Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

EFFECT OF SEEDS PRIMING AND FOLIAR APPLICATION WITH SEAWEED EXTRACT ON SOME YIELD TRAITS OF TWO SUNFLOWER CULTIVAR

[1]Hawraa A. Abbas , [2]Saudi A. H.
[1]Dept. of Field Crops, Coll. of Agric. Univ. of Karbala.
[2]Field Crops Dept., Coll. of Agric. Engineering Sci. University of Baghdad

ABSTRACT

A field experiment was conducted during tow spring seasons of 2022 and 2023 in the experimental fields of the College of Agricultural Engineering Sciences - University of Baghdad using RCBD design according to factorial experiments with three replicates and three factors including sunflower cultivars (Ishaqi 1 and Ishaqi 2). The second factor included seeds priming with seaweed extract (Acadian) concentrations (0, 3, and 4 mg L^{-1}), in addition to with, foliar application of seaweed extract at the aforementioned concentrations. The results showed the significant superiority of the Ishaqi2 cultivar in all studied traits for both seasons. The treatment with priming and foliar application with Acadian at a concentration 4 mg L^{-1} showed superiority in most of the studied traits. In the first season, the effects of the two-way and three-way interactions of the study factors varied in their impact, but the interaction between the Ishaqi2 cultivar, priming at a concentration 3 mg L^{-1}, and foliar application at a concentration 4 mg L^{-1} was the most prominent in most of the studied traits. To achieve the best increase in sunflower yield .

Keywords: Environmentally friendly fertilizers, food security of sunflower, oil percentage

Received: 22/2/2024, Accepted: 2/6/2024, Published: 31/3/2026

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is considered one of the most important oilseeds crops (Ahmed *et al*,2022,Shihab &Hamza,2020) , its seeds contain 47% oil and 35% protein, with a high proportion of polyunsaturated fatty acids and a low level of cholesterol (Nasrallah,2019). High, rapid, and uniform emergence leads to good field establishment, which be achieved by following agricultural practices aimed to improving seeds performance during emergence stages, including seeds priming before planting. Seeds priming is one of the cost-effective procedures that shorten the time between seeds sowing and seedling emergence, reducing effort. It is characterized by its high efficiency in seeds activation and improvement of performance, thus reducing the emergence period and ensuring uniformity of seedling emergence .The weakness of many crop seeds may be attributed to the seeds's history while still on the mother plant. During their formation stages on the mother plant, seeds may be exposed to various factors directly or indirectly affecting the quality of the produced seeds. One of these reasons could be the deficiency of nutrients during the rapid filling stage of the seeds (Elsahookie &Cheyed,2023). Seaweed extracts have been utilized to stimulate seeds emergence and as foliar application, serving as growth-promoting substances when used at low concentrations. contribute to most important physiological functions of any crop and are characterized by their non-toxicity, environmental friendliness, and cost-effectiveness (Saudi &Al-Rawi, 2023). Seaweed extracts contain differnt of nutrients

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

and hormones that enhance the plant's ability to withstand biotic and abiotic stresses, accelerating biochemical processes in the plant (Sarheed,2015). Nayak italics. (Oztur *et al*, 2017) mentioned that fertilizing plants with seaweed extract, such as Biozyme granules and *Ascophyllum nodosum* extract, significantly improved the components and grain yield of rice crops. They attributed the increases in yield to the presence of biologically stimulating substances, proteins, free amino acids, and hormones in seaweed extracts, which enhance biological processes, particularly carbon metabolism, dry matter accumulation, and conversion efficiency to grains. Several studies have confirmed the superior response of sunflower cultivars to seeds priming or foliar application with seaweed extract, resulting in the vitality and activity of their seeds and seeds yield (Al-Haidary,2018, Habib,2017). Therefore, this study was aimed to investigate the role of seaweed extract in seeds priming or foliar application on seeds yield and its components for two cultivars of sunflower crops and to assess the variability and response of these cultivars to the study factors.

MATERIALS AND METHODS

A field experiment was conducted during the two spring seasons of 2022 and 2023 at the experimental fields of the College of Agricultural Engineering Sciences - University of Baghdad. The experiment was designed using a randomized complete block design (RCBD) with three replicates and three factors. These factors included sunflower cultivars (Ishaqi1 and Ishaqi2), the second factor involved seeds priming with seaweed extract (*Ascophyllum nodosum*) at concentrations of 0, 3, and 4 mg L^{-1}, in addition to the third factor of foliar spraying of plants with seaweed extract at the aforemention concentrations. The plants were sprayed at three growth stages: the first stage at the four-true-leaf stage, the second stage at the onset of floral bud appearance, and the third stage at the beginning of flowering. Each experimental . plot had an area of 2 × 3 meters and included five rows with spacing of 75 cm between rows and 20 cm between plants within rows. Urea fertilizer (46% N) was applied at a rate of 360 kg ha^{-1} in two equal doses, the first after complete emergence, and the second at the beginning of the flowering stage. Triple superphosphate fertilizer (46% P2O5) was applied at a rate of 220 kg ha^{-1}, and potassium sulfate fertilizer (41% K) was applied at a rate of 200 kg ha^{-1}, both applied once before planting during soil preparation. Ten randomly selected plants were sampled from each.

Statistical analysis

The statistical analysis was conducted using the statistical analysis software Genstat (version 12.1). Means were analyzed and compared using the Least Significant Difference (L.S.D) test at a significance level of $P<0.05$ (Kadhim &Hamza 2021).

RESULTS AND DISCUSSION

Disc diameter (cm)

The statistical analysis was revealed a significant effects of sunflower cultivars, seeds priming, foliar spray with seaweed extract (Acadian), and their interactions on the Disc diameter in both spring seeding seasons of 2022 and 2023. In both seeding seasons, the Ishaqi2 cultivar exhibited the highest mean disc diameter, measuring 17.94 and 18.73 cm, respectively, compared to the Ishaqi1 cultivar, which showed the lowest mean for the trait, measuring 16.91 and 17.53 cm (Tables 1 and 2). The differences among the two cultivars could in disc diameter be attributed to genetic variation between the cultivars, which is reflected in their anatomical and morphological traits, including disc diameter. Ulaiwee and Elsahookie confirmed the genetic variation's control over this trait under similar environmental conditions. These results support what Sarheed etalic. (Saudi, 2017) indicated, emphasizing the differences between sunflower cultivars in disc diameter. The treatment with the highest concentration of seaweed extract (4 g L^{-1}) outperformed by yielding the highest mean of 18.88 and 19.59 cm, with no significant difference from the seeds priming treatment with a concentration of 3 g L^{-1} for both planting seasons. Whereas, the control treatment (seeds priming with distilled water) resulted the lowest mean trait

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

value for both seasons consecutively, 14.69 and 15.48 cm. The increases in disc diameter was a result of increasing concentrations of Acadian application. After initially having the lowest mean value (15.54 and 16.11 cm) in the control treatment, it significantly increased with the 3 g L^{-1} Acadian application treatment, then reached the highest mean value for the trait (19.36 and 20.26 cm) with the highest concentration of Acadian application in both planting seasons. The increase in sunflower disc diameter is attributed to the nutrients present in seaweed extract, which positively influences plant growth by enhancing cellular membrane permeability, stimulating enzymatic reactions, improving cell division, and elongation, as well as cell expansion, ultimately resulting in increased sunflower disc size (Attia &Kazem,2017). As for the interaction effects between the study factors, the two-way interaction between the sunflower cultivars and Acadian treatment (S×A), especially the interaction Ishaqi2 × 3 g L^{-1}, yielded the highest interaction value 19.58 cm for the first season and 20.31 cm for the second season. On the other hand, the interaction Ishaqi1 × control treatment had the lowest trait values 14.40 and 15.23 cm for both seasons, respectively. The two-way interaction (S×F) for Ishaqi2 × foliar application with a concentration 4 g L^{-1} showed the highest value, reaching 20.24 and 21.16 cm, while the lowest disc diameter values were observed for the interaction (Ishaqi1 × distilled water application), measuring 14.87 and 15.47 cm for both seasons, respectively. Furthermore, the two-way interaction between the seeds priming and Acadian spray treatments (A×F) (priming with a concentration 3 g L^{-1} × foliar application with a concentration 4 g L^{-1}) showed the highest disc diameter value for this interaction, reaching 22.03 and 23.27 cm for both seasons, respectively, while the control treatment for both study factors showed the lowest trait values, measuring 13.42 and 14.15 cm for both seasons, respectively.As for the three-way interaction between the study factors (S×A×F), the highest value was recorded 23.77 and 24.80 cm for the interaction (Ishaqi2 × 3 g L^{-1} × 4 g L^{-1}). On the other hand, the interaction (Ishaqi1 × 0 g L^{-1} (control) × 0 g L^{-1} (control)) showed the lowest value for the interaction, measuring 12.77 and 13.57 cm for both seasons, respectively.

Table 1. Effect seeds priming and foliar application with *seaweeds extract* on disc diameter cm in the first spring season of 2022

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	12.77	14.77	15.67	14.40
	3	14.70	18.57	20.30	17.86
	4	17.13	15.17	19.43	18.48
Ishaqi 2	0	14.07	15.17	15.70	14.98
	3	16.73	18.23	23.77	19.58
	4	17.87	18.70	21.27	19.28
Mean F		15.54	17.38	19.36	
L.S.D (0.05)			LSD $_{F}$ =0.43		LSD $_{A*S}$= 0.61
			LSD $_{F \times A \times S}$ =1.05		

F × S

Cultivar (S)	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
Ishaqi 1	14.87	17.40	18.47	16.91
Ishaqi 2	16.22	17.37	20.24	17.94
L.S.D $_{F*S}$		0.61		LSD $_{S}$ = 0.35

F ×A

Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* . (F) (g L^{-1}) 0	3	4	Mean A
0	13.42	14.97	15.68	14.69
3	15.72	18.40	22.03	18.72
4	17.50	18.78	20.35	18.88
L.S.D $_{F*A}$		0.74		LSD $_{A}$ = 0.43

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

Table 2. Effect seeds priming and foliar spray with Seaweed extract on disc diameter(cm) in the second application season of 2023

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	13.57	15.67	16.47	15.23
	3	14.97	18.27	21.73	18.32
	4	17.87	19.33	19.87	19.02
Ishaqi 2	0	14.73	16.07	16.40	15.73
	3	17.40	18.73	24.80	20.31
	4	18.3	20.07	22.27	20.16
Mean F		16.11	18.02	20.26	
L.S.D (0.05)			LSD $_{F}$ = 0.46		LSD $_{A*S}$= 0.65
			LSD $_{F \times A \times S}$ =1.12		

F × S

Cultivar (S)	Folia *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
Ishaqi 1	15.47	17.76	19.36	17.53
Ishaqi 2	17.76	18.29	21.16	18.73
L.S.D $_{F*S}$		0.65		LSD $_{S}$ = 0.37

F ×A

Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
0	14.15	15.87	16.43	15.48
3	16.18	18.50	23.27	19.32
4	18.00	19.70	21.07	19.59
L.S.D $_{F*A}$		0.79		LSD $_{A}$ = 0.46

Fertility Percentage (%)

Fertility ratios have a significant impact on determining plant yield due to their influence on the number of fertile ovaries and the number of fertilized and filled seeds in sunflower discs (Kadem & Abed,2018). The results indicated a significant differences for all three study factors (cultivars, priming, and atdic foliar application) and their interactions, both two-way and three-way, for both cropping seasons, except for the three-way interaction in the first season, which did not have a significant effect on the fertility percentage. Tables (3 and 4) showd the superiority of the Ishaqi 2 cultivar, giving the highest average fertility percentage 89.30% and 95.01%, while the Ishaqi 1 cultivar had the lowest fertility percentage 87.01% and 93.63% for the two consecutive seasons. Fertility ratios can range from zero to 100% depending on the nature of the cultivar and growth factors (Elsahookie,1994,Saudi, Ahmed Hamid,2012) Both concentrations of *Ascophyllum nodosum* priming, 3 and 4 g L^{-1}, outperformed by yielding the highest fertility percentages, reaching (89.88% and 90.58%) in the first season and (95.66% and 95.85%) in the second season, without any significant difference between them. Meanwhile, the water priming treatment (control treatment) had the lowest mean for the trait for both seasons 84.01% and 91.45%, respectively. The *Ascophyllum nodosum* foliar application at a concentration of 4 g L^{-1} showed the highest fertility percentage for both seasons, reaching 90.45% and 96.36%, while the control treatment had the lowest fertility percentage at 85.34% and 92.10% for the two seasons, respectively. The increases in seeds fertility due to priming or foliar spray with *Ascophyllum nodosum* extract is attributed to its content of biologically stimulating substances, proteins, free amino acids, and hormones that improve vital processes, especially carbon metabolism, dry matter accumulation, and its efficiency in conversion to sink organs. This results reflected in the size of the ovaries and the increase in fertility ratios (Nayak *et al*, 2020). As for the interaction effects, the two-way interaction (S×A) showed the highest value for the interaction of Ishaqi 2 cultivar × priming with concentrations of 3 and 4 g L^{-1}, reaching (90.57% and 91.52%) in the first season and (95.99% and 96.29%) in the second season, while the Ishaqi 1 cultivar × control treatment recorded the lowest value

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

for the interaction at 82.21% and 90.15% for the two consecutive seasons. Regarding the interaction (S×F), both cultivars (Ishaqi1 and Ishaqi2) × foliar spray at a concentration of 4 g L^{-1} achieved the highest value for the interaction, reaching 90.81% and 90.28%, respectively, while the interaction for the Ishaqi1 cultivar × control treatment showed the lowest value at 83.08%.The two-way interaction of the priming treatment with 3 g L^{-1} of *Ascophyllum nodosum* extract × foliar spray treatment with 4 g L^{-1} of *Ascophyllum nodosum* extract showed the highest value for the interaction, reaching 93.31% and 98.64% for both seasons consecutively, without significant difference from the interaction resulting from seeds priming and foliar spray with 4 g L^{-1} concentration of *Ascophyllum nodosum* extract in the second season only. Meanwhile, the control treatment for soaking and foliar spray with *Ascophyllum nodosum* extract showed the lowest value for the interaction at 80.75% and 89.11% for both seasons. The three-way interaction (S×A×F) for both Ishaqi1 and Ishaqi2 cultivars × priming with 3 g L^{-1} concentration of italic extract × foliar spray with 4 g L-1 concentration of *Ascophyllum nodosum* extract showed the highest value for the interaction, reaching 98.89% and 98.39% respectively, without significant difference from the interaction (Ishaqi2 × 4 g L^{-1} × 4 g L^{-1}) in the second season.

Table 3. Effect of seeds priming and foliar application with Seaweed extract on fertility percentage in the first spring planting season of 2022

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	77.17	83.64	85.82	82.21
	3	84.11	89.78	93.66	89.18
	4	87.95	89.60	91.36	89.64
Ishaqi 2	0	84.33	86.25	86.86	85.81
	3	88.02	90.72	92.96	90.57
	4	90.49	91.46	92.61	91.52
	Mean F	85.34	88.57	90.54	
	L.S.D (0.05)		LSD $_{F}$ = 0.89		LSD $_{A*S}$= 1.26
			LSD $_{F \times A \times S}$ = N.S		
F × S					
	Cultivar (S)	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
	Ishaqi 1	83.08	87.67	90.28	87.01
	Ishaqi 2	87.61	89.48	90.81	89.30
	L.S.D $_{F*S}$		1.26		LSD $_{S}$ = 0.73
F ×A					
	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
	0	80.75	84.94	86.34	84.01
	3	86..06	90.25	93.31	89.88
	4	89.22	90.53	91.98	90.58
	L.S.D $_{F*A}$		1.54		LSD $_{A}$ = 0.89

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

Table 4. Effect of Seeds Priming and Foliar application with Seaweed extract on Fertility Percentage in the second Spring Planting Season of 2023

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	86.48	90.87	93.10	90.15
	3	90.94	96.15	98.89	95.32
	4	94.20	95.38	96.63	95.40
Ishaqi 2	0	91.74	93.12	93.37	92.74
	3	94.15	95.44	98.39	95.99
	4	95.05	96.05	97.77	96.29
Mean F		92.10	94.50	96.36	
L.S.D (0.05)			LSD $_{F}$ = 0.70		LSD $_{A*S}$= 0.99
			LSD $_{F \times A \times S}$ =1.73		

F × S

Cultivar (S)	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
Ishaqi 1	90.54	94.13	96.21	93.63
Ishaqi 2	93.65	94.87	96.51	95.01
L.S.D $_{F*S}$		0.99		LSD $_{S}$ = 0.57

F ×A

Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
0	89.11	91.99	93.24	91.45
3	92.55	95.79	98.64	95.66
4	94.63	95.72	97.20	95.85
L.S.D $_{F*A}$		1.22		LSD $_{A}$ = 0.70

Number of seeds per disc (seeds per disc^{-1})

Statistical analysis revealed a significant effects of sunflower cultivars, seeds priming, foliar application with *seaweed* extract (Acadian), and their interactions on the number of seeds per disc for both spring planting seasons of 2022 and 2023, except for the interaction between sunflower cultivars and foliar application with Acadian in the second season of 2023. Plants of the Ishaqi2 cultivar exhibited the highest average number of seeds per disc in both planting seasons, reaching 1515.4 and 1453.6 seeds per disc^{-1}, compared to the Ishaqi1 cultivar, which produced lower average number of seeds, reaching 1299.3 and 1335.9 seeds (Tables 5 and 6). This can be attributed to the genetic variation between the cultivars, which is associated with the number of ovaries in the disc. These genotypes vary in the number of seeds per disc. Furthermore, the superiority of the Ishaqi2 cultivar in the number of seeds per disc can be attributed to its superiority in disc diameter (Table 1 and 2) and fertility percentage (Table 3 and 4), resulting an increase in the number of seeds per disc. This confirms with findings of (Eiliwi & Zeboon ,2021), who found a significant difference in the number of seeds per disc among sunflower cultivars, including the Ishaqi1 and Ishaqi2 cultivars, with the latter showing higher seeds numbers per disc than the former. The treatment with the highest concentration of seeds priming (4 g L^{-1}) exhibited the highest average for the trait (1576.6 and 1528.3 seeds per disc^{-1}), while the control treatment (distilled water priming) showed the lowest average for the trait, reaching 1175.2 and 1195.3 seeds per disc^{-1} for both planting seasons, respectively. Similarly, application plants with the highest concentration of acadian extract (4 g L^{-1}) resulted in the highest average number of seeds disc^{-1} (1537.7 and 1530.5 seeds disc^{-1}), while the control treatment showed the lowest average for the trait (1316.2 and 1275.8 seeds disc^{-1}) in both planting seasons. The increase in the number of seeds disc^{-1} due to seeds priming or foliar application with *Ascophyllum nodosum* extract (Acadian) could be attributed to the positive effect of this extract's contents on increasing disc size and fertility percentage (Tables 1-4), ultimately resulting in an increase in the number of seeds per disc. This is consistent with the findings of Hamdallah and Alak (Hamdalh & Alak. 2010), who confirmed a

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

direct correlation between the number of seeds in the sunflower disc and disc diameter. The interaction between study factors showed a significant effect on the number of seeds per disc for both planting seasons, except for the interaction between sunflower cultivars and foliar application with Acadian in the second season of 2023. The interaction between cultivars and Acadian priming (S×A), particularly the interaction resulting from the cultivar Ishaqi2 × 4 g L^{-1}, exhibited the highest value for the interaction, reaching 1724.6 and 1584.4 seeds $disc^{-1}$ for both consecutive seasons. In contrast, the interaction Ishaqi1 × control treatment showed the lowest value for the trait, reaching 1068.7 and 1111.1 seeds $disc^{-1}$ for both consecutive seasons. The interaction between cultivars and foliar spray (S×F), particularly Ishaqi2 × foliar application with Acadian at a concentration of 4 g L^{-1}, showed the highest value, reaching 1669.7 seeds $disc^{-1}$. conversely, the lowest number of seeds per disc was observed for the interaction Ishaqi1 × foliar application distilled water and the interaction from the same cultivar × foliar application with Acadian at a concentration of 3 g L^{-1}, reaching 1243.9 and 1248.1 seeds $disc^{-1}$ for both consecutive interactions, respectively, without any significant difference between them in the first season. The interaction between seeds priming and foliar application with Acadian (A×F), particularly priming with Acadian at a concentration of 3 g L^{-1} × foliar spray with Acadian at a concentration of 4 g L^{-1},

Table 5. Effect seeds priming and foliar application with Seaweed extract on the number of seeds per disc in the first spring planting season of 2022

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	980.3	1040.0	1185.7	1068.7
	3	1254.3	1430.0	1517.3	1400.6
	4	1497.0	1274.3	1514.3	1428.6
Ishaqi 2	0	1140.0	1219.0	1486.0	1281.7
	3	1300.7	1542.0	1777.0	1539.9
	4	1725.0	1702.7	1746.0	1724.6
Mean F		1316.2	1368.0	1537.7	
L.S.D (0.05)		LSD $_{F}$ = 17.8			LSD $_{A*S}$= 25.2
		LSD $_{F \times A \times S}$ =43.7			

F × S

Cultivar (S)	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
Ishaqi 1	1243.9	1248.1	1405.8	1299.3
Ishaqi 2	1388.6	1487.9	1669.7	1515.4
L.S.D $_{F*S}$		25.2		LSD $_{S}$ = 14.6

F ×A

Seaweed extract (A) (g l^{-1})	Foliar Acadian Conc. (F) (g L^{-1}) 0	3	4	Mean A
0	1060.2	1129.5	1335.8	1175.2
3	1277.5	1486.0	1647.2	1470.2
4	1611.0	1488.5	1630.2	1576.6
L.S.D $_{F*A}$		30.9		LSD $_{A}$ = 17.8

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

Table 6. Effect seeds priming and foliar application with Seaweed extract on the number of seeds per Disc in the second spring planting season of 2023

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	960.9	1170.0	1256.4	1111.1
	3	1231.4	1452.0	1590.2	1424.5
	4	1520.7	1357.8	1538.1	1472.2
Ishaqi 2	0	1125.0	1238.4	1475.1	1279.5
	3	1256.1	1531.5	1703.4	1497.0
	4	1614.9	1518.3	1620.0	1584.4
Mean F		1275.8	1378.0	1530.5	
L.S.D (0.05)			LSD_{F} = 17.5		LSD_{A*S}= 24.7
			$LSD_{F \times A \times S}$ =43.7		

F × S

Cultivar (S)	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
Ishaqi 1	1219.7	1326.6	1472.2	1335.9
Ishaqi 2	1332.0	1429.4	1584.4	1453.6
$L.S.D_{F*S}$		N.S		LSD_{S} = 14.3

F ×A

Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
0	1016.0	1204.2	1365.7	1195.3
3	1243.8	1491.8	1646.8	1460.8
4	1567.8	1438.0	1579.0	1528.3
$L.S.D_{F*A}$		30.2		LSD_{A} = 17.5

Showed the highest value for the number of seeds per disc for this interaction, reaching 1647.2 and 1646.8 seeds $disc^{-1}$ for both consecutive seasons, which did not differ significantly from the interaction (priming with 4 g L^{-1} × foliar application with 4 g L^{-1}). Conversely, the control treatment for both study factors showed the lowest value for this trait for both seasons, reaching 1060.2 and 1016.0 seeds per $disc^{-1}$. The triple interaction (Ishaqi2 × 3 g L^{-1} × 4 g L^{-1}) showed the highest value, reaching 1777.0 and 1703.4 seeds $disc^{-1}$ for both consecutive seasons, while the interaction (Ishaqi1 × 0 g L^{-1} × 0 g L^{-1}) had the lowest value for the interaction, reaching 980.3 and 960.9 seeds $disc^{-1}$ for both consecutive seasons.

Weight of 1000 seeds (g)

The results of tables (7 and 8) showed a significant superiority of cultivar Ishaqi 2 in 1000-seeds weight over cultivar Ishaqi 1, giving the highest average weight per 1000 seeds 46.66 and 53.80 seeds, respectively. Meanwhile, cultivar Ishaqi 1 yielded 45.09 and 52.25 seeds for the two consecutive seasons. The reason for the superiority of cultivar Ishaqi 2 in 1000-seeds weight lies in the genetic predisposition of the cultivar to increase the quantity and efficiency of carbon assimilation and its transfer to sinks (Praman *et al*,2020), resulting in increased disc size, fertility ratio, seeds count, and consequently, 1000-seeds weight (tables 1- Balešević-Tubić *et al*,2010). This result is consistent with the findings of (Eiliwi & Zeboon ,2021) in their study, which included several cultivars of sunflower, including cultivars Ishaqi 1 and Ishaqi 2, where cultivar Ishaqi 2 significantly outperformed in 1000-seeds weight compared to other genotypes. Treatment with the highest concentration of Acadian seaweed extract, 4 g L^{-1}, yielded the highest average trait value of 53.18 seeds, significantly differing from the other concentrations. Meanwhile, the control treatment resulted in the lowest average trait value of 52.80 seeds, but only in the second season (Table 8). There was no significant effect of the Acadian seaweed extract treatment in the first season (Table 7). The increase in 1000-seeds weight due to the Acadian seaweed extract treatments or foliar spray can be attributed to the nutritive contents and growth stimulants present in the extract, including various amino acids. These components enhance seedling vigor and plant growth, significantly improving the source's efficiency and size, as well as the efficiency of transferring synthesized metabolites to sinks (seeds), ultimately leading to increased seeds weight (Nayak *et al*, 2020). From the results in Table 7, it is show that the control treatment, which involved spraying with distilled water, yielded the highest average weight of 1000 seeds in the first season, at 46.69 seeds. The lowest average trait value (45.13 grams) was observed with the treatment involving spraying with Acadian seaweed extract at a concentration of 4 grams per liter, which did not differed significantly

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

from the treatment with Acadian seaweed extract at a concentration of 3 g L^{-1} in the first season. However, in the second season (Table 7), the treatment with Acadian seaweed extract at a concentration of 3 g L^{-1} o outperformed others, yielding the highest average weight of 1000 seeds at 54.34 grams. Meanwhile, the control treatment resulted in the lowest average trait value at 52.35 grams, without significant differences from the treatment with Acadian seaweed extract at a concentration of 4 g L^{-1}. The increases in 1000-seeds weight due to the Acadian seaweed extract treatments or foliar spray can be attributed to the nutritive contents and growth stimulants present in the extract, including various amino acids. These components enhance seedsling vigor and plant growth, significantly improving the source's efficiency and size, as well as the efficiency of transferring synthesized metabolites to sinks (seeds), ultimately leading to increased seeds weight (Nayak *et al*, 2020,Alargy *et al*,2020) The interaction between factors showed a significant effects only in the first season, unlike the second season, where no significant effect was observed for this interaction. Specifically, the interaction resulting from cultivar Ishaqi2 × Acadian seaweed extract at a concentration of 3 g L^{-1} yielded the highest value for the interaction, reaching 49.02 grams. In contrast, the interaction Ishaqi1 × Acadian seaweed extract at a concentration of 3 g L^{-1} had the lowest value for the trait, at 43.49 grams. Furthermore, the interaction Ishaqi2 × foliar application with distilled water at concentrations of 3 and 4 g L^{-1} of Acadian seaweed extract showed the highest value for the interaction (47.20, 46.22, and 46.55 grams, respectively) without any significant difference between them in the first season. However, in the second season, the interaction (Ishaqi2 × foliar spray at a concentration of 3 g L^{-1}) outperformed others and yielded the highest value for the interaction at 55.87 grams. Conversely, the lowest value for the weight of 1000 seeds was observed for the interaction Ishaqi1 × foliar spray at a concentration of 3 grams per liter, and the interaction from the same cultivar × treatment with distilled water, which amounted to 45.41 and 46.17 grams for the consecutive interactions, respectively, without any significant difference between them in the first season.

Table 7. Effect of seeds priming and foliar application with Seaweed extract on the weight of 1000 seeds (g) in the first spring season of 2022

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	48.60	46.80	41.93	45.77
	3	43.30	43.07	44.09	43.49
	4	46.60	46.35	45.08	46.01
Ishaqi 2	0	45.98	45.27	46.64	45.97
	3	52.08	47.80	47.19	49.02
	4	43.55	45.60	45.83	44.99
	Mean F	46.69	45.82	45.13	
	L.S.D (0.05)		LSD $_{F}$ = 0.75		LSD $_{A*S}$= 1.06
			LSD $_{F \times A \times S}$ =1.84		

F × S

Cultivar (S)	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
Ishaqi 1	46.17	45.41	43.70	45.99
Ishaqi 2	47.20	46.22	46.55	46.66
L.S.D $_{F*S}$		1.06		LSD $_{S}$ = 0.61

F ×A

Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
0	47.29	46.03	44.29	45.87
3	47.69	45.44	45.64	46.26
4	45.08	45.98	45.45	45.50
L.S.D $_{F*A}$		1.30		LSD $_{A}$ = N.S

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

Table 8. Effect of seeds priming and foliar application with Seaweed extract on the weight of 1000 seeds(g) in the second spring season of 2023

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	52.83	51.21	51.54	52.19
	3	52.00	53.30	51.51	52.27
	4	51.05	53.91	51.94	52.30
Ishaqi 2	0	53.08	55.91	51.20	53.40
	3	54.30	55.17	52.31	53.93
	4	50.85	56.52	54.83	54.06
Mean F		52.35	54.34	52.39	
L.S.D (0.05)			LSD $_{F}$ = 0.65		LSD $_{A*S}$= N.S
			LSD $_{F \times A \times S}$ =1.59		

F × S

Cultivar (S)	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
Ishaqi 1	51.96	52.81	52.00	52.25
Ishaqi 2	52.74	55.87	52.78	53.80
L.S.D $_{F*S}$		0.92		LSD $_{S}$ = 0.53

F ×A

Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
0	52.96	53.56	51.87	52.80
3	53.15	54.24	51.91	53.10
4	50.95	55.21	53.38	53.18
L.S.D $_{F*A}$		1.13		LSD $_{A}$ = N.S

The lowest value (51.96 grams) in the second season was attributed to the interaction (isaqi1 × foliar spray with distilled water). The interaction between the treatments of seeds priming and foliar spray with Acadian (A×F: priming with 3 g L^{-1} concentration of Acadian × foliar spray with distilled water) achieved the highest value for the weight of 1000 seeds for this interaction, reaching 47.69 grams, which did not differ significantly from the interaction (priming and foliar spray with distilled water) in the first season. In thesecond season, the interaction (priming with 4 g L^{-1} concentration of Acadian × 3 g L^{-1} concentration of Acadian) outperformed and had the highest average of 55.21 grams. On the other hand, the interaction between the treatment of priming with distilled water and foliar spray with 4 g L^{-1} concentration of Acadian in the first season, and the interaction (priming with 4 g L^{-1} concentration of Acadian × foliar spray with distilled water) in the second season, showed the lowest value for this trait, reaching 44.29 and 50.95 grams for the consecutive interactions, respectively, which did not differ from several other interactions. The (Isaqi2 × 3 g L^{-1} concentration of Acadian × foliar spray with distilled water for the first season) showed the highest value of 52.08 grams, while the interaction (isaqi1 × priming with distilled water × foliar spray with 4 g L^{-1} concentration of Acadian) in the first season and the interaction (Isaqi2 × 4 g L^{-1} concentration of Acadian × foliar spray with distilled water) in the second season had the lowest value for the interaction, at 41.93 and 50.85 seeds for the consecutive interactions.

The seeds yield (Mg ha^{-1}): The seeds yield (Mg ha^{-1}) showd a significant effect of sunflower cultivars, seeds priming, foliar spray with seaweed extract (Acadian), and their interactions on the seeds yield for both planting seasons, except for the interaction between sunflower cultivars × foliar spray treatments with Acadian in the second season. Ishaqi2 plants had the highest average seeds yield in both planting seasons at 4.703 and 5.208 Mg ha^{-1}, compared to Ishaqi1, which had the lowest average for the trait, reaching 3.895 and 4.651 Mg ha^{-1}. The superiority of Ishaqi2 in seeds yield is attributed to its superiority in disc diameter, fertility ratios, seeds count per disc, and 1000-seeds weight (Tables 1 to 8). The treatment with the highest concentration of Acadian (4 g L^{-1}) outperformed by yielding the highest average for the trait (4.776 and 5.416 Mg ha^{-1}), while the control treatment (priming with distilled water) had the lowest average for the trait for both consecutive seasons, reaching 3.586 and 4.204 Mg ha^{-1}. It was an increase in seeds yield due to the increase in Acadian application concentrations. After being at its lowest average

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

(4.077 and 4.440 megagram per hectare Mg ha^{-1}) with the control treatment, it significantly increased with the Acadian application concentration of 3 g L^{-1}, then reached the highest average for the trait (4.645 and 5.347 Mg ha^{-1}) with the highest concentration of Acadian application in both planting seasons. The increase in seeds yield due to the addition of seaweed extract (Acadian) can be attributed to its effect on increasing the components of the yield, including the seeds count per disc (Tables 5 and 6), which directly reflected in the increase in seeds yield, whether through seeds priming or foliar application with fertilizer. This result confirms with Shihab and Hamza (Singh *et al*,2015) and (Mustaf &Cheyed. 2018, Abdalwahed *et al*, 2019).

Table 9. Effect of seeds priming and foliar application with Seaweed extract on seeds yield in the first spring season of 2022

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	3.175	3.239	3.312	3.242
	3	3.620	4.107	4.462	4.063
	4	4.651	3.936	4.551	4.379
Ishaqi 2	0	3.493	3.679	4.620	3.931
	3	4.516	4.911	5.590	5.006
	4	5.008	5.176	5.335	5.173
	Mean F	4.077	4.175	4.645	
	L.S.D (0.05)		LSD $_{F}$ = 0.070		LSD $_{A*S}$= 0.099
			LSD $_{F \times A \times S}$ =0.172		
F × S					
	Cultivar (S)	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
	Ishaqi 1	3.815	3.761	4.108	3.895
	Ishaqi 2	4.339	4.589	5.182	4.703
	L.S.D $_{F*S}$		0.099		LSD $_{S}$ = 0.57
F ×A					
Seaweed extract (A) (g l^{-1})		Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
0		3.334	3.459	3.966	3.586
3		4.068	4.509	5.026	4.534

Table 10. Effect of seeds priming and foliar application with Seaweed extract on seeds yield in the second spring season of 2023

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	3.193	3.994	4.401	3.863
	3	4.269	5.159	5.460	4.962
	4	5.175	4.879	5.326	5.127
Ishaqi 2	0	3.984	4.617	5.035	4.545
	3	4.548	5.634	5.940	5.374
	4	5.474	5.721	5.921	5.705
	Mean F	4.440	5.000	5.347	
	L.S.D (0.05)		LSD $_{F}$ = 0.092		LSD $_{A*S}$= 0.130
			LSD $_{F \times A \times S}$ =0.225		
F × S					
	Cultivar (S)	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
	Ishaqi 1	4.212	4.677	5.062	4.651
	Ishaqi 2	4.669	5.324	5.632	5.208
	L.S.D $_{F*S}$		N.S		LSD $_{S}$ = 0.075
F ×A					
Seaweed extract (A) (g l^{-1})		Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
0		3.588	4.305	4.718	4.204
3		4.408	5.396	5.700	5.168
4		5.325	5.300	5.624	5.416
L.S.D $_{F*A}$			0.159		LSD $_{A}$ = 0.092

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

As for the interaction effect between the study factors, the two-way interaction between the cultivars and seeds priming with Acadian (S×A), especially the interaction (Ishaqi2 × seeds priming with Acadian at a concentration of 4 g L^{-1}), showed the highest value for the interaction, reaching 5.173 and 5.705 (Mg ha^{-1}). for both consecutive seasons. Meanwhile, the interaction (Ishaqi1 × control treatment) had the lowest value at 3.242 and 3.863 Mg ha^{-1} for both consecutive seasons.

The two-way interaction (S×F) for the variety Ishaqi2 × foliar application with Acadian at a concentration of 4 g L^{-1} showed the highest value at 5.182 Mg/ha. In contrast, the lowest value for seeds yield was attributed to the interaction (Ishaqi1 × foliar spray with Acadian at a concentration of 3 g L^{-1}), which reached 3.761 Mg ha^{-1} for both consecutive seasons in the first season. The interaction between seeds priming and foliar spray with Acadian (seeds priming at a concentration 3 g L^{-1} × foliar spray at a concentration 4 g L^{-1} of Acadian) achieved the highest value for seeds yield for this interaction, reaching 5.026 and 5.700 Mg ha^{-1} for both consecutive seasons. Meanwhile, the control treatment for both study factors showed the lowest value of 3.334 and 3.588 Mg ha^{-1} for both consecutive seasons. As for the three-way interaction between the study factors (S×A×F), the interaction (Ishaqi2 × 3 g L^{-1} × 4 g L^{-1} of Acadian) yielded the highest value for the interaction, reaching 5.590 and 5.940 Mg ha^{-1}, without significant difference from the interaction (Ishaqi2 × seeds priming and foliar spray with Acadian at a concentration of 4 g L^{-1}) in the second season. However, the interaction (Ishaqi1 × 0 g L^{-1} × 0 g L^{-1}) had the lowest value for the interaction, 3.175 and 3.193 Mg ha^{-1} for both consecutive seasons.

Oil content (%)

The results of Tables (11 and 12) revealed a significant effect of the study factors and the interaction between sunflower cultivars and priming treatments, while the remaining two-way interactions and the three-way interaction showed no significant effects to oil content Plants of the Ishaqi-2 cultivar achieved the highest average oil content in both planting seasons, reaching 43.642% and 43.078%, respectively. Meanwhile, seeds of the Ishaqi-1 cultivar exhibited the lowest average for the trait, with values of 41.230% and 40.414% in respectively. The superiority of the Ishaqi-2 cultivar in oil content is attributed to the influence of environmental and genetic factors (Pramanik *et al*,2020). These results align with the findings of (Eiliwi & Zeboon ,2021) in their study, which included several sunflower cultivars, including the Ishaqi-1 and Ishaqi-2 cultivars. Ishaqi-2 significantly outperformed other genotypes in seeds oil content. The treatment with activation at a concentration of 3 g L^{-1} achieved the highest average 43.642% and 43.090%, respectively, while the control treatment (activation with distilled water) yielded the lowest average at 40.873% and 40.152% for the consecutive seasons. It is noteworthy that the treatment of spraying with 4 g L^{-1} of *Ascophyllum nodosum* extract had the highest average 43.552% and 42.968%, respectively, while the lowest average for oil content was observed in the treatment of application with distilled water (the comparison), which recorded 41.177% and 40.408%. The content of marine algae extract, with its nutrients, organic materials, and growth regulators, has a positive effect on improving both quantitative and qualitative traits of sunflower seeds (Nayak *et al*, 2020).

Regarding the interaction effect between the study factors, the two-way interaction between cultivars and *Ascophyllum nodosum* activation (S×A), especially the interaction (Ishaqi-2 × *Ascophyllum nodosum* activation at a concentration of 3 g L^{-1}), yielded the highest value for the interaction, reaching 44.801% and 44.159%, respectively. Meanwhile, the interaction between Ishaqi-1 and the control treatment had the lowest value for the trait, at 39.041% and 38.223% for the consecutive seasons.

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:https://doi.org/10.36103/3czepg56

Table 11. Effect of seeds priming and foliar application with Seaweed extract on oil content (%)in the first spring season of 2022

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	37.980	39.133	40.010	39.041
	3	41.117	42.813	43.520	42.483
	4	40.630	42.643	43.220	42.164
Ishaqi 2	0	41.090	43.357	43.667	42.704
	3	43.973	44.583	45.847	44.801
	4	42.270	44.303	45.047	43.873
Mean F		41.177	42.806	43.552	
L.S.D (0.05)		LSD $_{F}$ =0.289			LSD $_{A*S}$= 0.409
		LSD $_{F \times A \times S}$ = N.S			
F × S					
Cultivar (S)		Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
Ishaqi 1		39.909	41.530	42.250	41.230
Ishaqi 2		42.444	44.081	44.853	43.642
L.S.D $_{F*S}$		N.S			LSD $_{S}$ = 0.57
F ×A					
Seaweed extract (A) (g l^{-1})		Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
0		39.535	41.245	41.838	40.873
3		42.545	43.698	44.683	43.642
4		41.450	43.473	44.133	43.019
L.S.D $_{F*A}$		N.S			LSD $_{A}$ = 0.289

Table 12. Effect of seeds priming and foliar application with Seaweed extract on oil content (%)in the second spring season of 2023

Cultivar (S)	Seaweed extract (A) (g l^{-1})	Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	A × S
Ishaqi 1	0	37.340	38.313	39.017	38.223
	3	40.960	42.080	43.023	42.021
	4	39.493	41.453	42.047	40.998
Ishaqi 2	0	40.530	42.480	43.233	42.081
	3	42.103	44.497	45.877	44.159
	4	42.020	42.347	44.613	42.993
Mean F		40.408	41.862	42.968	
L.S.D (0.05)		LSD $_{F}$ = 0.494			LSD $_{A*S}$= 0.699
		LSD $_{F \times A \times S}$ = N.S			
F × S					
Cultivar (S)		Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean S
Ishaqi 1		39.264	40.616	41.362	40.414
Ishaqi 2		41.551	43.108	44.574	43.078
L.S.D $_{F*S}$		N.S			LSD $_{S}$ = 0.403
F ×A					
Seaweed extract (A) (g l^{-1})		Foliar *seaweeds extract* (F) (g L^{-1}) 0	3	4	Mean A
0		38.935	40.397	41.125	40.152
3		41.532	43.288	44.450	43.090
4		40.757	41.900	43.330	41.996
L.S.D $_{F*A}$		N.S			LSD $_{A}$ =0.494

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

DECLARATION OF FUND

The authors declare that they have not received a fund.

REFERENCES

Abdalwahed M.S., Saudi,A.H. and naje, S.A., 2019. Effect of foliar spray with seaweeds extract on yield and quality four class of broad bean (*Vicia faba* L.). Jornal of Al-Muthanna for Agricultural.

DOI:10.18081/MJAS/2019-7/46-53.
Ahmed, M., H.M. Noaman and H. Zahran. 2022. Combining ability estimation for yield and its components of sunflower inbred lines. Egyptian J. Chem., 65(3): 19-28. DOI:10.21608/ejchem.2021.102004.4736
Alargy, A.A.A. and A.J.H. Al-Tameemi 2020. Effect of humic acid and anti- transpiration on the sunflower plants under the water stress condition. Iraqi Journal of Soil Sciences, 20(1):158-170. https://www.iasj.net/iasj/article/198985
Al-Haidary, H. Kh. M. A. 2018. Splitting of nitrogen application through growth stages in various sunflower cultivars to improve their vegetative growth and seed yield. Asin Journal Agriculture and Biological .6(3): 357-366. https://www.asianjab.com/media/2018/10/9-085.Splitting-of-nitrogen-application-through-growth-stages-in-various-sunflower-cultivars-to-improve-their-ve
Attia, H. A. and S. H. Kazem. 2017. Response of Some Vegetative Growth Traits to Two Genetic Compositions of Sunflower and Number of Sprays with Humic Acid. Karbala Journal of Agricultural Sciences. 4(1): 14-26. DOI: https://doi.org/10.59658/jkas.v4i1.76
Balešević-Tubić, S., M. Tatić, , V. Đorđević, , Z.Nikolić, and V. Đukić, 2010. Seed viability of oil crops depending on storage conditions. HELIA, 33(52): 153-160. DOI: 10.2298/HEL1052153B
Eiliwi, A.Y. and N.H. Zeboon 2021. Response of yield and quality of four genotypes from sunflower to foliar spray with folic acid. Al-Muthanna Journal of Agricultural Sciences, 8(3):1-10. DOI:10.52113/mjas04/8.2/41.
Elsahookie, M. M. 1994. Sunflower Production and Breeding. IPA Agric. Res. Center, Baghdad, Iraqi, pp.346. https://ijarmoa.gov.iq/wp content/uploads /2022
Elsahookie, M.M. and S.H. Cheyed 2023. Seed Growth Relationships. Ministry of Higher Education and Scientific Research. p. 174. https:/ /www .researchgate .net /publication /367541739 _SEED_ GROWTH_ RELATIONSHIPS
Habib, M.I. 2017. Improving the Performance of Sunflower Seeds (*Helianthus Annuus* L.) Using the Activation Transaction. MSc. Thesis. Department of Field Crops/College of Agriculture–Anbar University. p. 81. https://www.researchgate.net
Hamdalh, M. Sh. and M. K. Alak. 2010. Evaluation of Relationships of Seed Yield with Some Associated Traits in Sunflower. Al-Anbar Journal of Agricultural Sciences. 8(4) Special Issue: 457-465. https://ajas.uoanbar.edu.iq/
Kadem, F.A. and N.Y. Abed. 2018. Application of Statistics and Analysis of Agricultural Experiments (practical part). Ministry of Higher Education and Scientific Research, College of Agricultural, University of Baghdad, Iraq. pp: 200. https://en.coagri.uobaghdad.edu.iq/?page_id=1438
Kadhim, J. J. and J. H. J. H. Hamza 2021. Study of seed soaking and foliar application of ascorbic acid, citric acid and humic acid on growth, yield and active components in maize. IOP Conf. Series: Earth and Environmental Science 910 (2021) 012076 doi:10.1088/1755-1315/910/1/012076
Mustafa, A.S. and S.H. Cheyed. 2018. Effect of seed priming of organic, biochemical and mineral fertilizers on seed vigor of sorghum. Int. J. Agricult. Stat. Sci. 14(1):239-244. https://www.researchgate.net/publication/332029622_
Nasrallah, A. Y., I. H. H. Al-Helfi, and H. M. K. Al-Aboudi. 2012. "Response of Sunflower to Some Plant Extracts and Antioxidants." Karbala Journal of Agricultural Sciences (Special Issue/Second Scientific Conference of the College of Agriculture): 506-514. https://agriculture.uokerbala.edu.iq/wp/2014/11/20
Nayak, P., S. Biswas, , and D. Dutta, 2020. Effect of seaweed extracts on growth, yield and economics of kharif rice (*Oryza sativa* L.). J. of Pharmacognosy and Phytochemistry, *9*(3):247-253. DOI:10.22271/phyto.2020.v9.i3d.11269
Ozturk, A., P. Taksin, and S. Murat, 2017. The effect of sowing date and nitrogen fertilizer from on growth, yield and yield components in

sunflower. Turkish Journal. 22(1): 143-151. DOI:10.17557/tjfc.312373

Pramanik, S., R.P. Singh and R. Ghosh. 2020. Application of bio-orthogonal wavelet transform and genetic algorithm in image steganography. Multimedia Tools and Applications, 24(25):17463-17482. DOI:10.1007/s11042-020-08676-1

Sarheed, B.R., M.H.I. Al.Ani and M.A.A. Hassan 2015. Effect of manganese foliar application on growth and yield of three sunflower (*Helianthus annuus* L.) varieties. Al-Anbar Journal of Agricultural Sciences, 13(2):170-179. DOI:10.32649/ajas.2015.120062

Saudi, A.H. 2017. The effect of foliar spraying with seaweed extract on the growth, yield, and seed strength of bread wheat cultivars. Iraqi Agricultural Sciences Journal. 48(5): 1313-1325. DOI: https://doi.org/10.36103/ijas.v48i5.341

Saudi, A. H. and Al-Rawi, A.S.M.. 2023. Effect of seed priming duration with biostimulator (Appetizer) on germination characteristics and seedling emergence of sorghum. IOP Conference Series: Earth and Environmental Science 262(1): 052034 . DOI 10.1088/1755-1315/1262/5/052034

Saudi, Ahmed Hamid. 2012. Evaluation of the storability of sunflower (*Helianthus annuus* L.) seeds treated with gibberellic acid and stored for different storage periods. Dhi Qar University Journal of Agricultural Research, vol. 1(1). 1:301-319. https://www.researchgate.net/publication/279243976

Shihab, M. O. and J.H. Hamza. 2020. Germination and seedling growth in primed sorghum seed with gibberellic and salicylic acids. Plant Archives. 2(1): 1409-1416. https://www.researchgate.net/publication/341164693.

Singh, S.K, R. Thakur, M.K Singh, C.S, Singh, S.K Pal. 2015. Effect of fertilizer level and seaweed sap on productivity and profitability of rice (*Oryza sativa*). Indian J Agron. 60(3):420–425. DOI:10.59797/ija.v60i3.4473

Iraqi Journal of Agricultural Sciences –2026:57(3):812-827
P-ISSN: 0075- 0530 /E-ISSN: 2410-0862
DOI:

تأثير تحفيز البذور والرش الورقي بمستخلص الطحالب البحرية في صفات الحاصل لصنفين من زهرة الشمس

حوراء علي عباس [1] ، احمد حميد سعودي[2]

[1] قسم المحاصيل الحقلية،كلية الزراعة،جامعة كربلاء [2]قسم المحاصيل الحقلية،كلية علوم الهندسة الزراعية ، جامعة بغداد

المستخلص

نفذت تجربة حقلية خلال العروتين الربيعيتين لعامي 2022 و2023 في حقول التجارب التابعة لكلية علوم الهندسة الزراعية – جامعة بغداد باستعمال تصميم RCBD وفق التجارب العاملية بثلاثة قطاعات وبثلاثة عوامل تضمنت أصناف زهرة الشمس (اسحاقي1 واسحاقي2) والعامل الثاني تضمن تنشيط البذور بمستخلص الطحالب البحرية (أكاديان) بالتراكيز (0 و3 و4 ملغم لتر$^{-1}$)، فضلاً عن العامل الثالث رش النباتات بمستخلص الطحالب البحرية بالتراكيز أعلاه. أظهرت النتائج تفوق الصنف اسحاقي2 معنوياً في الصفات المدروسة جميعا ولكلا الموسمين، وتفوقت معاملة التنشيط والرش بالاكاديان بالتركيز 4 غم لتر$^{-1}$ في اغلب الصفات المدروسة ، وتباين تأثير التداخلات الثنائية والتداخل الثلاثي لعوامل الدراسة في صفات الحاصل الا ان التداخل بين الصنف اسحاقي2 والتنشيط بالتركيز 3 غم لتر$^{-1}$ والرش بالتركيز 4 غم لتر$^{-1}$ كان الأكثر تميزاً في اغلب الصفات المدروسة. ولتحقيق أفضل زيادة في حاصل زهرة الشمس. جزء من اطروحة دكتوراه للباحث الاول.

الكلمات المفتاحية : الاسمدة الصديقة للبيئة, الامن الغذائي لزهرة الشمس, نسبة الزيت.