A1**	
27.50	**32.76**	**28.46**	**25.50**	**23.27**	**A2**	
28.28	**34.80**	**28.76**	**25.93**	**23.62**	**A0**	**B2**
28.55	**35.25**	**29.00**	**26.20**	**23.75**	**A1**	
29.60	**38.31**	**29.37**	**26.54**	**24.18**	**A2**	
	26.91	**25.38**	**22.89**	**14.34**		**E effect**
effect B						
25.87	**29.85**	**27.10**	**24.72**	**21.80**	**B0**	**B x E**
26.20	**31.96**	**24.59**	**25.21**	**23.02**	**B1**	
28.81	**36.12**	**29.04**	**26.22**	**23.85**	**B2**	
effect A						
26.79	**31.92**	**27.83**	**25.16**	**22.25**	**A0**	**A x E**
26.25	**32.26**	**24.52**	**25.33**	**22.88**	**A1**	
27.83	**33.74**	**28.38**	**25.66**	**23.54**	**A2**	

B x A x E	**B x A**	**A x E**	**B x E**	**A**	**B**	**E**	
9.147	4.574	5.281	5.281	2.641	2.641	3.049	**LSD 0.05**

leaves, amounting to 84.55 mg.kg-1, compared to the control treatment (E0B0), which recorded the lowest rate for the same trait, amounting to 41.08 mg.kg-1. As for the dual interaction between biofertilizers and foliar spraying with seaweed extract, the treatment (B2A2) recorded the highest rate of 66.47 mg.kg-1, while the control treatment (B0A0) recorded a clear decrease of 55.20 mg.kg-1. We note from the same table that The bi- interaction between plant residues and foliar spraying with seaweed extract had a significant effect on the same trait. The treatment (E3A2) gave a significant superiority of 80.19 mg.kg-1 compared to the control treatment (E0A0), which gave the lowest rate of 43.73 mg.kg-1.

As for the triple interaction between the experimental treatments (E*A*B), a significant effect was found for the interaction of these factors, as the treatment (E3B2A2) gave the highest average leaf iron content, amounting to 88.00 mg.kg-1, while the control treatment (E0B0A0) recorded the lowest value. It amounted to 40.05 mg kg-1.

4- Iron content of leaves (mg.kg-1):

The results of Table (8) indicate that there are significant differences between the organic fertilization treatments in the iron content of the leaves, as treatment 3E (a mixture between palm frond waste and rice waste at a rate of 1 kg. seedling-1) recorded a significant effect for this trait if it gave the highest value amounting to 77.99 mg. kg-1, while the control treatment E0 gave the lowest rate, amounting to 44.67 mg.kg-1. As for bio fertilizers, the ground addition treatment with mycorrhizal B2 gave the highest rate, superior to the rest of the treatments, amounting to 65.02 mg.kg-1 compared to the control treatment B0, which recorded 56.41 mg. kg-1. As for the foliar spraying treatment with seaweed extract, treatment A2 at a rate of 4 ml.l-1 recorded the highest rate, amounting to 61.83 mg.kg-1, compared to the control treatment A0, which recorded the lowest rate, amounting to 59.42 mg.kg-1. As for the bi- interaction between plant residues and bio fertilizers, a significant effect was found for the treatment (E3B2) by giving it the highest rate of iron content in the

Table (8) The effect of organic fertilization with plant residues, biofertilization with some biofertilizers, and foliar spraying with seaweed extract and the interaction between them on the iron content of leaves (mg.kg-1) of apple seedlings.

treatments						
B x A	(Organic fertilizers (E				Fertilization A	Bio fertilizers B
	E3	E2	E1	E0		
55.20	70.76	60.33	49.64	40.05	A0	B0
56.18	72.00	61.46	50.44	40.80	A1	
57.86	73.12	64.30	51.63	42.40	A2	
59.58	75.67	66.60	52.44	43.60	A0	B1
60.91	77.31	68.73	53.20	44.40	A1	
59.81	79.44	69.20	45.00	45.60	A2	
63.47	81.27	69.82	55.27	47.54	A0	B2
65.12	84.37	70.12	57.27	48.73	A1	
66.47	88.00	70.53	58.46	48.87	A2	
	77.99	66.79	52.59	44.67	E effect	
effect B						
56.41	71.96	62.03	50.57	41.08	B0	B x E
60.10	77.47	68.18	50.21	44.53	B1	
65.02	84.55	70.16	57.00	48.38	B2	
effect A						
59.42	75.90	65.58	52.45 .5553	43.73	A0	A x E
60.74	77.89	66.77	53.64	44.64 6445	A1	
61.38	80.19	68.01	51.70	45.62	A2	

B x A x E	B x A	A x E	B x E	A	B	E	
15.945	7.973	9.206	9.206	4.603	4.603	5.315	LSD 0.05

elements through their work in improving the physical properties and increasing the readiness of the macro- and micro-elements necessary to carry out vital processes within the plant. Likewise, the nutritious elements present in these Waste plays an important role in plant growth and the vital activities of the plant, as nitrogen is involved in the synthesis of chlorophyll, as well as the formation of amino acids that are involved in the synthesis of chloroplasts and in the synthesis of proteins and nucleic acids, DNA and RNA. The

Discussion :

The results in Tables (2-8) showed a significant increase in all the studied traits (chlorophyll content of leaves, percentage of carbohydrates in leaves, leaf content of nutrients (nitrogen, phosphorus, potassium, boron and iron) as a result of adding organic plant residues. The reason for the superiority when adding palm fronds and rice residues may be attributed to the role of these organic fertilizers added to the soil in increasing soil fertility and providing nutritious

biostimulants, amino acids and various plant hormones, which work on the development of the shoot and root system and increase the process of absorption of nutrients, in addition to their role in increasing the plant's resistance to stresses. Various environmental conditions increase the process of photosynthesis and thus increase vegetative growth and the nutrient content of the leaves ("O Dell, 2003). The nutrients present in these extracts also play an important role in the metabolism of the protein necessary for milk.

E cells, thus increasing vegetative growth and the content of carbohydrates and nutrients in the leaves (Wample 1991). As a result of the role of these organic plant residues, biofertilizers, and seaweed extract, which contributed greatly to the absorption of nutrients from the growth medium to the apple seedlings, and the interaction of these factors with each other contributed significantly. In absorbing and accumulating nutrients in the plant, this was reflected positively in improving the growth and development of these seedlings.

Conclusions:

We conclude from the study that the triple intervention treatment was significantly superior to the rest of the treatments, as the ground application treatment with mycorrhiza at a rate of 10 g. seedlings-1, the ground addition treatment with palm frond waste with rice at a rate of 1 kg. seedlings-1, and foliar spraying with seaweed extract at a concentration of 4 ml. l-1. In all the studied traits.

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abundance of this element leads to an increase in the mass of protoplasm and cell division, which increases the size of the total. The vegetative growth of the plant (Taiz and Zeiger, 2006). As for the element phosphorus, it is involved in the synthesis of some organic compounds that have great importance in vital activities, such as respiration processes, carbon metabolism, and the metabolism of carbohydrates and fatty acids (Al-Sahhaf, 1989). In addition, organic fertilizer may be added to the soil. It has an effect in increasing the activity and numbers of microorganisms in the soil, which work to add nutrients to the soil continuously, which restores the balance of nutrients in it, which increases the absorption of elements by the plant and increases their concentration in it (Hao et al., 2008), as well as for the other elements present in these fertilizers. As for biofertilizers, the reason for the increase may be attributed to the role of mycorrhizal fungi, Azotobacter, Bacillus, and Pseudomonas bacteria when added individually or together, for their great role in improving the symbiotic relationship between plants and soil and their significant contribution to increasing the absorption of nutrients from the soil. These fertilizers also contribute significantly to improving the relationship. Water and increasing the surface area of the roots infected with these fertilizers. Also, when these fungi and bacteria infect the plant, they work to spread the fungal hyphae attached to the infected root to long distances from the root in the soil, which helps the plant in obtaining nutrients and water from the growing medium (Kumari et al., 2008). Or the reason may be due to the fact that these microorganisms work to improve the physical and chemical properties of the soil when they act as soil amendments in areas of root infection and work to increase the cation exchange capacity, which increases the activity of other microorganisms present in the soil (Dobbelaere et al., 2002). As for For foliar spraying with seaweed extract, the reason for the increase in the studied traits of plants treated with these extracts may be due to their containing

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