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Influence of Certain Biostimulants on the Vegetative Growth of Annual Moringa (*Moringa oleifera*. Lam)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Due to the importance of moringa leaves which can help improve the dietary diversity and quality of households that need to improve their nutritional intake, being a potential alternate source of protein, and for the sake of increasing its growth and yield, this study is determine the effect of some biofertilizers, amino acids and seaweed extract on vegetative growth of moringa seedlings As well as, to find out the best fertilization treatment to improve the vegetative growth of Moringa and reducing the intensive use of chemical fertilizers. This study was conducted in the Experimental Farm of the Faculty of Agriculture (Saba-Basha), Alexandria University, Egypt, during two consecutive seasons of 2020 and 2021, to study the effect of biofertilizers, amino acids, and seaweed extract and its combinations on the growth of Moringa (*Moringa oleifera*, L.). The experiment was designed as split-split plot design it included 27 treatments with three replicates. The results revealed that the highest significant values of vegetative growth as plant height (171.8

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cm), stem length (87.30 cm), stem diameter (3.49 cm), leaves fresh weight (70.61 g), leaves dry weight (13.35g), number of leaves per plant (72.03), and number of leaves per shoot (54.41) were achieved when the trees were soil bio-fertilized and sprayed with the investigated amino acid 700 mg/l + seaweed extract 700 mg/l + cerealine (T26) for both seasons of study. While the number of branches per plant (15.28), shoot fresh weight (138.1g), and shoot dry weight (24.07g) were concerned, the highest values were obtained when the plants were treated with soil bio-fertilization (Phosphorine), sprayed with amino acids, and seaweed extract, as the abovementioned treatments, amino acid 700 mg/l + seaweed extract 700 mg/l + Phosphorine (T25), for both seasons of study compared to the other treatments and control.

Keywords: Moringa oleifera; vegetative growth; Phosphorine; cerealine; amino acid; seaweed extract.

1. INTRODUCTION

Moringa is the sole genus in the Moringaceae plant family. It includes 13 species ranging in size from small herbs to huge trees from Africa and Asia's tropical and subtropical countries. *Moringa oleifera* Lam, generally known as the "drumstick tree," Other popular names for this tree are horseradish tree. Is the most extensively grown species, it is a shrub with a height of 5-12 meters and a diameter of around 30 cm. In Egypt, *M. oleifera* has been effectively cultivated recently, as the total area planted with Moringa trees in all of the republic is about 1,000 feddan, distributed among the governorates [1]. It is utilized in a variety of fields, including spices, flavor and taste, herbal medicine, and beverages. Practically every portion of the tree has edible qualities or other useful qualities, being a potential alternate source of protein. This is due to the flour's high protein level, which is three times that of milk powder. Moringa leaves can help improve the dietary diversity and quality of households that need to improve their nutritional intake [2]. The widespread use of conventional fertilizers in agriculture has disrupted soil ecology, polluted the environment, and decreased soil fertility, all of which have negative consequences on human health [2, 3 and 4]. To avoid this problem, it is necessary to renovate fertilization processes and develop inventive new approaches to raise agricultural yields and decrease inputs, with an emphasis on encouraging ecologically friendly agriculture [5].

Using chemicals (Biostimulators) that have a regulatory influence on plant growth and development which include compounds like seaweed extract and amino acids, has lately become a more widespread treatment in contemporary agricultural production. Natural extracts are crucial in the biofertilizer process since they help to reduce the use of chemical fertilizers, produce a natural product that is eco-friendly, and promote plant growth and productivity. In order to increase growth and production, encourage soil nutrient absorption, and encourage antioxidant characteristics, seaweed extract has developed into an efficient technique for fertilization when used as a foliar spray [6].

Due to the components of seaweed extract that may operate synergistically at various concentrations, while the method of action is yet unclear, the application of seaweed extract for various crops was of considerable relevance [7]. The application of seaweed extract to soybean increased yield as well as N, P, and K [6]. For mung bean, there was also a considerable increase in seed production and pod weight [8].

Amino acids are a well-known biostimulant that serves as a building block for protein synthesis, is involved in plant growth and development [9], and has good results for plant growth as well as yield [10]. The role of biostimulants on nutrient availability, plant growth, chemical composition, yield, and quality has been examined in a number of studies. According to research by [11], spraying dry yeast and tryptophan over the leaves of moringa plants significantly improved growth when compared to the control. The main purpose of this study is determine the effect of some biofertilizers, amino acids and seaweed extract on vegetative growth of moringa seedlings As well as, to find out the best fertilization treatment to improve the vegetative growth of Moringa and reducing the intensive use of chemical fertilizers.

2. MATERIALS AND METHODS

During the 2020 and 2021 growing seasons, two field experiments were conducted at the experimental farm of the Faculty of Agriculture (Saba Basha) Alexandria University, in the Abees district of Alexandria, Egypt, to evaluate

the response of soil bio-fertilization (Phosphorine and Cerealine), and spraying with different rates of amino acids, and seaweed extract on the vegetative growth of moringa of *M. oleifera* plants.

The physical and chemical characteristics of the experimental field soil were determined during the two seasons, and the results are presented in Tables 1 and 2. In accordance with the procedures described by [12].

The soil of the experiments was ploughed and divided into plots and rows then planted in 2.5 x 2.5-meter space, and the planting date was in March. Mineral fertilizers were applied uniformly

Table 1. Some physical and chemical properties of the experimental soil in 2020 growing seasons

Soil properties			Values	Unit
Mechanical analyses	Clay		42.62	%
	Sand		15.80	%
	Silt		41.58	%
	Soil texture		Silty Clay	-
Chemical properties	pH (1:1, soil : water suspension)		7.80	-
	EC (1:1, soil: water extract)		2.10	dS/m
	Soluble cations (1:2) (Cmol/kg soil)	K+	0.91	meq/l
		Ca++	4.22	meq/l
		Mg++	3.55	meq/l
		Na++	8.17	meq/l
	Soluble anions (1:2) (Cmol/kg soil)	CO-3+ HCO-3	2.22	meq/l
		CL-	11.19	meq/l
		SO-4	0.6	meq/l
	Calcium carbonate,		7.54	%
	Total nitrogen,		0.50	%
	Avaliable Phosphorus		3.80	mg/kg
	Avaliable K		165.2	mg/kg
	Organic matter		0.93	%

Table 2. Some physical and chemical properties of the experimental soil in 2021growing seasons

Soil properties			Values	Unit
Mechanical analyses	Clay		43.58	%
	Sand		14.71	%
	Silt		41.71	%
	Soil texture		Silty Clay	-
Chemical properties	pH (1:1, soil : water suspension)		7.83	-
	EC (1:1, soil: water extract)		2.92	dS/m
	Soluble cations (1:2) (Cmol/kg soil)	K+	0.85	meq/l
		Ca++	4.80	meq/l
		Mg++	3.12	meq/l
		Na++	7.89	meq/l
	Soluble anions (1:2) (Cmol/kg soil)	CO-3+ HCO-3	2.88	meq/l
		CL-	10.98	meq/l
		SO-4	0.5	meq/l
	Calcium carbonate,		6.89	%
	Total nitrogen,		0.45	%
	Avaliable Phosphorus		3.12	mg/kg
	Avaliable K		171.1	mg/kg
	Organic matter		0.98	%

to all the research plots as ammonium nitrate (33.5% N) applied at 600 g/tree, 250 g/tree of calcium superphosphate (15.5% P2O5), and 300 g/tree of potassium sulfate (48% K2O). The rate of calcium superphosphate was mixed within 0.15 m depth of top soil around the tree trunk at one dose, while nitrogen and potassium fertilizer were applied in three equal doses, the first dose was applied after 20 days after sowing, the second dose was applied after the first cut, and the third dose was applied after the second cut. Also, biofertilizers, namely Phosphorine (containing P dissolving bacteria including *Bacillus* sp.) and cerealine (produced by the Egyptian Ministry of Agriculture and containing *Bacillus polymyxa* and *Azotobacter chroococcum* bacteria, each at 107 colony-forming units (CFU)/g carrier), as a source of nitrogen. And amino acids and seaweed extract at (0, 350, and 700 ml/l) were applied as a foliar spray three times, the first one was sprayed after planting, the second one was sprayed after the first cut, and the third one was sprayed after the second cut. Control plants were sprayed with water. The plants were harvested three times in the first and second seasons by cutting the vegetative parts to determine some morphological data.

The experiment was designed as split-split plot design it included 27 treatments with three replicates as follows:

T0. Control (Untreated check).
T1. Phosphorine
T2. Cerealine
T3. 350mg/l Seaweed extract
T4. 350mg/l Seaweed extract + Phosphorine
T5. 350mg/l Seaweed extract + Cerealine
T6. 700mg/l Seaweed extract
T7. 700mg/l Seaweed extract + Phosphorine
T8. 700mg/l Seaweed extract + Cerealine
T9. 350mg/l Amino acid
T10. 350mg/l Amino acid + Phosphorine
T11. 350mg/l Amino acid + Cerealine
T12. 350mg/l Amino acid +350mg/l Seaweed extract
T13. 350mg/l Amino acid +350mg/l Seaweed extract + Phosphorine
T14. 350mg/l Amino acid +350mg/l Seaweed extract + Cerealine
T15. 350mg/l Amino acid +700mg/l Seaweed extract
T16. 350mg/l Amino acid +700mg/l Seaweed extract + Phosphorine
T17. 350mg/l Amino acid +700mg/l Seaweed extract + Cerealine
T18. 700mg/l Amino acid
T19. 700mg/l Amino acid + Phosphorine
T20. 700mg/l Amino acid + Cerealine
T21. 700mg/l Amino acid +350mg/l Seaweed extract
T22. 700mg/l Amino acid +350mg/l Seaweed extract + Phosphorine
T23. 700mg/l Amino acid +350mg/l Seaweed extract + Cerealine
T24. 700mg/l Amino acid +700mg/l Seaweed extract
T25. 700mg/l Amino acid +700mg/l Seaweed extract + Phosphorine
T26. 700mg/l Amino acid +700mg/l Seaweed extract + Cerealine

Vegetative growth measurements of Moringa plants as affected by the differential investigated twenty-seven treatments were evaluated through determining the response of the following parameters: Plant height, stem length, numbers of branches / plant, shoot fresh weight, leaves fresh weight and leaves dry weight.

The split-split plot design was used for arranging the above mentioned 27 treatments, whereas each treatment was replicated three times. All the obtained data in the two seasons of study were statistically analyzed using the analysis of variance method according to [13]**.** The least significantly differences test (L.S.D.) at 0.05 was used in compare between means of the different treatments.

3. RESULTS AND DISCUSSION

1. The effect of fertilizing treatments on Plant height and stem length of *M. oleifera* plant

The obtained results, given in Tables 3 clearly show that in the first and second seasons of fertilizing*, M. oleifera* significantly increased the plant height and Stem length compared with control plants. it was clear that the highest significant value of plant height and stem length was achieved when the trees were soil bio-fertilized and sprayed with the investigated amino acid 700 mg/l + seaweed extract 700 mg/l + cerealine (T26) for both seasons of study, where the mean plant height for both seasons was 171.8 cm. and the mean stem length for both seasons was 87.30 cm. Furthermore, we found that all tested bio-fertilization, amino acid, and seaweed extract treatments, as well as their combinations, improved shoot length and stem length especially at the highest levels in both seasons. This increment may be related to the

several functions of combinations of bio-fertilization, amino acids, and seaweed extract.

The outcomes were consistent with those reported by [14 and 15]. They discovered that the use of bio-fertilizers had a positive impact on all *M. oleifera's* vegetative growth parameters. However, the effectiveness of these improvements varied depending on the bio-fertilizers used—Microbine, Phosphorine, and Nitrobine. On the other hand, reported that rosemary plants' height was significantly increased by both nitrobien and phosphorein in both cuttings of both seasons at rates of 3 and 6 g/pot. Similarly [16]. In addition, Zayed [17] noted that soil inoculation with mixed biofertilizer cultures led to longer Moringa plant lengths. The metabolism of plants and the assimilation of proteins, both of which are essential for cell formation and hence increase fresh and dry matter, may be significantly influenced by amino acids. Abd El-Baset [18] observed that treating *M. oleifera* with amino acids at a rate of 3 cm^3/L led to the most significant increase in plant height in both seasons.

2. The effect of fertilizing treatments on stem diameter and number of branches per plant of *M. oleifera* plant

Concerning the stem diameter and the number of branches per plant of *M. oleifera* plants as impacted by soil biofertilization and spraying with amino acids and seaweed extract, the data presented in Table 4 clearly shows that the highest significant value of stem diameter was achieved when the plants were cerealine soil bio-fertilized and sprayed with amino acids and seaweed extract (T26), with a mean value for both seasons of 3.49 cm. Also, data indicate that there were significant differences among the investigated treatments as far as the number of branches was concerned, the highest values were obtained when the plants were treated with soil bio-fertilization (Phosphorine), sprayed with amino acids, and seaweed extract, as the abovementioned treatments, amino acid 700 mg/l + seaweed extract 700 mg/l + Phosphorine (T25), proved to be the most effective ones in enhancing and improving the mean number of branches during both seasons, with a mean of 15.28 branch/ plant. It could be concluded that, based on the data, foliar spraying of seaweed extracts and amino acids with soil bio-fertilization produced greater results than using each component separately. These results are in line with those stated by Radwan [19] stated that inoculation of moringa plants with biofertilization significantly increased stem diameter at three cuts during both seasons in comparison to uninoculation treatments. Also, [14 and 15], stated that *M. oleifera* plants treated with Phosphorine and Nitrobine biofertilizers produced the highest values of stem diameter compared with the control and revealed that Phosphorine was the most effective in increasing the number of branches per plant. Zewail [20] claimed that the combination of seaweed at 2 ml/l and amino acids at 4 ml/l was the most successful treatment for increasing the number of *Phaseolus vulgaris* branches. Atteya and Amer [21] found that combining seaweed extract and amino acids improved the growth parameters of *Hibiscus sabdariffa* plants.

3. The effect of fertilizing treatments on shoot fresh and dry weight of *M. oleifera* plant.

The response of shoot fresh and dry weight of *M. oleifera* plants to the different investigated treatments, the data presented in Table 5 refers to the fact that the highly positive response of shoot dry and fresh weight was detected with those plants that were bio-fertilized with the Phosphorine bio-fertilizers conjoined with the application of the amino acid and seaweed extracts as foliar sprays each at 700 mg/L (T25). Herein, the maximum mean value of leaves' fresh weight was detected at 138.1g, which proved to be the best one in this respect as compared with the other investigated treatments, also treatment produced the heaviest shoot dry weight as compared with the other investigated treatments, with a mean value for both seasons of 24.07g during the 1st and 2nd seasons of study. Similar results indicated that it was preferable to spray with the amino acid and seaweed extracts and soil bio-fertilization together to get a better response than using each factor alone. These effects have been observed in various crops, Sriyuni [22] advise using seaweed extract in conjunction with amino acids to increase the production of rice and vegetative growth parameters. Additionally, according to [23], the use of the biostimulants Phosphorene and Microbein had a significant positive influence on several of the Canino apricot trees observed vegetative development indices [14 and [15], who assessed the impact of bio fertilizers on the vegetative growth and chemical components of *M. oleifera* plants, they showed that the application of the bio fertilizers Microbine, Phosphorine, and Nitrobine led to the highest values of the dry weight of shoots.

Table 3. Average values of *Moringa oleifera* plant height and Stem Length as affected by Bio-fertilizers, Amino acids, and Seaweed extracts and their combinations during 2020 and 2021 growing seasons

Treatments	Plant height (cm)						Mean	Stem Length (cm)						Mean
	Season2020			Season2021				Season2020			Season2021			
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut		1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	
T_0 Untreated	71.30	89.30	98.60	132.9	139.5	145.5	112.9	15.70	56.00	61.40	17.00	58.00	63.20	45.22
T_1 Phosphorein	73.30	102.2	114.4	150.9	155.5	164.2	126.8	16.00	68.40	75.30	17.00	70.00	77.80	54.08
T_2 Cerealine	75.40	100.6	111.4	148.9	153.3	158.4	124.7	17.70	62.80	69.10	18.20	63.00	73.20	50.67
T_3 Seaweed 350mg/l	84.10	92.40	101.6	148.3	152.7	162.3	123.6	21.00	65.60	72.20	22.00	66.80	75.20	53.80
T_4 Seaweed 350mg/l + Phosphorein 350mg/l	86.20	105.7	116.5	155.3	160.9	183.1	134.6	24.70	75.30	82.90	26.00	78.10	85.00	62.00
T_5 Seaweed 350mg/l + Cerealine 350mg/l	86.50	102.9	113.9	157.8	163.7	170.5	132.6	26.30	71.80	79.10	27.10	74.00	82.90	60.20
T_6 Seaweed 700mg/l	79.40	96.30	106.1	138.4	145.6	158.6	120.7	24.30	73.50	80.90	25.00	76.30	83.00	60.50
T_7 Seaweed 700mg/l + Phosphorein 700mg/l	84.10	112.1	123.5	165.4	173.6	180.4	139.9	25.70	86.00	94.70	27.00	88.00	98.00	69.90
T_8 Seaweed 700mg/l + Cerealine 700mg/l	85.70	106.3	120.9	169.7	175.9	183.4	140.3	25.70	80.70	88.80	26.20	82.40	90.00	65.63
T_9 Amino 350mg/l	83.60	99.30	113.5	154.9	162.2	174.3	131.3	19.30	62.20	68.40	21.00	66.00	70.40	51.22
T_{10} Amino 350mg/l + Phosphorein	85.80	113.3	125.0	166	173.4	176.7	140.0	21.70	76.00	83.60	22.10	78.50	85.30	61.20
T_{11} Amino 350mg/l + Cerealine	87.53	111.8	125.6	166.7	175.5	183.1	141.7	22.00	69.70	80.20	24.00	72.40	84.20	58.75
T_{12} Amino 350mg/l + Seaweed 350mg/l	86.50	102.7	116.0	165.1	173.6	181.9	137.6	26.00	72.90	92.10	27.00	76.70	96.20	65.15
T_{13} Amino 350mg/l + Seaweed 350mg/l + Phosphorein	85.40	117.5	133.9	171.7	177.9	186.0	145.4	28.00	83.70	92.20	29.00	85.50	98.00	69.40
T_{14} Amino 350mg/l + Seaweed 350mg/l + Cerealine	85.50	114.3	133.5	172.8	179.0	185.6	145.1	28.30	79.80	87.80	30.00	81.20	90.00	66.18
T_{15} Amino 350mg/l + Seaweed 700mg/l	87.00	107.0	127.5	172.6	177.8	189.8	143.6	26.70	81.70	89.90	28.50	83.60	91.50	66.98
T_{16} Amino 350mg/l + Seaweed 700mg/l + Phosphorein	89.60	124.7	138.5	174.6	180.0	186.1	148.9	29.70	95.50	104.9	32.00	96.50	107.9	77.75
T_{17} Amino 350mg/l + Seaweed 700mg/l + Cerealine	92.90	118.1	133.5	173.1	176.3	184.5	146.4	30.00	89.70	95.80	33.00	93.70	100	73.70
T_{18} Amino acid 700mg/l	90.10	110.3	128.4	168.0	173.2	183.5	142.3	24.00	75.80	76.00	29.00	97.00	80.00	63.63
T_{19} Amino acid 700mg/l + Phosphorine	94.70	125.9	140.7	176.9	180.9	184.8	150.7	23.70	84.50	92.90	25.00	88.00	96.90	68.50
T_{20} Amino acid 700mg/l + Cerealine	96.90	124.2	141.0	179.6	185.8	189.8	152.9	26.00	77.60	85.20	28.00	79.40	90.80	64.5
T_{21} Amino acid 700mg/l + Seaweed extract 350mg/l	99.80	113.9	133.6	175.9	180.9	185.6	148.3	28.70	81.00	89.10	30.00	84.00	91.50	67.38
T_{22} Amino acid 700mg/l + Seaweed extract 350mg/l + Phosphorine	100.4	130.5	154.9	180.9	186.4	191.5	157.4	32.30	93.00	102.1	33.40	96.00	104.7	76.92
T_{23} Amino acid 700mg/l + Seaweed extract 350mg/l + Cerealine	108.7	127.0	154.5	180.4	184.4	192.1	157.9	34.30	88.70	97.40	36.00	90.00	101.2	74.60
T_{24} Amino acid 700mg/l + Seaweed extract 700mg/l	120.3	118.9	140.4	184.3	186.7	196.7	157.9	33.00	90.80	99.90	35.00	92.00	106	76.12
T_{25} Amino acid 700mg/l + Seaweed extract 700mg/l + Phosphorine	132.8	131.5	154.8	186.9	191.3	214.00	168.6	35.30	99.70	109.6	37.00	108.8	118	84.73
T_{26} Amino acid 700mg/l + Seaweed extract 700mg/l + Cerealine	147.1	134.4	155.1	186.4	192.6	215.00	171.8	40.00	106.1	116.7	42.00	100	119	87.30
L.S.D	3.29	2.02	5.47	10.74	10.57	9.42	-----	3.14	4.24	2.03	3.9	5.83	9.79	---

Table 4. Means of Stem diameter of *Moringa oleifera* and Number of branches as affected by Bio-fertilizers, Amino acids, and Seaweed extracts and their combinations during 2020 and 2021 growing seasons

Treatments	Stem diameter (cm)						Mean	Number of branches/plants						Mean
	Season2020			Season2021				Season2020			Season2021			
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut		1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	
T_0 Untreated	1.18	1.27	1.36	1.26	1.43	2.37	1.47	6.57	7.23	7.95	9.33	10.10	11.30	8.75
T_1 Phosphorein	2.12	2.20	2.37	2.23	2.54	2.67	2.36	8.91	9.80	10.80	12.10	13.40	15.00	11.67
T_2 Cerealine	2.12	2.31	2.51	2.25	2.92	2.97	2.51	8.06	8.86	9.75	11.60	12.60	14.00	10.81
T_3 Seaweed 350mg/l	1.37	1.56	1.81	1.50	2.23	2.93	1.90	6.77	7.41	8.18	10.80	12.40	14.00	9.927
T_4 Seaweed 350mg/l + Phosphorein 350mg/l	2.34	2.67	2.93	2.60	3.02	3.40	2.83	9.15	10.10	11.20	13.20	13.90	16.00	12.26
T_5 Seaweed 350mg/l + Cerealine 350mg/l	2.01	2.70	3.07	2.13	2.91	3.63	2.74	8.28	9.15	10.00	13.40	14.40	16.00	11.87
T_6 Seaweed 700mg/l	1.43	1.90	2.47	1.63	2.34	3.37	2.19	6.87	7.53	8.30	12.50	12.50	14.00	10.28
T_7 Seaweed 700mg/l + Phosphorein 700mg/l	2.58	2.68	2.93	2.78	3.39	3.63	3.08	9.25	10.20	11.20	14.50	15.20	17.00	12.89
T_8 Seaweed 700mg/l + Cerealine 700mg/l	2.21	2.40	2.81	2.43	1.01	3.39	2.38	8.40	9.21	10.20	12.40	12.90	14.00	11.19
T_9 Amino 350mg/l	1.32	1.63	1.92	1.62	3.37	3.69	2.26	7.31	8.05	8.85	11.00	11.40	12.10	9.785
T_{10} Amino 350mg/l + Phosphorein	2.37	2.85	3.05	2.59	3.59	3.96	3.07	9.90	10.80	11.90	14.40	15.40	17.00	13.23
T_{11} Amino 350mg/l + Cerealine	1.99	2.70	3.18	2.24	3.55	3.97	2.94	8.96	9.83	10.80	13.50	13.90	14.00	11.83
T_{12} Amino 350mg/l + Seaweed 350mg/l	1.42	1.78	2.01	1.89	3.16	3.27	2.26	7.52	8.22	9.13	11.20	12.40	13.30	10.30
T_{13} Amino 350mg/l + Seaweed 350mg/l + Phosphorein	2.60	2.91	3.11	2.80	3.52	3.83	3.13	10.20	11.20	12.30	14.30	14.80	16.00	13.13
T_{14} Amino 350mg/l + Seaweed 350mg/l + Cerealine	2.37	3.24	3.39	2.57	3.01	3.53	3.02	9.20	10.10	11.20	13.20	13.20	14.30	11.87
T_{15} Amino 350mg/l + Seaweed 700mg/l	2.24	2.60	3.34	2.56	2.97	3.15	2.81	7.63	8.39	9.23	11.40	12.20	13.00	10.31
T_{16} Amino 350mg/l + Seaweed 700mg/l + Phosphorein	1.59	2.32	2.92	2.18	3.71	3.60	2.72	10.30	11.30	12.40	14.20	15.20	16.00	13.23
T_{17} Amino 350mg/l + Seaweed 700mg/l + Cerealine	2.87	3.53	3.88	2.87	3.42	3.52	3.35	9.33	10.20	11.30	13.50	14.40	15.70	12.41
T_{18} Amino acid 700mg/l	2.46	3.29	2.90	3.06	3.09	3.53	3.06	8.12	8.93	6.55	11.10	12.10	13.00	9.967
T_{19} Amino acid 700mg/l + Phosphorine	1.47	2.36	3.74	1.82	3.04	3.30	2.62	11.00	12.10	13.30	15.20	16.20	16.70	14.08
T_{20} Amino acid 700mg/l + Cerealine	2.63	3.25	3.63	2.62	2.77	3.16	3.01	9.96	11.20	12.10	14.00	15.50	18.00	13.54
T_{21} Amino acid 700mg/l + Seaweed extract 350mg/l	2.21	3.25	3.60	2.80	3.12	3.44	3.07	8.36	9.19	10.10	12.30	12.50	16.00	11.41
T_{22} Amino acid 700mg/l + Seaweed extract 350mg/l + Phosphorine	1.58	2.92	3.22	2.74	3.29	3.60	2.89	11.30	12.30	13.70	15.40	16.30	18.50	14.50
T_{23} Amino acid 700mg/l + Seaweed extract 350mg/l + Cerealine	2.49	3.62	3.57	3.44	3.52	3.70	3.39	10.20	11.20	12.40	14.30	15.10	17.00	13.37
T_{24} Amino acid 700mg/l + Seaweed extract 700mg/l	2.89	3.08	3.18	3.26	3.37	3.65	3.24	8.48	9.29	10.30	13.60	13.90	17.00	12.10
T_{25} Amino acid 700mg/l + Seaweed extract 700mg/l + Phosphorine	1.77	2.78	3.30	3.08	3.39	3.51	2.97	11.40	12.50	13.80	16.60	17.40	20.00	15.28
T_{26} Amino acid 700mg/l + Seaweed extract 700mg/l + Cerealine	3.18	3.30	3.70	3.45	3.53	3.80	.3.49	10.40	11.30	12.50	14.80	15.40	18.00	13.73
L.S.D	1.16	0.92	0.90	2.53	0.68	0.50	----	0.058	0.19	0.086	0.68	0.71	0.56	-----

Table 5. Means of Shoot fresh and Dry Weight of *Moringa oleifera* as affected by Bio-fertilizers, Amino acids, and Seaweed extracts and their combinations during 2020 and 2021 growing seasons.

Treatments	Shoot fresh weight (g)						Mean	Shoot Dry Weight (g)						Mean
	Season2020			Season2021				Season2020			Season2021			
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut		1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	
T_0 Untreated	64.40	70.8	77.9	88.6	91	94.3	81.17	12.9	13.8	16.5	13.6	14.9	17.6	14.88
T_1 Phosphorein	76.40	84.1	92.5	98.3	100	101.3	92.1	15.3	16.5	18.6	16.2	18.3	19.7	17.43
T_2 Cerealine	67.90	74.7	82.2	92.3	93.7	97.3	84.68	13.6	15.3	17.3	14.4	16.2	18.9	15.95
T_3 Seaweed 350mg/l	70.80	77.9	85.7	95.6	97.7	99.7	87.90	14.2	17.5	18.2	15.2	18.7	20	17.3
T_4 Seaweed 350mg/l + Phosphorein 350mg/l	84.60	93.02	102.3	110.8	112	113.7	102.7	16.9	18	19.4	17.1	19.5	21	18.65
T_5 Seaweed 350mg/l + Cerealine 350mg/l	75.50	83.1	91.4	98.3	100.7	103.7	92.12	15.1	16.5	17.8	16.2	18.3	20.3	17.37
T_6 Seaweed 700mg/l	78.30	86.4	94.7	103.8	107.3	110	96.75	15.7	17	17.8	16.6	18.9	21.3	17.88
T_7 Seaweed 700mg/l + Phosphorein 700mg/l	92.90	102.1	112.3	118.6	120.3	122.7	111.5	18.6	19.6	21	19.6	21	22.6	20.4
T_8 Seaweed 700mg/l + Cerealine 700mg/l	85.10	93.6	102.9	111.4	116	119.7	104.8	17	18	19.1	17.8	19.1	20.5	18.58
T_9 Amino 350mg/l	71.60	78.7	86.6	95.4	100	105	89.55	14.3	15.5	18.1	15.8	17.7	20.7	17.02
T_{10} Amino 350mg/l + Phosphorein	84.9	93.4	102.7	111	113.7	117	103.8	16.9	17.9	19.6	18.2	19.9	21.7	19.03
T_{11} Amino 350mg/l + Cerealine	75.5	84.7	91.3	100.7	105.7	108.3	94.37	15.1	16.1	17.9	16.4	17.2	19.9	17.1
T_{12} Amino 350mg/l + Seaweed 350mg/l	78.7	86.6	94.2	103.8	105.7	110.3	96.55	15.7	17.3	19.8	16.8	18.9	20.9	18.23
T_{13} Amino 350mg/l + Seaweed 350mg/l + Phosphorein	93.9	103.4	113.7	123.5	125.3	127.7	114.6	18.8	19.9	22.2	19.7	20.7	23.1	20.73
T_{14} Amino 350mg/l + Seaweed 350mg/l + Cerealine	83.9	92.3	101.5	111	114	116.3	103.2	16.8	18	19.6	18.4	19.6	21.8	19.03
T_{15} Amino 350mg/l + Seaweed 700mg/l	86.9	95.7	105.2	115.6	119.7	122.7	107.6	17.4	18.3	20.1	19.1	20	23.9	19.80
T_{16} Amino 350mg/l + Seaweed 700mg/l + Phosphorein	103.2	113.5	124.8	135.2	137.7	139.7	125.7	20.6	21.3	22.3	21.5	22.6	24.7	22.16
T_{17} Amino 350mg/l + Seaweed 700mg/l + Cerealine	94.3	104.1	113.2	123.5	126	128.3	114.9	18.9	20	21.9	20.1	21.3	23.3	20.92
T_{18} Amino acid 700mg/l	79.5	87.5	96.2	104.9	108	110	97.68	15.9	17	18.9	17.3	18.9	20.8	18.13
T_{19} Amino acid 700mg/l + Phosphorine	94.4	103.8	114.2	124.7	128	132	116.2	18.9	19.8	21.5	19.8	21.3	24.4	20.95
T_{20} Amino acid 700mg/l + Cerealine	84.8	92.2	101.5	111.7	114.3	117.3	103.6	16.8	17.6	18.9	17.9	19.3	20.5	18.50
T_{21} Amino acid 700mg/l + Seaweed extract 350mg/l	87.6	96.2	105.8	115.3	119.3	123.3	107.9	17.5	18.7	21	18.9	20.4	23.7	20.03
T_{22} Amino acid 700mg/l + Seaweed extract 350mg/l + Phosphorine	104.5	114.9	126.2	135.3	137.3	139	126.2	20.8	22	23.6	21.5	22.7	25	22.60
T_{23} Amino acid 700mg/l + Seaweed extract 350mg/l + Cerealine	93.2	102.5	112.	128.4	131	134	116.9	18.6	20.4	21.2	19.6	21.5	23.7	20.83
T_{24} Amino acid 700mg/l + Seaweed extract 700mg/l	96.6	106.3	116.9	132.4	135	137.7	120.8	19.3	20.5	22.3	20.1	21.4	24.3	21.32
T_{25} Amino acid 700mg/l + Seaweed extract 700mg/l + Phosphorine	114.6	126.1	138.7	148.3	150	150.7	138.1	22.9	23.5	24.3	23.5	24.3	25.9	24.07
T_{26} Amino acid 700mg/l + Seaweed extract 700mg/l + Cerealine	104.5	114.9	126.4	137.9	142.3	145	128.5	20.9	21.9	22.6	21.8	22.9	24.6	22.45
L.S.D	9.95	1.79	1.8	6.93	7.29	9.07	----	0.13	1.65	1.83	0.95	1.42	2.16	----

4. The effect of fertilizing treatments on Leaves fresh and dry weight of *M. oleifera* plant.

The data tabulated in Table 6 indicates that there were significant differences among the investigated treatments as far as leaf fresh and dry weights were concerned. The treatment (T26) of amino acid 700 mg/l + seaweed extract 700 mg/l + cerealine, led to highly fresh and dry leaves with a mean value of 70.61 and 13.35 g, respectively for both seasons, as compared with the other investigated treatments. The results indicated that spraying with amino acid and seaweed extracts and soil bio-fertilization yielded a greater response than utilizing each component alone. Similarly, previous researches on other plants showed that on snap beans, Abou El-Yazied [24] indicated that spraying plants with seaweed extract at a higher rate significantly increased leaf fresh and dry weight per plant compared to control. Also, on *Vicia faba*, Salah El Din [25] reported that the application of seaweed extracts resulted in an increase in shoot fresh weight in *Vicia faba*. Also, Awad [26] demonstrated that providing potato plants with seaweed extract improved the dry weight of the leaves/plant.

5. The effect of fertilizing treatments on Number of leaves/plants.

The number of leaves per plant of *M. oleifera* plants is registered in Table 7, and the data indicate that there were significant differences among the investigated treatments as far as the number of leaves per plant was concerned. Meanwhile, the highest values of the tested parameter were obtained when the plants were sprayed with amino acid and seaweed extracts at 700 mg/L with soil bio-fertilization with cerealine (T26), which proved to be the most effective ones in enhancing and improving the investigated parameter with a mean value of 72.03 leaf/plant for both seasons, followed by Phosphorine soil bio-fertilization with amino acid and seaweed extracts at 700 mg/L (T25), which came after and occupied the second rank in this respect with a mean value of 71.44 leaf/plant for both seasons of study. The results indicated that spraying with amino acid and seaweed extracts + soil bio-fertilization yielded a greater response than utilizing each component alone. These results are in line with those stated by [14], who found that applying that *M. oleifera* plants inoculated with Microbine biofertilizers produced the highest significant number of leaves per plant as compared with the control. In the same direction, Abd El-Baset [18] demonstrated that utilizing high concentrations of amino acids as foliar sprays on both *M. oleifera* and *M. ovalifolia* plants gave a wonderful number of leaves compared to the control and stated that the increase in the number of leaves means good growth and quality. In the same direction, Vasantharaja [27] found that spraying cowpea plants with brown seaweed extract significantly improved the number of leaves per plant in comparison to the control treatment.

6. The effect of fertilizing treatments on Number of leaves/ Shoot of *M. oleifera* plant.

The response of the number of leaves/ shoot of *M. oleifera* plants as impacted by soil bio-fertilization and spraying with amino acid and seaweed extracts, presented in Table 8, revealed that there were significant differences among the investigated treatments in relation to the number of leaves/ shoot. The plants that were soil fertilized with the cerealine biofertilizers with the addition of sprayed amino acid and seaweed extracts as foliar spray each at 700 mg/L (T26) gave the highest number of leaves per shoot, with a mean value for both seasons 54.41 leaves per shoot as compared with the other investigated treatments. The results indicated that spraying with amino acid and seaweed extracts and soil bio-fertilization yielded a greater response than utilizing each component alone. Corroborated similar findings and opined that on *Amaranthus tricolor*, Abdel-Aziz [28] observed that the use of seaweed extract significantly increased the number of leaves. Also, Mahmoud [29] reported that brown seaweed, *Sargassum vulgare*, considerably enhanced the number of leaves on *Raphanus sativus* compared to the control. Furthermore, Shahira [30] stated that applying foliar treatment of algal extracts to fenugreek plants enhanced the number of leaves at the vegetative development stage considerably. Al-Hamzawi [31] observed that using a high concentration of seaweed extract improved the total leaf number of Gazania and Chinese carnation plants.

Table 6. Means of Leaves fresh and Dry weight of *Moringa oleifera* as affected by Bio-fertilizers, Amino acids, and Seaweed extracts and their combinations during 2020 and 2021 growing seasons

Treatments	Leaves fresh weight (g)						Mean	Leaves Dry weight (g)						Mean
	Season2020			Season2021				Season2020			Season2021			
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut		1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	
T_0 Untreated	25.50	29.70	25.60	39.90	42.60	40.30	33.93	5.10	5.50	5.10	8.40	8.60	8.80	6.92
T_1 Phosphorein	27.10	33.70	29.10	42.80	41.30	40.50	35.75	5.40	5.70	5.80	8.50	8.30	8.30	7.00
T_2 Cerealine	26.70	34.40	34.00	44.40	41.90	40.30	36.95	5.50	5.60	6.50	8.60	8.40	8.40	7.17
T_3 Seaweed 350mg/l	28.90	30.10	32.90	45.10	44.80	42.10	37.32	5.70	5.70	6.40	8.70	9.00	9.20	7.45
T_4 Seaweed 350mg/l + Phosphorein 350mg/l	29.40	35.60	34.70	45.40	45.20	45.40	39.28	6.50	5.80	6.30	9.20	9.10	9.50	7.73
T_5 Seaweed 350mg/l + Cerealine 350mg/l	29.50	34.70	33.30	43.10	42.70	46.30	38.27	6.70	6.60	6.40	9.20	9.40	9.50	7.97
T_6 Seaweed 700mg/l	30.40	31.10	29.40	44.30	43.20	44.60	37.17	6.80	5.90	6.00	8.80	9.00	9.40	7.65
T_7 Seaweed 700mg/l + Phosphorein 700mg/l	32.90	36.00	31.10	50.60	42.60	47.10	40.05	7.30	5.90	6.40	9.40	9.70	9.50	8.03
T_8 Seaweed 700mg/l + Cerealine 700mg/l	31.70	39.00	33.90	40.70	44.30	46.60	39.37	7.30	7.20	6.50	9.40	9.60	10.20	8.37
T_9 Amino 350mg/l	31.20	30.80	39.10	48.30	45.40	50.70	40.92	6.20	8.00	7.50	10.20	10.10	9.20	8.53
T_{10} Amino 350mg/l + Phosphorein	32.10	36.50	40.10	49.40	47.80	55.60	43.58	6.60	7.30	7.60	10.90	10.20	10.50	8.85
T_{11} Amino 350mg/l + Cerealine	33.50	35.40	38.10	49.70	45.80	55.60	43.02	6.50	7.50	7.50	10.30	10.40	10.30	8.75
T_{12} Amino 350mg/l + Seaweed 350mg/l	34.60	32.20	38.40	50.50	48.60	52.40	42.78	6.50	7.90	7.90	10.20	10.60	10.40	8.92
T_{13} Amino 350mg/l + Seaweed 350mg/l + Phosphorein	34.80	35.10	40.90	51.50	53.50	56.90	45.45	7.70	8.00	8.00	10.80	11.50	10.40	9.40
T_{14} Amino 350mg/l + Seaweed 350mg/l + Cerealine	36.60	37.70	39.80	52.10	50.10	55.70	45.33	7.70	7.80	8.10	10.80	11.30	11.90	9.60
T_{15} Amino 350mg/l + Seaweed 700mg/l	37.40	29.70	41.10	52.10	56.70	56.90	45.65	7.90	7.30	8.50	10.00	11.40	12.60	9.62
T_{16} Amino 350mg/l + Seaweed 700mg/l + Phosphorein	38.70	39.10	41.70	55.20	54.00	58.30	47.83	8.00	7.60	8.20	11.50	12.60	11.40	9.88
T_{17} Amino 350mg/l + Seaweed 700mg/l + Cerealine	39.70	41.80	40.20	60.50	55.80	60.00	49.67	8.40	8.20	8.30	12.30	12.40	12.40	10.30
T_{18} Amino acid 700mg/l	39.30	33.10	48.90	60.70	56.70	48.40	47.85	8.60	7.80	8.50	12.50	12.50	12.40	10.40
T_{19} Amino acid 700mg/l + Phosphorine	41.60	44.30	47.80	62.10	50.50	55.50	50.30	8.60	8.20	8.80	13.60	13.30	13.60	11.02
T_{20} Amino acid 700mg/l + Cerealine	42.40	42.70	49.40	63.50	57.00	55.10	51.68	8.80	9.30	8.80	13.80	13.50	13.40	11.30
T_{21} Amino acid 700mg/l + Seaweed extract 350mg/l	43.30	31.50	55.30	55.30	71.10	74.50	55.17	8.80	8.60	9.70	14.60	14.60	14.30	11.80
T_{22} Amino acid 700mg/l + Seaweed extract 350mg/l + Phosphorine	45.20	39.80	50.00	62.90	75.80	75.40	58.18	8.90	8.80	10.60	14.80	14.60	14.70	12.10
T_{23} Amino acid 700mg/l + Seaweed extract 350mg/l + Cerealine	47.10	49.40	56.20	70.10	76.90	74.70	62.40	9.40	9.30	11.10	14.70	15.40	15.10	12.50
T_{24} Amino acid 700mg/l + Seaweed extract 700mg/l	49.10	35.90	59.90	77.40	77.30	81.00	63.62	9.70	9.60	11.30	15.90	15.60	15.90	13.00
T_{25} Amino acid 700mg/l + Seaweed extract 700mg/l + Phosphorine	51.50	54.20	61.00	80.40	85.80	76.70	68.26	9.40	10.40	11.20	16.30	16.20	16.40	13.31
T_{26} Amino acid 700mg/l + Seaweed extract 700mg/l + Cerealine	54.70	59.70	63.80	81.10	80.70	83.70	70.61	9.30	10.20	11.50	15.90	16.30	16.90	13.35
L.S.D	1.67	4.80	5.16	2.18	6.24	3.20	----	0.49	1.12	0.61	5.48	0.27	0.64	----

Table 7. Means of number of leaves /plants of *Moringa oleifera* as affected by Bio-fertilizers, Amino acids, and Seaweed extracts and their combinations during 2020 and 2021 growing seasons

Treatments	Number of leaves/plant						Mean
	Season2020			Season2021			
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	
T_0 Untreated	34.64	38.09	41.90	48.04	48.57	55.18	44.40
T_1 Phosphorein	41.02	45.12	46.63	53.69	54.63	64.14	50.87
T_2 Cerealine	34.91	38.39	42.24	51.59	54.27	55.94	46.22
T_3 Seaweed 350mg/l	38.91	42.80	46.74	50.22	55.42	59.14	48.87
T_4 Seaweed 350mg/l + Phosphorein 350mg/l	48.60	53.46	55.45	63.33	67.18	70.42	59.74
T_5 Seaweed 350mg/l + Cerealine 350mg/l	42.02	45.92	50.51	58.02	64.53	69.33	55.06
T_6 Seaweed 700mg/l	43.09	45.36	49.93	56.57	61.57	64.75	53.55
T_7 Seaweed 700mg/l + Phosphorein 700mg/l	46.52	51.17	56.29	58.06	64.92	68.59	57.59
T_8 Seaweed 700mg/l + Cerealine 700mg/l	44.49	48.94	53.83	59.35	64.17	67.61	56.40
T_9 Amino 350mg/l	38.49	42.33	46.56	55.55	56.74	64.23	50.65
T_{10} Amino 350mg/l + Phosphorein	45.57	50.13	55.15	48.13	67.89	70.50	56.24
T_{11} Amino 350mg/l + Cerealine	40.90	44.96	49.45	58.66	63.29	65.93	53.87
T_{12} Amino 350mg/l + Seaweed 350mg/l	43.23	47.56	52.31	60.3	63.87	66.19	55.58
T_{13} Amino 350mg/l + Seaweed 350mg/l + Phosphorein	54.01	55.74	61.31	74.13	75.09	80.07	66.73
T_{14} Amino 350mg/l + Seaweed 350mg/l + Cerealine	46.61	51.28	56.41	61.90	71.31	76.99	60.75
T_{15} Amino 350mg/l + Seaweed 700mg/l	47.88	50.64	55.70	60.22	59.64	62.99	56.18
T_{16} Amino 350mg/l + Seaweed 700mg/l + Phosphorein	51.69	56.86	61.69	64.01	75.22	78.63	64.68
T_{17} Amino 350mg/l + Seaweed 700mg/l + Cerealine	49.44	54.37	59.81	63.69	69.55	75.35	62.04
T_{18} Amino acid 700mg/l	42.76	47.04	51.74	60.20	64.78	70.83	56.23
T_{19} Amino acid 700mg/l + Phosphorine	50.64	55.70	61.27	64.45	69.66	75.01	62.79
T_{20} Amino acid 700mg/l + Cerealine	46.45	51.07	56.21	64.40	69.77	65.17	58.85
T_{21} Amino acid 700mg/l + Seaweed extract 350mg/l	48.04	52.84	58.13	68.09	75.87	80.60	63.92
T_{22} Amino acid 700mg/l + Seaweed extract 350mg/l + Phosphorine	56.30	61.93	68.12	64.76	73.22	76.94	66.88
T_{23} Amino acid 700mg/l + Seaweed extract 350mg/l + Cerealine	51.79	56.98	62.67	76.39	73.18	77.09	66.35
T_{24} Amino acid 700mg/l + Seaweed extract 700mg/l	51.12	56.23	61.85	73.79	80.07	84.45	67.92
T_{25} Amino acid 700mg/l + Seaweed extract 700mg/l + Phosphorine	57.43	63.18	69.49	73.39	77.63	93.28	71.44
T_{26} Amino acid 700mg/l + Seaweed extract 700mg/l + Cerealine	54.93	60.43	66.47	74.71	79.33	90.56	72.03
L.S.D	2.53	2.21	2.02	16.8	10.07	10.09	

Table 8. Means of Number of leaves /shoots of *Moringa oleifera* as affected by Bio-fertilizers, Amino acids, and Seaweed extracts and their combinations during 2020 and 2021 growing seasons

Treatments	Number of leaves/ Shoot						Mean
	Season2020			Season2021			
	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	
T_0 Untreated	33.45	45.83	47.10	37.11	45.50	23.98	33.25
T_1 Phosphorein	33.30	41.62	43.67	39.63	42.99	44.00	35.32
T_2 Cerealine	37.00	40.93	44.67	37.00	41.93	45.33	34.98
T_3 Seaweed 350mg/l	40.94	46.01	47.67	42.28	46.74	49.00	38.62
T_4 Seaweed 350mg/l + Phosphorein 350mg/l	37.28	42.12	46.25	41.61	43.32	47.25	36.76
T_5 Seaweed 350mg/l + Cerealine 350mg/l	34.43	42.40	48.74	37.76	44.73	50.24	37.31
T_6 Seaweed 700mg/l	36.94	40.54	44.82	40.61	41.94	45.49	35.57
T_7 Seaweed 700mg/l + Phosphorein 700mg/l	33.91	41.12	52.33	36.25	42.47	53.83	37.67
T_8 Seaweed 700mg/l + Cerealine 700mg/l	36.85	40.32	46.41	36.85	40.32	46.74	35.11
T_9 Amino 350mg/l	39.92	41.65	47.42	39.99	41.65	47.42	36.36
T_{10} Amino 350mg/l + Phosphorein	34.62	38.70	49.70	34.62	38.70	49.76	35.25
T_{11} Amino 350mg/l + Cerealine	40.59	45.60	47.99	40.59	45.60	47.99	37.96
T_{12} Amino 350mg/l + Seaweed 350mg/l	44.65	49.35	53.53	44.65	49.35	53.53	41.74
T_{13} Amino 350mg/l + Seaweed 350mg/l + Phosphorein	46.10	47.85	52.05	39.43	47.85	52.05	39.87
T_{14} Amino 350mg/l + Seaweed 350mg/l + Cerealine	42.65	47.04	53.84	43.66	47.37	50.13	40.00
T_{15} Amino 350mg/l + Seaweed 700mg/l	40.67	49.06	57.03	47.33	50.06	53.84	42.89
T_{16} Amino 350mg/l + Seaweed 700mg/l + Phosphorein	44.00	46.20	53.42	46.49	50.05	57.03	42.20
T_{17} Amino 350mg/l + Seaweed 700mg/l + Cerealine	43.63	48.59	51.57	43.87	46.20	53.42	40.61
T_{18} Amino acid 700mg/l	43.26	47.60	53.84	44.30	48.59	51.57	40.98
T_{19} Amino acid 700mg/l + Phosphorine	50.07	54.65	58.59	50.93	51.13	57.18	45.41
T_{20} Amino acid 700mg/l + Cerealine	47.36	55.25	55.93	51.40	55.58	57.59	45.96
T_{21} Amino acid 700mg/l + Seaweed extract 350mg/l	46.16	54.65	61.92	49.49	55.65	62.25	47.33
T_{22} Amino acid 700mg/l + Seaweed extract 350mg/l + Phosphorine	53.81	59.94	66.71	54.15	60.27	66.71	51.30
T_{23} Amino acid 700mg/l + Seaweed extract 350mg/l + Cerealine	57.62	63.61	61.62	54.95	63.61	61.62	50.90
T_{24} Amino acid 700mg/l + Seaweed extract 700mg/l	50.09	61.86	61.92	52.09	61.89	65.26	50.50
T_{25} Amino acid 700mg/l + Seaweed extract 700mg/l + Phosphorine	58.53	63.28	68.93	58.53	63.28	66.26	53.38
T_{26} Amino acid 700mg/l + Seaweed extract 700mg/l + Cerealine	58.19	65.51	67.12	58.52	66.51	68.79	54.41
L.S.D	8.09	6.74	6.66	3.37	6.30	8.2	

4. CONCLUSION

This study is determining the effect of some biofertilizers, amino acids and seaweed extract on vegetative growth of moringa seedlings As well as, to find out the best fertilization treatment to improve the vegetative growth of Moringa (*Moringa oleifera*, L.) and reducing the intensive use of chemical fertilizers, during two consecutive seasons of 2020 and 2021. The results revealed that the highest significant values of vegetative growth as plant height, stem length, stem diameter, leaves fresh weight, leaves dry weight, number of leaves per plant, and number of leaves per shoot were achieved when the trees were soil bio-fertilized and sprayed with the investigated amino acid 700 mg/l + seaweed extract 700 mg/l + cerealine (T26) for both seasons of study. While the number of branches per plant, shoot fresh weight, and shoot dry weight were concerned, the highest values were obtained when the plants were treated with soil bio-fertilization (Phosphorine), sprayed with amino acids, and seaweed extract, as the abovementioned treatments, amino acid 700 mg/l + seaweed extract 700 mg/l + Phosphorine (T25), for both seasons of study compared to the other treatments and control.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Seleem S, Hashem S, Youssef A, Mohamed M, Abdel Megeed M. Environmental and Economic Assessment for the Production of Moringa in Maritime Face-Case Study: Netron Valley. J. Environ. Sci. 2016;33(2):241-260.
2. Agyepong A. The possible contribution of *Moringa oleifera* lam. leaves to dietary quality in two Bapedi communities in Mokopane, Limpopo Province. Ph.D. Thesis. South Africa: South Africa Univ. 2009;1–76.
3. Tang Q, Chaopu T, Longlong X, Yong-qiu X, Zhijun W, Xiaoyuan Y. Eco-system services of partial organic substitution for chemical fertilizer in a peri-urbanzone in China." Journal of Cleaner Production. 2019;224:779-788.
4. Ostadi A, Abdollah J, Mostafa M, Mohammad R, Mojtaba N, Farzad R, Filippo M. Effect of different fertilizer sources and harvesting time on the growth characteristics, nutrient uptakes, essential oil productivity and composition of *Mentha piperita* L." Industrial Crops and Products. 2020;148:1 12290.
5. Garcia-Gonzalez J, Sommerfeld M. Biofertilizer and biostimulant properties of the microalga *Acutodesmus dimorphus*. J. Appl. Phycol. 2015;28:1051-1061.
6. Rathore S, Chaudhary D, Boricha N, Ghos A, Bhatt P, Zodapc S, Patolia J. Effect of seaweed extract on the growth, yield and nutrient uptake of soybean (Glycine max) under rain fed conditions. South African J. Bot. 2009;75(2): 351- 355.
7. Fornes F, Sánchez-Perales M, Guadiola J. Effect of a seaweed extract on the productivity of ‘de Nules’ Clementine mandarin and navelina orange. Botanica Marina. 2002;45:486–489.
8. Zodape S, Mukhopadhyay K, Eswaran R, Chikara J. Enhanced yield and nutritional in green gram (*Phaseolus radiata* L) treated with seaweed (*Kappaphycus alvarezii*) extract. J. Sci. Industrial, Res. 2020;69:468-471.
9. Hounsome N, Hounsome B, Tomos D, Edwards-Jones G. Plant metabolites and nutritional quality of vegetables. J. Food. Sci. 2008; 73(4): 48-65.
10. Kowalczyk K, Zielony T. Effect of Amino plant and Asahi on yield and quality of lettuce grown on rock wool.Conf.of

biostimulators in modern agriculture. 2008; 7-8 Febuary, Warsaw, Poland.

11. Haraz A, Shaaban H, Abido I. Growth, Yield and Chemical Composition of Moringa as affected by some Mineral Fertilizers, Amino Acids and Active Dry Yeast. J. Adv. Agric. Res. (Fac. Agric. Saba Basha). 2019; 24(1):118-131.
12. Page A, Miller R, Keeney K. Methods of soil analysis Part 2-chemical and microbiological properties. 1982; Part II. ASA-SSSA. Agronomy, Madison, USA.
13. Gomez K, Gomez A. Statistical Procedures for Agricultural Research 2nd edition. 1984; John Wiley & Sons. Inc., New York.
14. Mazher A, Abdel-Aziz G, El-Dabh R, El-Khateeb M, Abd El-Badaie A. Effect of Bio Fertilization on Growth and Constituents of *Moringa oleifera* Lam. Plants. Middle East J. Agric. R, 2014; (4): 793-798.
15. Youssef M. Impact of bio-fertilizers on growth and yield of *Moringa oleifera* Lam. plants. Al-Azhar. J. Agric. Res. 2016; 26 (3): 127-138.
16. EL-Leithy A. Effect of irrigation intervals and biofertilization on yield, oil production and chemical constituents of chamomile (*Matricaria chamomilla*, L.) Plants. J. Product. Dev. 2007; 12(1): 85 - 99.
17. Zayed M. Improvement of growth and nutritional quality of *Moringa oleifera* using different bio-fertilizers. Annals,Agric. Sci. 2012; (1):53-62.
18. Abd El-Baset M. Effect of Foliar Application of Yeast Extract and some of Amino Acids on Growth and Chemical Composition of Two Drum Sticks Species (*Moringa oleifera* and *Moringa ovalifolia*). J. Plant Prod., Mansoura Univ. 2017; 8 (10): 953 – 959.
19. Radwan F, Abido A, Shaben E, Abdel Gabr N. Effect of Mineral, Organic and Bio-fertilization on Growth and Production of Moringa (*Moringa oleifera*, L.) Plants. J. Advanc. Agric. Res. 2016; 21(2): 308-324.
20. Zewail R. Effect of seaweed extract and amino acids on growth and productivity and some biocostituents of common bean (*Phaseolus vulgaris* L) plants. J. Plant Prod. 2014; 5(8): 1441-1453.
21. Atteya A, Amer H. Influence of seaweed extract and amino acids on growth, productivity and chemical constituents of *Hibiscus sabdariffa* L. plants. Bioscience, Res. 2018; 15(2): 772-791.
22. Sriyuni O, Mansyurdin M, Izmiarti N. Application of seaweed extract *Sargassum cristaefolium* and amino acid to growth and yield of upland rice (*Oryza sativa* L.). Int. J. Sci. Technol. Res. 2020; 9(3): 2014-2018.
23. Fawzia E. Use of some biostimulants in activation of soil microflora for yield and fruit quality improvement of "Canino" apricot. J. Agric. Res. Tanta Univ. 2003; 29 (1) :175- 194.
24. Abou El-Yazied A, El-Gizawy M, Ragab I, Hamed I. Effect of seaweed extract and compost treatments on growth, yield and quality of snap bean. J. American, Sci. 2012; 8: 1-20.
25. Salah El Din R, Elbakry A, Ghazi S, Abdel Hamid O. Effect of seaweed extract on the growth and yield of faba bean (*Vicia faba* l.). Egyptian J. Phycol. 2008; 9(1):25-38.
26. Awad M, Youssef N, El-Shall Z. Effect of foliar spraying with seaweed extracts and inorganic fertilizers levels on growth, yield and quality of potato crop. J. Agric. Sci. Masoura Univ. 2006; 31(10): 6549-6559.
27. Vasantharaja R, Abraham L, Inbakandan D, Thirugnanasambandam R, Senthilvelan T, Jabeen S, Prakash P. Influence of seaweed extracts on growth, phytochemical contents and antioxidant capacity of cowpea (*Vigna unguiculata* L. Walp). Biocatal. Agric. Bio. 2019; 17:589–594.
28. Abdel-Aziz N, Mahgoub M, Siam H. Growth, flowering and chemical constituents performance of Amaranthus tricolor plants as influenced by seaweed (*Ascophllum nodosum*) extract application under salt stress conditions. – J. Appl. Sci. 2011, 7(11): 1472-1484.
29. Mahmoud S, Salama D, El-Tanahy A, Abd El-Samad E. Utilization of seaweed (*Sargassum vulgare*) extract to enhance growth, yield and nutritional quality of red radish plants. Annal, Agric. Sci. 2019; 64(2): 167-175.
30. Shahira A, Iman M, Abo El – Khair B, Laila K. Iflunce of foliar application of algae extract and amino acids mixture on fenugreek plants in sandy and clay soil. Nusantara Bioscience. 2015; 7 (1): 33-37.

31. Al-Hamzawi M. Effect of seaweed extract and micronutrients mixture on some growth characters and flowering of *Dianthus chinensis* l. and *Gazania splender* l. plants. J. Phys.: Conf. Ser. 2019; 1294, 092001–092009

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