Assessment of the water quality of the rivers of Al-Jazirah region, east of Basra, and its effects on the growth of sunflower plants under the influence of phosphate fertilizer

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The summery

Water samples were collected from twelve sites from the Al-Jazirah rivers, the Jibasi River, the Bab Al-Hawa River and the Al-Faw River, in four locations each, during the January 2019. Chemical analyzes of the water were carried out and classified according to some international classifications for the purpose of assessing 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 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 .

Key words: water locations, phosphate fertilizer, plant height, dry weight, phosphorous concentration

The 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 has increased recently, represented by surface and ground water because of their great importance to agriculture in the world, especially in light of the conditions of water scarcity (Ministry of Planning, Central Bureau of Statistics, 2014).

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, and the sunflower crop Helianthus annuus L. var is grown in this area. Flame, which is one of the most important crops in the world and is important in the agricultural and industrial sectors, but in recent years it has been observed that there has been a noticeable loss of this plant and 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 (Sumalatha and Lebarathnam, 2018).

Materials and working methods

Twelve sites were adopted from the Al-Jazirah rivers, the Jibasi River, Bab Al-Hawa River, and the Faw Project River, with four sites each. Water samples were collected from the above-mentioned sites in addition to the Shatt al-Arab water during January 2019 and were placed in polyethylene containers to conduct chemical and physical analyzes according to the methods described in AWPHA (2005) (Table 1, 2, 3, 4). 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 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. (1982) tissue was estimated by absorbent method according to the method described in Black (1965).

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	Location
		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	Location
		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	Location
		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	المتوسط

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

Soil of Al-Jazirah region	**measruing unit**	**Properties**	
7.35	-----	Soil reaction (1:1) pH	
3.50	dSm^{-1}	electrical conductivity Ece	
19.10	Centimol kg^{-1}	Positive exchange capacitance CEC	
35.90	mg kg^{-1}	ready-made nitrogen	
12.12		ready-made phosphorous	
158.00		ready-made potassium	
6.24	mmol $liter^{-1}$	Ca^{++}	dissolved ions
4.80		Mg^{++}	
16.63		Na^+	
0.41		K^+	
22.00		Cl^-	
6.91		SO_4^{-2}	
3.09		HCO_3^-	
0.0		$CO_3^=$	
403.9	gm kg-1	الطين	Soil Separators
310.5		الغرين	
285.6		الرمل	
مزيجة طينية غرينية	النسجة		

The soil included 36 experimental units and was designed according to the factorial experiment, a complete random design with three replications (Al-Rawi and Khalaf Allah, 1980).

Sowed 6 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 and for 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 need.

studied traits

1- plant height

2- Dry weight of the vegetative part

3- Phosphorous concentration

Results and discussion

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

The waters of the island's rivers and their suitability for irrigation purposes were evaluated through the internationally approved systems by Richards (1954), Ayers and Westcot (1985) and Fipps (2001, 2004) 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 (1954) 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 Jibsi 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					
Ayers and Westcot (1985)		Richards (1954)			
SAR $Mg.L^{-1}$	EC Dsm-1	SAR $Mg.L^{-1}$	EC Dsm^{-1}	**Location**	**rivers**
Severe little to moderate		C4S1 (very saline water - low sodium)		W1	Al-Jabyasi
There is no	little-medium	C4S1		W2	
low-medium	sever	C4S1		W3	
low-medium	low-medium	C4S1		W4	
Little-moderate	sever	C4S1 (very saline water - medium sodium)		W1	Bab alhawa
sever	sever	C4S2		W2	
Little-moderate	sever	C4S1		W3	
sever	sever	C4S2		W4	
sever	sever	C4S1		W1	Faw quilted project
sever	sever	C4S2		W2	
sever	sever	C4S2		W3	
sever	sever	C4S2		W4	

When looking at table (6), we find that the classification of the studied river sites according to the Ayers and Westcot system (1985), 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 (2004) (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).

Table (7). Water quality rating according to Fipps (2001, 2004)

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

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 respectively compared to the treatment of W (Shatt al-Arab).

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)

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

(B)

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

(C)

Site Impact Rate	120	80	40	0	Phosphate fertilizer levels/ location
127.79	133.64	130.14	126.25	121.13	**W**
47.69	50.17	49.31	47.19	44.12	**W1**
42.00	44.33	43.00	41.22	39.45	**W2**
47.01	49.77	48.91	46.11	43.25	**W3**
52.59	53.87	53.81	52.41	50.28	**W4**
	66.35	65.03	62.63	59.64	**Fertilizer level effect rate**
Site = 12.6, Fertilizer Level = 5.81, Overlap =7.3					**The slightest difference LSD ATP (0.05)**

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 (2017). 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. (2017).

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 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. (2011) and Dambale et al. (2018) 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.

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)

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

(B)

Site Impact Rate	120	80	40	0	Phosphate fertilizer levels/ location
12.70	16.21	13.18	11.48	9.96	**W**
7.92	10.00	8.47	7.32	5.89	**W1**
7.58	9.51	8.13	7.04	5.64	**W2**
7.19	9.34	7.53	6.41	5.51	**W3**
6.82	9.01	7.03	6.11	5.14	**W4**
	10.81	8.86	7.67	6.42	**Fertilizer level effect rate**
Site = 3.10, Fertilizer Level = 2.90, Overlap = 3.77					**The slightest difference LSD aTP (0.05)**

(C)

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

Effect of irrigation with the water of Al-Jazeera rivers and levels of phosphate fertilizer on the concentration of phosphorous in the vegetative part (gP kg-1 dry matter) after the end of the sunflower season

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 for sites W4, W3, W2, and W1, respectively, compared with the control treatment W. This study agrees with the study of Blunden (2014), 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 The amount absorbed (Lawloret et al., 2016).

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 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 (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)

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

(B)

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

(C)

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

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