A COMPARATIVE STUDY OF ORGANIC AND PHOSPHATE FERTILIZERS WITH IRRIGATION WATER QUALITY ON SOME SOIL PROPERTIES AND BEAN YIELD.

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ABSTRACT

A factorial experiment was carried out in the Jisr Diyala region, east of Baghdad, to study a comparison of the types of organic fertilizers in interaction with the levels of phosphate fertilizer and the quality of irrigation water on some soil properties and yield of broad bean(*Vicia faba* L), using a randomized complete block design (RCBD) according to the split- split plot arrangement, and with three replications. Three factors were used, the first factor is water quality (well water and Diyala River water, I_1 and I_2) and the second is two types of organic fertilizers (control, sludge and sheep waste by 5 Mg ha^{-1}, M_0, M_1 and M_2) and the third is the addition of three levels of phosphorus (0, 80 and 160 kg ha^{-1}, P_0, P_1, and P_2) respectively. Seeds of faba bean (*Vicia faba* L.), cultivar Luz-de-otoho, were sown in winter season 2022, and analyzes were made for some physical and chemical properties of the soil after harvest. The results showed that the type of organic fertilizers had an effect on some chemical properties of the soil after harvest, as the electrical conductivity (EC) of the soil after harvest decreased significantly. The highest decrease was in the treatment $I_2M_2P_2$, which amounted to 2.74 dS m^{-1}, with a decrease of 52.10% compared to treatment ($I_1M_0P_0$). The degree of soil reaction (pH) also decreased significantly, and the highest decrease was for treatment $I_1M_2P_2$ at 7.41, with a decrease 3.89% compared to treatment ($I_2M_0P_0$) . While the organic carbon increased significantly, and the highest significant increase was for the treatment $I_2M_2P_2$ at 17.10 g Kgt^{-1}, with an increase rate of 179.87% compared to treatment ($I_1M_0P_0$). It was found that there was a significant effect on the dry pods weight, as the highest significant increase occurred when for the treatment $I_2M_2P_2$ at 33.95 g plant^{-1}, with an increase of 141.12% compared to treatment ($I_1M_0P_0$) .

Keywords: EC, pH, sludge , Diyala river, well water , organig fertilizer, pods.

دراسة مقارنة لسمادين عضويين بالتداخل مع مستويات السماد الفوسفاتي ونوعية مياه الري في بعض صفات التربة وحاصل الباقلاء

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المستخلص

نفذت تجربة عاملية في منطقة جسر ديالى شرق بغداد لدراسة مقارنة لسماديين عضويين بالتداخل مع مستويات السماد الفوسفاتي ونوعية مياه الري في بعض صفات التربة وحاصل الباقلاء ، باستعمال تصميم القطاعات العشوائية الكاملة (RCBD) وفق ترتيب الالواح-المنشقة المنشقة، وبثلاث عوامل العامل الأول هو نوعية المياه (ماء بئر وماء نهر ديالى، I_1 وI_2) والثاني سمادين عضويين هما(الحمأة ومخلفات الاغنام بمقدار 5 ميكاغرام هـ $^{-1}$، M_1 وM_2) والثالث إضافة ثلاث مستويات من الفسفور (0 و80 و160 كغم p هـ $^{-1}$، (P_0 وP_1 وP_2) بالتتابع وبثلاثة مكررات تمت زراعة بذور الباقلاء .*Vicia faba* L صنف Luz-de-otoho للموسم الشتوي 2022، و تم آجراء التحاليل لبعض الصفات الفيزيائية والكيميائية للتربة بعد الحصاد . بينت النتائج ان لنوع السماد العضوي تأثيراً في بعض الصفات الكيميائية للتربة بعد الحصاد إذ إنخفضت معنوياً الايصالية الكهربائية (EC) للتربة وكان اعلى انخفاض عند المعاملة $I_2M_2P_2$ بلغ 2.74 ديسي سيمنز م$^{-1}$ وبنسبة انخفاض 52.10 % بالمقارنة مع معاملة $I_1M_0P_0$ وإنخفض معنوياً ايضاً الاس الهيدروجيني (pH) وكان أعلى إنخفاض عند المعاملة $I_1M_2P_2$ بلغ 7.41 وبنسبة انخفاض 3.89 % بالمقارنة مع معاملة $I_2M_0P_0$، بينما ازداد معنوياً الكاربون العضوي وكانت أعلى زيادة معنوية عند المعاملة $I_2M_2P_2$ بلغ 17.10 غم كغم$^{-1}$ وبنسبة زيادة 179.87% بالمقارنة مع معاملة $I_1M_0P_0$، وتبين وجود تأثيرا معنوياً في الوزن الخضري الجاف للنبات إذ حصلت أعلى زيادة معنوية عند المعاملة $I_2M_2P_2$ اذ بلغت 33.95 غم نبات$^{-1}$ وبنسبة زيادة 141.12% .

الكلمات المفتاحية: الايصالية الكهربائية، الاس الهيدروجيني ، الحمأة، نهر ديالى، ماء البئر، السماد العضوي، القرنات.

Received:3/1/2022, Accepted:29/3/2022

INTRODUCTION

Organic matter added to the soil could be improving the physical and chemical properties of the soil. In addition, the organic matter enhances the biological and enzymatic activities of the soil and increases the number of living organisms (22). It increases the availability of nutrient concentration, improves soil structure and aeration, facilitates root penetration, increases the soil's water-holding capacity, reduces nutrient loss and soil maintenance, it also works to reduce soil erosion, increase microbial activity, and increase plant resistance to diseases (16). Phosphorus (P) is one of the essential nutrients for plant growth and production (10). Soils of arid and semi-arid regions contain lower amounts of phosphorus (P) compared to humid regions due to lower total phosphorus and increased soil phosphorus fixation (27). Dry regions are characterized by low water inputs and leaching of salts, causing calcium accumulation (15, 26). Therefore, most of the water-soluble phosphorous from fertilizers is rapidly converted in the soil to other forms of low availability (24). Thus, it requires more attention to the use of organic conditioners, as some of them are not treated and inexpensive (9, 33, 34), so it requires more evaluation and attention to study the integration between soil conditioners and the use of different water quality. Water scarcity is one of the major challenges facing arid semi-arid regions, as Iraq suffers from a shortage of fresh water resources that are used for agricultural purposes due to drought that it has been exposed to in recent years and continuous storage of water in neighboring countries where the sources of these rivers are located. In view of the great expansion of the agricultural area, the increase in the population, and the increasing need for food, the reason for the increase in the demand for water, which led to the use of alternative water resources of poor quality, including the use of drainage water to compensate for the shortage of fresh water. Therefore, when using this water, it is necessary to find ways and means for the purpose of successful use of it without badly affecting the productivity of the land and polluting the environment (14, 15). Studies have indicated the possibility of using this water for irrigation, while following the method of coexistence in its use with good soil and water management and the use of salinity-resistant varieties (17, 18). The broad bean crop is a major source of protein and energy for much of the world's population. Therefore, increasing its productivity is one of the most important goals of agricultural policy for many countries of the world, as well as being a good and cheap alternative to meat protein, especially in many developing countries (21). This study was aimed to know the joint effect of the types of organic amendments with phosphate fertilizer and the quality of irrigation water on some soil properties and yield of broad bean.

MATERIALS AND METHODS

The site of the experiment was chosen at Jisr Diyala area, which depends for irrigation with water of the Diyala river (the sewage water of the Rustamiya station flows into it) and well water. Plowing, smoothing, and soil leveling operations were carried out, and representative samples of field soil were taken from the surface layer (0-30 cm) in order to conduct some laboratory analyzes of the soil. Table 1 shows some physical and chemical characteristics and characteristics of the study soil before planting. A factorial experiment was carried out according to the RCBD design with in split-plot arrangement, where water quality allocated to the main-plot, and organic fertilizers and phosphate fertilizer levels as sub-plot (both are equally important). Three factors were used, the first factor is water quality (well water and Diyala River water, I_1 and I_2) and the second is two types of organic fertilizers (control, sludge and sheep waste by 5 Mg ha^{-1}, M_0, M_1 and M_2) and the third is the addition of three levels of phosphorus (0, 80 and 160 kg ha^{-1}, P_0, P_1, and P_2) respectively, by using Triple superphosphate fertilizer (21% P). the number of treatments was 18 (2 x 3 x 3), with three replications, thus the number of experimental units was 54. the field was divided into three blocks, each block includes 18 plots 3 x 2 m, i.e. 6 m^2 and each plot represents an experimental unit, the distance between plots 1 m and between blocks 2 m. Each plot consists 3 lines, and the distance between lines 75 cm. All irrigation water used analyzes were chemically analyzed. Sodium adsorption ratio (SAR) was calculated, and this water was classified according to the Salinity Laboratory in the United States of America. Table 2 shows some chemical properties of water used in irrigation. Organic fertilizers were added to each plot and according to the treatment. Analyzes of the organic fertilizers were carried out according to the methods described. Table 3 shows the most important chemical properties of the fertilizers used. Seeds of broad bean (var. Luz-de-otoho) were planted for the winter season 2022 in rows inside each plot, and phosphorous levels of 0, 80, and 160 kg P_2O_5 ha^{-1}as Triple super phosphate were added to each plot according to the treatments, in one batch, in a line next to the planting lines, with a distance of 10 cm and a depth of 10 cm. Whereas, the nitrogen fertilizer was added in the amount of 100 kg N ha^{-1} (urea, 46% N), and the potassium fertilizer was added in the amount of 40 kg K ha^{-1} (potassium sulfate, 42% K) in two batches, the first with phosphate fertilizer at planting and the second after 40 days of planting. The available water was determined, and all the plots were irrigated with river water and well water, according to the treatment. The depth of irrigation water to be added in each irrigation was calculated according to Kovda (18) equation. Soil samples were taken from each experimental unit from the rhizosphere after the end of the experiment for analyzes. Plant samples were dried at the stage of final maturity of the seeds for all treatments and their weights were taken. The experiment data was analyed using Genstat discovery edition 3 program, and the means were compared by the least significant difference (LSD) at the level of 0.05 (29).

Table 1. Some physical and chemical properties of soil before planting

	Character	Value	Unit	References
	$pH_{1:1}$	7.73	--	Page and others
	$EC_{1:1}$	10.78	dS m^{-1}	(1982)
	CEC	28.68	Cmol+kg^{-1}	Black and others
dissolved ions	Ca^{2+}	15.52		
	Mg^{2+}	12.70		
	Na^{+}	47.73		
	K^{+}	0.74	mmol L^{-1}	Richard(1954)
	HCO_3^{-}	0.017		
	Cl^{-}	52.18		
	SO_4^{2-}	11.55		
Available nutrients	N	31.66		Nelson, Keeney
	P	7.30	mg kg^{-1}	Page and others
	K	96.50		Black(1965)
	Field capacity	0,2416	cm^3 cm^{-3}	Black and
	Bulk density	1.345	Mg m^{-3}	others(1965)
	Organic matter	9.53		Page and others
	Organic carbon	5.53		(1982)
	Carbonate minerals $CaCO_3$	332.5		
	Gypsum $CaSO_{4.2H2O}$	5.10	g kg^{-1}	Artieda and others
Soil separates	sand	87.0		
	silt	244.0		Black(1965)
	clay	669.0		
	Texture	Clay		

Table 2. Some chemical properties of the irrigation water used in the experiment

Character	Well water (I_1)	Diyala River water	Unit	References
pH	7.31	7.44	-	Page and others
EC	4.87	1.67	dS m^{-1}	(1982)
Ca^{2+}	4.58	2.65		
Mg^{2+}	6.67	1.89		
Na^{+}	23.21	11.80	mmol L^{-1}	Richard(1954)
HCO_3^{-}	0.27	0.16		
Cl^{-}	28.05	14.65		
SO_4^{2-}	7.19	3.08		
Cd^{2+}	0.025	0.045	mg L^{-1}	
Pb^{2+}	0.036	0.187		Jackson (1958)
SAR	9.17	5.54	$(mmol\ L^{-1})^{0.5}$	
SAR Class		S1		

Table 3. Some chemical properties of the organic fertilizers used in the experiment

Character	Sludge (M_1)	Sheep waste (M_2)	Unit	References
$EC_{1:5}$	2.32	3.83	dS m–1	
$pH_{1:5}$	7.21	7.11	–	Page and others (1982)
C/N	13.02	14.90		
O.C	16.15	31.9		
N	1.24	2.14	%	Nelson, Keeney (1982)
P	2.18	1.08		Page and others (1982)
K	0.422	0.795		Black (1965)
Cd	14.65	2.55	mg kg^{-1}	Jackson (1958)
Pb	30.58	0.547		

RESULTS AND DISCUSSION

Electrical conductivity (EC, dS m^{-1})

The results in Table 4 show the effect of water quality, type of organic fertilizers and phosphorus levels on the mean electrical conductivity of the soil after harvesting. The results show that there is a significant effect of the water of the Diyala river (I_2) in reducing the electrical conductivity values of the soil after harvesting compared to the well water (I_1), as the average values were 4.66 and 3.82 dS m^{-1}, respectively, with a decrease of 18.03%. The results also showed a decrease in the mean of electrical conductivity when organic fertilizers were added, as it was significant in sheep waste (M_2) and sludge (M_1), as the values reached 4.28 and 3.89 dS m^{-1}, with a decrease of 14.51 and 5.93%, respectively, compared to the control treatment (M_0) of 4.55 dS m^{-1}. The results showed that the addition of phosphorus levels (P_1 and P_2) had a significant effect on reducing the electrical conductivity values of the soil after harvest, as the mean values were 4.27 and 3.69 dS m^{-1}, with a decrease of 10.48 and 22.64% compared to the control treatment (P_0) of 4.77 dS m^{-1}. The results indicate significant effect of binary interaction of water quality and the type of organic conditioners (I x M) on the mean of electrical conductivity (EC) of the soil after harvesting, as the values decreased in the two treatments I_1M_2 and I_2M_2, reaching 4.34 and 3.43 dS m^{-1} with a decrease of 12.50 and 17.15% compared to the two control treatments (I_1M_0 and I_2M_0) of 4.96 and 4.14 dS m^{-1}. Also, a significant effect of binary interaction between water quality and phosphorus levels (I x P) in the mean EC of the soil after harvest, the highest significant decrease was found in the two treatments I_1P_2 and I_2P_2, which amounted to 4.04 and 3.33 dS m^{-1}, with a decrease of 23.19 and 22.01% compared to the two control treatments (I_1P_0 and I_2P_0) of 5.26 and 4.27 dS m^{-1}. A significant effect of binary interaction of adding organic conditioners and phosphorus levels (M x P) was found in the mean electrical conductivity values after harvesting, as the highest significant decrease occurred in the M_2P_2 treatment, which reached 3.26 dS m^{-1}, with a decrease of 36.45% compared to the control treatment (M_0P_0) of 5.13 dS m^{-1}.

Table 4. Effect of water quality, organic fertilizers, and phosphorus levels on soil EC1:1 dS m^{-1} after harvest soils

Water quality (I)	Organic conditioner (M)		P_2O_5 kg ha^{-1} P_0 0	P_1 80	P_2 160	Mean I × M
I_1		M_0	5.72	4.89	4.28	4.96
		M_1	5.25	4.75	4.07	4.69
		M_2	4.82	4.41	3.78	4.34
	Mean I × P		5.26	4.68	4.04	4.66
I_2		M_0	4.53	4.15	3.73	4.14
		M_1	4.24	3.88	3.51	3.88
		M_2	4.04	3.52	2.74	3.43
	Mean I × P		4.27	3.85	3.33	3.82
			P_0	P_1	P_2	Mean
Mean M × P	M_0		5.13	4.52	4.01	4.55
	M_1		4.75	4.32	3.79	4.28
	M_2		4.43	3.97	3.26	3.89
	Mean		4.77	4.27	3.69	
			$LSD_{0.05}$			
I	M	P	M×I	P× I	P× M	P× M×I
0.34	0.06	0.06	0.27	0.27	0.11	0.26

The results also show that there is a significant effect of the triple interaction of water quality, organic fertilizers, and phosphorus levels on the average electrical conductivity of the soil after harvest, as the highest decrease occurred in the treatment $I_2M_2P_2$, which reached 2.74 dS m^{-1}, with a decrease of 52.10% compared to the treatment $I_1M_0P_0$, with 5.72 dS m^{-1}. The results of is study showed that the treatment of irrigation with water from Diyala River was superior to irrigation than could water in reducing soil salinity values in general, which may be due to the fact that the well water has a relatively higher salinity than Diyala river, as show in Table 2. It could also be due to that Diyala river water containing organic compounds and organic acids that facilitate the movement and penetration of water, in addition to increasing the organic carbon content of the soil, which improves the physical properties and water relations within the soil, which as a result helps to leach, remove salts from the soil and reduce soil salinity values. (4). The results shows a decrease in soil salinity with an increase in the levels of phosphate fertilizer addition in the case of irrigation with well water or the water of Diyala River, which could be explained by the fact that the growth of roots and their penetration into the soil increases with the increase in the levels of phosphate fertilizer addition, which works to increase the movement and mobility of water and remove the amount of salt from the soil profile. and reducing soil salinity values (24). Could be due to the role of phosphate fertilizers in the adsorption and stabilization of salts and reduce their solubility, since phosphate fertilizers are attractive to salt ions in the soil and tend to precipitate in Iraqi soil conditions with relatively high pH, which helps reduce the solubility of these salts and reduce soil salinity (11, 28). The results showed a decreases in soil salinity EC values when adding organic waste (sludge and sheep waste), with the superiority of the treatment of adding sheep waste over the treatment of adding sludge, which could be due to the fact that these organic residues improve soil properties, water relations and water movement within the soil, which increases the efficiency of desalting. from the soil (34). The superiority of the treatment of sheep manure (despite its relatively high salt content compared to sludge) could be due to the sheep manure containing relatively higher organic carbon compared to sludge (Table 3) and more organic compounds, organic and amino acids than sludge, which improves the physical properties of the soil. (31). It increases the movement of water and the removal of salts from the soil (20).

Soil reaction (pH): The results indicated a significant effect of water quality, type of organic fertilizers, and phosphorous levels on the average degree of soil reaction (pH) after harvest (Table 5). The results show that there is a significant effect of the water of (I_1) in reducing the values of soil reaction after harvest compared to the water of the Diyala river (I_2), as the mean values were 7.52 and 7.57, respectively, with a decrease of 0.66%. The results also showed a decrease in the average of soil reaction when adding organic fertilizers. The decrease was significant for the waste of sheep (M_2) and sludge (M_1), as the values reached 7.48 and 7.54, with a decrease of 1.71 and 0.92%, respectively, compared to the control treatment (M_0), which amounted to 7.61. The results showed that the addition of phosphorous levels (P_1 and P_2) had a significant effect on reducing the values of the degree of soil reaction after harvest, as the mean values were 7.55 and 7.50, with a decrease of 0.52 and 1.19% compared to the control treatment (P_0) of 7.59. The results indicate that there is a significant effect of the binary interaction of water quality and the type of organic conditioners on the average degree of soil reaction after harvest. The values of the two treatments I_1M_2 and I_2M_2 decreased, reaching 7.46 and 7.51, with a decrease of 1.71 and 1.70%, compared to the two control treatments (I_1M_0 and I_1M_0), which amounted to 7.59 and 7.64 respectively. The results also indicated a significant interaction between water quality and phosphorus levels in the mean degree of soil interaction after harvest, as the highest decrease was found in the two treatments (I_1P_2 and (I_2P_2), as the values reached 7.48 and 7.52, with a decrease of 1.06 and 1.44% compared to the two control treatments (I_1P_0 and I_2P_0) with 7.56 and 7.63 respectively. A significant effect of the interaction between the addition of organic fertilizers and phosphorus levels (M x P) was found in the mean values of the degree of soil reaction after harvest, as the highest significant decrease occurred in the M_2P_2 treatment of 7.43, with a decrease of 3.26% compared to the control treatment (M_0P_0) of 7.68. The results also indicated a significant triple interaction of water quality, organic fertilizers, and phosphorus levels in the mean soil reaction after harvest, as the highest decrease occurred in the treatment $I_1M_2P_2$ of 7.41, with a decrease of 3.89% compared to the treatment $I_2M_0P_0$ of 7.71.

Table 5. Effect of water quality, organic fertilizers and phosphorus levels on soil reaction (pH) after harvest

Water quality (I)	Organic fertilizers (M)	P_0 0	P_1 80	P_2 160	Mean I × M
		P_2O_5 kg ha^{-1}			
I_1	M_0	7.64	7.58	7.54	7.59
	M_1	7.53	7.50	7.48	7.50
	M_2	7.50	7.47	7.41	7.46
	Mean I × P	7.56	7.52	7.48	7.52
I_2	M_0	7.71	7.63	7.58	7.64
	M_1	7.62	7.57	7.53	7.57
	M_2	7.55	7.52	7.45	7.51
	Mean I × P	7.63	7.57	7.52	7.57
		P_0	P_1	P_2	Mean
Mean M × P	M_0	7.68	7.61	7.56	7.61
	M_1	7.58	7.54	7.51	7.54
	M_2	7.53	7.50	7.43	7.48
	Mean	7.59	7.55	7.50	

LSD 0.05						
I	M	P	M×I	P× I	P× M	P× M×I
0.02	0.02	0.02	0.03	0.03	0.05	0.06

The results of the soil reaction after harvesting showed that irrigation with well and Diyala River water has led to a decrease in its values, with the superiority of irrigating with well water over Diyala river water in reducing soil reaction. Which can be attributed to the increase in soil moisture and the activity of microorganisms that secrete organic compounds and work to decompose organic matter more in the presence of moisture, which helps in lowering the pH of the soil (8, 25). In addition to increasing the activity of soil organisms, such as earthworms whose output increases the release of organic compounds and organic acids, which further lowers the pH values of the soil (1). the superiority of the irrigation treatment with the water of the well over the treatment of irrigation with water of the Diyala river in reducing the pH values could be due to the fact that the water of the well contains sulfate and chloride ions, which are an acidic effect in relatively higher quantities compared to the sulfate and chlorides in the water of the Diyala river (Table 2). It may be due to the fact that the water of the well is more saline than the water of the Diyala River (Table 2), which works to reduce the pH values due to the effect of salinity in reducing the pH values of the soil (17). The results showed a decreases in pH values with increasing levels of phosphate fertilizers, which could be attributed to the fact that the residual effect of adding phosphate fertilizers to the soil is often acidic because phosphate fertilizers contain phosphoric acid and sulfate as one of its components, which have an acidic effect on the soil, which lowers the pH values of the soil (23, 24). The results showed that the addition of organic waste in general led to a decrease in the pH values of the soil, which may be due to the fact that these residues contain organic compounds, organic acids, amino acids, and sugars, whose decomposition products increase the release of hydrogen ions, which works to reduce the pH values in the soil. The superiority of sheep waste treatment may be due to the relatively higher organic carbon content of these wastes compared to sludge wastes, as shown in Table 3. As well as the fact that sheep waste contains organic compounds with advanced stages of decomposition and relatively easy ionization compared to sludge waste (31).

Soil content of organic carbon (g kg^{-1})

The results indicate a significant effect of water quality, type of organic fertilizers, and phosphorous levels on the soil content of organic carbon after harvest (Table 6). The results show that there is a significant effect of the water of the Diyala river (I_2) in raising the soil organic carbon content values after harvest compared to the water of the well (I_1), as the mean values were 11.36 and 13.01 g kg^{-1}, respectively, with an increase of 14.52%. The results also showed an increase in the organic carbon content of the soil when adding organic fertilizers. Sheep waste and sludge outperformed with 14.59 and 16.74 g kg^{-1}, compared to the control treatment (M_0) of 8.46 g kg^{-1}. with an increase of 72.46 and 97.74%, respectively. The results showed that the addition of phosphorus levels had a significant effect on raising soil organic carbon content values after harvest, as the mean values were 12.16 and 13.26 g kg^{-1}, with an increase of 9.16 and 19.03% compared to the control treatment (P_0) of 11.14 g kg^{-1}. The results show a significant interaction between water quality and the type of organic conditioners in the average soil organic carbon content values after harvest, as the values increased in the two treatments I_1M_2 and I_2M_2, as the values reached 14.83 and 15.93 g kg$_{-1}$, with an increase of 109.76 and 91.01% compared to the two control treatments. I_2M_0 and I_1M_0 with 7.07 and 8.34 g kg^{-1} respectively. The results also indicated a significant interaction between water quality and phosphorus levels in the mean soil organic carbon content values after harvest, as a significant increase was found for irrigation with the water of the Diyala river at the two treatments I_2P_1 and I_2P_2 reached 12.42 and 14.10 g kg-1, with an increase of 20.00 and 18.29% compared to with the control treatments (I_1P_0) and I_2P_0) with 10.35 and 11.92 g kg^{-1} respectively. The results confirmed the significant interaction between the addition of organic conditioners and the levels of phosphorus (M x P) in the average soil organic carbon content values after harvest, as the highest significant increase was obtained in the M_2P_2 treatment with 15.30 g kg^{-1}, with an increase of 126.00% compared to the control treatment (M_0P_1) of 6.77 g kg^{-1}.The results in Table 6 indicate a significant three-way interaction (I x M x P) in the mean soil organic carbon content values after harvest. The highest value was obtained in the $I_2M_2P_2$ treatment, which amounted to 17.10 g kg^{-1}, with an increase of 179.87% compared to the control treatment ($I_1M_0P_0$), which amounted to 6.11 g kg^{-1}. The results showed an increase in the soil content of organic carbon in general after harvest, with the superiority of the irrigation treatment with the water of the Diyala river compared to the irrigation with the well water which may be attributed to the water of the Diyala river containing dissolved organic compounds and organic colloids suspended with the water of the Diyala river, which increase the soil content of organic carbon and increase the effectiveness of soil microorganisms, which is reflected positively in increasing the soil content of organic carbon (5). It may be due to the fact that the water of the Diyala river has a relatively lower content of salts compared to the water of the well (Table 2), which is reflected positively in increasing the effectiveness of microorganisms and the release of organic compounds (1, 17). As well as an increase in plant and root growth, which leads to an increase in secretions and root residues (32) compared to the growth of plants and roots when irrigated with well water. The results showed an increase in soil content of organic carbon with increasing levels of phosphate fertilizers, which may be attributed to increased plant and root growth, which increases the secretions of the roots and leaves the residues of the roots in the soil, which is reflected positively in increasing the soil content of organic carbon. (13, 14).

Table 6. Effect of water quality, organic fertilizers, and phosphorus levels on the soil content of organic carbon (g kg^{-1}) for post-harvest soils

Water quality (I)	Organic conditioner (M)	P_2O_5 kg ha^{-1} P_0 0	P_1 80	P_2 160	Mean I × M
I_1	M_0	6.11	7.25	7.84	7.07
	M_1	11.24	12.30	13.05	12.20
	M_2	13.70	14.40	16.38	14.83
	Mean I × P	10.35	11.32	12.42	11.36
I_2	M_0	7.43	8.50	9.08	8.34
	M_1	13.84	14.30	16.12	14.75
	M_2	14.50	16.20	17.10	15.93
	Mean I × P	11.92	13.00	14.10	13.01
		P_0	P_1	P_2	Mean
Mean M × P	M_0	8.46	6.77	7.88	8.46
	M_1	14.59	12.54	13.30	14.59
	M_2	16.74	14.10	15.30	16.74
	Mean	13.26	11.14	12.16	13.26

LSD $_{0.05}$

I	M	P	M×I	P× I	P× M	P× M×I
0.0731	0.0664	0.0664	0.0847	0.0847	0.1151	0.1569

In addition, the presence of phosphorus in the soil helps the growth of soil microorganisms and increases the activity of soil organisms such as earthworms and soil insects, which increases the soil content of organic carbon (5). The results showed an increase in soil organic carbon content when sheep and sludge waste were added, which can be attributed to their high content of organic carbon and the release of organic compounds, amino acids, sugars, cellulose and hemicellulose as a result of their decomposition, and also due to the increase in the effectiveness of soil microorganisms and soil organisms whose decomposition products are organic compounds that increase the soil content of organic carbon. The superiority of the treatment of sheep waste from soil organic carbon content over the treatment of sludge waste may be due to the fact that the organic carbon content of sheep waste is relatively higher than the content of sludge waste (Table 3). It could be attributed to the fact that the components of sheep waste are rich in organic compounds that are easy to ionize and have relatively more advanced stages of decomposition compared to sludge waste (12, 30).

Dry pods yield(g $plant^{-1}$)

The results presented in Table 7 indicate the effect of water quality, type of organic fertilizers, and phosphorus levels on the fruit dry weight after harvest**.** The results show that there is a significant difference between the water of the well (I_1) and Diyala river water (I_2) in the dry weight of the fruits after harvest, as the average values were 20.39 and 26.81 g $plant^{-1}$, respectively, with an increase of 31.49%.The results also showed an increase in the values of the dry weight of the fruits when adding organic fertilizers, as it was significant of the sheep waste (M_2) and sludge (M_1), as the values reached 23.82 and 26.76 g $plant^{-1}$, with an increase of 14.36 and 30.28%, respectively, compared to the control treatment (M_0) of 20.54 g $Plant^{-1}$. The results showed that the addition of phosphorus levels P_1 and P_2 had a significant effect on raising the dry weight values of fruits after harvest, as the mean values were 23.82 and 26.61 g $plant^{-1}$, with an increase of 16.94 and 30.63% respectively, as compared to the control treatment (P_0) of 20.37 g $plant^{-1}$. The results in Table 7 show a significant interaction between the water quality and the type of organic fertilizers in the mean values of the dry weight of the fruits after harvest, as the values increased in the two treatments I_1M_2 and I_2M_2, reaching 23.67 and 29.86 g $plant^{-1}$, with an increase of 38.83 and 24.21% respectively, as compared to the two control treatments I_2M_0 and an I_1M_0 of 24.04 and 17.05 g $plant^{-1}$ respectively. Also, the interaction was significant between water quality and phosphorus levels in the average values of dry weight of fruits after harvest, as the highest significant increase was found in the two treatments I_1P_2 and I_2P_2, which amounted to 23.12 and 30.10 g $plant^{-1}$, with an increase of 33.10 and 28.80%, compared to the two control treatments (I_1P_0 and I_2P_0) of 17.37 and 23.37 g $plant^{-1}$ respectively. The binary interaction (M x P) was significant, the highest significant increase in M_2P_2 treatment reached 29.99 g $plant^{-1}$, with an increase of 72.36% compared to (M_0P_0) treatment, of 17.40 g $plant^{-1}$.

Table 7. Effect of water quality, organic fertilizers, and phosphorus levels on dry pods yield (g $plant^{-1}$) post-harvest soils

Water quality (I)	Organic fertilizers (M)	P_0 0	P_1 80	P_2 160	Mean I × M
		P_2O_5 kg ha^{-1}			
I_1	M_0	14.08	17.34	19.72	17.05
	M_1	17.58	20.12	23.62	20.44
	M_2	20.44	24.55	26.02	23.67
Mean I × P		17.37	20.67	23.12	20.39
I_2	M_0	20.73	24.60	26.80	24.04
	M_1	23.93	26.13	29.55	26.53
	M_2	25.45	30.18	33.95	29.86
Mean I × P		23.37	26.97	30.10	26.81
		P_0	P_1	P_2	Mean
Mean M × P	M_0	17.40	20.97	23.26	20.54
	M_1	20.75	23.12	26.59	23.49
	M_2	22.95	27.36	29.99	26.76
Mean		20.37	23.82	26.61	

LSD 0.05						
I	M	P	M×I	P× I	P× M	P× M×I
0.43	0.12	0.12	0.33	0.33	0.21	0.37

The results indicate a significant (I x M x P) interaction, as the highest value was obtained in the $I_2M_2P_2$ treatment, which amounted to 33.95 g $plant^{-1}$, with an increase of 141.12%, compared to the treatment ($I_1M_0P_0$ of 14.08 g $plant^{-1}$. The results showed that the treatment of irrigation with Diyala river water was superior to the treatment of irrigation with the well water, which may be attributed to the effect of the relatively high salinity of the well water compared to the salinity of the Diyala river water (Table 2), in reducing the productivity of plants and to the relative sensitivity of broad bean plant to salinity, which works to reduce plant growth as a result of the osmotic effect and the property of specialized ions such as chloride and sodium that usually accompany the salinity effect (6, 7, 8, 21). The results showed an increase in the yield of the dry pods with the increase in the levels of phosphate fertilizer, which can be attributed to the plant's need and response to the addition of phosphate fertilizer due to the lack of availability of phosphorus in the Iraqi soil. It is also attributed to the important role that phosphorus plays in plant growth and increased productivity, as it is one of the basic nutrient that plants need to complete their growth (4). The results showed an increase in the dry pods of the fruits when adding sheep manure and sludge, which can be attributed to the role of these organic substances in improving the plant growth environment from the physical properties and water relations in the soil (5). and improving the fertility and vital properties of the soil (21). Increasing soil content of organic carbon and reducing soil salinity, as explained in the previous paragraphs, and that the superiority of the treatment of adding sheep manure over the treatment of adding sludge may be due to the improvement of the fertile soil characteristics in a way that the sheep monure contains nutrients and organic carbon that is higher than the sludge (Table 3), it also has a relatively low salty effect compared to the salty effect when sludge is added (19).

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