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Article

Impact of potassium in alleviating water stress on wheat plants irrigated with treated water Some vegetative growth characteristics

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Abstract: The study was conducted using plastic pots during the growing season 2020-2021 in private field crops at the Holy Karbala Governorate to study the effect of the quality of water, soil moisture and potassium levels on some growth parameters of wheat plant var. A.L. baraka. A factorial experiment was carried out using a completely randomized design (C.R.D.) with three replications, which included two types of irrigation water treated heavy water and soft water, three levels of field capacity, i.e., %, 50% and 100% and four levels of potassium, i.e., 0, 1000, 2000 and 3000 mg. L^{-1} The experiment included 72 experimental units. The results were statistically analyzed, and the means of treatments were compared using the least significant difference under the probability level 0.05. The following characteristics were measurements: plant height, number of leaf areas, dry weight of shoot and root systems. Results could be summarized as follows: Water quality had a statistical effect on the traits under study, as the treatment with treated heavy water gave the highest values of plant height, number of tillers, number of leaves, leaf area, root and shoots dry weights, which amounted to 70.21cm, 14.03leaf, 23.42cm^2, 6.24g, 1.76g respectively compared to soft water, which amounted to 69.17 cm, 3.52tiller, 13.24leaf, 22cm^2, 58, 5.94 and 1.68g. The addition of 100% of the field capacity value gave the highest averages of the following height, number of leaves, leaf area, root and shoots dry weights, which amounted to 80.80cm, 15.98leaves, 27.81cm^2, 7.69g and 2.15g sequentially. The addition of 3000 $mg.L^{-1}$ of potassium gave the highest averages for the traits plant height, number of leaves, leaf area, shoot dry weight and root dry weight, where their averages were 73.11cm, 14.66 leaves, 25.11cm^2, 6.63g and 1.87g respectively. Some bi- and tr-interactions between studied factors showed a different effect on the studied characteristics.

Keywords: Wheat plant, water quality, field capacity, potassium concentration.

Introduction

Bread wheat (*Triticum aestivum* L.) is the first cereal crop in the world in terms of its importance, cultivated area and global production, being a main food for more than a third of the world's population [1]. Wheat is the first cereal crop in Iraq and the world in terms of food and industrial importance. Although Iraq is one of the first citizens of its cultivation, its productivity did not rise to the required level, which requires attention and the creation of suitable conditions and sound management to obtain high productivity due to the low local production of the wheat crop. Several need to adopt modern scientific methods in the agricultural field and strategies are limited for managing soil, water resources, soil fertility and plant nutrition. Water sources are the most important natural resources on which the agricultural development of any country in the world depends. As a result of the significant expansion in the agricultural field to address the worsening food crisis in the world, water availability has become the primary determinant of agricultural production, especially in arid and semi-arid areas due to the prevailing harsh climatic conditions[2].

Water stress is one of the most critical obstacles to the growth and productivity of the wheat plant, as it contributes to shortening the plant height, reducing the leaf area and the growth of leaves, which hurts growth processes, cell division and elongation, which is reflected on the productivity of wheat and reducing the yield of the unit area compared to developed countries. Water prevents the crop from exploiting its inherent physiological and genetic potential to the highest level. 3. Therefore, thinking about developing strategies has become necessary to confront this problem by rationalizing water consumption in quantity and quality and finding possible solutions to balance water resources and raise the efficiency of water use—industrial, agricultural and health drainage. Using wastewater in irrigation is one of the modern strategies that reduce the use of fresh water in irrigation, which reduces water scarcity problems. Although this water contains nutrients such as nitrogen and phosphorous and micronutrients that benefit the crops that are irrigated with this water, it contains heavy elements that may accumulate in the soil and plants as a result of its use in irrigation with concentrations that are harmful to the plant and the living organisms that feed on it [4]. The use of wastewater in treatment is part of the national water mobilization and exploitation strategy, as it contributes to the protection of the natural environment, the sustainability of agricultural production, the economy of traditional water and the expansion of irrigated areas. It also contributes to reducing the intrusion of saline water into coastal groundwater by using the artificial feeding of water resources with treated wastewater [5,6].

On the other hand, it provides nutrients for soil and plants, thus reducing the total need for chemical fertilizers and increasing economic returns for farmers in addition to the use of fertilizers and irrigation techniques and the factors involved in production, such as the use of potassium fertilizers, which did not receive much care and use in Iraqi soils, as did nitrogen and phosphate fertilizers, because of the prevailing belief that there is sufficient storage of potassium in these soils that can meet the requirements of the plant's need because of its importance in resisting pathogens and resisting sluggishness. Through its role in the process of lignin and thickening of cell walls and its active role in the various metabolic activities of the plant, especially under drought conditions, high temperatures and fluctuations in the amount of rain falling, its importance lies in increasing the tolerance of water stress through increasing the osmotic pressure of cells, and increasing the relative water content In the tissues of the leaves and controlling the movement of closing and opening of the stomata [7]. Therefore, the study aimed to:-

1. We are assessing the effect of water stress on some growth parameters of Wheat plants.
2. Studying the best concentration level of potassium helps increase growth conditions and reduce the negative impact of heavy elements.
3. Studying the effect of the interaction between different levels of water stress, added potassium and water quality on the growth of wheat plants.
4. The possibility of using treated heavy water to irrigate plants.

Materials and Methods

A factorial experiment was carried out in plastic pots with a diameter of 30 cm and a capacity of 10 kg of soil in a private field for the growing season of 2020-2021. The wheat crop *Triticum aestivum* L. cultivar (Al baraka) seeds were obtained. A factorial experiment was conducted using a completely randomized design (C.R.D.) with three replications. The experiment included studying the effect of the following factors:

1. The first factor is water quality (treated heavy water and irrigation water), represented hereafter by the I letter.
2. The second factor is water stress (25%, 50% and 100%) of the value of the field capacity represented hereafter by S letter.
3. The third factor is the addition of potassium by spraying from a source of potassium sulfate (0, 1000, 2000 and 3000) mg. L^{-1} is represented hereafter by the K letter.

Accordingly, the number of experimental units becomes 72 (2 × 3 × 4 × 3) for water quality, field capacity, potassium and replicates, respectively.

The process of planting wheat seedsvar (Al-baraka) was carried out on 11/20/2020, as it is considered the most appropriate date for planting the wheat plant crop [8]. 10 seeds were planted in each pot at a depth of 3 cm, taking into account the selection of healthy seeds of close sizes, and the seedlings were thinned. Up to 5 seedlings per pot after 15 days of planting. All pots were covered with a plastic cover to protect them from rain, wind and birds during crop growth. When it is required. The experimental units were irrigated according to the required treatments by adding irrigation water (25%, 50% and 100%) of the value of the calculated field capacity. They conducted The rest of the soil and crop service operations during the growing season as needed.

2.1. Collection and analysis of plant samples

2.1.1. vegetative growth indicators

1. Plant height

The height of the plant was measured from the average length of all plants in one pot through a measuring ruler inserted from the base of the plant to the base of the spike of the main stem, except spike [10].

2. Number of leaves. $plant^{-1}$

Leaves were counted for all plants in one pot, from which the average number of leaves per plant was extracted by dividing the total leaves of one pot by the number of its plants.

3. Leaf area (cm^2) per plant

The plant's leaf area was calculated according to the following equation [11].

Leaf area = leaf length * maximum width x 0.95 for all plant leaves.

4. Root dry weight (g)

The samples were dried in an oven at 72° C until the weight was stable [12]. Then, they were weighed with a sensitive scale (Sartorius type), after which the average dry weight of the root system was extracted.

5. Dry weight of the shoot

It was measured as the dry weight of the root system was measured, and the average dry weight of the vegetative group of one pot was extracted.

Results

Effect of water quality, field capacity and potassium concentration in some vegetative growth indicators

Plant height (cm)

The results in Table (1) show no significant effect of the two interactions between water quality and field capacity, water quality and potassium, as well as the triple interaction on plant height. The water quality affected this trait, as heavy water treatment was significantly superior to regular water, and the increase rate was 1.5%. Given a value of 80.80 cm with an increase of 35.9%, the 50% field capacity treatment also increased significantly compared to the first treatment, giving a value of 68.80 cm with an increase of 15.7%. It should be noted that the 100% field capacity treatment also significantly outperformed the 50% field capacity treatment.

The interaction between field capacity and potassium significantly affected plant height, as the interaction treatment of 25% of field capacity without potassium gave the lowest value of 57.53 cm. In contrast, the highest value was obtained from the treatment of 100 field capacity and a concentration of 3000 mg/kg potassium, giving a value of 85.00 cm and an increase of 47.7%.

Water quality I	Field capacity S (%)	K(mg-1)				I× S
		0	1000	2000	3000	
Soft water	25	56.90	58.20	59.63	61.23	58.99
	50	63.30	67.63	69.57	72.23	68.18
	100	74.03	80.27	82.20	84.87	80.34
Heavy water	25	58.17	59.37	60.87	61.43	59.96
	50	65.33	68.73	70.67	72.97	69.42
	100	74.63	81.43	83.00	85.93	81.25
Mean K		65.39	69.27	70.99	73.11	
L.S.D. (0.05)		K = 1.32				N.S.

	K× I× S= N.S				
I	K(mg-1)				Mean I
	0	**1000**	**2000**	**3000**	
Soft water	**64.74**	**68.70**	**70.47**	**72.78**	**69.17**
Heavy water	**66.04**	**69.84**	**71.51**	**73.44**	**70.21**
L.S.D. (0.05)	**N.S.**				**0.93**
S	**K**				**Mean S**
	0	**1000**	**2000**	**3000**	
25	**57.53**	**58.78**	**60.25**	**61.33**	**59.47**
50	**64.32**	**68.18**	**70.12**	**72.60**	**68.80**
100	**74.33**	**80.85**	**82.60**	**85.40**	**80.80**
L.S.D. (0.05)	**2.29**				**1.14**

Table 1. Effect of water quality, field capacity, potassium concentration and the interactions between them on wheat plant height (cm).

Number of leaves. Plant

Table 2 shows the effect of water quality, field capacity, potassium concentration and their interactions on the number of leaves in the wheat plant. The water quality significantly affected this trait. The treatment of heavy water (treated) was significantly superior in this trait (14.03) compared to regular water (13.24). With a percentage increase of 6.1%. This trait also increased with an increase in field capacity, as it gave 11.08, 13.86 and 15.98 leaves for capacity 25, 50 and 100%, with a significant increase of 15.1 and35.6%, respectively, where this value increased again by 17.6% and with an increase of 17.6%. The rest of the two values came between. The effect of the bi-interaction between field capacity and potassium was significant in the number of leaves and leaves in 25% of the field capacity without potassium; the lowest value was 9.40, while the highest value resulted from the interaction treatment 100% field capacity and the concentration of 3000 ml^{-1} K and it was 16.87 leaves with a percentage increase of 79.8%. The effect of the triple interaction in water, capacity and potassium was significant on the number of leaves, as the treatment of normal water with a capacity of 25% without adding potassium gave the lowest value, amounting to 9.20 leaves. The highest value was obtained from the treatment of heavy water (treated) with a capacity of 100% and a concentration of 3000 mg L^{-1} potassium (17.27 leaves) with a percentage increase of 87%. Neither the interaction between water quality and field capacity nor the interaction between water quality and potassium had a significant effect on this trait.

Water quality I	**Field capacity S (%)**	**K(mg L^{-1})**				**I× S**
		0	**1000**	**2000**	**3000**	
Soft water	**25**	**9.20**	**10.40**	**11.40**	**12.07**	**10.77**
	50	**12.53**	**13.07**	**13.60**	**14.33**	**13.38**

	100	**14.73**	**15.33**	**15.80**	**16.467**	**15.58**
Heavy water	**25**	**9.60**	**10.80**	**12.33**	**12.80**	**11.38**
	50	**13.60**	**14.13**	**14.60**	**15.00**	**14.333**
	100	**15.47**	**16.07**	**16.73**	**17.27**	**16.383**
Mean K		**12.52**	**13.30**	**14.08**	**14.66**	
L.S.D. (0.05)		**K = 0.176**				**N.S.**
		K× I× S= N.S				
I		**K**				**Mean I**
		0	**1000**	**2000**	**3000**	
Soft water		**12.16**	**12.93**	**13.60**	**14.29**	**13.24**
Heavy water		**12.89**	**13.67**	**14.56**	**15.02**	**14.03**
L.S.D. (0.05)		**N.S.**				**0.124**
S		**K**				**Mean S**
		0	**1000**	**2000**	**3000**	
25		**9.40**	**10.60**	**11.87**	**12.43**	**11.08**
50		**13.07**	**13.60**	**14.10**	**14.67**	**13.86**
100		**15.10**	**15.70**	**16.27**	**16.87**	**15.98**
L.S.D. (0.05)		**0.305**				**0.152**

Table 2. Effect of water quality, field capacity, potassium concentration and their interactions on the number of leaves in a wheat plant (leaf. plant^{-1}).

Leaf area (cm^2)

Table (3) shows that the leaf area was not significantly affected by the interaction between water quality, field capacity, water quality and potassium concentration, as well as the triple interaction between water quality, field capacity and potassium concentration.

Heavy water treatment was significantly higher than regular water treatment, as it gave a percentage increase of (3.7%) of field capacity and was significantly outperformed by 100% over the rest. The treatment gave an increase in leaf area of (27,810) cm^2 compared to treatments of 25 and 50% of field capacity, as they gave (17,831 and 23,370) cm^2, respectively, and the increase percentage was (56 and 19%) compared to the two treatments, respectively. Potassium had a significant effect on these treatments. The treatment of 3000K mg L-1 gave the highest value (25.116) cm^2 compared to the other treatments (21.056, 22.259 and 23.582) cm^2. The percentage increase for the higher treatment reached (19.3, 12.8 and 6.5%).) respectively. The treatment of 3000 mg L^{-1} potassium was significantly superior to the rest. The interaction between field capacity and potassium showed a significant effect on this trait, as the field capacity treatment 25% gave the lowest values, amounted to 15,443 cm^2, the highest value obtained from the treatment 100% field capacity, and 3000 mg L-1 potassium reached 29.553 cm^2, with a percentage increase of 90.7%. The rest of the field capacity and potassium interactions came between the lowest and highest values.

Water quality I	Field capacity S (%)	K(mg L-1)				I× S
		0	**1000**	**2000**	**3000**	
Soft water	**25**	**15.037**	**16.560**	**18.097**	**19.980**	**17.418**
	50	**20.773**	**22.570**	**23.047**	**25.007**	**22.849**
	100	**25.913**	**26.993**	**28.033**	**28.953**	**27.473**
Heavy water	**25**	**15.850**	**16.867**	**19.097**	**21.160**	**18.243**
	50	**22.520**	**23.430**	**24.167**	**25.443**	**23.890**
	100	**26.240**	**27.137**	**29.053**	**30.153**	**28.146**
Mean K		**21.056**	**22.259**	**23.582**	**25.116**	
L.S.D. (0.05)		**K = 0.343**				**N.S.**
		K× I× S=				
I		**K**				**Mean I**
		0	**1000**	**2000**	**3000**	
Soft water		**20.574**	**22.041**	**23.059**	**24.647**	**22.580**
Heavy water		**21.537**	**22.478**	**24.106**	**25.586**	**23.426**
L.S.D. (0.05)		**N.S.**				**0.242**
S		**K**				**Mean S**
		0	**1000**	**2000**	**3000**	
25		**15.443**	**16.713**	**18.597**	**20.570**	**17.831**
50		**21.647**	**23.000**	**23.607**	**25.225**	**23.370**
100		**26.077**	**27.065**	**28.543**	**29.553**	**27.810**
L.S.D. (0.05)		**0.594**				**0.297**

Table 3. Effect of water quality, field capacity, potassium concentration and their interactions on leaf area in wheat plant (cm^2).

Dry weight of the vegetative system

Table 4 shows the effect of water quality, field capacity and potassium concentration on the dry weight of the vegetative system of wheat plants. The interaction between water quality and field capacity, the interaction between water quality and potassium, and the triple interaction did not significantly affect this trait. The water quality significantly affected the dry weight of the vegetative group, as the treatment of heavy water gave the highest value of 6.248 g. In comparison, the lowest value associated with soft water treatment was 5.943 g, with a percentage increase of 5.1%. The dry weight values differed significantly with the effect of field capacity 100%. The highest value was 7.695 g compared to the lowest value produced from 25% field capacity (4.368 g). The percentage increase was 23.7 and 76.2%. Respectively. The treatments differed significantly by the effect of potassium, as 3000 mg L^{-1} potassium gave the highest value, 6.63 g, and the lowest value resulted from the control treatment, which amounted to 5.527 g, with a percentage increase of 20.1%. The rest of the treatments came between the two values.

The interaction between field capacity and potassium significantly affected the dry weight of the shoot, as the treatment of 100% of the field capacity and 3000 mg L^{-1} of potassium gave the highest value of 8.168 g. In comparison, the treatment of 25% of the field capacity without adding potassium gave the lowest values of 3.800 g, with an increase of 114.9%, and the rest of the transactions came in between these two values.

Water quality I	Field capacity S (%)	K(mg L^{-1})				I× S
		0	1000	2000	3000	
Soft water	25	3.700	3.933	4.433	4.833	4.225
	50	5.367	5.903	6.267	6.567	6.026
	100	7.080	7.460	7.763	8.010	7.578
Heavy water	25	3.900	4.200	4.743	5.200	4.511
	50	5.783	6.333	6.667	6.900	6.421
	100	7.333	7.670	7.920	8.327	7.812
Mean K		5.527	5.917	6.299	6.639	
L.S.D. (0.05)		K = 0.091				N.S.
		K× I× S= N.S				
I		K				Mean I
		0	1000	2000	3000	
Soft water		5.382	5.766	6.154	6.470	5.943
Heavy water		5.672	6.068	6.443	6.809	6.248
L.S.D. (0.05)		N.S.				0.064
S		K				Mean S
		0	1000	2000	3000	
25		3.800	4.067	4.588	5.017	4.368
50		5.575	6.118	6.467	6.733	6.223
100		7.207	7.565	7.842	8.168	7.695
L.S.D. (0.05)		0.158				0.079

Table 4. Effect of water quality, field capacity, potassium concentration and their interactions on the dry weight of the vegetative mass of wheat (gm.plant^{-1}).

Dry weight of the root system

It appears from the data of Table (5) that the water quality had a significant effect on the dry weight of the roots system, as the heavy water treatment (treated) outperformed the treatment of soft water, giving a value of 3.76 g compared to the treatment of soft water, which gave 1.681 g. Also, the field capacity treatment had a significant effect.

The field capacity treatment of 100% was superior to the rest of the treatments, as it gave a value of 2.157 g, compared to the two treatments, 50 and 25%

field capacity, which gave 1.633 and 1.376 g, respectively. Potassium treatment significantly affected the dry weight of the root system, as it was superior to the treatment of 3000 mg $^{-1}$ Potassium over the rest of the treatments, where the value was 1.874 g. In contrast, the lowest value was accompanied by the control treatment (1.598), and the increase was 8.8, 11.6 and 17.3%, respectively. The effect of the interaction between water quality and field capacity was significant in this trait. Heavy water treatment (treatment) and a field capacity of 100% gave the highest value, 2.214 g, while the lowest value was obtained from soft water treatment with a field capacity of 25%, giving a value of 1.329 g. The rest of the coefficients came between these two values. At the same time, the interaction between water quality and potassium treatment did not significantly affect this trait. The interaction between field capacity and potassium was significant.

Water quality I	Field capacity S (%)	K(mg L^{-1})				I× S
		0	1000	2000	3000	
Soft water	25	1.250	1.283	1.327	1.457	1.329
	50	1.503	1.570	1.613	1.770	1.614
	100	1.900	2.073	2.160	2.267	2.100
Heavy water	25	1.350	1.383	1.457	1.500	1.422
	50	1.547	1.607	1.643	1.807	1.651
	100	2.040	2.160	2.210	2.447	2.214
Mean K		1.598	1.679	1.723	1.874	
L.S.D. (0.05)		K = 0.014				0.017
		K× I× S= 0.034				
I		K				Mean I
		0	1000	2000	3000	
Soft water		1.551	1.642	1.700	1.831	1.681
Heavy water		1.646	1.717	1.770	1.918	1.763
L.S.D. (0.05)		N.S.				0.009
S		K				Mean S
		0	1000	2000	3000	
25		1.300	1.333	1.392	1.478	1.376
50		1.525	1.588	1.628	1.788	1.633
100		1.970	2.117	2.185	2.357	2.157
L.S.D. (0.05)		0.024				0.012

Table 5. Effect of water quality, field capacity, potassium concentration and their interactions on dry weight of wheat plant roots system(g).

The difference in the dry weight of the root system, as the field capacity treatment 100% and 3000 mg L^{-1} potassium, gave the highest value of 2.357 g. In comparison, the lowest value resulted from the 25% field capacity treatment without potassium (1.300 g). The triple interaction between the study factors showed a significant effect on this characteristic as the treatment of (treated) water with a field capacity of 100% with the addition of potassium at a concentration of 3000 mg l-1 gave the highest values (2.447 g). In comparison, the lowest value was accompanied by soft water treatment with a field capacity of 25% without adding potassium (1,250 g).

Discussion

Effect of irrigation water quality on some vegetative growth characteristics. The results of Tables (1-5) show the height of the plant, the number of leaves, the leaf area, the dry vegetative weight, and the dry root weight; an increase in the sum of these characteristics was observed when using heavy water (treated) compared to the use of normal water. The reason for this is that heavy water contains essential elements, which are considered macro and micronutrients and necessary for plant growth and play an essential role in increasing the studied traits [12] and several studies confirmed this, as it was noted [13,14] the elongation of the internodes and then the increase in plant height compared to the treatment of irrigation with soft water. These results agreed that using irrigation water has a significant effect on bread wheat cultivars' growth characteristics. Also, these results agreed with [15], which attributed this to the positive role of macro and micronutrients in wastewater, which provides what the plant needs of nutrients in addition to what is in the soil and what was added to it, which led to improving the vegetative and root growth of the plant, which was reflected positively on the outcome and its components. The fact that water contains organic matter leads to an increase in the availability of nutrients through the role of organic acids resulting from the decomposition of organic matter. It thus increases the nutrients essential for plant growth, such as phosphorous, by forming organic complexes with it [16].

Effect of water stress on some vegetative growth characteristics

The results of the study show the effect of water stress on the vegetative indicators under study (plant height, number of leaves, leaf area, dry vegetative weight and dry root weight

The presence of water in optimal quantities with the availability of other suitable conditions increases the process of photosynthesis. It thus increases the productivity of the plant, which is positively reflected in the increase in the indicators of vegetative growth, as well as its role in transporting the necessary elements and nutrients as well as plant hormones to complete the necessary interactions that are needed in cell division and elongation, as well as its role in endurance Salt stress and elemental stress.

On the other hand, plant growth under water stress conditions negatively affects the vegetative indicators, and this was evident through the presence of significant differences between the treatments that were exposed to water stress compared to the control treatment. The results of these results are in agreement with [17]—effect of spraying with potassium on some vegetative growth characteristics. The results of the study show the effect of foliar spraying with potassium on the studied vegetative indicators (plant height, number of leaves and leaf area), as potassium plays a vital role in the synthesis of enzymes for the synthesis of proteins (proteases), energy (kinases) and cytokinins [18] and the accumulation of carbohydrates in the stem and an increase in the number of The nodes and their thickness, as well as its role in increasing cell division, elongation of the internodes, and encouraging the growth of meristematic tissues of plants [19,20]. Potassium also has a role in increasing vegetative growth and thus increasing the number of tillers. This result agreed with [21]. The addition of potassium increases nitrogen absorption, which improves plant growth and thus increases the number of plant tillers. The number of leaves was increased when plants were treated with potassium. This is due to its influential role in activating several enzymes in all phases of plant growth necessary to represent proteins and carbohydrates. This leads to the strength of vegetative growth, delaying the aging of leaves and maintaining their activity. This result is similar to the results of [22], who noticed the effect of potassium in increasing the number of leaves. These results confirm what was mentioned by several researchers. Researchers found that the added potassium improves the growth and development processes of plants [23] in addition to the effect of potassium in increasing the content of chlorophyll and its role in cell division, number of leaves, leaf area, vegetative and root dry weight, which led to an increase in the process of carbon metabolism and chlorophyll index. [24] who found that potassium fertilization had a significant effect on chlorophyll content, vegetative weight and root dry weight w of the plant.

Conclusions

Reducing the amount of irrigation water led to different responses in growth characteristics, physiological characteristics, yield, and components due to different field capacity coefficients. The use of potassium fertilizer at different levels significantly affected growth characteristics when the concentration (3000) $mg.l^{-1}$ was added. It was found that the interaction between potassium concentrations and levels of added water in terms of field capacity and water quality played a role in improving some traits affected by water stress, which was positively reflected in improving most growth traits. It shows that high potassium levels (above the recommended amounts), especially the level (of 3000) $mg.L^{-1}$, have a positive effect in improving the water balance of plants exposed to water stress by increasing the potassium concentration in the leaves that regulates the opening and closing of stomata.

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