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المجلة العراقية لبحوث السوق وحماية المستهلك

EFFECT OF SOME PLANT AND ALGAE EXTRACTS ON GROWTH AND BIOLOGICAL YIELD OF SUNFLOWER

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ABSTRACT

A field experiment was conducted at the fields of Dubana Company for Modern Agricultural Equipment in the Yusufiyah area, Al-Rashid district, Baghdad Governorate, located on a line between 44°E longitude and 33°N latitude during the spring season of 2022. The objective was to study the effect of using some plant extracts and seaweed on the growth of three genotypes of sunflower and their reflection on the biological yield. The experiment was conducted using randomized complete block design (RCBD) with split-plot arrangement with three replications, including five bio nutrition treatments (spraying the biological stimulant with seaweed extract BMstart, spraying seaweed extract Alga600, adding bamboo extract Seek, spraying Moringa leaf extract, and a control treatment spraying with distill water only) allocated to the main plots, and three genotypes (Lilo, Ishaqi-2, and Flamy) allocated to the sub plots. The results showed the superiority of the treatment of spraying seaweed extract Alga600 in stem diameter (2.87 cm), plant height (207.50 cm), leaf area (2414.3 cm^2), and biological yield (22.28 tons ha^{-1}), while the treatment of spraying Moringa leaves extract showed superiority in the number of leaves (30.28 leaf plant^{-1}) and harvest index (22.49%). As for the genotypes, Ishaqi-2 showed superiority in stem diameter (2.72 cm), leaf area (2325.6 cm^2), biological yield (24.11 tons ha^{-1}), and harvest index (21.92%), while Lilo was superior in number of leaves (29.31 leaf plant^{-1}), and Flamy was superior in plant height (201.98 cm).

Keywords: Sunflower, Biological yield, Growth enhancement, Bio stimulants.

تأثير بعض مستخلصات الطحالب والنباتات على النمو والحاصل البيولوجي لزهرة الشمس

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الخلاصة

نفذت تجربة حقلية في احد الحقول التابعة لشركة دبانة للتجهيزات الزراعية الحديثة في منطقة اليوسفية ناحية الرشيد التابعة الى محافظة بغداد والواقعة على خط بين خطي طول 44° شرقا و دائرتي عرض 33° شمالا في خلال الموسم الربيعي لعام 2022، بهدف دراسة تاثير استعمال بعض المستخلصات النباتية والاعشاب البحرية في النمو لثلاثة تراكيب وراثية من زهرة الشمس وانعكاسها على الحاصل البايلوجي، استعمل تصميم القطاعات العشوائية الكاملة RCBD بترتيب الالواح المنشقة Split-plot بثلاثة مكررات، شملت الالواح الرئيسة Main plot على خمسة معاملات تغذية (رش المحفز الحيوي مع مستخلص الاعشاب البحرية BMstart، ورش مستخلص الاعشاب البحرية Alga600 ، واضافة مستخلص قصب الخيزران Seek ورش مستخلص اوراق المورنكا، ومعاملة المقارنة رش بالماء

[*] **The research is taken from a master's thesis by the first researcher.**

فقط)، وتضمنت الالواح الثانوية ثلاثة تراكيب وراثية (ليلو، واسحاقي2، وفلامي)، اظهرت النتائج تفوق معاملة رش مستخلص الاعشاب البحرية Alga600 في قطر الساق(2.87 سم)، وارتفاع النبات (207.50 سم) والمساحة الورقية (2414.3سم٢) والحاصل البايلوجي (22.28 طن هـ-١)، بينما تفوقت معاملة رش مستخلص اوراق المورنكا في عدد الاوراق (30.28 ورقة نبات-١)، ودليل الحصاد (22.49%).اما بالنسبة للاصناف فقد تفوق التركيب الوراثي اسحاقي2 في قطر الساق (2.72 سم) والمساحة الورقية (2325.6 سم٢) والحاصل البايلوجي (24.11 طن هـ-١) ودليل الحصاد،(21.92%) وتفوق التركيب الوراثي ليلو بعدد الاوراق (29.31 ورقة نبات-١)، بينما تفوق التركيب الوراثي فلامي في ارتفاع النبات (201.98 سم) .

الكلمات المفتاحية: زهرة الشمس ,الحاصل البايلوجي, النمو، تعزيز النمو، المنشطات الحيوية.

INTRODUCTION

Sunflower is an oilseed crop belonging to the composite family, with seeds containing an oil content of 40-50% **(Nasralla *et al*., 2014).** rich in unsaturated fatty acids (90%), which contributes to reducing cholesterol levels in the blood and is also rich in protein. It occupies an important place among oil crops due to its short season and ability to adapt to a wide range of environmental conditions (**Bajehb, 2010)**. The low productivity of this crop in Iraq may be due to the non-use of suitable and promising genotypes, as well as poor crop management and the lack of adoption of modern agricultural methods, especially nutrient management, which is one of the most important areas of management for farmers. The intensive use of mineral fertilizers leads to the deterioration of the physical and chemical soil properties, exacerbating pollution problems, in addition to contaminating water and food with the residues of these fertilizers, which have harmful effects on human and animal health **(Al-Hilfy & Al-Temimi, 2017)** . Each crop has potential energy for production, which is rarely accessible in the field due to one or more factors that determine production, some of which can be distinguished and diagnosed in the field and controlled, such as nutrient deficiency and the balance of nutrients that the plant needs for growth and development during its different stages of growth, and the method of fertilization **(Al-Temimi 2021)**. Many studies have indicated that genotypes generally differ from each other due to the dominance of genetic actions that affect growth stages and differences in the physiological performance of the genotypes and their response to growth conditions. The response of genotypes (Ishaqi-1, Ishaqi-2, Ekmars, and Tarsan) to the study conditions varied in growth traits, biological yield, and harvest index, ekmars excelled in plant height (200.03 cm), stem diameter (3.45 cm), leaf area (1.033 m^2), and biological yield (14.917 micrograms ha^{-1}) **(Elawi & Zeboon2020; Hassan, 2019).** Although chemical fertilizers are efficient in increasing production and improving quality, they have harmful effects on human health, in addition to their high economic costs, to reduce the amounts of mineral fertilizers added, complementary organic compounds can be added that are harmless to the environment, improve soil properties, provide plants with nutrients, and increase their tolerance to harsh environmental conditions **(khashan *et al*, 2021).** Researchers focus on using environmentally friendly and safe alternatives that lead to increased production and fertility rates for crops and reduce losses, such as biological stimulants like plant extracts and seaweed that stimulate physiological processes in plants and reduce stress during different growth stages, characterized by ease of application and low cost **(Shukla *et al*., 2019; Jaafar & Alnaimi, 2022; Al-Omairi & Al-Hilfy, 2021).**

Studies have shown that the use of seaweed extracts, in their various types, as organic and biologically active fertilizers is an important source that is used in many applications on economic crops due to their natural, environmentally friendly, biodegradable and cost-effective properties **(Khan *et al.*, 2009; Saudi, 2017; Al-Hilfy *et al.*, 2018).** Marine algae extracts contain macro and micro elements, amino acids, and some basic plant growth hormones such as auxins, gibberellins, and cytokinins, which, when used on plants, lead to a significant increase in yield **(Lotze & Hoffman, 2016).** The growth indicators can be improved and increased by spraying seaweed extracts at concentrations of 10% on maize **(Al-Temimi & Al-Hilfy, 2022; Al-Omairi & Al-Hilfy, 2024)**. The number of leaves can be increased to 40.39 leaf $Plant^{-1}$ and stem diameter (22.82 mm) when spraying seaweed extract Alga600 at a concentration of 20% on sunflowers **(Al-Naimi, 2018).**

Studies have shown that using extracts of Moringa leaves as an organic and cheap stimulant is a similar source to the effect of industrial growth regulators, as it contains macro and micronutrients, antioxidants, purine adenine, and zeatin, which work to enhance the properties of a number of antioxidant enzymes and protect cells from the effects of aging caused by various types of reactive oxygen species **(Nita *et al*., 2022).** Spraying a 6% concentration of Moringa leaf extract on maize resulted in an increase in growth and biological yield by 8.42% and 2.55% for two consecutive seasons **(Al-Temimi, 2021).** And wheat spraying a 20% concentration of Moringa leaves extract (Sura **& Al-Hilfy, 2022).** Spraying a 20% concentration of Moringa leaf extract on sunflowers increased the leaf area by 14% and the plant height by 10%, due to the nutrients necessary to meet the plant's needs and activate several enzymes for good growth **(Iqbal, 2014).**

The use of organic material for fertilizing is the foundation that should be established to reduce environmental pollution resulting from the excessive use of chemical fertilizers and to increase the productivity of agricultural lands **(Al-Hilfy, 2014).** Various sources of organic waste, such as animal and plant waste, can be used to improve soil and plant growth **(Ibrahim *et al*., 2008).** However, there are also less well-known and unused materials such as Seek, an organic material derived from bamboo cane waste, rich in vitamins and amino acids that enhance soil water retention and nutrient retention in the root zone, improve fertilizer availability, reduce leaching and fertilizer waste in the soil, and help increase plant nutrient absorption capacity **(Nasralla *et al*.,2014)**.

Based on the aforementioned, the study aims to investigate the effect of the Moringa leaf extract, marine algae extract Alga600, bamboo cane waste Seek, and the bio stimulant B Mstart on some growth traits of three genotypes of sunflowers and their reflection on the biological yield and harvest index.

MATERIALS AND METHODS

To study the effect of using some plant extracts and seaweed on the growth of three genotypes of sunflower and its reflection on the biological yield, a field experiment was conducted during the spring season of 2022 in the Yousufiya area, Al-Rashid district, in the fields of Dubaneh Company for Modern Agricultural Equipment, which is located 29 km from the center of Baghdad province. The experiment was conducted using randomized complete block design (RCBD) with split-plot arrangement with three replications The study included two factors: the main factor included four treatments of bio nutrition spraying in addition to the control treatment (spraying with distill water only) which included spraying with the biological stimulant (BMstart), spraying with marine algae extract (Alga600), adding bamboo waste (Seek), and spraying with Moringa leaves extract as described in Table 1.

Table (1): Components of the nutrition treatments used in the experiment.

Moringa Leaves Extract	Seek	Alga600	BMstart
Macro-elements: (nitrogen, phosphorous, potassium, calcium, magnesium) Micro-elements: (Manganese, Boron, Iron, Zinc, Copper) Enzymatic and non-enzymatic antioxidants: (GA3, IAA, POD, SOD, CAT) Protein	Organic substances derived from bamboo cane debris, such as fulvic acid, amino acids, humic acid, and NPK	Organic material derived from seaweed, natural nitrogen, phosphorus, and potassium, as well as a comprehensive assortment of microelements, humic acids, amino acids, proteins, enzymes, and natural vitamins.	GA142 Seaweed Emulsion, Boron, Magnesium

The sub-plot factor included three genotypes for sunflower crops (Lilo, Ishaqi-2, and Flamy). The field was prepared by plowing, smoothing, and dividing into 45 experimental units of 9 m² (3*3) area, containing four rows with a distance of 75 cm between each row and a distance of 20 cm between plants. The seeds were planted on 21/2/2022 And harvest 4/6/2022, and DAP fertilizer was added at a rate of 220 kg ha^{-1} (48% P_2O_5 and 18-21% N) during planting. The plants were also supplemented with urea (46% N) at a rate of 360 kg ha^{-1} to complete their nitrogen needs **(Al-Rawi, 2001)** with the first dose added at the rosette stage (4-3 true leaves) and the second dose at the beginning of the appearance of floral buds **(Jenkins & Leitch, 1986**). Other managements such as irrigation, and weed control were done as needed.

At flowering, ten plants were randomly selected from the middle two rows of each experimental unit to studying the following characteristics:

1- Plant height (cm): measured using a measuring tape from the soil surface to the base of the disc.
2- Stem diameter (cm): measured from the middle area using a Verniea.
3- Number of leaves: counted from the first green leaf above the soil surface to the last leaf on the plant **(Hunt, 1982).**
4- Leaf area (m²): by using the following equation: The sum of the squares of the maximum width of the sixth Roll x 4.31 **(Hardan & Elsahooki, 2014).**
5- Biological yield (ton ha^{-1}): calculated at harvest by averaging the dry weight of ten plants from each experimental unit. The plants were cut (stems, leaves, heads) from the area of contact with the soil, air-dried, and then the weight was converted to ton after multiplying it by the plant density (66666 plants ha^{-1}).
6- Harvest Index: calculated after harvest using the following equation:
Harvest Index = (seed yield / biological yield) x 100

The data were statistically analyzed using the Genstat v.7 according to the randomized complete block design (RCBD) with split plot arrangement. The mean comparisons were performed using the least significant difference (LSD) test at a significance level of 5% **(Steel & Torrie, 1980).**

RESULTS AND DISCUSSION

RESULTS

Number of leaves

The results showed significant differences between the different bio nutrition treatments in the number of leaves (Table 2). The treatment of spraying the Moringa leaves extract gave the highest number of leaf at 30.28, leaf plant^{-1}, followed by the treatment of spraying the seaweed extract Alga600 at 29.32 leaf plant^{-1}, and there was no significant difference between the treatment of adding bamboo waste (Seek) and the control treatment with 28.54 and 28.52 leaf plant^{-1}, respectively. While the treatment of the biological stimulant BMstart gave the lowest number of leaves at 27.60 leaf per plant^{-1}.

The genotypes also differed significant in this trait, Lilo hybridgave the highest number of leaves at 29.31 leaf plant^{-1} with no significantly different from cultivar Ishaqi-2 with 28.78 leaf plant^{-1}, while the Flamy genotype recorded the lowest number of leaves (28.47 leaf plant^{-1}).

The results indicate a significant interaction between the two factors, the combination of the Ishaqi-2 cultivar with the Moringa leaves extract gave the highest number of leaves, at 31.13 leaf plant^{-1}, It did not differ significantly from Lilo hybrid with the Moringa leaves extract, which reached 30.63 leaf plant^{-1}. The lowest mean was 26.87 leaf plant^{-1} for the combination of the Lilo hybridwith the BMstart biological stimulant.

Table (2): The number of sunflower leaves as affected by some bio nutrition treatments and genotypes and their interaction for the spring season 2022.

Treatment of Bio Nutrition	Cultivar			Mean
	Lilo	Flamy	Ishaqi-2	
BMstart bio stimulants	26.87	28.60	27.33	27.60
Alga600 seaweed extract	30.47	29.00	28.50	29.32
Seek (bamboo plant residue)	29.43	27.27	28.93	28.54
Moringa leaves extract	30.63	29.07	31.13	30.28
Distill water (control)	29.13	28.43	28.00	28.52
L.S.D. 5%	1.27			0.93
Mean	29.31	28.47	28.78	
L.S.D. 5%	0.58			

Stem diameter (cm)

The results indicate significant differences between the different bio nutrition treatments, genotypes, as well as their interaction, in the stem diameter (Table 3). The bio nutrition treatments led to an increase in stem diameter compared to the control treatment, and the treatment of spraying the seaweed extract Alga600 had the highest stem diameter, reaching 2.74 cm, which did differ significantly from the treatment of Moringa leaves extract (2.67 cm). while the control treatment recorded the lowest stem diameter of 2.53 cm.

As for the genotypes, the Ishaqi-2 cultivar gave the highest mean for stem diameter, which reached 2.72 cm, and did differ significantly from the Flamy cultivar (2.68 cm), while the Lilo genotypes recorded the lowest mean of 2.67 cm.

The results indicate a significant interaction between the two factors , the response of the genotypes to the bio nutrition treatments differed, and the highest value was for the combination of the Ishaqi-2 cultivar and the seaweed extract Alga600, reaching 2.93 cm, which did not differ significantly from Lilo hybrid and the seaweed extract Alga600, which reached 2.89 cm, and the combination of the Ishaqi-2 cultivar and Moringa leaves extract (2.89 cm). The lowest value was 2.45 cm, which was for the combination of the Lilo hybrid and the control treatment.

Table (3): Stem diameter of sunflower as affected by some bio nutrition treatments and genotypes and their interaction for the spring season 2022.

Treatment of Bio Nutrition	Cultivar			Mean
	Lilo	Flamy	Ishaqi-2	
BMstart bio stimulants	2.65	2.60	2.65	2.63
Alga600 seaweed extract	2.89	2.79	2.93	2.87
Seek (bamboo plant residue)	2.66	2.70	2.64	2.67
Moringa leaf extract	2.67	2.66	2.89	2.74
Distill water (control)	2.45	2.65	2.49	2.53
L.S.D. 5%	0.10			0.08
Mean	2.67	2.68	2.72	
L.S.D. 5%	0.04			

Plant height (cm)

The results indicate a significant effect of the different nutrition treatments, genotypes, and their interaction on plant height (Table 4). All bio nutrition treatments led to a significant increase in plant height compared to the control treatment, with the treatment of spraying the seaweed extract Alga600 showing the highest increase percentage of 20.76%. It did not differ significantly from the treatment of adding bamboo waste (Seek), which reached 201.30 cm, and the treatment of spraying Moringa leaves extract, which showed an increase percentage of 12.57%. while the control treatment recorded the lowest plant height of 171.97 cm.

As for the genotypes, the Flamy genotypes outperformed and recorded the highest plant height, which reached 201.98 cm, followed by the Ishaqi 2 cultivar (194.60 cm). The Lilo variety had the lowest plant height of 178.04 cm.

Regarding the interaction between genotypes and bio nutrition treatments, the response of the genotypes to the treatments differed, with the highest plant height of 221.00 cm being recorded for the combination of the cultivar Flamy and the seaweed extract Alga600. It did not differ significantly from the combination of the cultivar Flamy and bamboo waste (Seek), which reached 214.30 cm, and the combination of the cultivar Flamy and the control treatment. The lowest value was recorded for the combination of the hybrid Lilo and the control treatment, which reached 128.50 cm.

Table (4): Plant height (cm) of sunflower as affected by some bio nutrition treatments and genotypes and their interaction for the spring season 2022.

Treatment of Bio Nutrition	Cultivar			Mean
	Lilo	Flamy	Ishaqi-2	
BMstart bio stimulants	187.30	172.50	190.20	183.33
Alga600 seaweed extract	195.20	221.00	206.30	207.50
Seek (bamboo plant residue)	185.60	214.30	204.00	201.30
Moringa leaf extract	193.60	191.40	195.80	193.60
Distill water (control)	128.50	210.70	176.70	171.97
L.S.D. 5%	14.01			11.02
Mean	178.04	201.98	194.60	
L.S.D. 5%	5.48			

Leaf area (cm^2)

The bio nutrition treatments led to an increase in leaf area by a percentage of 32.09%, 31.71%, 27.55%, and 13.84% for the treatment of spraying the seaweed extract Alga600, spraying Moringa leaves extract, spraying the biological stimulant BM Start, and adding bamboo waste (Seek), respectively, compared to the control treatment, which gave the lowest leaf area of 1827.67 cm^2 (Table 5).

The data also indicate significant differences between genotypes, with the Ishaqi 2 cultivar outperforming and recording the highest value of 2325.6 cm^2, while the Flamy cultivar recorded the lowest value (2116.6 cm^2) and did not differ significantly from the Lilo hybrid (2194.6 cm^2).

Similarly, the interaction between the two factors was significant, with the highest leaf area recorded for the combination of the Ishaqi 2 cultivar and Moringa leaves extract, which reached 2767.0 cm^2. The combination of the Ishaqi 2 cultivar and the control treatment recorded the lowest value of 1662.0 cm^2.

Table (5): Leaf area (cm^2) of sunflower as affected by some bio nutrition treatments and genotypes and their interaction for the spring season 2022.

Treatment of Bio Nutrition	Cultivar			Mean
	Lilo	Flamy	Ishaqi-2	
BMstart bio stimulants	2644.0	2161.0	2189.0	2331.3
Alga600 seaweed extract	2222.0	2398.0	2623.0	2414.3
Seek (bamboo plant residue)	1856.0	1999.0	2387.0	2080.7
Moringa leaf extract	2313.0	2142.0	2767.0	2407.3
Distill water (control)	1938.0	1883.0	1662.0	1827.7
L.S.D. 5%	257.50			173.80
Mean	2194.6	2116.6	2325.6	
L.S.D. 5%	114.70			

Biological yield (ton ha^{-1})

The results indicate significant differences between the bio nutrition treatments, genotypes, and their interaction on the biological yield (Table, 6). The seaweed extract treatment Alga600 had the highest biological yield, reaching 22.28-ton ha^{-1}, with no significant difference with the from spraying the Moringa leaves extract, which recorded 22.27-ton ha^{-1}. While the control treatment recorded the lowest value of 19.86-ton ha^{-1}.

The cultivar Ishaqi 2 had the highest biological yield value at 24.11-ton ha^{-1}, while the Lilo hybrid recorded the lowest value of 18.19-ton ha^{-1}.

As for the interaction, the interaction between the Ishaqi2 cultivar and the Moringa leaves extract spray had the highest value for the biological yield, reaching 26.97-ton ha^{-1}, with no significant difference from the Ishaki2 cultivar and the Alga600 seaweed extract spray treatment, which reached 26.08-ton ha^{-1}, while the lowest value was for the interaction between the Lilo hybrid and the control treatment was 16.41 ton ha^{-1}.

Table (6): Biological yield (ton ha^{-1}) of sunflower as affected by some bio nutrition treatments and genotypes and their interaction for the spring season 2022.

Treatment of Bio Nutrition	Cultivar			Mean
	Lilo	Flamy	Ishaqi-2	
BMstart bio stimulants	18.10	20.06	22.36	20.17
Alga600 seaweed extract	19.05	21.71	26.08	22.28
Seek (bamboo plant residue)	18.72	21.75	23.16	21.21
Moringa leaf extract	18.71	21.14	26.97	22.27
Distill water (control)	16.41	21.15	22.02	19.86
L.S.D. 5%	1.44			0.969
Mean	18.19	21.16	24.11	
L.S.D. 5%	0.64			

Harvest index (%)

The results indicate significant differences between the bio nutrition treatments, genotypes and their interactions on the harvest index (Table 7). Spraying Moringa leaves extract had the highest harvest index reach at 22.49%, while adding bamboo extract waste (Seek) had the lowest value of 19.63%.

Regarding the genotypes, the Ishaqi2 cultivar had the highest harvest index value of 21.92%, with no significant difference from Flamy cultivar of 21.82%. While the Lilo hybrid recorded the lowest mean (19.58%).

As for the interaction, the combination of the Flamy cultivar and the Moringa leaves extract spray had the highest value (24.34%), with no significant difference the combination of the Flamy cultivar and the control treatment (23.54%) As well as the interactions of cultivar Ishaqi 2 with each of seaweed extract Alga600 and bamboo extract waste Seek (23.73 and 23.54%, respectively)., respectively. However, the combination of the Lilo hybrid and the bamboo extract waste (Seek) had the lowest value of 15.38%.

Table (7): Harvest index (%) of sunflower as affected by some bio nutrition treatments and genotypes and their interaction for the spring season 2022.

Treatment of Bio Nutrition	Cultivar			Mean
	Lilo	Flamy	Ishaqi-2	
BMstart bio stimulants	21.44	21.54	20.21	21.06
Alga600 seaweed extract	19.37	20.20	23.73	21.10
Seek (bamboo plant residue)	15.38	19.96	23.54	19.63
Moringa leaf extract	22.13	24.34	20.99	22.49
Distill water (control)	19.59	23.04	21.15	21.26
L.S.D. 5%	1.59			1.06
Mean	19.58	21.82	21.92	
L.S.D. 5%	0.71			

DISCUSSION

Spraying the Moringa leaves extract resulted in an increase in the number of leaves for the sunflower (Table, 2), which may be attributed to containing antioxidants and hormones that protect the cell from the damage of free radicals during the plant's metabolism, such as carbon assimilation and respiration. This led to improve the cell's condition to carry out these processes, and therefore, reflecting on plant growth and an increase in the number of leaves, as shown in its components in (Table, 1). In addition, the extracts contain major nutrients, including nitrogen, which plays an important role in increasing cell division, elongation, and resulting in an increase in plant vegetative growth and height (Table, 4). This is reflected in an increase in the number of leaves in Table 2 **(Hassanin, 2020).** This is consistent with **Hamza (2003),** who indicated differences in genotypes in the number of leaves when using foliar nutrition.

The increase in stem diameter (Table, 3) when spraying the Alga600 seaweed extract may be attributed to its role in increasing vascular bundles, which reflects on the stem diameter. In addition, its role in preserving the largest number of leaves and increasing the chlorophyll content, which reflected in the improvement of the efficiency of carbon assimilation and an increase into its products, especially carbohydrates, and this is reflected in the increase in stem diameter **(Al-Naimi, 2018).**

The reason for the superiority of the Alga600 bio stimulant in plant height (Table, 4) is due to the role of seaweed extract that contains a high percentage of nitrogen (Table, 1), which has a major role in increasing plant growth as it is involved in building chlorophyll., which increases the efficiency of photosynthesis by increasing the leaf area (Table, 5) and producing a high percentage of carbohydrate and protein products, thereby increasing vegetative growth. Additionally, the role of plant growth regulators present in the extract affects cell growth and division, leading to an increase in stem elongation, which is reflected in an increase in plant height **(Hassanin, 2020).** The role of calcium, which plays an important role in the division of plant cells and the growth of plant tissue, also contributes to increasing the elongation of the growing tip of sunflower plants. This is consistent with **Al-Naimi (2018),** who indicated an increase in leaf area when using the Alga600 seaweed extract. The extract also contains amino acids and major nutrients such as phosphorus, nitrogen, and potassium (Table, 1), all of which contribute to increased vegetative growth by expanding cells and stimulating their division, which is reflected in an increase in leaf area. This result is consistent with **Abdul-jabar *et al.***

(2012); **Saudi (2017),** who found in their study that spraying seaweed extracts on plants led to significant differences in leaf area. In addition, the seaweed extract contains auxins and cytokinins, which stimulate physiological activities and increases the content of chlorophyll in the leaves, which positively affects the effectiveness of photosynthesis and manufactured materials, and then reflects positively on the vegetative growth characteristics of the plant **(Zodape, 2001; Al-Jubouri, 2017).** Based on the above mentioned, the biological yield increased due to the increase in its components represented in the plant height (Table, 4) and leaf area (Table, 5). These results are consistent with (Al**-Hilfy & Al-Omairi, 2023)** who reported an increase in biological yield when using growth-promoting substances.

Regarding the harvest index (Table, 7), which indicates the efficiency of converting the products of photosynthesis into economic and biological yield, it increased when spraying with Moringa leaves extract due to the increase in both economic and biological yield. The reason for the difference in growth and yield among cultivar is attributed to their different responses to growth conditions and the genetic makeup that controls the studied traits. This is consistent with the findings of **Nasralla *et al*. (2014)**; **Elawi & Zeboon (2020),** who noted the variation in genotypes and their responses to management.

Also, the difference in genotypes is due to the nature of their genetic material and their response to growth factors. This result is consistent with **Hassan (2016); Al-Nuaimi (2018),** who found significant differences between genotypes in the number of leaves.

Similarly, the difference in stem diameter between genotypes of sunflower may be due to differences in the physiological performance of the gene controlling growth. This result is consistent with **Khan *et al*. (2015)**, who found significant differences in stem diameter between genotypes. This may be due to the different genetic material of the varieties and their response to growth conditions (Table, 4). These results are consistent with **Abed & Zeboon (2020)**, who reported differences between genotypes.

CONCLUSION

In conclusion, the results of the study showed the superiority of spraying seaweed extract treatment in leaf area and yield of biology, while the treatment of spraying Moringa leaves extract was superior in number of leaves and harvest index. As for the genotypes, Ishaqi 2 gave the highest leaf area, biological yield and harvest index, while the Lilo recorded the highest number of leaves and the genotypes Flami genotypes the highest height of the sunflower plant.

REFERENCES

1. Abdul-Jabar, A.S., Hussein, A.S., & Mohammed, A.A. (2012). Effect of the difference seaweed extract (Seamino) concentrations on growth and seed chemical composition of two wheat varieties. *Rafidain J.* of *Sci*., 23(1), 100-113.
2. Abed, A M R & Zeboon N H (2020), Effect of spraying with organic and bio-fertilizers on some growth characteristics of sunflower plant (*Helianthus annuus* L.). *Plant Archives,* **20**(2): 1050-1055.

3. Al-Hilfy I.H., AL-Naqeeb, M., Jaiai H., Sadiq A., & Mohamad H. (2018). Biofertilizer (EM-1) effect on growth and yield of three bread wheat Genotypes. *Journal of Central European Agricultune* ,19(3):530-543.
4. Al-Hilfy, I. & Al-Temimi A. (2017), Response of some synthetic maize genotypes to mineral, Organic and bio fertilizer. *The Iraqi Journal of Agricultural Science*, 48(6): 1447-1455.
5. Al-Hilfy, I. H. H., & Al-Omairi, A. A. (2023). Reducing heat stress on maize during spring season by using selenium and its reflection on pollen vitality and grain yield. *International Scientific Congress of Pure, Applied and Technological Sciences* 8th (Minar Congress) Rimar Academy, 124-137.
6. Al-Hilfy, I.H. (2014). Response of cotton varieties to mineral and organic fertilization. *Al-Anbar Journal of Agricultural Sciences*, 12(2): 270-281.
7. Al-Jubouri, S.A.A. (2017). *Effect of planting distances on growth, yield, and quality of seeds of three genetic structures of sunflower* (*Helianthus annuus* L.). MSC. thesis, College of Agriculture, Tikrit University.
8. Al-Nuaimi, M.Y.K. (2018). *Impact of spraying algae extract Alga600 on growth, yield, and quality of three sunflower genotypes Helianthus annuus L*. (MSC. thesis). College of Agriculture, University of Tikrit.
9. Al-Omairi, A.A., & Al-Hilfy, I.H. (2024), Reducing the heat stress on maize during spring season by using some bio stimulants. *The Iraqi Journal of Agricultural Science.* (Acceptable)
10. Al-Omairi, A.A., & Al-Hilfy, I.H. (2021*)*. Effect of soaking maize seeds with selenium and Chitosan on improving germination, Vigour and viability of seed and seedling. *Earth Environ. Sci*. 904 (1) 012075.
11. Al-Rawi, W. (2001). Guidance in the sunflower cultivation. public authority for maize production in an arid area. *Agri. Water Manage*, 45, 267-274.
12. Al-Tamimi, S. A. (2021). *Response of maize varieties for bio-fertilizer, plant extracts, Tropeovan and NPK.* PhD. Thesis, College of Agriculture, University of Baghdad.
13. Al-Temimi, A.H., & Al-Hilfy, I.H. (2022). Role of plant growth promoting in improving productivity and quality of maize. *Iraqi Journal of Agricultural Sciences*, 53(6), 1437-1446.
14. Bajehb, A. A. (2010). The effect of water deficit on characteristics physiological chemical of sunflower (*Helianthus annuus* L.) varieties, *Advances in Environmental Biology*, 4(1), 24-30.
15. Elawi, A. Y., & Zeboon, N. H. (2020). Effect of folic acid on growth traits of four sunflower *Helianthus annuus* L., genotypes. *Plant Archives*, 20(2), 4735-4741.
16. Hamza, J.H. (2003). *Effect of different levels of phosphorus and potassium fertilizers on the growth, yield, and quality of sunflower*. MSC. thesis, Department of Field Crops, College of Agriculture, University of Baghdad.
17. Haradan, H.M., Elsahooki, M.M. (2014). Estimation of leaf area of sunflower plant by adopting one roll and the relationship of yield to disk diameter. *Iraqi Journal of Agricultural Sciences*, 45(5): 549-554.
18. Hassan, W A, (2016), Estiomation of some parameters of growth and yield characters of sunflower under. *Iraqi Journal of Agricultural Sciences*.47(4):921-932.

19. Hassan, W A., (2019), Phenotypic,genotypic correlation and path coefficient in Sunflower *(Helianthus annuus* L.) . *Plant Archives,*.19(1):765-771.
20. Hassanin, A. H. M. (2020). *Crop Physiology.* Second ed. College of Agriculture: *Al Azhar university*.
21. Hunt, R. (1982). Plant growth curves: The functional approach to plant growth analysis. London: Edward Arnold. 248.
22. Ibrahim, M., ul-Hasan A., Iqbal, M., & Valeem, E. E. (2008). Response of wheat growth and yield to various levels of compost and organic manure. *Pak. J. Bot*, 40(5); 2135-2141.
23. Iqbal, M.A. (2014). Managing sunflower (*Helianthus annuus* L.) nutrition with foliar application of Moringa (*Moringa oleifera* Lam.) leaf extract. *American-Eurasian Journal of Agricultural & Environmental Sciences*, 14, 1339-1345.
24. Jaafar, M.S., & Alnaimi, S.B.I.M. (2022). The Combined Effect of Bio-Fertilizers, Coconut Endosperm Fluid and Amino Acids Tryptophan on the Vegetative Growth Characteristics of Cumin (*Cuminum cyminum* L.). in IOP Conference Series: *Earth and Environmental Science*. IOP Publishing. 62,201-248.
25. Jenkins, P.D., & Leitch, M.H. (1986). Effects of sowing date on the growth and yield of oilseed rape (*Brassica napus). J. Agric. Sci. Camb*., 105: 405-420.
26. Khan, I., Anjum, S. A., Khan, R. W., Ali, M., Chatta, M. U., & Asif, M. (2015). Boosting Achene Yield and Yield Related Traits of Sunflower Hybrids through Boron Application Strategies. *American Journal of Plant Sciences*, 6: 1752-1759.
27. Khan, W., Rayirath, U. P., Subramanian, S., Jithesh, M. N., Rayorath, P., Hodges, D. M., Critchley, A. T., Craigie, J. S., Norrie, J., & Prithiviraj, B. (2009). Seaweed extracts as bio of plant growth and development. *Plant Growth Regul*., 28: 386-399.
28. Khashan A., Husam S.M., Ali A.H & Al-Hilfy I., H.H. (2021).Thffect of Seaweed Spirulina Platensis Extract and Miccronutrients on Wheat Yield and Yield Components. *Earth and Environmental Science* .9(23): 210-252.
29. Lotze, E., & Hoffman, E.W. (2016). Nutrient composition and content of various biological active compounds of three South African-based commercial seaweed bio stimulants. *J. Appl Phycol*, 28: 1379–1386.
30. Nasralla, A. Y., Al-Hilfy, I. H., Al-Abodi, H. M., & Mahmood, M. (2014). Effect of spraying some plant extractions & antioxidant on growth and yield of sunflower. *Iraqi Journal of Agricultural Sciences*, 45(7- special issue): 651-659.
31. Nita, Y., K., Mubarok S., & Nurhadi B., (2022). The Role of Moringa Leaf Extract as a Plant Bio stimulant in Improving the Quality of Agricultural Products. Plants, 11: 21-86.
32. Saudi, Y.A. (2017). The effect of foliar spray with marine algae extracts on the growth, yield, and seed strength of varieties of wheat. *Iraqi Journal of Agricultural Sciences*, 48(5): 13-31.
33. Shukla, V, Basile, A, Fambrini M, Tani C, Licausi F & Puglies C. (2019), The Ha-ROXL gene is required for initiation of axillary and floral meristems in sunflower Institute of Life Sciences, *Scuola Superiore Sant'Anna, Pisa, Italy genesis* **57**(9): 23-07.
34. Steel, R. G. D., & Torrie, J. H. (1980). *Principles and procedures of statistics, a biometrical approach*. McGraw-Hill Kogakusha, Ltd.
35. Sura J.B.& Al-Hilfy I.H.H. (2022), Effect of foliar application of Moringa leaves extract on yield and quality of bread wheat. *Iraqi Journal of Agricultural Sciences*,53(2):315-321.
36. Zodape, S.T. (2001). Seaweeds as a biofertilizer. Journal. *Sci. Ind. Res*., 60: 378-382.