Assessment of the water quality of Al-Jazirah River, east of Basra, and its effects on the growth of sunflower plants exposed to phosphate fertilizer

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DOI: https://doi.org/10.36077/kjas/2024/v16i4.12057

Received date: 10/5/2023

Accepted date: 30/6/2023

Abstract

Water samples were collected from twelve sites from the Al-Jazirah River, the Jibasi River, the Bab Al-Hawa River, and the Al-Faw River, in four locations each, during January 2019. Chemical analyses of the water were carried out and classified according to some international classifications to assess its quality. The agricultural experiment was carried out in the wooden canopy of the Department of Soil Sciences and Water Resources at the College of Agriculture / University of Basra in Karmat Ali for the spring season of 2020 to study the effect of Al Jazeera water in the above sites and the effect of adding four levels of phosphate fertilizer (0, 40, 80, 120) kg P ha-1 on sunflower plant growth. The results showed a significant decrease in the values of height and dry weight of the vegetative total of sunflower plants according to the values of water salinity and pollution, and there was an increase in the phosphorous concentration in the studied plants with an increase in the level of added phosphorus, as the concentration of 120 kg P ha-1 recorded the highest percentages in the growth vocabulary of sunflower plants.

Keywords: water locations, phosphate fertilizer, plant height.

Introduction

Water is considered an essential pillar of the pillars that create conditions suitable for life and its continuity, and the need and attention to water sources have increased recently, represented by surface and groundwater because of their great importance to agriculture in the world, especially in light of the conditions of water scarcity (10).

The water of the rivers of Al-Jazirah region, east of Basra Governorate, is the main source on which the region depends in providing water and using it for irrigation. The waters of these rivers are exposed to pollution due to the liquid and solid waste products. The sunflower crop *Helianthus annuus* L. var is grown in this area. Flame. It is one of the most important crops in the world and is important in the agricultural and industrial sectors. Recent years it has been observed that there has been a noticeable loss of this plant in proportions that vary in different locations. Therefore, this experiment was carried out through a simulation of reality in order to evaluate the water quality of the region's rivers and classify it according to the international classification and its impact on the growth rates of the sunflower plant under the influence of fertilization with phosphorous, which is one of the essential nutrients for the plant through its contribution to the formation of ATP energy compounds and the building of nucleic acids Phospholipids and enzymatic chaperones are important in the process of photosynthesis and respiration, as well as cell division, seed formation, and fruit reproduction (15).

Materials and Methods

Twelve sites were adopted from the Al-Jazirah River, the Jibasi River, the Bab Al-Hawa River, and the Faw Project River, with four sites each. according to the methods described in APHA (3) (Table 1, 2, 3, and 4). Water samples were collected during January 2019 and were placed in polyethylene containers to analyzes.Water was used to conduct an experiment in the wooden canopy of the Department of Soil Sciences and Water Resources at the College of Agriculture/ University of Basra in the Karmat Ali site for the spring season of 2019 using silty clay soil. Soil samples were collected from the surface layer (0-30)cm from the Gezira area, air dried, crushed and passed through a sieve with holes diameter of 2 mm, the soil was mixed to be more homogeneous and some chemical and physical analyzes were conducted on it (Table 5) according to the methods mentioned in Page *et al*.(11), tissue was estimated by absorbent method according to the method described in Black (1965). The soil included 36 experimental units and was designed according to the factorial. The soil included 36 experimental units and was designed according to the factorial experiment, a complete random design with three replications (1).

Sowed6 seeds of sunflower *Helianthus annuus* L. var. Flame variety, which was sourced from the General Company for Industrial Crops/Ministry of Agriculture on February 15, 2019, in plastic pots of 10 kg of soil and 8 kg of soil, triple superphosphate fertilizer (20.21% P) was added at four levels (0, 40, 80, 120 kg P ha^{-1} immediately before sowing in one lot and nitrogen and potassium were added at the levels of 200 kg N ha^{-1} and 120 kg K ha^{-1} as urea (46%N) and potassium sulfate(43%K) respectively All experimental treatments, Nitrogen was added in two batches, the first half of the amount when planting and the other half at the flowering stage. The plants were irrigated with the water mentioned above, in addition to the use of the Shatt Al-Arab water (W), which is the main source that finances the waters of the Al-Jazirah River and the Basra Governorate in general. As a comparative treatment, the plants were thinned, leaving 3 plants in each pot, and irrigation was carried out according to the plant's needs.

Table 1. Elementary properties and ionic composition of the waters of the Jeepasi River

The total hardness is mg. L^{-1}	Total dissolved salts (TDS)mg. L^{-1}	Negative ions mg. L^{-1}				Positive ions mg. L^{-1}				EC $dS.m^{-1}$	pH	Locations along the river
		HCO_3^-	CO_3^{-2}	SO_4^{-2}	Cl^{-1}	K^+	Na^+	Mg^{+2}	Ca^{+2}			
1804.3	2506.0	308.98	0.0	1015.65	872.36	117.53	435.57	194.28	397.92	3.92	7.90	W1
1635.1	1564.0	166.95	0.0	869.43	433.74	112.05	191.50	173.00	365.74	2.45	7.83	W2
1297.2	2370.0	464.30	0.0	864.43	607.00	153.57	487.90	114.98	327.28	3.71	7.87	W3
1217.9	1704.0	326.86	0.0	762.60	406.10	112.92	328.36	63.19	381.89	2.66	7.70	W4
5167.6	1502.75	316.77	0.0	878.02	579.80	94.63	360.73	136.36	368.20	3.18	7.82	average

Table 2. Elementary properties and ionic composition of Bab al-Hawa River water

The total hardness is mg. L^{-1}	Total dissolved salts(TDS) mg. L^{-1}	Negative ions mg. L^{-1}				Positive ions mg. L^{-1}				EC $dS.m^{-1}$	pH	locations along the river
		HCO_3^-	CO_3^{-2}	SO_4^{-2}	Cl^{-1}	K^+	Na^+	Mg^{+2}	Ca^{+2}			
2634.8	5431	830.46	0.0	1716.64	1321.91	163.39	881.30	263.96	614.01	6.80	7.62	W1
1928.8	5989	1324.50	0.0	1650.45	1253.47	35.03	1260.45	144.21	531.20	7.50	7.60	W2
3141.4	6426	889.46	0.0	1611.16	1780.01	212.15	1003.63	365.18	647.98	8.04	8.23	W3
2061.9	6863	925.09	0.0	1116.65	2210.24	74.17	1347.77	146.77	580.19	8.60	7.54	W4
		1372.93	0.0	1522.22	1641.40	402.00	123.28	230.03	593.34	7.73	7.74	average

Table 3. Elementary properties and ionic composition of the water of the Al-Faw River project

The total hardness is mg. L^{-1}	Total dissolved salts (TDS) mg. L^{-1}	Negative ions mg. L^{-1}				Positive ions mg. L^{-1}				EC $dS.m^{-1}$	pH	Locations along the river
		HCO_3^-	CO_3^{-2}	SO_4^{-2}	Cl^{-1}	K^+	Na^+	Mg^{+2}	Ca^{+2}			
3217.9	7421.00	993.95	0.0	1515.95	2210.88	174.76	1326.46	361.61	684.49	9.41	7.60	W1
3408.4	8711.00	976.88	0.0	1817.01	2919.81	149.0	1568.15	367.31	751.22	10.89	7.84	W2
2792.7	7856.00	379.53	0.0	896.00	3910.00	273.44	1793.15	298.00	620.69	9.82	7.61	W3
2211.0	7142.43	1005.75	0.0	1329.26	2057.00	167.07	1428.31	197.18	556.2	8.79	7.56	W4

2907.5	7782.60	839.02	0.0	1389.55	2774.42	191.06	1529.01	306.02	653.15	9.72	7.65	Average

Table 4. Elementary properties and ionic composition of Shatt Al-Arab waters

The total hardness is mg. L^{-1}	Total dissolved salts (TDS) mg. L^{-1}	Negative ions amalgam. L^{-1}				Positive ions mg. L^{-1}				EC $dS.m^{-1}$	pH
		HCO_3^-	CO_3^{-2}	SO_4^{-2}	Cl^{-1}	K^+	Na^+	Mg^{+2}	Ca^{+2}		
518.0	1268.0	166.49	0.0	865.10	274.0	86.43	242.0	50.75	224.24	1.98	7.71

The SAR values were calculated from the equation
SAR = Na √{Ca^(+2)+Mg^(+2)}

Table 5. Some chemical and physical properties of the study soil before planting

Properties	measruing unit	Al-Jazirah region soil	
Soil reaction (1:1) pH	-----	7.35	
electrical conductivity Ece	dSm^{-1}	3.50	
Positive exchange capacitance CEC	Centimol kg^{-1}	19.10	
ready-made nitrogen	mg kg^{-1}	35.90	
ready-made phosphorous		12.12	
ready-made potassium		158.00	
Ca^{++}	MmoleL^{-1}	6.24	**dissolved ions**
Mg^{++}		4.80	
Na^+		16.63	
K^+		0.41	
Cl^-		22.00	
SO_4^{-2}		6.91	
HCO_3^-		3.09	
$CO_3^=$		0.0	
Clay	Gmkg^{-1}	403.9	**Soil Separators**
Silt		310.5	
Sand		285.6	
Soil texture	Mixture, Clay, Silty		

Results and Discussion

Assessment of the water quality of Al-Jazirah rivers, east of Basra

The water of the island's rivers and their suitability for irrigation purposes were evaluated through the internationally approved systems by Richards (13), Ayers and Westcot (4) and Fipps (8) and their conformity with the determinants and standards adopted in water resource systems according to the results shown in the Table (6). The water classification according to the Richards (13) system and during the study period January 2019 (the water of the Jibasi River, Bab Al-Hawa River and the Faw Lined Project) falls within the category C4 (water with very high salinity) and the values of the sodium adsorption ratio for all sites of the Jabyasi River are located Within the low-sodium category, the Bab Al-Hawa rivers fall into the first and third locations within the S1 category, while the second and

fourth sites fall within the S2 category (medium sodium) and the Al-Faw lined river sites fall within the S2 grade except for the first site, which falls within the S1 category.

Table 6. Evaluate the water quality of the Al-Jazirah rivers

Water quality					
Location	**Rivers**	**Ayers and Westcot (1985)**		**Richards (1954)**	
		SAR Mg.L^{-1}	**EC Dsm-1**	**SAR Mg.L^{-1}**	**EC Dsm-1**
W1	Al-Jabyasi	low-medium	sever	C4S1 (very saline water - low sodium)	
W2		There is no	low-medium	C4S1	
W3		low-medium	sever	C4S1	
W4		low-medium	low-medium	C4S1	
W1	Bab Alhawa	Little-moderate	sever	C4S1 (very saline water - low sodium)	
W2		sever	sever	C4S1	
W3		Little-moderate	sever	C4S1	
W4		sever	sever	C4S1	
W1	Faw quilted project	sever	sever	C4S1	
W2		sever	sever	C4S1	
W3		sever	sever	C4S1	
W4		sever	sever	C4S1	

In Table (6), we find that the classification of the studied river sites according to the Ayers and Westcot (4), they fall within the category of severe to low average salinity, and also, the SAR values fell within the category of severe to little medium, except for the Faw lined project river, which fell within Very saline and severe SAR variety. When adopting the classification of Fipps (8) (Table 7) to evaluate the water quality of the Jeepasi River in terms of electrical conductivity values, we find that the sites W2 and W4 fall within the category of questionable water, and sites W1 and W3 fall into an inappropriate class. As for the classification of this water on the basis of the amount of total dissolved salts TDS, we find that the site W2 and W4 fall within a questionable category, and the site W1 and W3 has exceeded the fifth category of this classification (unsuitable) and when the same classification was adopted for the year

(2001) to determine the danger of sodium by relying on SAR values We find that all the sites of the Jeepasi River fall into the category (low sodium hazard).The results of Table (7) show that all sites of Bab al-Hawa and Al-Faw lined rivers fall within the category of electrical conductivity and TDS within the category exceeding grade 5, which is unsuitable, while the SAR values vary from few to medium. Effect of irrigation with the water of the island rivers and levels of phosphate fertilizer on the rate of height of sunflower plant (cm).The results of Table (8) A, B, C showed the effect of water locations in the island's rivers and phosphate fertilizer levels on the height of sunflower plants (cm). Decrease rates amounted to (13.82, 7.04, 12.67, 7.95)% and (51.57, 54.78, 57.44, 58.42)% and (62.68, 66.59, 63.21, 58.84)% for Al-Jibassi River, Bab Al-Hawa, Al-Faw Project and for sites W4, W3, W2, W1 in the studied locations that mentioned above respectively compared to the treatment of W (Shatt Al-Arab)

Table 7. Water quality assessment according to the fipps classification (2001,2004)

water quality				
Locations	**Rivers**	**Fipps (2001)**	**Fipps (2004)**	
		SAR **MmolL^{-1}**	**TDS** Mg.L^{-1}	**EC** Dsm^{-1}
Al-Jabyasi	**W1**	little sodiume danger	----	unsuitable water
	W2	little sodiume danger	questionable water	questionable water
	W3	little sodiume danger	----	unsuitable water
	W4	little sodiume danger	questionable water	questionable water
Babalhawa	**W1**	little sodiume danger	Exceeding grade 5 is inappropriate	Exceeding grade 5 is inappropriate
	W2	Average	Exceeding grade 5 is inappropriate	Exceeding grade 5 is inappropriate
	W3	little sodiume danger	Exceeding grade 5 is inappropriate	Exceeding grade 5 is inappropriate
	W4	Average	Exceeding grade 5 is inappropriate	Exceeding grade 5 is inappropriate
Fao quilted project	**W1**	Little	Exceeding grade 5 is inappropriate	Exceeding grade 5 is inappropriate
	W2	Average	Exceeding grade 5 is inappropriate	Exceeding grade 5 is inappropriate
	W3	Average	Exceeding grade 5 is inappropriate	Exceeding grade 5 is inappropriate

	W4	Average	Exceeding grade 5 is inappropriate	Exceeding grade 5 is inappropriate

Table 8. Height of sunflower plant (cm) under the influence of irrigation with Al-Jazirah water and levels of phosphate fertilizer (A) Al-Jibassi River (B) Bab Al-Hawa River (C) Al-Faw Lined Project

(A)

Phosphate fertilizer levels / location	**0**	**40**	**80**	**120**	**Site Impact Rate**
W	121.13	126.25	130.14	133.64	127.79
W1	100.00	109.11	114.18	117.21	110.12
W2	108.19	118.22	123.15	125.61	118.79
W3	102.15	110.00	115.22	119.00	111.59
W4	107.44	117.11	122.00	124.00	117.63
Fertilizer level effect rate	107.76	116.13	120.93	123.89	The slightest difference
LSD ATP (0.05)	Site = 8.53, Compost Level = 6.22, Overlap = 8.61				

(B)

Phosphate fertilizer levels / location	**0**	**40**	**80**	**120**	**Site Impact Rate**
W	121.13	126.25	130.14	133.64	127.79
W1	56.17	61.22	64.31	65.84	61.88
W2	54.20	57.31	59.44	60.19	57.78
W3	50.0	54.12	56.40	57.00	54.38
W4	49.13	51.98	53.11	54.32	53.13
W5	66.12	70.17	72.68	74.13	
The slightest difference LSD ATP (0.05)	Site = 10.7, Fertilizer Level = 4.3 Overlap = 11.6				

(C)

Phosphate fertilizer levels / location	**0**	**40**	**80**	**120**	**Site Impact Rate**
W	121.13	126.25	130.14	133.64	127.79
W1	44.12	47.19	49.31	50.17	47.69
W2	39.45	41.22	43.00	44.33	42.00
W3	43.25	46.11	48.91	49.77	47.01

W4	50.28	52.41	53.81	53.87	52.59
	59.64	62.63	65.03	66.35	
The slightest difference LSD ATP (0.05)	Site = 12.6, Fertilizer Level = 5.81, Overlap =7.3				

This may be attributed to the effects of water pollution due to the dumping of domestic and industrial waste and high salinity, which affects most of the vital processes inside the plant, especially the process of photosynthesis and inhibiting the work of enzymes Shock (14). The results of Table (8) A, B, and C show that the addition of phosphate fertilizer led to a significant increase in the heights of sunflower plants, with an increase of (77.7, 12.22, 14.97)% (6.12, 9.92, 12.11)% and (5.0, 9.03, 11.25)% for Al-Jibassi River, Bab Al-Hawa and Al-Faw project and for sites W4, W3, W2, W1 respectively compared to W treatment, and the level of 120 kg P ha^{-1} was superior in giving the highest height of sunflower plants. This is attributed to the effect of phosphorus on bio-building processes through energy compounds and physiological processes, and thus an increase in growth, including plant height Amruth *et al*.(2).

Effect of irrigation with the water of Al-Jazirah rivers and levels of phosphate fertilizer on the average dry weight of the vegetative part (pot^{-1} g) of sunflower plants.

The results of Table (9) A, B, and C showed the effect of water locations in the Gezira rivers and levels of phosphate fertilizer on the dry weight of the vegetative part of the sunflower plant (potted gm-1), as the results of the statistical analysis at the 0.05 level showed a significant effect of water 1-4 Effect of irrigation and levels of phosphate fertilizer on the concentration of phosphorous in the vegetative part (g P kg^{-1} dry matter) after the end of the sunflower season.

locations in reducing The dry weight of the vegetative part with a decrease of (25.74, 10.55, 23.62, 11.88)% and (37.63, 40.31, 43.38, 46.29)% and (52.51, 67.55, 53.46, 57.16)% for the Jibasi River, Bab Al-Hawa and the Faw project and for sites W4, W3, W2, W1 respectively compared to W treatment. This may be attributed to the effect of water pollution, high salinity, and the effect of vital processes inside the plant, especially the process of photosynthesis and inhibition of enzymes.

The results of Table (9) A, B, C show a significant increase in the dry weight of the vegetative part of the sunflower plant with an increase in the levels of addition and a significant difference between one level and another, with an increase of (23.68, 46.86, 74.56)% and (19.47, 38.00, 68.38). % and (16.73, 37.78, 60.10)% for Al-Jibassi River, Bab Al-Hawa, Al-Faw Project and for sites W4, W3, W2, W1, respectively compared to W treatment. The fertilizer level 120 kg P ha^{-1} gave the highest percentage increase. These results are similar to Rathore *et al*. (12) and Dambale *et al*.(7) who indicated an increase in the dry weight of the vegetative part with an increase in the levels of superphosphate fertilizer added, and attributed this to the increase in the amount of ready phosphorus in the soil, which led to the formation of a good root system capable of absorbing nutrients and transferring them to the upper part of the plant.

The results of Table (10) A, B, and C showed the effect of water locations in the Gezira rivers and phosphate fertilizer levels on the phosphorous concentration in the vegetative part (gm P kg^{-1} kg dry matter), as the results of the statistical analysis at the

0.05 level showed a significant effect of water locations in Reducing the phosphorous concentration with percentage decreases of (15.43, 11.11, 14.8, 12.65)% and (19.44, 29.32, 40.43, 44.44)% and (51.23, 55.86, 52.77, 47.83)% in the vegetative part of plants irrigated by the waters of the Jibasi River, Bab Al-Hawa and the Fao project and The results of Table (10) A, B, C show a significant increase in the phosphorous concentration with the increase in the levels of addition, with a significant difference between one level and another, with an increase of (21.73, 36.08, 45.21)% and (17.09, 24.01, 43.52)% and (14.46, 20.5, 37.10)% in the vegetative part of plants irrigated by the waters of the Jeebasi River, Bab al-Hawa and the Faw project and for for sites W4, W3, W2, and W1, respectively, compared with the control treatment W. This study agrees with the study of Blunden (6), and this was attributed to the negative effect of the roots in salinity and consequently their weak ability to absorb phosphorous, and the increase in salinity levels of irrigation water affects the amount absorbed (9).

sites W4, W3, W2, W1, respectively compared to treatment W. And the fertilizer level 120 kg P ha-1 gave the highest percentages of increase. This is due to the fact that the increase in the levels of phosphate fertilizer led to an increase in the readiness of phosphorus that can be absorbed by the roots, which in turn was reflected in the concentration of phosphorus in the plant.

Table 9. Dry weight of the vegetative part of the sunflower plant (gm^{-1}) under the influence of irrigation with Al-Jazirah water and levels of phosphate fertilizer (A) Al-Jibassi River (B) Bab Al-Hawa River (C) Faw Lined Project(A)

Phosphate fertilizer levels / location	0	40	80	120	Site Impact Rate
W	9.96	11.48	13.18	16.21	12.70
W1	6.54	8.62	10.08	12.51	9.43
W2	8.41	10.22	12.61	14.22	11.36
W3	6.88	8.92	10.31	12.71	9.70
W4	8.12	10.15	12.46	14.04	11.19
Fertilizer level effect rate	7.98	9.87	11.72	13.93	
The slightest difference LSD ATP (0.05)					
	Site = 2.37, Fertilizer Level = 3.00, Overlap = 3.40				

(B)

Phosphate fertilizer levels / location	0	40	80	120	Site Impact Rate
W	9.96	11.48	13.18	16.21	12.70
W1	5.89	7.32	8.47	10.00	7.92
W2	5.64	7.04	8.13	9.51	7.58

W3	5.51	6.41	7.53	9.34	7.19
W4	5.14	6.11	7.03	9.01	6.82
Fertilizer level effect rate	6.42	7.67	8.86	10.81	
The slightest difference LSD ATP (0.05)	Site = 3.10, Fertilizer Level = 2.90, Overlap = 3.77				

(C)

Phosphate fertilizer levels / location	**0**	**40**	**80**	**120**	**Site Impact Rate**
W	9.96	11.48	13.18	16.21	12.70
W1	4.73	5.41	6.81	7.20	6.03
W2	4.00	5.00	5.62	6.00	4.12
W3	4.67	5.22	6.62	7.15	5.91
W4	5.12	6.10	7.00	9.01	5.44
Fertilizer level effect rate	5.69	6.64	7.84	9.11	
The slightest difference LSD ATP (0.05)	Site = 4.11, Compost Level = 3.41, Overlap = 3.55				

Table 10. The concentration of phosphorous in the vegetative part, g P kg-1, dry matter at the end of the season for sunflower plants under the influence of irrigation with water in the Al-Jazeera region and levels of phosphate fertilizer (A) Al-Jibassi River (B) Bab Al-Hawa River (C) Al-Faw Lined Project

(A)

Phosphate fertilizer levels / location	**0**	**40**	**80**	**120**	**Site Impact Rate**
W	2.62	3.16	3.41	3.80	3.24
W1	2.16	2.64	3.01	3.15	2.74
W2	2.28	2.82	3.12	3.30	2.88
W3	2.18	2.70	3.04	3.19	2.76
W4	2.26	2.71	3.10	3.28	2.83
Fertilizer level effect rate	2.30	2.80	3.13	3.34	
The slightest difference LSD aTP (0.05)	Compost Level = 0.25, Overlap = 0.31,location=0.22				

(B)

Phosphate fertilizer levels / location	0	40	80	120	Site Impact Rate
W	2.62	3.16	3.41	3.80	3.24
W1	2.11	2.51	2.83	3.00	2.61
W2	1.75	2.08	2.61	2.75	2.29
W3	1.60	1.82	2.00	2.31	1.93
W4	1.57	1.77	1.86	2.00	1.80
Fertilizer level effect rate	1.93	2.26	2.54	2.77	
The slightest difference LSD aTP (0.05)		location= 0.40, Fertilizer Level = 0.29, Overlap = 0.51			

(C)

Phosphate fertilizer levels / location	0	40	80	120	Site Impact Rate
W	2.62	3.16	3.41	3.80	3.24
W1	1.36	1.52	1.66	1.78	1.58
W2	1.24	1.38	1.50	1.62	1.43
W3	1.32	1.45	1.64	1.73	1.53
W4	1.41	1.60	1.81	1.97	1.69
Fertilizer level effect rate	1.59	1.82	2.00	2.18	
The slightest difference LSD ATP (0.05)	Site = 0.51, Compost Level = 0.32, Overlap = 0.61				

Conflict of interest

The authors have no conflict of interest.

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DOI:10.1234/lsl.v57i0.167