Influence of foliar application with algae and potassium on yield and elements content of sunflower plant.

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ABSTRACT:

A field experiment was carried out in El Behira Governorate during the summer season of the 2022 year. Four levels of algae extract (0.25, 0.50, 0.75, and 1.0 g/l) with four levels of potassium sulfate were applied (0.5, 0.1, 1.5, and 2 g/l). The results indicated that both Algae and K_2SO_4 spray significantly enhanced sunflower plant nutritional levels, shoot yield, seed yield, and weight of 100 seeds.

Keywords: Potassium; Algae extract; Growth; Chemical composition; sunflower plant.

INTRODUCTION:

The current study aims to study the effect of foliar spray of two materials (Algae extract spirulina and Potassium sulphate K_2SO_4) on the yield and chemical composition of sunflower *(Helianthus annuus L.),* which has a high amount of unsaturated fatty acids, is one of the most significant oil crops. Sunflower is the third-largest producer of oil in the world, behind soy and rapeseed, but its economic value extends beyond just oil production. Sunflower seed meal has a high digestible protein content of 30%, making it a good source of animal feed. Sunflower seeds also have a high oil content of up to 50%, as well as a high degree of liquidity and a low level of saturated fatty acids, which are crucial in the development of cardiovascular disease., Numerous research studies have shown that marine algae extract affects sunflowers and other crops, according to Bhattacharyya et al. (2015). Chaves et al (2014) Fertilizer is essential to the growth of crops. For optimal yield production, its prompt availability is crucial. To prevent having a negative impact on the ecology, the fertilizer dosage must be applied with extreme caution. According to Manea et al. (2019), foliar application is a supplementary strategy that enables plants to absorb nutrients through their leaves or other sections of the plant, such as their fruits and stems, to get the nutrients they require., diffusion, and chemical composition all have a way of getting into the cell membrane. According to Gandhiyappan and Perumal (2001), seaweed extracts are currently offered for sale under a variety of brand names, including Sea Born, marinara, Seaspray, Seasol, SM3, Cytex, and Seacrop. According to Karthikeyan and Shanmugam (2015), sunflower plants treated with a foliar spray of seaweed extract at a dosage of (5%) produced significantly more seeds than controls (51.50% more seeds per plant)., also showed that the proportion of oil in the treated plants was higher than in the control treatment, indicating that the treatment had an impact on the plants' development, production, and constituent parts. A related method is foliar fertilization or foliar feeding, in which nutrients may be absorbed by leaves or other plant components like fruits and stems to provide the plant with the nutrients it needs. Water and diffusion allow nutrients to enter through the cell membrane. Hasan et al. (2019). The use of seaweed extracts is encouraged since it is one of the key sources utilized in several applications on commercially significant crops. This method has helped to enhance output while also reducing the phenomenon of the use of chemical fertilizers. This has improved the quality of the product Khan (2009). Nitrogen makes up 2-4 percent of the dry weight of plant tissue and accounts for 18 percent of the weight of proteins; its lack causes plants to produce more proteins and other organic molecules (1999) Shaktawat. The activation of the enzymes responsible for starch synthesis, protein synthesis, and photosynthesis all depend heavily on potassium. According to Asif et al. Ayub et al (2002) A crop needs potassium as much as nitrogen, making it one of the most important components for plant growth. Potassium also enhances product quality and increases grain output. Because seaweed liquid extracts include growth-promoting hormones, cytokinin, trace minerals, and vitamins, they are increasingly used as foliar sprays for many crops. Mamatha and others, 2007. El-Bakry et al. (2006) reported that the use of seaweed extract as a plant growth supplement in agriculture had positive impacts, such as an improvement in fruit production, an increase in crop productivity, and high chlorophyll levels in plant leaves. Plant nutrient intake, increased seed weight, increased stress tolerance, decreased

2nd International Scientific Conference "Agriculture and Futuristic Challenges (Food Security: Challenges and Confrontation)", Faculty of Agriculture, Al-Azhar University, Cairo, Egypt, October 10th –11th, 2023.

occurrence of fungal disease and insect assault, and decreased water's negative effects on plants (Salah El Din et al., 2008)

MATERIALS AND METHODS

Before cultivation, soil samples were taken, and analyzed according to Klute (1986) for the determination of physical properties, and according to Page et al. (1982) for the determination of chemical properties. Available elements in the soil before cultivation were extracted using ammonium bicarbonate-DTPA in accordance with Soltanpour and Schwab (1977). Tables 1, 2, 3 and 4 exhibit some chemical characteristics of the applied irrigation water, soil, organic debris, and algae. During the summer of 2022, a field experiment was conducted at Kafr El Waq, Housh Issa in El Behira Governorate. Three replicates were used in the split-plot design of the experiment. Farmyard manure contributed to 23.8 m3/ha of organic fertilizers. Ammonium nitrate (33.5% N), superphosphate (12.5% P_2O_5), and potassium sulphate (50%) were the inorganic fertilizers used. The recommended quantities of nitrogen, phosphorus, and potassium fertilizers were respectively 285.6 kg N/ha, 59.5 kg P_2O_5/ha, and 59.5 kg K_2O/ha. Spirulina was used in three of the foliar applications used to treat the algae at the following concentrations: 0.25, 0.50, 75, and 1 g/l and 0.5, 0.1, 1.5, and 2 g/l of potassium sulfate. Following the experiment's 110-day runtime, plant materials were collected, processed according to standard procedures, and stored for lab examination. We assessed the weight, shoot production, and seed yield of s100-seeds. Plant samples were gathered and ready for examination. To assess NPK and micronutrients, representative parts were wet digested with $HClO_4$ and H_2SO_4 acids. The ascorbic acid method was used to assess total P, whereas the micro-Kjeldahl method was used to estimate total N. According to Page et al. (1982), a flame photometer was used to measure total K, and an ICP (plasma 400) spectrometer was used to measure micronutrients. The goal of this research was to examine how potassium and algae affected the nutritional content and production of sunflowers (Helianthus annuus l. 601).

A statistical analysis of the data was performed by Gomez and Gomez (1984). The Least Significant Differences (LSD) test was run at the 0.05 level of probability when the F-test revealed significant differences in the means.

RESULTS AND DISCUSSION

Data in Table (5) reveal that both shoot, seeds and 100 seed (g) were significantly increased with increasing algae and potassium concentration, the highest shoot yields were 4710.62 (kg ha^{-1}) obtained with 1 g/l alga with 2 g/l potassium treatments, compared to other treatments and control. Concerning the effect of treatments on seed yields (kg ha^{-1}) data presented in the same Table (5) revealed that, the highest seed yield was 2563.14 (kg ha^{-1}) obtained with 1 g/l algae with 2 g/l potassium treatments. Data given in Table (5) on the impact of treatments on the weight of 100 seed (g) showed that the greatest weight of 100 seed (g) achieved with 1 g/l algae and 2 g/l potassium treatments was 17.90 (g) compared to control. In comparison to the control, the effects of algae and potassium foliar application significantly increased the parameters of shoot, seeds, and weight of 100 seeds (g). These increases in dry matter of the shoot, seed yield, and weight of 100 seed (g) can be attributed to a direct role for both the interaction effect between algae and potassium foliar application. These findings correspond with those of Latique and colleagues (2013). The algal extract had favorable impacts on growth and yield characteristics since it included all the nutrients and plant growth hormones that plants need to produce more. Prasad et al (2010).

Data introduced in Table (6) showed that nitrogen concentrations (%) of shoot significantly increased with increasing algae and potassium concentration, the highest value was 1.39 (%) obtained at 1 g/l algae with 2 g/l potassium treatments, compared to other treatments and control. Regarding the impact of treatments on the nitrogen concentration (%) of the seed, results presented in the same Table (6) showed that, when compared to other treatments and the control, the greatest nitrogen concentration (%) of the seed was 3.01 (%) achieved at 1 g/l algae with 2 g/l potassium treatments. Data prefixed in Table (6) reveal that the highest nitrogen uptake was 87.30 (kg ha^{-1}) of the shoots, while the highest nitrogen uptake was 102.87 (kg ha^{-1}) of the seed obtained with1 g/l algae with 2 g/l potassium treatments respectively, compared to other treatments and control. According to Zaghloul et al. (2009), potassium increases the levels of nitrogen, phosphorus, and potassium in plants as a result of enhanced metabolism due to its effects on nutrient uptake and transfer. According to Dhargalkar and Pereira (2005), algae extract is widely utilized in agriculture to maximize the usage of mineral fertilizers and to improve nutrient absorption.

Data tabulated in Table (7) showed that phosphorus concentrations (%) of shoot significantly increased with increasing algae and potassium concentration, the highest value was 0.30 (%) obtained at 1 g/l algae with 2 g/l potassium treatments, compared to other treatments and control. Concerning the impact of treatments on the seed's percentage of phosphorus in comparison to other treatments and the control, data given in the same Table (7) showed that the maximum nitrogen content (%) of the seed was 0.51 (%) achieved at 1 g/l algae with 2 g/l potassium treatments. According to data in Table (7), when compared to other treatments and the control, the shoot absorbed the most phosphorus (18.59 kg ha-1), while the seed absorbed the most (17.43 kg ha-1) when treated with 1 g/l algae and 1.5 g/l potassium. According to Osman and Salem (2011), sunflower plants that received foliar sprays of seaweed extracts dramatically boosted their seed output, oil yield, and potassium content.

Data in Table (8) showed that potassium concentrations (%) of the shoot were significantly increased with increasing algae and potassium concentration, the highest value was 1.79 (%) obtained at 1 g/l algae with 2 g/l potassium treatments, compared to other treatments and control. Concerning the effect of treatments on the potassium concentration (%) of the seed data introduced in the same Table (8) revealed that, the highest nitrogen concentration (%) of the seed was 4.17 (%) obtained at 1 g/l algae with 2 g/l potassium treatments, compared to other treatments and control. Data introduced in Table (8) showed that the highest potassium uptake was 112.43 (kg ha^{-1}) of the shoots, while the highest potassium uptake was 142.51 (kg ha^{-1}) of the seed obtained with1 g/l algae with 2 g/l potassium treatments respectively, compared to other treatments and control. The presence of nutrients in the algal extract, together with its impact on boosting biological and enzymatic activity as well as the process of photosynthesis, proteins, and carbohydrates, maybe the cause of the rise in seed production seen after the addition of the extract. According to Ma et al. (2001), potassium improved the biological yield, stalk yield, and stem girth. According to Mancuso et al. (2006), applying seaweed extract improved the absorption of nitrogen, phosphorus, potassium, and magnesium by cucumber and grapevine plants.

Data in Table (9) showed that iron concentrations (mg/kg) of shoot were significantly increase with increasing algae and potassium concentration, the highest were 221.47 (mg/kg) obtained at 1 g/l algae with 2 g/l potassium treatments, compared to other treatments and control. Concerning the impact of treatment on the iron concentrations (mg/kg) of the seed data introduced the same Table (9) showed that the highest iron concentration (mg/kg) of the seed was 375.09 ((mg/kg) obtained at 1 g/l algae with 2 g/l potassium treatments, compared to other treatments and control.

Data in Table (9) showed that zinc concentrations (mg/kg) of shoot were significantly increase with increasing algae and potassium concentration, the highest were 21.98 (mg/kg) obtained at 1 g/l algae with 2 g/l potassium treatments, compared to other treatments and control. Concerning the impact of treatment on the zinc concentrations (mg/kg) of the seed data introduced. The same Table (9) showed that the highest zinc concentration (mg/kg) of the seed was 46.12 (mg/kg) obtained at 1 g/l algae with 2 g/l potassium treatments, contrasted with other treatments and the control. These findings concur with those of Dhargalkar and Pereira (2005). Data in Table (9) showed that manganese concentrations (mg/kg) of shoot were significantly increase with increasing algae and potassium concentration, the highest were 45.48 (mg/kg) obtained at 1 g/l algae with 2 g/l potassium treatments, compared to other treatments and control. The application of algae extract considerably increases the impact of nutrients like N, Fe, Mn, and Zn on sunflower leaves. These findings concur with those of Karthikeyan and Shanmugam (2015). Regarding the impact of treatments on the manganese concentrations (mg/kg) of the seed, data presented in the same Table (9) showed that, when compared to other treatments and the control, the highest manganese concentration (mg/kg) of the seed was 65.37 (mg/kg) obtained at 1 g/l algae with 2 g/l potassium treatments. Because algal extract contains all the nutrients and plant growth hormones necessary for plants to produce more, it has an impact on growth and yield measures (Latique *et al* ,.2013).

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Table 1: Some chemical analyses of irrigation water:

Irrigation water	pH	EC $dS.m^{-1}$	Soluble cations mmolc L^{-1}				Soluble anions mmolc L^{-1}			
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}
(canal)	7.27	0.57	1.39	2.16	1.67	0.19	-	1.23	3.65	0.53

Table 2: Some physical and chemical analyses of soil before cultivation

Property			Soil
Particle size distribution, %		Sand	25.12
		Silt	31.55
		clay	43.33
Textural class			Clay
O.M mg kg^{-1}			10.71
Ca CO_3 g kg^{-1}			27.10
pH (Soil paste)			8.13
EC ($dS.m^{-1}$, at 25 C^{o}) 1:5			0.059
Soluble ions (mmolc L^{-1})	Cations	Ca^{+2}	0.75
		Mg^{+2}	1.10
		Na^{+}	3.71
		K^{+}	0.53
	Anions	CO_3^{-2}	-
		HCO_3^{-}	1.93
		Cl^{-}	2.79
		SO_4^{-2}	1.37
Total (mg kg^{-1})		N	57.12
Available (mg kg^{-1})		P	9.73
		K	179.13
		Fe	23.12
		Zn	7.13
		Mn	9.13

Table 3: Some chemical analyses of farmyard manure:

Material	pH	EC 1:5	C: N	O.M	N	P	K	Fe	Zn	Mn
	1:1	dSm^{-1}	Ratio	g kg^{1}	%	%	%	$mgkg^{-1}$	$mgkg^{-1}$	$mgkg^{-1}$
F.Y.M	8.13	1.76	18:10	41.19	1.09	0.37	0.87	396.15	41.18	89.17

Table 4: Some chemical analyses of algae**:**

properties	Results
PH (1:1)	9.11
Organic matter	50%
Amino acids	1.5%
N	7.19 %
P_2O_5	2.13 %
K	16.15 %
Ca	2.16 %
Mg	0.41 %
SO_4	1.5 %
Na	1.5 %
Fe	243 (mg/kg)
Zn	51 (mg/kg)
Mn	13 (mg/kg)
Cu	11 (mg/kg)
B	9 (mg/kg)
Cytokinin (CTK)	231 (mg/kg)
Gibberellin (G)	91 (mg/kg)
Indole Acetic Acid (IAA)	73 (mg/kg)

Table 5: Interaction effect between algae and potassium on dry weight and 100-seed weight (g) in sunflower plant

	Dry weight shoots (kg/h)					Dry weight seeds (kg/h)					100-seed weight (g)				
Algae(g/l)					Mean	Algae(g/l)				Mean	Algae(g/l)				Mean
Control	3753.91					2380.30					15.41				
K	0.25	0.50	0.75	1		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5	3755.58	3838.05	3964.25	4461.96	4004.96	2381.13	2452.77	2463.18	2504.41	2450.37	15.55	15.84	16.05	16.83	16.07
1	3795.56	4045.46	4081.28	4546.93	4117.31	2421.53	2492.34	2504.00	2546.90	2491.19	15.98	15.98	16.22	16.99	16.29
1.5	3964.66	4145.01	4170.41	4646.89	4231.74	2423.61	2502.75	2534.40	2548.15	2502.23	16.08	16.01	16.56	17.03	16.42
2	3921.76	4088.78	4213.73	4710.62	4233.72	2425.28	2504.41	2521.49	2563.14	2503.58	16.17	16.23	16.23	17.90	16.63
Mean	3859.39	4029.325	4107.4175	4591.6		2412.89	2488.07	2505.77	2540.65		15.95	16.02	16.27	17.19	92.66
LSD at 0.05% A		0.829					0.537					0.687			
B		0.635					0.875					0.367			
AB		1.004					1.174					N. S			

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Table 6: Interaction effect between algae and potassium on nitrogen content in sunflower plant:

N – content shoots							N – content seeds				
Algae(g/l)						Mean	Algae(g/l)				Mean
Control		1.11					2.33				
K		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5		1.13	1.15	1.18	1.29	1.19	2.77	2.80	2.87	2.93	2.84
1		1.17	1.18	1.22	1.32	1.22	2.71	2.79	2.89	2.95	2.84
1.5		1.15	1.21	1.30	1.36	1.26	2.80	2.83	2.89	2.99	2.88
2		1.19	1.25	1.33	1.39	1.29	2.83	2.85	2.91	3.01	2.90
Mean		1.16	1.20	1.26	1.34		2.78	2.82	2.89	2.97	
LSD at 0.05	A	0.007					0.005				
	B	0.006					0.008				
	AB	0.004					0.006				
N – uptake shoots (kg/h)							N – uptake seeds (kg/h)				
Algae(g/l)						Mean	Algae(g/l)				Mean
Control		31.25					41.59				
K		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5		56.58	58.850	62.371	76.75	63.64	87.94	91.57	94.26	97.84	92.90
1		59.21	63.649	66.389	80.03	67.32	87.50	92.72	96.49	100.18	94.22
1.5		60.79	66.873	72.287	84.26	71.05	90.48	94.44	97.66	101.59	96.04
2		62.23	68.146	74.723	87.30	73.10	91.51	95.17	97.83	102.87	96.85
Mean		59.70	64.38	68.94	82.09		89.36	93.48	96.56	100.62	
LSD at 0.05	A	0.004					0.003				
	B	0.007					0.007				
	AB	0.008					0.009				

Table 7: Interaction effect between algae and potassium on phosphorus content in sunflower plant:

P – content shoots							P – content seeds				
Algae(g/l)						Mean	Algae(g/l)				Mean
Control		0.16					0.29				
K		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5		0.18	0.21	0.25	0.27	0.23	0.32	0.34	0.37	0.42	0.36
1		0.18	0.23	0.26	0.28	0.24	0.31	0.35	0.37	0.43	0.37
1.5		0.21	0.24	0.26	0.30	0.25	0.35	0.37	0.39	0.43	0.39
2		0.19	0.24	0.28	0.29	0.25	0.36	0.36	0.41	0.51	0.41
Mean		0.19	0.23	0.26	0.29		0.34	0.36	0.39	0.45	
LSD at 0.05	A	0.002					0.002				
	B	0.042					0.007				
	AB	0.005					0.003				
P – uptake shoots (kg/h)							P – uptake seeds (kg/h)				
Algae(g/l)						Mean	Algae(g/l)				Mean
Control		4.50					2.50				
K		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5		9.01	10.75	13.21	16.06	12.26	10.16	11.12	12.15	14.02	11.86
1		9.11	12.41	14.15	16.98	13.16	10.01	11.63	12.35	14.60	12.15
1.5		11.10	13.26	14.46	18.59	14.35	11.31	12.35	13.18	14.61	12.86
2		9.94	13.08	15.73	18.21	14.24	11.64	12.02	13.78	17.43	13.72
Mean		9.79	12.38	14.39	17.46		10.78	11.78	12.87	15.17	
LSD at 0.05	A	0.004					0.001				
	B	0.005					0.002				
	AB	0.003					0.004				

Table 8: Interaction effect between algae and potassium on potassium content in sunflower plant**:**

K – content shoots							K – content seeds				
Algae(g/l)						Mean	Algae(g/l)				Mean
Control		1.31					2.91				
K		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5		1.35	1.39	1.59	1.67	1.50	3.35	3.53	3.67	3.86	3.60
1		1.37	1.45	1.58	1.68	1.52	3.39	3.66	3.84	3.98	3.72
1.5		1.41	1.54	1.63	1.72	1.58	3.43	3.71	3.98	4.01	3.78
2		1.40	1.57	1.65	1.79	1.60	3.41	3.79	3.87	4.17	3.81
Mean		1.38	1.49	1.61	1.72		3.40	3.67	3.84	4.01	
LSD at 0.05	A	0.002					0.004				
	B	0.004					0.001				
	AB	0.003					0.002				
K – uptake shoots (kg/h)							K – uptake seeds (kg/h)				
Algae(g/l)						Mean	Algae(g/l)				Mean
Control		36.88					51.95				
K		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5		67.60	71.13	84.04	99.35	80.53	106.36	115.44	120.53	128.89	117.81
1		69.33	78.21	85.98	101.85	83.84	109.45	121.63	128.20	135.16	123.61
1.5		74.54	85.11	90.64	106.57	89.22	110.84	123.80	134.49	136.24	126.34
2		73.21	85.59	92.70	112.43	90.98	110.27	126.56	130.11	142.51	127.36
Mean		71.17	80.01	88.34	105.05		109.23	121.86	128.33	135.70	
LSD at 0.05	A	0.003					0.005				
	B	0.002					0.002				
	AB	0.003					0.004				

Table 9: Interaction effect between algae and potassium on some micronutrient concentration (mg/kg) in sunflower plant:

Fe – (mg/kg) shoots							Fe – (mg/kg) seeds				
Algae(g/l)						Mean	Algae(g/l)				Mean
Control		91.15					233.19				
K		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5		103.61	115.48	135.45	168.01	130.64	237.25	265.48	295.34	365.45	290.88
1		109.56	123.46	142.23	194.25	142.38	245.47	287.45	299.34	367.47	299.93
1.5		113.47	129.35	148.23	199.56	147.65	249.23	268.46	289.46	374.58	295.43
2		121.12	133.41	157.67	221.47	158.42	257.20	291.48	329.24	375.09	313.25
Mean		111.94	125.43	145.90	195.82		247.29	278.22	303.35	370.65	
LSD at 0.05	A	0.001					0.002				
	B	0.003					0.004				
	AB	0.007					0.001				
Zn – (mg/kg) shoots							Zn – (mg/kg) seeds				
Algae(g/l)						Mean	Algae(g/l)				Mean
Control		11.15					27.17				
K		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5		13.01	14.68	15.58	18.54	15.45	31.10	36.17	41.48	43.16	37.98
1		14.12	15.65	17.74	18.87	16.60	35.45	38.48	44.44	45.17	40.89
1.5		17.48	19.85	19.58	19.68	19.15	37.15	39.46	43.76	46.12	41.62
2		16.47	17.24	20.67	21.98	19.09	40.18	43.48	44.03	43.09	42.70
Mean		15.27	16.86	18.39	19.77		35.97	39.40	43.43	44.39	
LSD at 0.05	A	0.005					0.004				
	B	0.007					0.005				
	AB	0.002					0.003				
Mn – (mg/kg) shoots							Mn – (mg/kg) seeds				
Algae						Mean	Algae				Mean
Control		33.1					45.13				
K		0.25	0.50	0.75	1		0.25	0.50	0.75	1	
0.5		33.12	35.17	38.15	40.58	36.76	49.25	51.57	58.35	61.69	55.22
1		36.24	37.21	39.54	43.57	39.14	50.52	55.08	61.87	63.28	57.69
1.5		37.28	40.21	40.31	43.67	40.37	53.31	56.59	63.54	65.34	59.70
2		39.38	41.57	41.57	45.48	42.00	55.21	59.35	64.54	65.37	61.12
Mean		36.51	38.54	39.89	43.33		52.07	55.65	62.08	63.92	
LSD at 0.05	A	0.007					0.004				
	B	0.005					0.002				
	AB	0.003					0.003				

تأثير الرش بالطحالب البحرية والبوتاسيوم على المحصول و محتوى العناصر لنبات عباد الشمس.

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الملخص العربي:

أقيمت تجربة حقلية لدراسة تأثير الرش بالطحالب البحرية والبوتاسيوم على إنتاجية ومحتوى العناصر فى نبات عباد الشمس صنف (جيزة 601) خلال الموسم الصيفى لعام 2022م بتركيزات (0.25, 0.50, 0.75, 1 جم/لتر) من الطحالب البحرية (اسبيرولينا) وتركيزات (0.50, 1و 1.5, 2 جم/لتر) من البوتاسيوم (كبريتات البوتاسيوم) . وكانت أهم النتائج المتحصل عليها كما يلي: كان لإضافة المعاملات من الطحالب البحرية والبوتاسيوم تأثير معنوي فى زيادة المادة الجافة من القش والبذور ومتوسط وزن ال100 بذرة وزيادة الكمية الممتصة من المغذيات الكبرى والصغرى بواسطة النبات. وتم الحصول على أفضل النتائج عند الرش بتركيز 1جم/لتر من الطحالب البحرية مع 2جم/لتر من البوتاسيوم حيث أعطت محصول 4710.62 كجم/هكتار من القش؛ و 2563.14 كجم/هكتار من البذور و كان متوسط وزن ال100 بذرة 17.90جم ، بينما كانت أعلى القيم لتركيز وامتصاص النيتروجين الفوسفور والبوتاسيوم فى القش (1.39، 0.30، 1.79%) و (87.30، 18.59، 112.43كجم/هكتار) على التوالي، بينما كانت أعلى القيم لتركيز وامتصاص النيتروجين الفوسفور والبوتاسيوم فى البذور (3.01، 0.51، 4.01 %) و (102.87، 17.43، 142.51كجم/هكتار) على التوالي.

الكلمات الاسترشادية : عباد الشمس،الطحالب،البوتاسيوم، تركيز،امتصاص.