Effect of pruning methods and foliar spraying with seaweed extract on the growth and productivity of watermelon (*Citrullus lanatus*, L.)

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Abstract: The research was carried out during the agricultural season of 2024 in a private farm in Deir Ezzor Governorate on watermelon (*Citrullus lanatus*, L.) hybrid (Embla F1) plants. The aim of this study was to study the effect of foliar spraying with the seaweed extract Biozyme TF using four concentrations 0, 2.5, 5, and 7.5 ml L^{-1} and three sprays, the first at the appearance of the second true leaf, the second at the beginning of fruit set, and the third two weeks before maturity, and the pruning methods (Method A: Pruning plants to three stems, keeping one fruit on each stem, Method B: Pruning plants to four stems, keeping one fruit on each stem, Method C: Pruning plants to five stems, keeping one fruit on each stem, Control D: No pruning) on the growth and productivity characteristics of watermelon plants, using a Randomized Complete Block Design (RCBD) with 3 replicates per treatment. The results showed that the unpruned control treatment significantly outperformed the other pruning treatments in the number of leaves formed on the plant, while the three-branch pruning treatment significantly outperformed the control treatment and the other pruning treatments in terms of leaf surface area, leaf chlorophyll content, and fruit weight. Fruit weight increased significantly when pruning on three branches, while productivity was superior in the pruning treatment on four branches. As for foliar spraying, the 7.5 ml L^{-1} treatment outperformed the rest of the spraying treatments and the control significantly in: number of leaves, leaf surface area, while the 5 ml L^{-1} foliar spray treatment outperformed them significantly in the two traits of fruit weight and productivity.

Keywords: watermelon, seaweed extract, pruning, growth indicators, productivity

Citation: Al-Amer, N. H. 2026. Effect of pruning methods and foliar spraying with seaweed extract on the growth and productivity of watermelon (*Citrullus lanatus*, L.). Agricultural Engineering International: CIGR Journal, 28(1):221-230.

1 Introduction

Watermelon (*Citrullus lanatus* L.) belongs to the Cucurbitaceae family. It is an annual, creeping herbaceous plant that produces most of its fruit from seeds and grows best in warm climates (Gupta et al., 2023). Watermelon originated in ancient agriculture and was domesticated in Africa, a later spread to southern Europe (the Mediterranean region), the Middle East, the Americas, and India (Pérez et al., 2015). Watermelon is considered one of the best foods for blood vessels and heart in America. Its fruit contains very few calories and can be eaten in large quantities to feel full without fear of gaining weight. In addition, it contains alpha-carotene (Lewinsohn et al., 2005). It is highly sought after for its sweet taste, rich watery flavor, bright flesh color, crumbly texture, and good nutritional value. The presence of the amino acid citrulline, potassium, water, vitamin C, vitamin

Received date: 2025-06-10 **Accepted date:** 2025-11-18

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A (carotenes), and vitamin K in watermelon has proven its effectiveness as an alternative medicine for patients with hypertension (Trizayuni et al., 2022). Watermelon quality is determined by the type and method of fertilizer application, as watermelon plants are affected by and respond to fertilization (Kuwar et al., 2014). Nutrients play an important role in watermelon growth and productivity, as they participate in or assist metabolic processes and are among the driving forces behind all vital activities performed by the plant. Their deficiency causes physiological dysfunction resulting from nutritional imbalance. Fertilization is critical for watermelon quality. Several studies have found that a deficiency or imbalance in plant nutrients leads to deterioration in watermelon quality (Lopez-Zaplana et al., 2020). Syria's watermelon production in 2022 amounted to about 348,711 tons ha^{-1}. Serving the crop requires the introduction of modern technologies to increase productivity and move away from the traditional methods followed by the farmer, thus obtaining a good economic return and a good quality product. As a result of the increasing demand for the crop, many experiments were conducted to improve the crop in quantity and quality. Research has shown that the yield of the watermelon crop can be improved through some agricultural service operations, including pruning (Oga and Umekwe, 2016).

Watermelon is a multi-branching plant, producing numerous stems that can reach 4 meters in length. Therefore, pruning has been considered an alternative that reduces energy expenditure on stems, leaves, and fruits. Instead, this energy can be invested in other parts of the plant (Muñoz-Rengifo et al., 2018). Pruning is the process of cutting off living or dead parts of plants to achieve vegetative, fruitful and root balance, thus removing unproductive parts to transfer energy to parts capable of bearing fruit (Thakur et al., 2018), in addition to affecting the quantitative and qualitative characteristics of fruits. It also plays a role in changing the hormonal balance and the C/N ratio. Sultana et al. (2016) studied the effect of pruning on the growth and productivity of tomato plants and found a significant increase in the total number of flowers and fruit weight in plants pruned on three branches compared to both the unpruned control and plants pruned on two stems. Olasantan and Salan (2008) found an increase in the number of pods, productivity, and early maturity in pruned okra plants compared to the unpruned control. Like other cucurbits, watermelon is also a crop whose vines produce female flowers approximately every five male flowers (Dube et al., 2020). The number of vines per plant is an important criterion determining the performance of cucurbit crops, including watermelon (Gomes et al., 2019). On the other hand, the number of fruits per plant is an important criterion determining fruit size, mass, and yield (Lins et al., 2013). Therefore, paying attention to these aspects in cucurbit management is crucial. In cucurbits, the number of vines per plant and the number of fruits per plant can be regulated through various methods, including vine and fruit pruning (Campos et al., 2019). Watermelon fruits are formed on third-order lateral branches and beyond. Therefore, plants are pruned above the third leaf during the young plant stage, after which about three independent branches are formed. These are then pruned to produce third-order branches, which bear female flowers.

Third-order branches are pruned again to stimulate the formation of fourth-order branches, which inevitably produce female flowers, and so on. Tworkoski et al. (2006) demonstrated increased levels of auxins, cytokinins, and gibberellins in pruned branches. Foliar feeding is a suitable and necessary system for plants to meet their requirements for essential nutrients through the leaves, because their transport through the roots requires a long time compared to spraying on the leaves, and it has a direct impact on many physiological processes affecting growth and yield (Stojanova et al., 2022). In recent years, the use of seaweed as biostimulant has increased, as they contain phytohormones, polysaccharides, minerals, proteins, fatty acids, and polyphenols that enhance plant performance even under stress conditions (Subramaniyan et al., 2023). The use of seaweed and algae extracts has become one of the modern techniques that have become widespread as plant growth stimulants. Researchers and specialists have obtained positive results due to the nutrients, hormones, amino acids and vitamins they contain. They lead to increased plant strength and increased absorption of nutrients.

They also strengthen the immune system in the plant, which increases its resistance to diseases and thus reflects on increased productivity and improved quality. They are usually used as sprays on the vegetative group as foliar fertilizers (Battacharyya et al., 2015). Seaweed extracts are among the important organic sources used in agricultural production and are a complement to fertilizers, not a substitute for them (Begum et al., 2018). Amujoyegbe et al. (2010), and Abd El-Kader et al. (2010) indicated that the extracts contain magnesium and iron, which are components of the chlorophyll molecule, which helps in increasing the photosynthesis process. This increase results in good vegetative growth, which is reflected in increasing the components of productivity.

The results of the study by Al-Akayshi and Al-Sahaf (2017) also showed that spraying okra plants with algae extract (alpha takamine) at a concentration of 1, 2, and 3 ml L^{-1} gave the highest vegetative and productive characteristics compared to the control treatment. The results of Al-Maliki (2013) showed the superiority of the treatments of adding the marine extract Biozyme TF in all the studied traits on the cabbage plant, and the most effective was the three-time addition, as it caused a significant increase in the plant height, the number of curled leaves, the wet and dry weight of the root system, the width and area of the outer leaf, the total weight of the plant, the weight and diameter of the curled head, and the total production compared to the control treatment. Abdel-Mawgoud et al. (2010) found that spraying watermelon plants with seaweed extract increased the response of various growth parameters and yield responses, while the differences between hybrids remained the same. In a study conducted by Wahab (2020) on two varieties of Hungarian Wax-California Wonder pepper to determine the effect of the levels of the sea extract Seamino on growth and yield, the results showed that the California Wonder variety was significantly superior in the studied vegetative growth traits (plant height, number of leaves, number of branches, and leaf area). The California Wonder variety also showed the highest results in yield traits.

Studies and research on watermelon pruning are still very few despite its importance to the plant and the breeder, as pruning helps to obtain a product that matches the specifications of the cultivated variety, is early in production, and of excellent quality. In addition, awareness of the dangers of chemical fertilizers has increased and the trend towards reducing their use as much as possible to obtain a safe product by using marine extracts, whose components are relied upon as natural materials in agriculture as an alternative to chemical materials. Also, due to the lack of experience of the farmer in choosing what is appropriate for better production and good quality, the research came to achieve the following objectives:

(1) Study the effect of foliar spraying with seaweed extract on the growth and productivity of watermelon and determine the optimal concentration.

(2) Study the effect of pruning on the growth and productivity of watermelon.

(3) To determine the effect of the interaction between spraying seaweed extract and pruning on the growth and productivity of watermelon.

2 Materials and methods

2.1 Research materials

2.1.1 Place where the research was carried out

The research was conducted on a private farm in Deir Ezzor Governorate, Syria, during the 2024 season. The site soil is alkaline pH=7.89, EC=2.9 dS m^{-1}, organic matter 0.65%, nitrogen 4.17 ppm, phosphorus 6.3 ppm, potassium 221 ppm, and mechanical analysis of the soil: 28.66% sand, 32.4% silt, 38.94% clay.

2.1.2 Plant material

The Impala F1 watermelon variety was used in the research.

2.1.3 Experiment treatments

Factor 1: Pruning: (A): Prune plants to three stems, leaving one fruit on each stem (three fruits per plant). (B): Prune plants to four stems, leaving one fruit on each stem (four fruits per plant). (C): Prune plants to five stems, leaving one fruit on each stem (five fruits per plant). (D): No pruning (control).

The second factor: contains three treatments of foliar spraying with seaweed extract 2.5, 5, and 7.5 ml L^{-1} in addition to the control treatment of distilled water extract 0 ml L^{-1} at a rate of three sprays: the first when the second true leaf appears, the second at the beginning of fruit set, and the third two weeks before fruit ripening.

Seaweed Extract (Biozyme TF): Use Biozyme TF seaweed extract.

Table 1 Components of seaweed extract

The material	value
% plant hormones	78.87 %
Auxin	32.2 ppm
GA Gibberellin 3	32.2 ppm
Zentins cytokinin	83.2 ppm
Mineral elements% (magnesium-sulfur-iron-boron-manganese-zinc)	1.86 %
Other substances (vitamins, free amino acids, etc)	19.20 %

2.2 Working methods

2.2.1 Preparing the land for agriculture

The experimental land was planned in the form of terraces with a width of 300 cm, with each terrace containing five plants. Then the seeds were planted in holes at a rate of 3-5 seeds per hole with a distance between each plant of 250 cm according to the experimental treatments. The seeds were soaked in warm water at 30℃ for 24 hours before planting. Planting took place on 3/29/2024, and one plant was left in the hole after germination, which was the strongest plant (separation process). The irrigation process was carried out immediately after planting. Agricultural service operations were carried out on all treatments as followed in watermelon cultivation.

2.2.2 Fertilizers added

Phosphate and potassium fertilizers were added before planting, 11 kg P dunum^{-1} (triple superphosphate fertilizer 46%), 6 kg K dunum^{-1} (potassium sulfate 50%), while nitrogen fertilizers, 10 kg N dunum^{-1} (urea 46%), were added in batches after planting, in accordance with the soil content of mineral elements according to the chemical analysis of the soil at the research site.

3 Data recorded

Number of leaves (leaf per plant): Leaves were counted per plant in the field by averaging the number of leaves in five plants per treatment.

Leaf surface area (cm^2): The leaf surface area was calculated using an Area Meter by taking leaves from the bottom, middle and top of the branch during the flowering stage.

Chlorophyll content of leaves: The chlorophyll content of leaves was measured with a Chlorophyll Meter Spad- 502 Plus.

Fruit weight (kg).

Productivity (tons ha^{-1}).

4 Experiment design and statistical analysis

The experimental design used factorial experiments according to a randomized complete block design (RCBD) with three replicates and an average of five plants per replicate. Each experimental plot included pruning methods (factor 1) and spraying rates with the seaweed extract Biozyme TF (factor 2). Therefore, the experiment required 48 experimental plots, and a total number of 240 plants. The results were statistically analyzed using the ANOVA method by calculating the least significant difference (LSD) value at the 5% level for the field results using the GenStat 12 statistical program.

5 Results and discussion

5.1 Number of leaves (leaf per plant)

It is noted from Table 2 that the control treatment (not pruned) recorded a significant superiority in the number of leaves compared to the other pruning treatments, as the number of leaves reached 223.25 leaf per plant, followed by the pruning treatment on five branches (213.25 leaf per plant), followed by the pruning treatment on four branches (203.5 leaf per plant), while it was less valuable in the pruning treatment on three branches (194 leaf per plant). The increase in the number of leaves in the un-pruned plants is due to the fact that they contain a larger number of branches compared to the pruned plants (Mardhiana et al., 2017).

Regarding the spray treatments with seaweed extract, plants treated with a concentration of 7.5 ml L^{-1} significantly outperformed the rest of the spray treatments, and the average number of leaves was (226.25 leaf per plant), while the number of leaves decreased significantly in the control (185.25 leaf per plant). The significant superiority of using seaweed extract may be attributed to its hormonal nature, which led to an increase in the concentration of these hormones within the plant, which was positively reflected in the increase in vegetative growth, as these hormones interact with each other in their physiological work, causing an increase in cell division in the plant, and thus an increase in the number of leaves (Kadhim and Athfua, 2023).

As for the combined effect of the spraying and pruning treatments, the unpruned control with spraying at a concentration of 7.5 ml L^{-1} achieved the highest number of leaves (237 leaf per plant), and there were no significant differences between it and the pruning treatment on five branches when spraying at the same concentration, while the combined effect of the pruning method on three branches with the control (not sprayed with the extract) achieved the lowest value in the number of leaves.

Table 2 Effect of pruning method and foliar spraying with seaweed extract (Biozyme TF) on the number of leaves of watermelon plants (leaf per plant)

Pruning method	Seaweed extract concentration ml^{-1}				Average pruning treatments
	0	2.5	5	7.5	
A	170	186	208	212	194d
B	176	198	219	221	203.5c
C	185	209	224	235	213.25b
D	210	217	229	237	223.25a
Average foliar spray treatments	d 185.25	c 205.5	b 220	a 226.25	208.15
LSD5% For pruning			3.10		
LSD5% For foliar spraying			3.95		
LSD5% for reaction			3.74		

5.2 Surface area of leaf (cm^2)

Table 3 shows a significant increase in leaf surface area in the pruning treatments. The three-branch pruning treatment significantly outperformed the remaining pruning treatments and the control (not pruned) (2749.5 cm^2), followed by the four-branch pruning treatment (2622 cm^2), which significantly outperformed the five-branch pruning treatment, which in turn outperformed the control (2490 cm^2). The increase in leaf surface area is due to the plants' response to pruning as a result of the change in the relationship between the remaining parts after pruning and the variation in auxin production. The ability of their leaves to carry out photosynthesis increases rapidly, and their root system and internal vascular tissues develop to connect leaf tissues with the roots, so that they can supply these organs with water and nutrients (Shivaraj et al., 2018).

Regarding foliar spray treatments, the leaf surface area increased with increasing spray concentration, and the concentration of 7.5 ml L^{-1} achieved a significant superiority over the remaining spray treatments and the control treatment (2883.25 cm^2). The reason for the increase in leaf area is that the seaweed extract contains auxin and cytokinin, which play an effective role in cell division and enlargement.

This leads to increased bud growth and leaf area (Sarhan et al., 2011).

Table 3 also shows that the combined effect of the three-branch pruning method and foliar spraying at a concentration of 5 ml L^{-1} achieved the highest leaf surface area (3145 cm^2), while the leaf surface area decreased significantly in the unpruned and unsprayed control (2110 cm^2).

Table 3 Effect of pruning method and foliar spraying with seaweed extract (Biozyme TF) on leaf surface area (cm^2) of watermelon plants

Pruning method	Seaweed extract concentration ml^{-1}				Average pruning treatments
	0	2.5	5	7.5	
A	2232	2588	3145	3033	2749.5a
B	2195	2537	2831	2925	2622b
C	2139	2479	2721	2770	2527.25c
D	2110	2396	2649	2805	2490d
Average foliar spray treatments	2169d	2500c	2836.5b	2883.25a	2597.18
LSD5% For pruning			15.26		
LSD5% For foliar spraying			14.11		
LSD5% for reaction			15.11		

5.3 Chlorophyll content of leaves

The results in Table 4 show that the three-branch pruning treatment outperformed the other pruning treatments and the unpruned control in leaf chlorophyll content (81.82 Spad). Pruning has an effect on increasing the vigor of vegetative growth and leaf growth as a result of vigorous branch growth, which increases the chlorophyll content and increases the production of nutrients. This is because the pruned plants receive sufficient light. (Singh and Kaur, 2018).

As for the spray treatments, the concentration of 7.5 ml L^{-1} achieved the highest value in leaf chlorophyll content (79.23 Spad) compared to the rest of the spray treatments and the control not sprayed with algae extract. The above may be due to the presence of iron in the extract, as iron increases chlorophyll, and this was confirmed by (Al-Zubaidi and Marwan, 2017) when spraying two potato varieties with iron and humic acid. As for the role of iron in increasing the chlorophyll content in the leaves, it may be due to the role it plays in biological processes, as it is involved in chlorophyll metabolism. Iron is an essential mediator in the formation of chlorophyll but is not included in its composition. This is because iron is a cofactor, as it enters into the composition of porphyrin and activates the enzymes that metabolize chlorophyll.

The interaction between pruning and spraying with the extract also had a clear effect on the chlorophyll content of the leaves, as the highest value was reached when pruning was done on three branches with spraying at a rate of 7.5 ml L^{-1} and was (88.63 Spad). The lowest chlorophyll value was in the unpruned and unsprayed control (60.22 Spad).

Table 4 Effect of pruning method and foliar spraying with seaweed extract (Biozyme TF) on the chlorophyll content of watermelon leaves (Spad)

Pruning method	Seaweed extract concentration ml^{-1}				Average pruning treatments
	0	2.5	5	7.5	
A	72.67	80.90	85.11	88.63	81.82 a
B	65.31	69.96	75.55	79.80	72.65 b
C	62.14	66.89	73.97	76.16	69.79 c
D	60.22	63.49	70.56	72.34	66.65 d
Average foliar spray treatments	65.08 d	70.31c	76.29 b	79.23 a	72.73
LSD5% For pruning			1.76		
LSD5% For foliar spraying			2.58		
LSD5% for reaction			2.11		

5.4 Fruit weight (kg)

We conclude from the data in Table 5 that there is a significant increase in fruit weight when pruning on three branches compared to the rest of the pruning treatments. With the unpruned control, the average fruit weight in this treatment was (9.50 kg), followed by the pruning treatment on four branches and then the pruning treatment on five branches. While the fruit weight decreased in the unpruned control (5.82 kg). This is due to the effect of the pruning process on increasing vegetative growth indicators, which led to an increase in leaf area and an increase in chlorophyll, which contributed to an increase in fruit weight as a result of the metabolism products going to storage areas (Ndereyimana et al., 2021). Successful pruning also provides an appropriate balance between the number of fruits and their size, leaving an appropriate number of branches on the plant, and the low number of buds improves the quality and weight of the fruits (Aydın et al., 2020).

We also noticed an increase in fruit weight in treatments with high concentrations of seaweed extract, as the highest fruit weight was reached in the 5 ml L^{-1} concentration treatment (8.67 kg), and there were no clear significant differences between it and the 7.5 ml L^{-1} concentration treatment, while the weight decreased in the control (6.33 kg). This may be due to the increase in nutrients provided to the fruit, as the abundance of nutrients and their balanced availability helped the plant reach a good nutritional state, which led to an increase in the plant's efficiency in absorbing elements, building compounds in the leaves, and accumulating manufactured materials in storage areas, including fruits, which caused an increase in their weight (De Paula et al., 2022).

As for the interaction, the highest fruit weight was reached when the pruning treatment on three branches was interacted with spraying at a concentration of 5 ml L^{-1}, which reached 11.00 kg, while it decreased in the unpruned and unsprayed control to 4.7 kg.

Table 5 Effect of pruning method and foliar spraying with seaweed extract (Biozyme TF) on fruit weight (kg)

Pruning method	Seaweed extract concentration mL^{-1}				Average pruning treatments
	0	2.5	5	7.5	
A	8	8.4	11.00	10.62	9.50 a
B	7.6	8.00	9.7	9.1	8.6 b
C	5.03	5.8	7.3	6.5	6.15 c
D	4.7	5.5	6.7	6.4	5.82 d
Average foliar spray treatments	6.33 d	6.92 c	8.67 a	8.15 b	7.52
LSD5% For pruning			0.195		
LSD5% For foliar spraying			0.189		
LSD5% for reaction			0.201		

5.5 Productivity tons ha^{-1}

From the results of Table 6, we note a significant superiority in productivity when pruning with four branches compared to the remaining pruning treatments and the unpruned control (45.86 tons ha^{-1}). This was followed by the five-branch pruning treatment, which outperformed the remaining treatments, followed by the three-branch pruning treatment and the unpruned control treatment, where productivity decreased, and there were no significant differences between them. The lower the number of branches per plant, the larger the root size and the stronger the plant. Finally, the yield increased due to improved nutrient and water absorption (Ndereyimana et al., 2021).

As for the treatments of different concentrations of the extract, the highest productivity value was achieved when plants were treated with a concentration of 5 ml L^{-1}, reaching 45.03 tons ha^{-1}, while productivity decreased in the control treatment not sprayed with the extract. Regarding the effect of pruning and spraying together, the highest productivity value was achieved when using the four-branch pruning method and spraying with the seaweed extract at a concentration of 5 ml L^{-1} (51.73 tons ha^{-1}). We also note that increasing the number of fruits plays a positive role when using the four-branch pruning method in raising productivity, as the number and weight of fruits are included in the productivity calculation compared to the three-branch pruning method, which outperformed in the rest of the indicators.

The reason for the increase in productivity can be explained as a direct result of the increase in morphological and fruit indicators, and this was confirmed by the correlation between spraying with seaweed extract, pruning, and growth indicators. For example, the positive effect of the extract and the pruning method on the leaf surface area leads inevitably to an increase in the efficiency of the photosynthesis process, which leads to an increase in the accumulation of manufactured carbohydrates in addition to its role in increasing enzyme activities, and this is consistent with (Canellas and Olivares, 2014).

The highest productivity value was achieved when using a concentration of 5 ml L^{-1} and the pruning method on four branches (51.73 tons ha^{-1}). This may be due to the increased growth strength of the stems on which the plants are raised, and thus the increase in the number of flowers and fruits and the yield of one plant, especially when spraying with organic fertilizers that stimulate plants to continue flowering and fruit setting. This result is consistent with what was reached by (Baral et al., 2021).

Table 6 Effect of pruning method and foliar spraying with seaweed extract (Biozyme TF) on the productivity of watermelon plants (tons ha^{-1}).

Pruning method	Seaweed extract concentration ml^{-1}				Average pruning treatments
	0	2.5	5	7.5	
A	32	33.6	44	40.80	37.6 c
B	40.53	42.66	51.73	48.53	45.86 a
C	33.53	38.66	48.66	43.33	41.04 b
D	25.06	29.33	35.73	34.13	31.06 d
Average foliar spray treatments	32.78 d	36.06 c	45.03 a	41.69 b	38.89
LSD5% For pruning			1.24		
LSD5% For foliar spraying			1.36		
LSD5% for reaction			1.42		

6 Conclusion

Spraying with Biozyme TF seaweed extract at a concentration of 7.5 ml L^{-1} achieved significant improvements in all studied traits, including leaf number, chlorophyll content, and leaf surface area, with the exception of fruit weight and yield, which reached their highest values at a concentration of 5 ml L^{-1}.

Although the unpruned control was significantly superior to the other pruning treatments in the number of leaves formed on the plant, the three-branch pruning treatment was significantly superior in the leaf surface area, chlorophyll content of the leaves, and fruit weight, while productivity reached its highest values when pruning on four branches.

The interaction between spraying and pruning had a significant effect on all studied traits.

Based on the above, it is recommended to use the three-branch pruning method and spray with a seaweed extract (Biozyme TF) at a concentration of 5 ml l-1 when achieving heavier fruit. It is suggested that in-depth studies be conducted on the application of pruning to watermelon plants and its positive impact on various plant characteristics.

Reference

Abd El-Kader, A. A., S. M. Shaaban, and M. S. Abd El-Fattah. 2010. Effect of irrigationlevels and organic compost on okra plants (*Abelmoschus esculentus* I.) growth insandy calcareous soil. *Agriculture and Biology Journal of North America*, 1(3): 225-231.

Abdel-Mawgoud, A. M. R., A. S. Tantaway, M. M. Hafes, and H .A. M. Habib. 2010. Seaweed extract improved growth, yield and quality of different watermelon hybrids. *Research Journal of Agriculture and Biological Science*, 6(9): 161-168.

Al-Akayshi, H. M. S., and F. H. R. H. Al-Sahaf. 2017. Spraying some plant extracts and their role in the vegetative and floral growth characteristics and yield of three okra cultivars. *Abelmoschus esculentus* L. *Kufa Journal of Agricultural Sciences*, 9(3): 60-77.

Al-Maliki, Q. A. 2013. Effect of seaweed extract Biozyme TF on the growth and yield of two varieties of cabbage (*Brassica oleracea var.capitata* L.) grown in desert areas. *Basra Research Journal*, 39(4B): 88-97.

Al-Zubaidi, H. A. A., and M. H. Marwan. 2017. Effect of spraying with humic acid and iron on some growth characteristics and yield of two potato cultivars Solanum tuberosum L. BIM-872811. Ramadi, Iraq: University of Anbar, College of Agriculture.

Amujoyegbe, B. J., J. T. Opabode, and A. Olayinka. 2010. Effect of Organic and Inorganic Fertilizer on Yield and and Chlorophyll content of Maize (*Zea mays* L.) and Sorghum (*Sorghum bicolour* (L.) Moench. *African Journal of Biotechnology*, 6(16): 1869-1873.

Aydın, A., H. Başak, and A. N. Çetin. 2020. Effects of different pruning systems on fruit quality and yield in california wonder peppers (*Capsicum annuum* L.) grown in soilless culture. *Manas Journal of Agriculture Veterinary and Life Sciences*, 12(1): 31-39.

Baral, B., M. Shrestha, S. Subedi, P. R. Dulal, and N. R. Joshi. 2022. Effect of foliar spray of ethephon doses and pruning intensities on growth, sex expression, and yield of cucumber (var- *Bhaktapur local*) in Kaski, Nepal. *Archives of Agriculture and Environmental Science,* 7(3): 347–354.

Battacharyya, D., M. Z. Babgohari, P. Rathor, and B. Prithiviraj. 2015. Seaweed extracts as biostimulants in horticulture. *Scientia Horticulturae*, 196: 39–48.

Begum, M., B. C. Bordoloi, D. D. Singha, and N. J. Ojha. 2018. Role of sea-weed extract on growth, yield, and quality of some agricultural crops: A review. *Agricultural Reviews*, 39(4): 321-326.

Campos, A. M. D., J. M. Q. Luz, D. G. Santana, and G. R. Marquez. 2019. Influences of plant density and fruit thin- ning on watermelon hybrid production cultivated in different seasons. *Horticultura Brasileira*, 37(4): 409-414.

Canellas, L. P., and F. L. Olivares. 2014. Physiological responses to humic substances as plant growth promoter. *Chemical and Biological Technologies in Agriculture*, 1(1): 3.

De Paula, B. S., D. Feltrim, D. H. C. Engel, J. L. C. Baptistella, M. Rodrigues, E. Engel, and P. Mazzafera. 2022. Algae-based biostimulants increase yield and quality of mini tomatoes under protected cultivation. *JSFA Reports*, 2(4): 155-160.

Dube, J., G. Ddamulira, and M. Maphosa. 2020. Watermelon production in Africa: challenges and opportunities. *International Journal of Vegetable Science*, 27(3): 211-219.

Gomes, R. F., L. D. S. Santos, L. T. Braz, F. L. D. N. Andrade, and S. M. F. Monteiro. 2019. Number of stems and plant density in mini watermelon grown in a protected environment. *Pesquisa Agropecuária Tropical*, 49(6): e54196.

Gupta, R., G. P. Kumar, G. Singh, J. Malik, V. K. Siroliya, and. N. K. Maurya. 2023. Ethnomedicinal significance of *Citrullus lanatus* (Watermelon): A pharmacological review. *International Journal of Pharmaceutical and Clinical Research*, 5(2): 1-5.

Kadhim, R. A., and Q. J. Athfua. 2023. Effect of Nano Zinc Oxide and Acadian Seaweed Extract on the Growth and Mineral Content of Watercress Plant, Eruca Sativa Mill. *European Scholar Journal (ESJ)*, 4(3): 97-102.

Kuwar, P., A. G. Durgude, S. R. Kadam, and A. A. Patil. 2014. Response of watermelon to foliar application of different water soluble fertilizer. *Asian Journal of Horticulture*, 9(2): 431-434.

Lewinsohn, E., Y. Sitrit, E. Bar, Y. Azulay, A. Meir, D. Zamir, and Y. Tadmor. 2005. Carotenoid pigmentation affects the volatile composition of tomato and watermelon fruits, as revealed by comparative genetic analyses. *Journal of Agricultural and Food Chemistry*, 53(8): 3142-3148.

Lins, H. A., R. C. F. Queiroga, A. D. M. Pereira, G. D. Silva, and J. R. T. Albuquerque. 2013. Growth, yield and quality of fruits of watermelon in function changes in relation sink-source. *Revista Verde de Agroecologia e Desenvolvimento Sustentável*, 8(3): 143-149.

Lopez-Zaplana, A., G. Bárzana, A. Agudelo, and M. Carvajal. 2020. Foliar mineral treatments for the reduction of melon (*Cucumis melo* L.) fruit cracking. *Agronomy*, 10(11): 1815.

Mardhiana, M., A. P. Pradana, M. Adiwena, K. Kartina, D. Santoso, R. Wijaya, and A. Maliki. 2017. Effects of pruning on growth and yield of cucumber (Cucumis sativus) Mercy variety in the acid soil of North Kalimantan, Indonesia. *Cell Biology and Development*, 1(1): 13-17.

Muñoz-Rengifo, J., R. Villamar-Torres, J. Molina-Villamar, L. G. Cruzaty, B. T. Navarrete, B. C. Moncada, J. C. Olaya, A. M. Matute, D. Ortega-Guevara, and S. M. Jazayeri. 2018. A correct combination of pruning, spacing and organic fertilizer improve development and quality of fruit in watermelon cultivar: Case of Ecuadorian littoral. *Bioscience Research*, 15(3): 1462-1471.

Ndereyimana, A., B. W. Waweru, B. Kagiraneza, A. N. Niyokuri, P. Rukundo, and G. Hagenimana. 2021. Effect of vine and fruit pruning on yield attributes of two watermelon (*Citrullus lanatus*) cultivars. *Advances in Horticultural Science*. 35(3): 269-275.

Oga, I. O., and P. N. Umekwe. 2016. Effects of pruning and plant spacing on the growth and yield of watermelon (*Citrullus lanatus* L.) in Unwana-Afikpo. *International Journal Science Research*, 5(4): 110-115.

Olasantan, F. O., and A. W. Salan. 2008. Effect of pruning on growth leaf yield and pod yield of okra *Abelmoschus esculentus* L. Moench). *Journal of Agricultural Science*, 146(1): 93-102.

Pérez, N. G. U., A. J. C. González, and J. H. R. Silva. 2015. Diagnóstico socioeconómico del cultivo de sandía en el estado de Campeche, México. *Revista mexicana de ciencias agrícolas*, 6(6): 1331-1344.

Sarhan, T. Z., S. T. Ali, and S. M. S. Rasheed. 2011. Effect of bread yeast application and seaweed extract on cucumber (*Cucumis Sativus* L.) plant growth, yield and fruit quality. *Mesopotamia Journal of Agriculture*, 39(2): 26-34.

Shivaraj, D., D. Lakshminarayana, P. Prasanth, and T. Ramesh. 2018. Studies on the effect of pruning on cucumber cv. Malini grown under protected conditions. *International Journal of Current Microbiology and Applied Sciences*, 7(03): 2019–2023.

Singh, I., and A. Kaur. 2018. Effect of pruning systems on growth and yield traits of greenhouse grown bell pepper (*Capsicum annuum* L. var. grossum). *Indian Journal of Agricultural Research*, 52(4): 414-418.

Stojanova, M. T., D. Djukic, M. Stojanova, I. Ivanovski, and A. Şatana. 2022. Effect of Foliar Fertilizing on the Yield of some Almond Cultivars Grown in North Macedonia. *Plant Physiology and Soil Chemistry*, 2(1): 8-11.

Subramaniyan, L., R. Veerasamy, J. Prabhakaran, A. Selvaraj, S. Algarswamy, K. M. Karuppasami, K. Thangavel, and S. Nalliappan. 2023. Biostimulation Effects of Seaweed Extract (A*scophyllum nodosum*) on Phytomorpho-Physiological, Yield, and QualityTraits of Tomato (*Solanum lycopersicum* L.). *Horticulturae*, 9(3): 348.

Sultana, R., S. Dilruba, K. Parveen, U. Kulsum, and N. Parvin. 2016. Effect of pruning on growth and yield of tomato (*lycopersicon esculentum Mill,*). *European International of Science and Technology*, l5(9): 127-132.

Thakur, O., V. Kumar, and J. Singh. 2018. A review on advances in pruning to vegetable crops. *International Journal of Current Microbiology and Applied Sciences*, 7(2): 3556-3565.

Trizayuni, R., W. Warnita, and A. Ardi. 2022. Growth Responses of Watermelon (*Citrullus Vulgaris* L.) to Vesicular Arbuscular Mycorrhizal Application and Pruning Variation on Peat Soil Growing Media. In *International Conference on Sustainable Environment, Agriculture and Tourism*, 190-196. Sungailiat, Bangka, 21-23 July.

Tworkoski, T., S. Miller, and R. Scorza. 2006. Relationship of pruning and growth morphology with hormone ratios in shoots of pillar and standard peach trees. *Journal of Plant Growth Regulation*, 25(2): 145-155.

Wahab, A. A. 2020. Effect of Seamino levels on the growth and yield of two pepper (Capsicum annuum L.) cultivars. *Kirkuk University Journal of Agricultural Sciences*, 11(1): 52-59.