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Article

The Effect Of The Quality Of Irrigation Water, Organic Waste, And Tea Water Extract On The Readiness Of Potassium In The Soil And The Growth Of Barley Plants

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Abstract: An agricultural experiment was conducted in the canopy of the Department of Soil Sciences and Water Resources College of Agriculture\University of Basrah during the 2023-2024 agricultural season, in which a mixed sandy soil from the Barjasia area was used, treated with organic waste as follows: tea waste 2% and 3%, peatmoss 2% and 3% The tea water extract was 1:1 at a level of 3%, and two types of irrigation water were used: Shatt al-Arab water and tap water. A completely randomized design with three replications was used. Barley seeds were planted with 10 seeds in each pot, and irrigation treatments were applied for both types of water (Shatt al-Arab and tap) to the limits of the field capacity of the soil. The plants were reduced to 6 per pot after germination. The results showed that the Shatt al-Arab water treatment was superior in the average fresh weight of barley plants, and the values reached 5.438 and 5.244 gm pot-1 and the dry weight 1.610 and 1.748 gm pot-1 for the first and second harvests, respectively. It also excelled in the average concentration of available potassium in the soil, and reached 703.400 mg kg-1, while the aqueous extract of tea treatment was superior in all the studied characteristics, and the values reached 6.375, 2.130, 6.720 and 2.240 gm pot-1 for the fresh and dry weight and for the two harvests, respectively.

Keywords: Irrigation Water, Organic Waste, Tea Water, Potassium, Barley Plants

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1. Introduction

The scarcity of water resources in arid and semi-arid areas is a factor that threatens sustainable agriculture in Iraq due to changing climate conditions, human activities, and land use changes. Therefore, there is a need to adopt an approach to rationalize the use of irrigation water without reducing crop productivity or deteriorating soil properties (Ahmed and Saleh, 2016).

Applying organic fertilizers and foliar spraying is a factor that contributes to developing barley growth and increasing its productivity, and previous studies have indicated that adding organic fertilizers increases the ability of crops to overcome the negative effects of drought (Bowden et al, 2010 and Azab, 2016). It helps improve some of the physical and water properties of the soil and increases the void ratio and water content available to the plant (Guo et al, 2016 and Aiad et al, 2021). The oxidation of organic matter by soil revitalization contributes to improving the chemical and biological properties, which increases the soil content. It contains macro- and micro-nutrients, increases its readiness, increases the plant's ability to absorb nutrients, and improves the plant's ability to tolerate conditions of salt stress and drought (Abdulkareem and Mohamed, 2018).

Adding water extracts is of great importance in increasing soil fertility through their ability to prepare nutrients and release positive ions within the area of root activity, as they have a high effectiveness in releasing nutrients upon demand due to the presence of effective aggregates that chelate positive ions and provide them in a form ready for absorption by Plant (Aheer et al, 2008).

Potassium is one of the important nutrients for plants, as it plays a major role in the process of photosynthesis, the movement of nutrients within the plant, and controlling the osmotic potential of the plant cell, in addition to its role in activating many enzymes. Decreased of potassium in the soil does not lead to a decrease in overall production, but rather effects on the type yield. Potassium from the soil is exposed to the process of stabilization between aggregate, which affects its readiness in the soil (Khalifa et al. 2022).

Therefore, the study aims to determine the effect of the type of organic waste on increasing the readiness of potassium in the soil and its impact on the growth of barley plants.

2. Materials and Methods

An agricultural experiment was conducted in the canopy of the Department of Soil Sciences and Water Resources\College of Agriculture\University of Basrah during the 2023-2024 agricultural season, in which a mixed sandy soil from the Barjasia area was used, treated with organic waste as follows: tea waste 2% and 3%, peatmoss 2% and 3% The tea water extract was 1:1 at a level of 3%, and two types of irrigation water were used: Shatt al-Arab water and tap water.

A completely randomized design with three replications was used, and the number of experimental units was 30. An analysis of the elemental characteristics of soil and water (Tables 1 and 2) was conducted according to the methods mentioned in Black et al (1965), Page et al (1982), and EPA (1992), and the I R of the organic residues used in the experiment was measured. The soil was passed through a sieve with a diameter of 4 mm and packed into plastic pots with a capacity of 5 kg. The organic matter (tea waste and peatmoss) was mixed with the soil at a rate of 2% and 3% for each type, except for the water extract of tea, which was added at a rate of 3%. Barley seeds were planted with 10 seeds in each pot, and irrigation treatments were applied for both types of water (Shatt al-Arab and tap) to the limits of the field capacity of the soil.

The plants were reduced to 6 per pot after germination. The first cutting of the barley plant was taken a month after germination and its fresh and dry weight was measured. The second cutting was taken a month after the first cutting and its fresh and dry weight was measured. Soil samples were collected at the end of the experiment, and the electrical conductivity of paste (ECe) was measured, and the available potassium was measured after being extracted from the soil using ammonium acetate, according to the method described in Page et al. (1985) and was estimated using a flame apparatus.

Table 1 some characteristics of irrigation water

	Ec	pH	Ca	Mg	Na	K	HCO3	Cl	SO4
	dS m^{-1}		meq l^{-1}						
Shatt Al-Arab	3.45	7.7	12.30	10.20	8.20	4.00	3.34	17.30	14.00
Water Tape	1.6	7.2	8.20	2.20	4.40	2.00	1.60	5.70	7.40

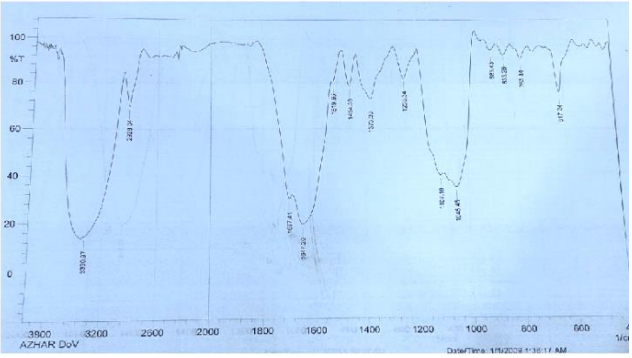
Table 2: Some primary soil properties

properties	Unit	
ECe	dS m^{-1}	2.30
pH		7.67
Ca	meq l^{-1}	8.20
Mg		4.75
Na		6.50

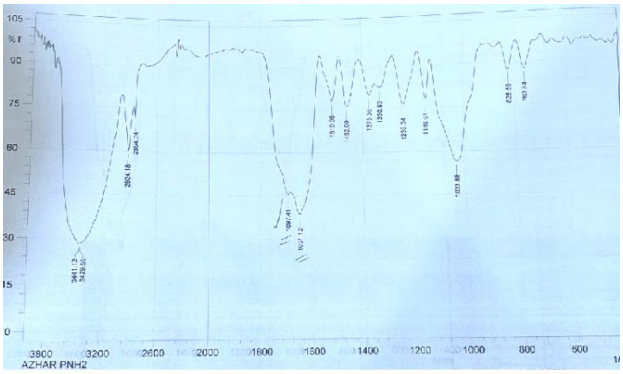
K		1.82
HCO3		2.00
Cl		
SO4		
Field Capacity	%	18
Clay	g kg soil-1	178.00
Silt		172.90
Sand		649.10
Texture		Sandy loam

3. Results and Discussion

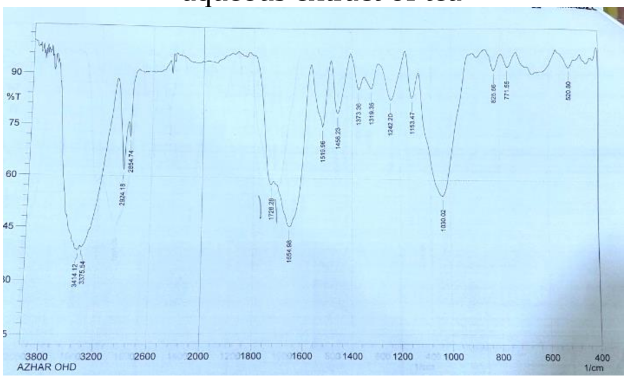
The results of the spectral diagnosis of organic wastes (Figure 1) showed the appearance of a main and distinctive absorption band around 3375-3448 cm-1, which is due to the broad vibration of the OH- group in the aqueous extract of tea and tea waste and the aqueous extract of peatmoss and peatmoss, in addition to the appearance of the absorption band due to the broad vibration of the COO- group, which appears around 1650-1700 cm-1 for all types of wastes studied. This is consistent with what was found by Ahmed et al (2024).



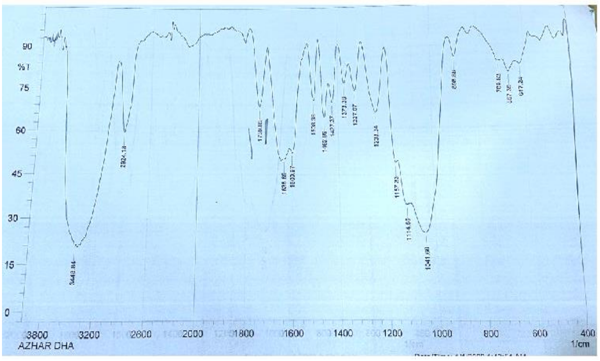
aqueous extract of tea



Tea waste



peatmoss



aqueous extract of peatmoss

The results in Figure 2 show the effect of irrigation water quality on the fresh weight of barley plants grown in mixed sandy soil (first cutting), as Shatt al-Arab water was significantly increased and reached 5.438 gm pot-1, while it reached 4.050 gm pot-1 for the tap water treatment, and these results are consistent. With the findings of Ahmed and Saleh (2016) of an increase in the fresh weight of plants when irrigated with Shatt al-Arab water compared to other types of irrigation water.

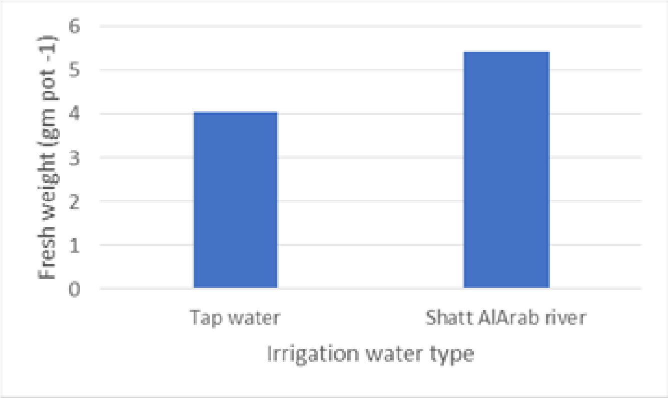


Fig.2 Effect of irrigation water quality on the fresh weight of barley (first cutting),

Figure 3 shows the effect of the quality of organic waste and the water extract of tea on the fresh weight of the barley plant (first cutting). The treatment with the water extract of tea was significantly increase and the value reached 6.375 gm pot-1, while the lowest values were 4.200 gm pot-1 for the 2% tea waste treatment. The reason for this is that the addition of the aqueous extract led to the availability of nutrients in a ready form released from the active groups (Figure 1).

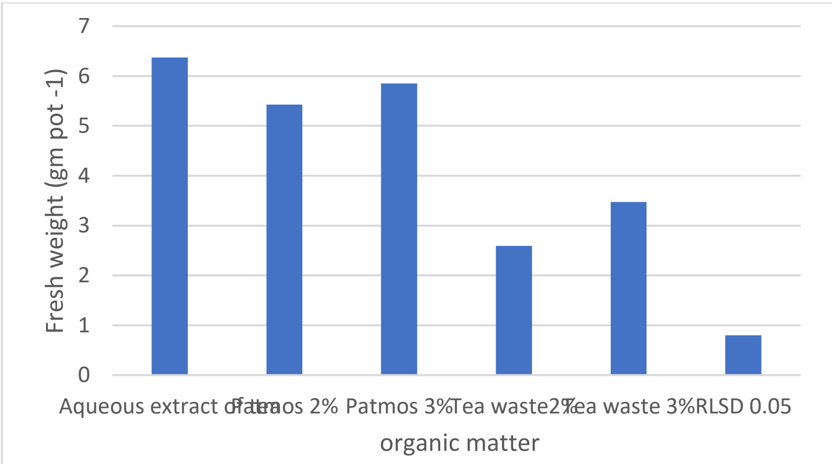


Fig.3 Effect of quality of organic waste and the water extract of tea on the fresh weight of barley (first cutting),

The results in Figure 4 showed the significant increased of the Shatt al-Arab treatment in the dry weight of the first cutting of barley plants, and the value reached 1.810 gm pot^{-1}, while the lowest values were for the tap water treatment and amounted to 1.350 gm pot^{-1}. The reason for this may be due to the concentration of elements in Shatt al-Arab water (Ahmed, 2007)

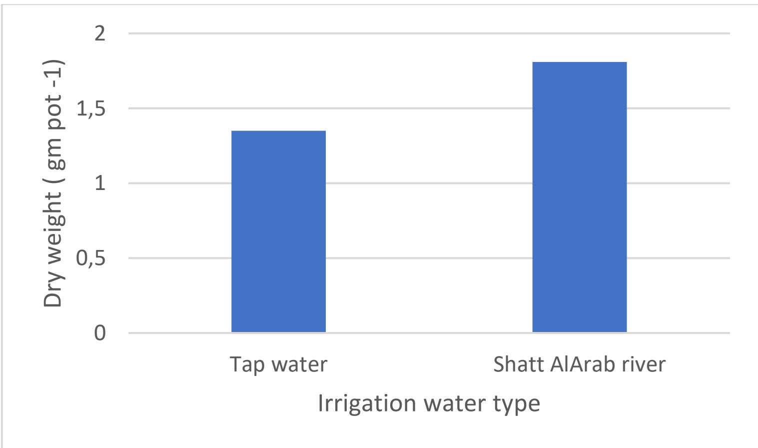


Fig.4 Effect of irrigation water quality on the dry weight of barley (first cutting)

The results in Figure 5 show that the tea aqueous extract treatment was significantly increase in the average dry weight of the first cutting of the barley plant, and the value was 2.130 gm pot^{-1}, while the 2% tea waste treatment achieved the lowest values and amounted to 0.860 gm pot^{-1}. These results are consistent with the findings. Aheer et al (2008) who found that the type of aqueous extract has a major role in increasing the dry weight of the plant as it is an important source for preparing nutrients for the plant.

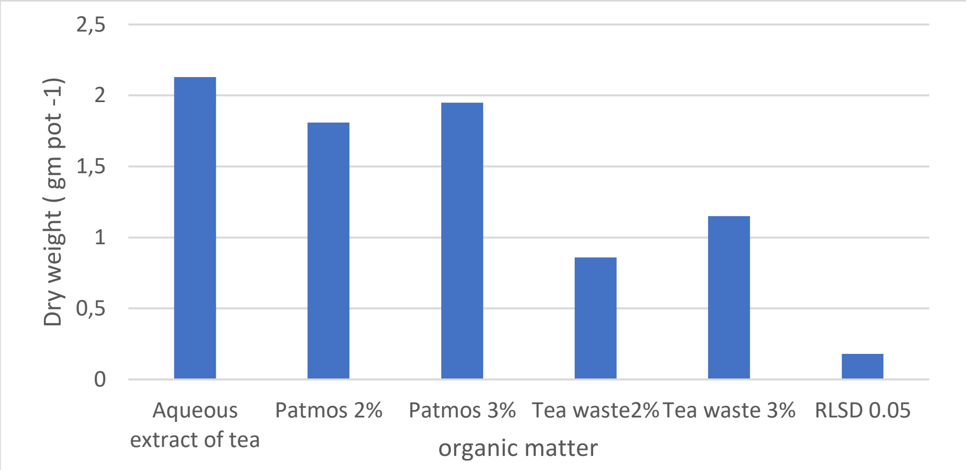


Fig.5 Effect of quality of organic waste and the water extract of tea on the dry weight of barley (first cutting),

The results of Figure 6 show that the Shatt al-Arab water treatment was significantly increased in the average fresh weight of the second cutting of barley plants, and the value reached 5.244 gm pot^{-1}, while the tap water treatment achieved the lowest values and reached 3.922 gm pot^{-1}. These results are consistent with the findings of Ahmed and Saleh (2016) An increase in the fresh weight of plants when irrigated with Shatt al-Arab water compared to other types of irrigation water.

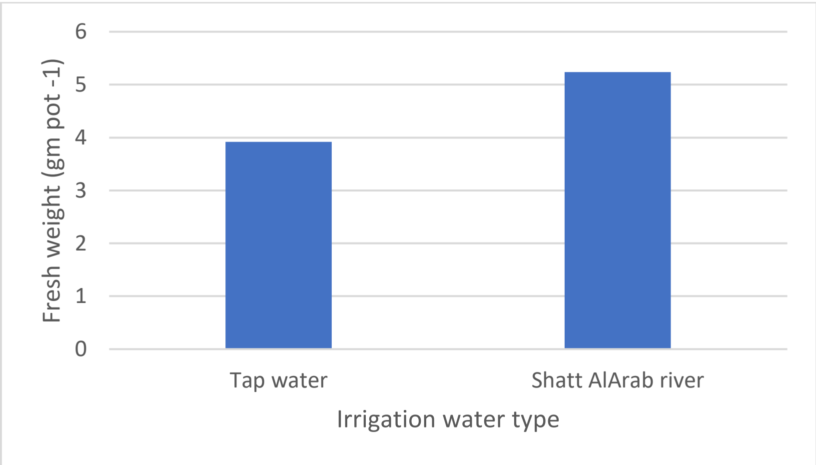


Fig.6 Effect of irrigation water quality on the fresh weight of barley (second cutting)

The results in Figure 7 show that the tea aqueous extract treatment was significantly increase to the rest of the organic waste treatments in terms of the average fresh weight of the second cutting of the barley plant, and the value reached 6.720 gm pot^{-1}, while the lowest values were for the tea third treatment and it was 2.190 gm pot^{-1}. This is due to In this case, the addition of the aqueous extract led to the availability of nutrients in a ready form released from the active groups (Figure 1)

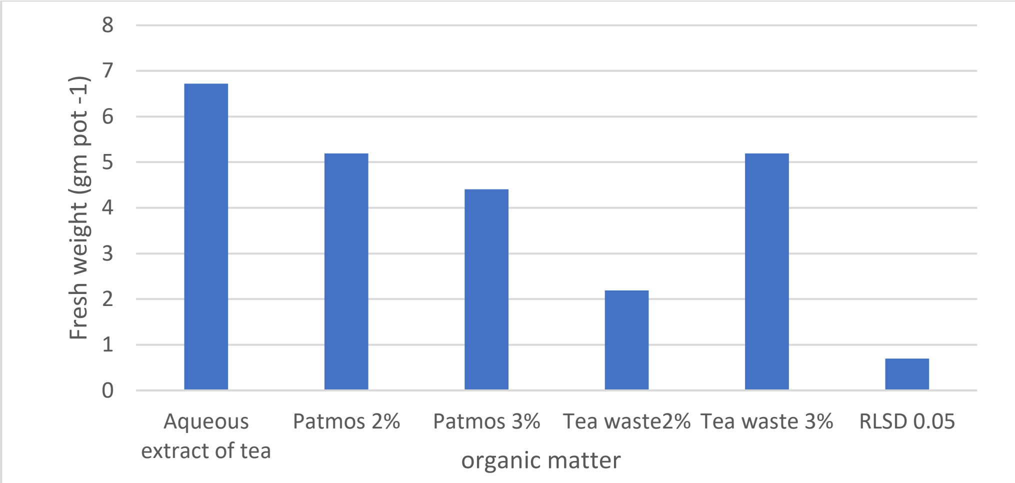


Fig.7 Effect of quality of organic waste and the water extract of tea on the fresh weight of barley (second cutting),

The results of Figure 8 showed that the Shatt al-Arab water treatment was significantly increased in the average dry weight of the second cutting of barley plants, as the values reached 1.748 gm pot^{-1}, while the lowest values were for the tap water treatment and amounted to 1.334 gm pot^{-1} as a result of improved vegetative growth (Figure 6)

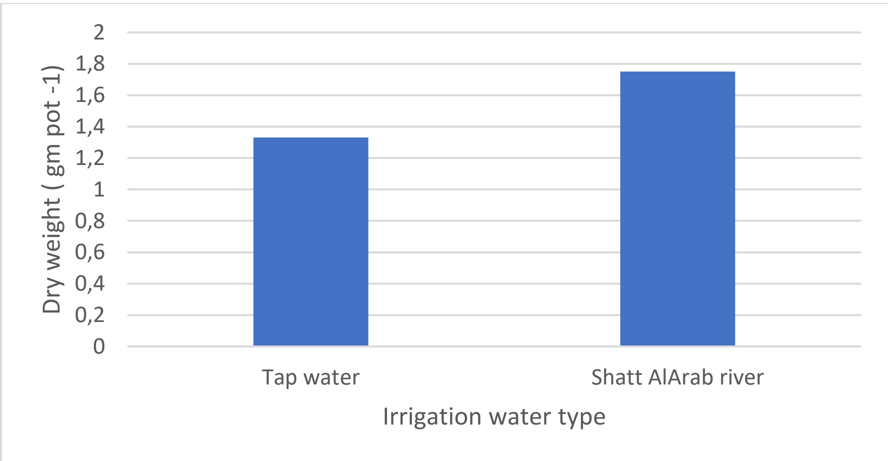


Fig.8 Effect of irrigation water quality on the dry weight of barley (second cutting)

The results in Figure 9 show the significant increase of the tea extract treatment in the average dry weight of the second cutting of the barley plant, and the value reached 2.240 gm pot^{-1}, while the lowest values were for the 2% tea waste treatment, and the value reached 0.730 gm pot^{-1}.

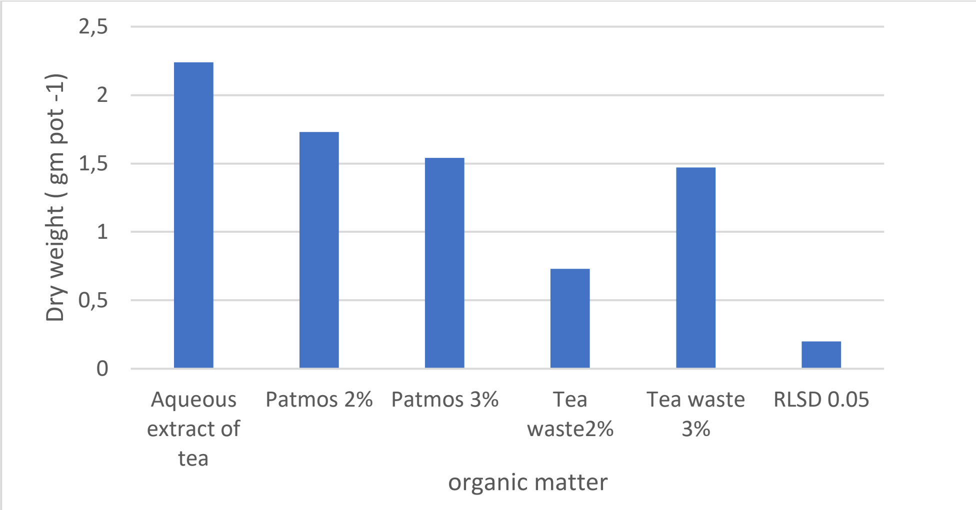


Fig.9 Effect of quality of organic waste and the water extract of tea on the dry weight of barley (second cutting),

The results in Figure 10 show that there are significant differences between the types of water used in the soil electrical conductivity rate values at the end of the experiment. The highest values were for Shatt al-Arab water, reaching 5,480 dS m^{-1} compared to tap water, which achieved the lowest values, reaching 3,900 dS m^{-1}. This is due to This refers to the high salinity values of Shatt al-Arab water compared to tap water (Al-Fariji, 2022).

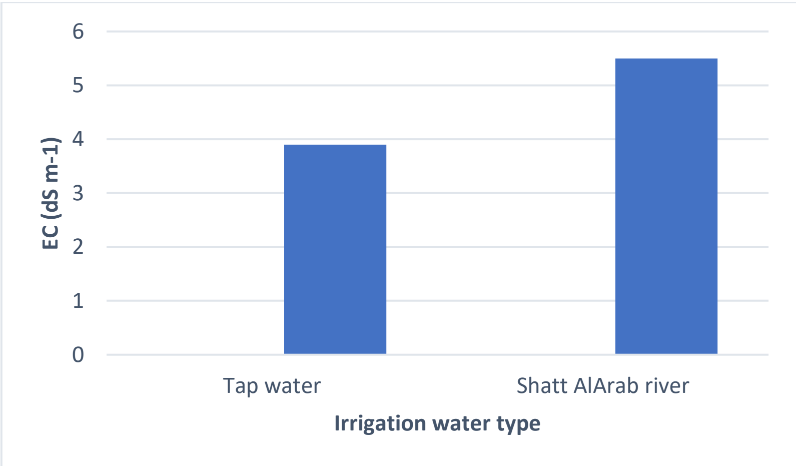


Fig.10 Effect of irrigation water quality on ECe at soil (end experiment)

The results in Figure 11 showed that there were significant differences in electrical conductivity values with different treatments for the added organic waste. The highest values reached 7,900 dS m^{-1} for the tea aqueous extract treatment, while the lowest values reached 2,950 dS m^{-1} for the 2% tea waste treatment. This may be due to the reason This includes the role of adding tea residue in improving soil structure and reducing its bulk density, which reflected positively on the movement of water downward and the washing of salts (Abdul Rasoul et al., 2013, Al-Bayati and Al-Anizy, 2017).

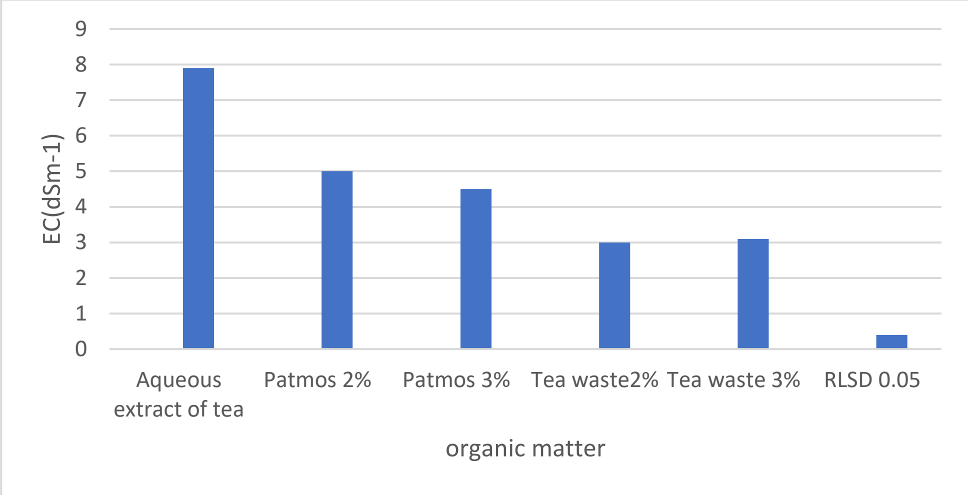


Fig.11 Effect of quality of organic waste and the water extract of tea on ECe at soil (end experiment)

The results in Figure 12 show that there are significant differences between the types of water used in available potassium rate in soil at the end of the growing season. The highest values were for Shatt al-Arab water, reaching 703,400 mg kg^{-1}, compared to tap water, which achieved the lowest values, reaching 578,660 mg kg^{-1}. The reason for this may be due to the higher concentration of elements in Shatt al-Arab water compared to tap water (Ahmed and Saleh 2016).

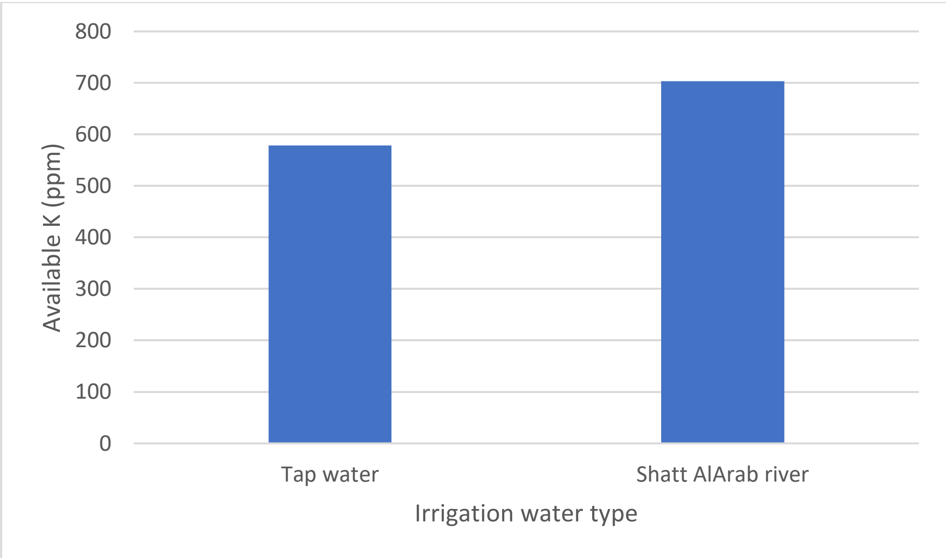
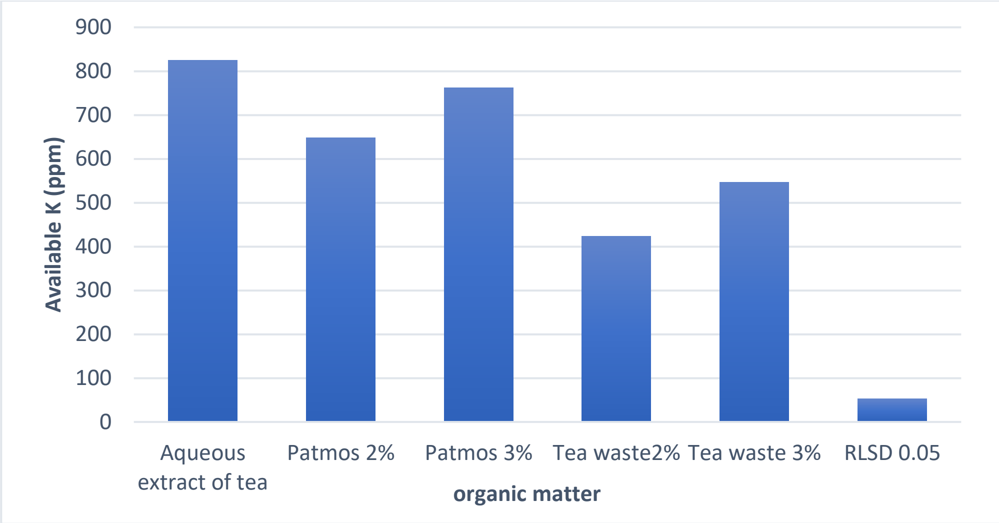


Fig.12 Effect of irrigation water quality on available potassium of soil (end experiment)

The results in Figure 13 show the significant increase of the tea aqueous extract treatment in available potassium in soil at the end of the experiment, and the value reached 825.160 mg kg^{-1}, while the lowest values were for the tea waste treatment, 2%, and the value reached 423.330 mg kg^{-1}. These results are consistent with what was found Al Azzawi et al. (2021) who indicated that the use of organic waste leads to improving the chemical properties of the soil and increasing the availability of nutrients.



4. Conclusion

The findings of this study demonstrate the significant impact of irrigation water quality and the application of organic waste, specifically tea water extract, on the growth and potassium availability in barley plants cultivated in sandy soils. The superior performance of Shatt al-Arab water in enhancing both fresh and dry weight of barley plants, along with the notable increase in potassium availability due to tea water extract, highlights the potential of these treatments to improve soil fertility and crop productivity in arid regions. These results imply that adopting such practices could mitigate the challenges of water scarcity and nutrient deficiency in agriculture. Further research is recommended to explore the long-term effects of these treatments on soil health and their applicability to other crops and soil types.

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