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Original article

Effect of salinity stress and different levels of potassium fertilizer on yield quantitative and qualitative of Kochia (*Bassia scoparia* (L.) A.J. Scott)

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Extended abstract

Introduction

Today, increasing demand for plant products has been coupled with the reduction of the area of cultivated land due to the limitation of water and soil resources. Water and soil salinity are among the factors that prevent the yield of sufficient yield in crops. Live or non-live-stress tensions can have negative effects on plant production and can even threaten the survival of a plant (Boyer, 1982). Salinity stress is one of the most important factors limiting plant growth and agricultural production, especially in arid and semi-arid regions. However, passionate crops such as kochia can be used as a forage, soil remediation, biofuel and green space and carbon stabilizer (Khan and Ansari, 2008). Potassium is the dominant mineral ion in plant solutions and plays an important role in reducing osmotic potential in plant cells.

Material and methods

This research was carried out at the research farm of Agricultural Research Institute of Zabol University in 2016-17. The experiment was split plot based on randomized complete block design with three replications. Salinity stresses were classified into three levels including: 1, 7 and 14 $dS.m^{-1}$ as the main plot and potassium sulfate fertilizer at three levels: 100, 200 and 300 $kg.ha^{-1}$ as a sub plots. Each plot was four rows of cultivation, the distance between rows was 50 cm and the distance between 2 plants per row was 20 cm. Each plot consisted of 4 rows of planting. In this research, quantitative traits included: plant height, number of lateral branches, fresh and dry weight of the plant, leaf weight, leaf to stem ratio. And qualitative traits was measured include DMD, water soluble carbohydrates (WSC), acid soluble fiber (ADF), neutral detergent fiber (NDF), crude protein (CP) and ash (Ash). For evaluation of forage quality has been used, a NIR device or a near infrared spectrometer, which is the most accurate and, at the same time, the fastest technique for estimating the chemical composition of agricultural products.Analysis of variance of data was performed using SAS software version 9/1. The mean comparison of treatments was done using Duncan test at 5% level. Charts and tables were drawn using Excel and Word software.

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Results and discussion

According to the results of analysis of variance of data (Table 2), the main effects of salt stress and potassium fertilizer also showed a significant effect on plant height. Comparison of the mean interactions of the investigated factors showed that at all salinity levels, along with increasing potassium fertilizer, the height also increased with the highest altitude with 300 $kg.ha^{-1}$ potassium sulfate applications in salinity conditions of 1 $dS.m^{-1}$ (Table 3). Results of analysis of variance of data (Table 4) showed that the effects of salinity stress and potassium fertilizer, as well as their interactions, did not show a significant effect on the DMD of the plant. Comparison of mean of traits showed that salinity stress (1 dsm^{-1}) with 11.49% maximum water soluble carbohydrate and salinity level (14 dsm^{-1}) with 11.44% of the lowest values (Table 5). Also, comparison of mean of traits showed that salinity stress (1 dsm^{-1}) with 12.69% higher and salinity level (14 dsm^{-1}) with the lowest crude protein was 12.34% (Table 5).Comparison of mean of traits showed that salinity stress (1 dsm^{-1}) with 12.69% had the highest crude protein and salinity level (14 dsm^{-1}) with 12.34% of the lowest values (Table 5).

Conclusions

The results of the study on the effect of salinity stress and different levels of potassium on the quantitative characteristics of Kochi showed that all quantitative traits were completely subjected to salt stress and significantly decreased. The highest forage yield belonged to irrigation with salinity of 1 dSm-1 and lowest for irrigation with salinity of 14 dsm^{-1}. It seems that salinity was more effective on the quantitative traits of the plant and did not affect the quality of forage.

Keywords**:** Ash percentage, Crude protein, Forage yield, Stress

Table 1. Physical and chemical properties of soil

Soil texture	Sand	Silt	Clay	Nitrogen	Sodium	Potassium	Calcium	EC	pH
	---------- % ----------				----------ppm----------			ds/m	
Sandy loam	65.7	24	10.3	0.015	90.6	160	10.80	1.02	8.4

Table 2. Analysis of variance of quantitative traits in Kochia under the influence of salt stress and potassium sulfate

S.O.V	df	Leaf/ Stem Ratio	stem dry weight	leaf dry weight
Replication	2	0.013 ^{ns}	110.05 ^{ns}	47.53 ^{ns}
Salt stress (A)	2	0.006 ^{ns}	2347.37**	1939.56**
Error a	4	0.007	28.63	15.16
fertilizer	2	0.003 ^{ns}	345.21**	350.37**
A*B	4	0.0005^{ns}	22.90**	13.16*
Error b	12	0.001	2.79	3.05
C.V%	-	4.33	2.88	3.62

Table 2. Continued

S.O.V	df	plant dry weight	plant wet weight	No. lateral branch	High plant
Replication	2	232.12 ^{ns}	1838.48 ^{ns}	218.05*	31.21^{ns}
Salt stress (A)	2	8570.65**	23389.7**	1984.83**	2135.29**
Error a	4	56.08	647.84	26.19	10.56
fertilizer	2	1377.44**	8253.47**	576.21**	783.48**
A*B	4	63.97**	736.71*	28.43**	81.47**
Error b	12	6.42	152.16	5.03	10.35
C.V%	-	2.39	4.46	3.22	4.98

^{ns}, * and ** are non-significant, significant at 5% and 1% probability levels, respectively

Table 3. Comparison of means in the interactions between salinity and potassium sulfate on kochia quantitative traits

Saline	K_2SO_4	Leaf/ Stem Ratio	stem dry weight	leaf dry weight	plant dry weight	plant wet weight	No. lateral branch	High plant
$ds.m^{-1}$	$kg.ha^{-1}$		----------$kg.ha^{-1}$----------					cm
1	100	0.82^{abc}	67.90^{b}	55.70^{b}	123.26^{b}	296.97^{bc}	76.20^{c}	71.80^{bc}
	200	0.88^{a}	74.66^{a}	65.86^{a}	140.40^{a}	318.83^{b}	82.80^{b}	77.40^{b}
	300	0.86^{ab}	$76.^{03a}$	65.83^{a}	141.76^{a}	368.47^{a}	95.13^{a}	90.26^{a}
7	100	0.80^{bc}	55.10^{d}	43.60^{d}	98.66^{d}	259.95^{de}	69.93^{e}	59.66^{ef}
	200	0.81^{bc}	60.80^{c}	49.10^{c}	109.86^{c}	278.73^{cd}	69.20^{d}	64.86^{de}
	300	0.82^{abc}	65.26^{b}	53.96^{b}	118.82^{b}	296.67^{bc}	74.26^{c}	70.33^{cd}
14	100	0.78^{c}	30.93^{g}	24.33^{g}	55.06^{g}	180.50^{f}	44.46^{g}	33.13^{g}
	200	0.82^{abc}	42.33^{f}	35.03^{f}	77.13^{f}	239.13^{e}	57.40^{f}	54.13^{f}
	300	0.81^{bc}	49.23^{e}	40.03^{e}	88.80^{e}	253.93^{e}	63.20^{e}	59.80^{ef}
	LSD	*0.06*	*2.97*	*3.11*	*4.50*	*21.95*	*3.99*	*5.72*

Means within each column of each section followed by the same letter are not significantly different at P< 0.05 by Duncan's multiple range test

Table 4. Analysis of variance of qualitative traits in Kochia under the influence of salt stress and potassium sulfate

S.O.V	df	CF	Ash	NDF	ADF	WSC	DMD	CP
Replication	2	9.93^{ns}	1.25^{*}	25.87^{ns}	6.25^{ns}	1.50^{ns}	6.12^{*}	7.29^{ns}
salt stress (A)	2	0.99^{ns}	0.16^{ns}	0.61^{ns}	0.69^{ns}	0.10^{ns}	0.53^{ns}	0.31^{ns}
Error a	4	1.11	0.07	17.66	1.84	0.22	0.71	4.06
Fertilizer	2	1.14^{ns}	0.03^{ns}	0.27^{ns}	1.99^{ns}	1.26^{ns}	1.43^{ns}	0.84^{ns}
A*B	4	1.17^{ns}	0.09^{ns}	11.83^{ns}	1.24^{ns}	0.94^{ns}	1.48^{ns}	1.44^{ns}
Error b	12	0.78	0.15	12.77	3.50	0.69	2.42	2.65
C.V (%)	-	*2.55*	*4.49*	*5.29*	*3.08*	*7.04*	*3.93*	*13.05*

ns, * and ** are non-significant, significant at 5% and 1% probability levels, respectively

Table 5. Comparison of means in the interactions between salinity and potassium sulfate on Kochia qualitative traits

Treatment	CF	Ash	NDF	ADF	WSC	DMD	CP
Salt stress ($ds.m^{-1}$)							
1	34.97^{a}	8.77^{a}	67.76^{a}	61.02^{a}	11.94^{a}	39.77^{a}	12.69^{a}
7	34.59^{a}	8.71^{a}	67.53^{a}	60.64^{a}	11.90^{a}	39.47^{a}	12.42^{a}
14	34.30^{a}	8.69^{a}	67.24^{a}	60.48^{a}	11.74^{a}	39.29^{a}	12.34^{a}
LSD 5%	*1.38*	*0.36*	*5.50*	*1.77*	*0.62*	*1.10*	*2.63*
K_2SO_4 ($kg.ha^{-1}$)							
100	34.77^{a}	8.80^{a}	67.57^{a}	60.48^{a}	11.46^{a}	39.71^{a}	12.16^{a}
200	34.88^{a}	8.71^{a}	67.65^{a}	60.41^{a}	11.92^{a}	39.74^{a}	12.77^{a}
300	34.21^{a}	8.67^{a}	67.32^{a}	61.26^{a}	12.20^{a}	39.05^{a}	12.52^{a}
LSD 5%	*0.90*	*0.40*	*3.67*	*1.92*	*0.85*	*1.59*	*1.67*

Means within each column of each section followed by the same letter are not significantly different at P< 0.05 by Duncan's multiple range test.