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Hormones of Maize Crop as Affected by Potassium Fertilization , Water Quality and Ascobin Foliar Application .

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Abstract

A pot assay on the plastic container of the wire sunshade in the University of Kerbala's Agricultural Division was conducted to research the impact of potassium treatment, the salinity of irrigation water and ascobin sprinkling, just as their connections, on the some plant hormones activities (auxin, gibberellin and abscisic acid) in developing *Zea mays* crops in a soil with sandy texture during the farming fall period of 2017–2018. The trial was planned as a factorial one with three factors, Potassium adding are 0, 100 and 200 Kg $K.ha^{-1}$. the irrigation water salinity are 1, 3 and 6 $ds.m^{-1}$; and the third factor incorporates foliar application with 0, 300 and 600 $mg.L^{-1}$ ascobin (ascorbic acid + citric acid 2:1) at two phases: the main stage at 6 leaves and 21 days after germination and the second stage at 12 leaves and 70 days after germination. This test included 81 exploratory units dependent on a complete randomized design (CRD) with three recreates. The outcomes show that variables engaged with this experiment and their associations significantly affect the some plant hormones activities , which increment when the foliar ascobin application focus increment. The outcomes likewise show the chance of utilizing saline water for *Zea mays* irrigation when the foliar ascobin and potassium are adding .

Keywords

Potassium, Ascobin, Salinity stress, Zea mays, Hormones

Cover Page Footnote

University of Kerbala

1. Introduction

Iraq experiences serious water deficiency due to precipitation variance and the various approaches of ripari-a nations on the Tigris and Euphrates, which requires scanning for water of low quality and including it for sup-plementary water system in rural fields. The nature of water system water is one of the most significant elements af-fecting crop efficiency. Populace development and eco-nomic improvement are related with an expanding requirement for water in Iraq and the comparing outcomes in this fundamental asset because of an ex-panding abuse of water assets in the neighbor-ing nations of Iraq. The saltwater issue, accordingly, isn't unavoidable; rather, it exists as of now. In this manner, it has not been managed appropriately as per the current. Conditions in the nation, so we need to give genuine consideration to this issue in the coming decades [1]. Salinity effectsly affects plants, including direct impacts, for example, poisonous impacts, and optional impacts, for example, enzymatic, food or ionic impacts, which help order plants' vulnerability dependent on their organic exercises. Water deficiency owing saltiness stress can be watched, which results from the diminished procedures of division, extension and cell association, which primarily causes decreased leaf territories and influences plant tallness and the quantity of green branches [2, 3],. A few examinations have been led to address salt pressure and manage the issue of saltiness and saltwater use to inundate farming harvests by shower ing supplements, development controllers and assimilation controllers, as they assume a functioning job in the development and yield of yields presented to saltiness stress conditions. The substances managing assimilation are ascorbic corrosive and citrus extract, which assume a significant job in numerous physiological procedures in plants, for example, development, cell division, extension, biosynthesis of the cell divider and optional metabolites and stress resistance [4]. They likewise assume a job in directing maturing and creating plant guard against pests [5], just as in shielding plants from destructive burdens, for example, the impact of substantial metals, salts, herbicides and pathogens [6]. Citrus extract assumes a significant job in invigorating photosynthesis [7]. It is a non-enzymatic cancer prevention agent in a plant that influences unpredictable food shifts, affecting the electron transport chain, expanding plasma layer corruption and expanding fat peroxidation [8]. Late examinations have been led to decide the impact of ascobin on the substance of significant supplements and amino corrosive, particularly in creating plants under saline pressure conditions [9]. Different methods of rewarding saline water in-clude great soil and water the executives techniques to miti-entryway the unsafe impacts of saline water just as utilize the best salt-safe assortments to meet the developing food needs [10–13]. *Zea mays* L. was utilized in this examination for its monetary significance. The point of this examination is deciding the chance of utilizing saline water for water system to develop the previously mentioned crop and miti-entryway the destructive impacts of saltiness on a portion of the harvest's hormones (which have been known to direct the vari-ous physiological procedure in plant), by adding potassium compost to the dirt, showering ascobin on the plant and considering the idea of the impact of their cooperations.

2. Materials and methods

2.1. *Methods of planting, treatments and*

2.1.1. *Collection of samples*

The examination was led by planting *Z. mays* crop in the wire overhang at the University of Ker-bala's Agricultural Division in the fall period of 2017–2018 utilizing sandy topsoil soil. The dirt example was taken from a field in the area of Hussainiya in the territory of Kerbala at a profundity of 0–30 cm. The dirt was air-dried and gone through a 2 mm distance across strainer. It was altogether homogenized and afterward stuffed into a 30 cm plastic compartment at a tallness of 55 cm and a load of 30 kg. The physical and substance properties of soil−1 for every pot were assessed dependent on the standard strategies portrayed by Ref. [14], as appeared in Table 1.

The investigation was planned as a factorial one utilizing a totally randomized structure (CRD) with three variables for three repeats. The main factor (A) speaks to three degrees of potassium (0, 100, 200 kg K ha−1) in the potassium sulfate compost (41% K), which was included two equivalent augmentations as indicated by the treatment (6, 12 leaves) following 21 and 70 days of agribusiness. The subsequent factor (B) speaks to three degrees of water system water saltiness (1, 3, 6 ds m^{-1}), and the third factor (C) guarantees that three convergences of ascobin (0, 300, 600 $mg.L^{-1}$)

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Table 1
Some physical and chemical characteristics of soil sample used in this study.[a]

Adjective		Value	Unit
pH		7.30	–
Electrical conductivity (EC)		2.21	ds.m^{-1}
Organic matter		6.90	gm. kg^{-1}
Soluble cations	Ca^{2+}	2.20	C mol.Kg^{-1} Soil
	Mg^{2+}	1.20	C mol.Kg^{-1} Soil
	Na^{1+}	1.12	C mol.Kg^{-1} Soil
	K^{+}	0.13	C mol.Kg^{-1} Soil
	$SO4_2^-$	1.22	C mol.Kg^{-1} Soil
Soluble anions	$HCO3_1^-$	0.22	C mol.Kg^{-1} Soil
	CO_3^{2-}	Nill	C mol.Kg^{-1} Soil
	Cl^-	2.83	C mol.Kg^{-1} Soil
Available N		35.00	gm. kg^{-1}
Available K		12.30	gm. kg^{-1}
Available P		12.39	gm. kg^{-1}
Soil separators	Sand	61.30	gm. kg^{-1}
	Silt	26.60	gm. kg^{-1}
	Clay	12.10	gm. kg^{-1}
Texture			Sandy loam

[a] Analyzes in soil analysis laboratories at the Faculty of Agriculture - University of Baghdad.

were splashed on the plants. Tween 20 was included as a treatment at the 6-and 12-leave stage to build the ingestion effectiveness of the plants. *Z. mays* seeds were planted on 15/7/2018 for the fall season at 10 seeds for every pot. Then the plants was reduced into two in each pot 30 days after the seedling.

Nitrogen fertilization was introduced at a rate of 320 Kg N.ha^{-1} using urea fertilizer (46% N) in four batches: the first after emergence, the second at three whole leaves, the third at six leaves and the fourth at flowering. Phosphorus was added at 200 kg P ha^{-1} using superphosphate fertilizer (20% P_2O_5), once during soil preparation for agriculture [15]. Potassium was added in two doses at three levels with spraying dates.

Plant leaves were collected dry, and plant hormones (auxin, gibberellin, abscisic acid) were estimated according to the method described by Refs. [16].

2.2. Statistical methods

The data were subjected to analysis of variance using the SAS statistical package version 9.1 th ed. at $P < 0.05$ probability level [17].

3. Results

3.1. Auxin content in leaves (μg.gm^{-1} dry weight)

The outcomes appeared in Table 2 demonstrate that potassium fertilizer, the nature of water system water and ascobin showering significantly affect auxin content in leaves.Auxin content diminished when potassium fertiliz-er and the salanity of water system water

Table 2
Effect of potassium fertilizer, Irrigation water and spraying of ascobin in the auxin hormone content (μg gm^{-1}dry weight) in leaves of the *Zea mays* under different salinity stress levels.

Potassium added kg K. ha^{-1} A		Salinity irrigation water ds. m^{-1} B	Spray level of Ascobin mg. L^{-1} C				A*B
0 A_1			0C_1	300C_2		600C_3	
		1 B1	0.0482	0.0859		0.0880	0.0741
		3 B2	0.0748	0.0784		0.0815	0.0783
		6 B3	0.0581	0.0785		0.0872	0.0746
100 A_2		1 B1	0.0770	0.0642		0.0881	0.0765
		3 B2	0.0724	0.0649		0.0587	0.0653
		6 B3	0.0888	0.0676		0.0611	0.0625
200 A_3		1 B1	0.0687	0.0813		0.0767	0.0755
		3 B2	0.0685	0.0891		0.0832	0.0802
		6 B3	0.0669	0.0550		0.0867	0.0696
C			0.0693	0.0739		0.0791	A
A*C		A1*C	0.0604	0.0809		0.0847	0.0753
		A2*C	0.0794	0.0655		0.0693	0.0714
		A3*C	0.0680	0.0751		0.0822	0.0751
							B
B*C		B1*C	0.0647	0.0771		0.0843	0.0753
		B2*C	0.0719	0.0774		0.0744	0.0746
		B3*C	0.0713	0.0670		0.0783	0.0722
L.S.D	A	B	C	A*B	A*C	B*C	A*B*C
P < .0.05	0.00074	0.00074	0.00074	0.00013	0.00013	0.00074	0.00221

levels expanded, yet auxin content expanded when splashing concentra-tions expanded, and the most noteworthy incentive in treatment C3 was 0.0791 μg. gm−1 dry weight, contrasted and treat-ment C1, which had an estimation of 0.0693 μg. gm−1 dry weight and an expansion pace of 14.14%.

The outcomes show that potassium compost and the nature of water system water significantly affect auxin content, with a most extreme estimation of 0.0802 μg.gm−1 dry load in treatment A3B2, contrasted and that in treatment A2B2, which gave the least estimation of 0.0653 μg. gm−1 dry weight. The twofold cooperation between potassium treatment and ascobin splashing additionally has a significant impact on auxin, with the most noteworthy estimation of 0.0847 μg. gm−1dry load in treatment A1C3 and a 40.23% expansion comparable to the treatment for which potassium compost was not included and the plants were not splashed with ascobin in treatment A1C1.

The outcomes show that the nature of water system water and ascobin showering have a critical impact. Treatment B1C3 indicated the most elevated auxin movement with an estimation of 0.0843 μg. gm−1 dry weight, contrasted and the least estimation of auxin content in treatment B1C1.

The triple collaboration between potassium treatment, nature of water system water and ascobin splashing significantly affects auxin content. Treatment A3B2C1 indicated the most noteworthy incentive at an auxin movement of 0.0891 μg. gm−1 dry weight, contrasted and the least incentive in treatment A1B1C1, which was 0.0482 μg. gm^{-1} dry weight.

3.2. Gibberellin content in leaves (μg. gm−1 dry weight)

The outcomes appeared in Table 3 demonstrate that potassium manure, water system water and ascobin showering have no huge impact on gibberellin content. The outcomes show that the collaboration of potassium compost and the nature of water system water significantly affects gibberellin content, with a greatest estimation of 0.0734 μg. gm−1 dry load in treatment A3B2, contrasted and that in treatment A1B2, which gave the most reduced an incentive at 0.0471 μg. gm−1 dry weight. The twofold collaboration be-tween the potassium manure and ascobin showering additionally significantly affects gibberellin, with the most noteworthy estimation of 0.0710 μg. gm−1 dry load in treatment A2C3, with an expansion of 56.73% in examination with that in treatment A2C1. The outcomes show a huge contrast ence between the nature of water system water and ascobin showering. Treatment B1C3 demonstrated the most noteworthy gibberellin content at 0.0687 μg. gm−1 dry weight, contrasted and the most minimal substance in treatment B3C1.

Table 3
Effect of potassium fertilizer and spraying of ascobin in the gibberellin hormone content (μg. gm^{-1}dry weight) in leaves of the *Zea mays* under different salinity stress levels.

Potassium added kg K. ha^{-1} A		Salinity irrigation water ds. m^{-1} B	Spray level of Ascobin mg. L^{-1} C				A*B
0 A_1			$0C_1$	$300C_2$		$600C_3$	
		1 B1	0.0659	0.0535		0.0541	0.0578
		3 B2	0.0550	0.0452		0.0412	0.0471
		6 B3	0.0665	0.0624		0.0742	0.0677
100 A_2		1 B1	0.0454	0.0598		0.0849	0.0634
		3 B2	0.0480	0.0713		0.0759	0.0651
		6 B3	0.0426	0.0482		0.0521	0.0476
200 A_3		1 B1	0.0750	0.0732		0.0672	0.0718
		3 B2	0.0684	0.0823		0.0695	0.0734
		6 B3	0.0420	0.0557		0.0701	0.0559
C			0.0565	0.0613		0.0654	A
A*C		A1*C	0.0625	0.0537		0.0563	0.0576
		A2*C	0.0453	0.0598		0.0710	0.0587
		A3*C	0.0618	0.0705		0.0690	0.0671
							B
B*C		B1*C	0.0621	0.0622		0.0687	0.0643
		B2*C	0.0571	0.0663		0.0622	0.0619
		B3*C	0.0503	0.0555		0.0654	0.0571
L.S.D	A	B	C	A*B	A*C	B*C	A*B*C
$P < .05$	0.0018	0.0018	0.0018	0.00319	0.00319	0.00319	0.00552

The triple association between potassium treatment, nature of water system water and ascobin significantly affects gibberellin content. Treatment A2B1C3 demonstrated the most elevated gibberellin content at 0.0849 μg. gm−1 dry weight, contrasted and the least substance in treatment A1B2C3, which was 0.0412 μg. gm−1 dry weight.

3.3. Abscisic acid content in leaves (μg. gm^{-1} dry weight)

The results shown in Table 4 indicate that potassium fertilizer has no significant effect on abscisic acid content in *Z. mays* leaves.

The results show that irrigation water has a significant effect on this trait. Treatment B3 gave the highest value at 3.282 μg. gm−1 dry weight, compared with treatment B1, which had a value of 2.854 μg. gm−1 dry weight, where abscisic acid content increased by increasing salinity. Increasing the ascobin level significantly increased abscisic acid content in *Z. mays* leaves (3.155 and 3.506 μg. gm−1 dry weight) by spraying ascobin at levels C2 and C3 sequentially, compared with level C1.

Bilateral interactions between the potassium fertilizer and irrigation water have no significant effect on this trait. In the interaction of potassium fertilization and ascobin, the highest abscisic acid content was in treatment A1C3 at 3.847 μg. gm−1 dry weight, while the lowest abscisic acid content was in treatment A3C1 at 2.341 μg. gm−1 dry weight. The interaction between saline water and ascobin has a significant effect on the hormone. The highest value was in treatment B1C3 at 3.576 μg. gm−1 dry weight, compared with treatment B1C1, which gave the lowest value at 2.367 μg. gm−1 dry weight.

The results show that the triple interaction between the factors in this study has a significant effect. Treatment A1B2C3 achieved the highest abscisic acid content at 4.220 μg. gm−1 dry weight.

Table 3 shows the effect of the potassium fertilizer and ascobin spraying on gibberellin content (μg. gm−1 dry weight) in *Z. mays* under different salinity stress levels.

4. Discussion

The results of this study show a significant differences in the content of leaf plant hormones, such as auxin, gibberellin and abscisic acid treated with the potassium fertilizer (Tables 2–4).

The results shown in Tables 2 and 3 indicate a significant differences in the plant hormones auxin and gibberellin treated with saline water at different levels. In current study, the endogenous auxin and gibberellin contents decreased with increase water salinity levels

Table 4
Effect of potassium fertilizer and spraying of ascobin in the abscisic acid hormone content (μg. gm^{-1} dry weight) in leaves of the *Zea mays* under different salinity stress levels.

Potassium added kg K. ha^{-1} A		Salinity irrigation water ds. m^{-1} B	Spray level of Ascobin mg. L^{-1} C				A*B
0 A_1			$0C_1$	$300C_2$		$600C_3$	
		1 B1	2.550	2.340		3.920	2.937
		3 B2	2411	3.210		4.220	3.280
		6 B3	2.980	3.201		3.401	3.194
100 A_2		1 B1	2.680	2.680		3.410	2.923
		3 B2	3.030	3.111		2.591	2.911
		6 B3	2.631	3.911		3.781	3.441
200 A_3		1 B1	1.871	2.840		3.400	2.703
		3 B2	2.562	3.021		3.301	2.961
		6 B3	2.591	4.080		3.531	3.400
C			2.252	3.155		3.506	A
A*C		A1*C	2.647	2.917		3.847	3.137
		A2*C	2.780	3.234		3.261	3.091
		A3*C	2.341	3.314		3.411	3.847
							B
B*C		B1*C	2.367	2.620		3.576	3.411
		B2*C	2.668	3.114		3.271	3.051
		B3*C	2.544	3.731		3.571	3.345
L.S. D	A	B	C	A*B	A*C	B*C	A*B*C
$P < 0.05$	0.0086	0.0086	0.0086	0.0149	0.0149	0.0149	0.0258

as compared to control. It suggests that the reduction in growth under salt stress conditions is caused by reduced production of auxin and gibberellin. Table 4 shows significant differences in the estimation of plant hormones, such as abscisic acid, whose value increased by increasing salinity levels, which is attributed to the increased production of abscisic acid, which in turn stimulates the closure of the stomata. The closure of the stomata causes reduced photosynthesis, which reduces carbon dioxide content and increases oxidative stress [18].

Tables 2–4 indicate that auxin, gibberellin and abscisic acid increase when ascobin spraying concentrations increase because of the role of ascorbic acid in nutrient absorption, thus stimulating the increase of hormones. Ascorbic corrosive goes about as a cofactor for a few chemicals and directs the phytohormone-intervening flagging genius cesses and numerous physiological procedures in plants. These results are consistent with those found by Ref. [19]. Also, bilateral interactions between the potassium fertilizer and irrigation water have significant effects on the plant hormones auxin, gibberellin and abscisic acid in maize. The abscisic acid content in the leaf has a significant effects, which indicates that potassium plays a role in enhancing plants' tolerance to different salt stresses as well as in controlling plant hormones [20,21]. In this study, the bilateral interactions between ascobin spraying and irrigation water with different salinity levels show significant effects on plant hormones in the fall seasons, which positively reflects maize's improved tolerance to salt stress. These results are consistent with those found by Ref. [22] that ascobin improved salt resistance in cowpea by upgrading the gathering of nontoxic metabolites, for example, all out solvent sugars, proline and glycine betaine just as N, P and K as defensive adjustment.

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