Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 485-487
Received: 19-09-2019
Accepted: 21-10-2019

Rodda Chandana Devi
Research Scholar, Department of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

JV Polara
Professor, Department of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Corresponding Author:
Rodda Chandana Devi
Research Scholar, Department of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Effect of levels of sodic irrigation water on growth and yield attributing characteristics, yield and quality parameters of wheat (*Triticum aestivum* L.)

Rodda Chandana Devi and JV Polara

Abstract

A pot experiment was conducted at Net House, Department of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh to assess the effect of different levels of sodic irrigation water on growth and yield attributing characters, yield and quality parameters of wheat crop during the *rabi*- 2017. The experiment comprising of four levels of sodic irrigation water *viz*., 5.0, 10.0, 15.0 and 20.0 SAR (one factor) in completely randomized design (Factorial) replicated three times. Application of different levels of sodic irrigation water produced significant effect on days to heading, plant height (cm), number of tillers per plant, number of grains per spike, number of spikelets per spike, grain and straw yield, weight of 1000 grain and protein content (%) and produced non-significant effect on germination percentage, length of main spike (cm), number of grains per spikelet and days to maturity. The highest grain and straw yield of wheat crop was observed with the SAR- 5.0 and found lowest with SAR-20.0.

Keywords: Sodicity levels, growth, yield attributing characters, grain and straw yield, quality parameters

Introduction

Water is one of the most important inputs required for crop production. Much of the water contains high concentration of salts and its continuous use for irrigation may adversely affect the soil health and agricultural production. Degradation of soils with the use of alkali ground waters constitutes a major threat to irrigated agriculture in semi-arid parts especially South Asia (Minhas and Bajwa, 2001) [3].

About one-third of the food and fiber in the world is harvested from irrigated area, which occupy only about one-sixth of the crop land (Hillel, 2000). The rate of growing global population warrants increases in the area under irrigated agriculture to fulfill the future food and fiber needs, which will need additional amounts of water. Contrasting to this, the annual renewable freshwater resources for the foreseeable future are now largely allocated. There may be some areas where freshwater resources increase or decrease according to rainfall changes due to climate change, however, these are likely to occur at the level that is small compared to the increased future demands for freshwater (Wallace, 2000) [5].

In some parts of Rajasthan, Gujarat, Punjab, Haryana, Uttar Pradesh, Andhra Pradesh and Karnataka, the underground water available for irrigation has high sodicity (EC-variable, SAR>10 and RSC>4 me L^{-1}). The sodic water containing residual sodium carbonate (RSC) more than 2.5 me L^{-1} has been considered unsatisfactory for the irrigation (Wilcox *et al*. 1954) [6]. With the growing shortage of fresh water supplies, relatively poorer quality water will have to be increasingly utilized for irrigation purposes. Amongst the various categories of poor quality waters, sodic water have greater irrigation potential by virtue of their low salinity and amendability to reclam especially in semi-arid regions of North-West India where their occurance in ground waters is around 30-54% (Minhas and Bajwa, 2001) [3].

Research Methodology

For knowing the effect of different levels of sodic irrigation water on growth and yield attributing characters, grain and straw yield and quality parameters of wheat crop a pot experiment was done at Net House, Department of Agricultural Chemistry and Soil Science, Junagadh Agricultural University, Junagadh.

The soil of the experimental plot was clay loam in texture and slightly alkaline in reaction ($pH_{2.5}$ 8.08) without having any problem of salinity ($EC_{2.5}$ 0.48 dS m^{-1}). From the fertility point of view, the soil was moderately supplied with organic carbon (6.5 g kg^{-1}), available nitrogen

(297 kg ha^{-1}) and phosphorus (39.20 kg ha^{-1}) but was high in available potassium (425 kg ha^{-1}). Among the DTPA extractable micronutrients, iron (5.91 mg kg^{-1}), zinc (0.75 mg kg^{-1}) and manganese (8.72 mg kg^{-1}) status of the experimental soil found medium but was high with respect to copper (0.62 mg kg^{-1}) during *rabi*-2017 and the soil was stabilized by growing wheat crop.

Wheat variety GJW-463 was selected for this study. It was released in the year July, 2016 and this variety was released and developed by Wheat Research Station, Junagadh Agricultural University, Junagadh, Gujarat. All recommended package of practices was adopted for raising wheat.

Experiments designs was randomized complete block under one factor (water sodicity (SAR)) of the 16 water quality treatment combinations keeping 3 replications, sixteen treatments consisted of combinations of 4 levels of salinity (EC 2, 4, 6 and 8 dS m^{-1}) and 4 levels of sodicity (SAR 5, 10, 15 and 20). These waters were synthesized by dissolving required quantities of NaCl, Na_2SO_4, $CaCl_2$ and $MgSO_4$ in deionized water and the Cl: SO_4 and Mg: Ca ratios in above waters were kept as 1:1 and 2:1, respectively.

Results and Discussion

Effect of levels of sodic irrigation water on growth and yield attributing characters of wheat

The data concerned with growth and yield attributing characters like germination percentage, plant height, number of tillers $plant^{-1}$, number of grains per spike, number of grains per spikelet, number of spikelets per spike, length of main spike, weight of 1000 seed, days to heading and days to maturity were significantly influenced by irrigation water having variable sodicity and are presented in Table-1

Table 1: Effect of levels of sodic irrigation water on grain and straw yield of wheat

Treatments	Grain yield (g $plant^{-1}$)	Straw yield (g $plant^{-1}$)
Sodicity levels (S)		
S_1: 5.0 SAR	2.69	7.70
S_2: 10 SAR	2.63	7.63
S_3: 15 SAR	2.57	7.56
S_4: 20 SAR	2.44	7.43
S.Em.$\pm$	0.04	0.03
C.D. (P=0.05)	0.11	0.09

Germination percentage

The effect of different levels of sodic irrigation water did not show any significant effect on germination percentage of wheat crop, because of using of normal tap water for first two irrigations, the germination occurred with normal tap water only

Days to heading

The different levels of sodic irrigation water on number of days to heading was found significant. The number of days required for heading (59.58) was found significantly higher in S_1 (SAR-5.0) and it was at par with S_2 (59.25), and significantly the lowest number of days required for heading (58.17) was observed in S_4 (SAR-8.0) level of irrigation water. The results suggest that as the sodicity of the irrigation water increases, the number of days to heading decreases

Plant height

Plant height is a reliable index of plant growth and represents the infrastructure build up over a period. Plant height represents catalogue of growth and development indicating the building up of plant. Significant reduction in plant height was observed with increasing sodic irrigation water level. Result showed that plant height decreased with increased SAR. The highest plant height (53.56 cm) was observed in S_1 (SAR-5.0) and it was at par with S_2 (SAR-10.0), and S_2 (SAR-10.0) was at par with S_3 (SAR-15.0) and the lowest plant height (51.34 cm) was recorded at S_4 (SAR-20.0) level of sodicity of irrigation water. The plant height of wheat crop decreases to the tune of 1.17, 2.29 and 4.14 per cent as the sodicity levels increases in S_2, S_3 and S_4, respectively over S_1 level.

Number of tillers $plant^{-1}$

The effect of sodic irrigation water on number of tillers $plant^{-1}$ in wheat crop was statistically significant. Result showed that significantly number of tillers $plant^{-1}$ decreased with increasing sodicity. The highest number of tillers per plant (2.03 tillers $plant^{-1}$) was observed with S_1 (SAR-5.0), but it was at par with the S_2 (SAR-10.0), and S_2 (SAR-10.0) was remain at par with the S_3 (SAR-15.0) and S_4 (SAR-20.0) and the lowest (1.82 tillers $plant^{-1}$) was recorded at S_4 (SAR-20.0) level of sodicity of the irrigation water.

Length of main spike

Length of main spike of wheat crop was not significantly affected by different levels of sodic irrigation water. However the highest length of main spike (9.42 cm) was observed in S_1 (SAR-5.0), and the lowest (9.13 cm) was recorded at S_4 (SAR-20.0) level of sodic irrigation water.

Number of grains per spike

The effect of sodicity level of irrigation water on number of grains per spike of wheat crop was found significant. Significantly the highest number of grains per spike (41.98) was observed with S_1 (SAR-5.0) and it was at par with the S_2 (SAR-10.0) with 41.70 and S_3 (SAR-15.0) with 41.07 grains $spike^{-1}$. Significantly the lowest number of grains per spike (39.70) was found with sodicity levels of S_4 (SAR-20.0) level.

Number of grains per spikelet

Different levels of sodic irrigation water were not significantly influenced on number of grains per spikelet in wheat crop.

Number of spikelet's per spike

Number of spikelets per spike of wheat crop was significantly affected by different levels of sodic irrigation water. Result indicated that number of spikelets per spike was decreased with increased sodicity levels of irrigation water. Significantly the highest number of spikelets per spike (15.73) was observed in S_1 (SAR-5.0), but it was remain at par with S_2 (SAR-10.0) with 15.37 spikelets $spike^{-1}$, while S_2 was at par with S_3 with 15.00 spikelets $spike^{-1}$ and S_4 with 14.95 spikelets per spike

Days to maturity

The effect of different levels of sodic irrigation water did not show any significant difference on number of days to maturity on wheat crop.

Effect of Different Levels of Sodic Irrigation Water on Grain and Straw yield of wheat Crop

The data pertaining to the effect of different levels of sodic irrigation water on grain and straw yield of wheat were recorded after harvest of the crop and are presented in Table-2.

Table 2: Effect of levels of sodic irrigation water on test weight and protein content of grain after harvest of wheat

Treatments	Wt. of 1000 grain (g)	Protein content (%)
Sodicity levels (S)		
S_1: 5.0 SAR	46.92	23.13
S_2: 10 SAR	46.48	22.94
S_3: 15 SAR	45.85	22.56
S_4: 20 SAR	45.11	22.15
S.Em.±	0.40	0.05
C.D. (P=0.05)	1.15	0.14

Grain yield

The grain yield of wheat was decreased with increasing the level of sodicity of irrigation water. Significantly the highest grain yield (2.69 g plant^{-1}) was recorded under application of S_1 (SAR-5.0) sodic irrigation water, but it was remain at par with S_2 (SAR-10.0) and the yield obtained was (2.63 g plant^{-1}). Significantly the lowest grain yield (2.44 g plant^{-1}) was obtained with S_4 (SAR-20.0). The same trend was observed by Bajwa *et al.* (1992) [1] in cotton-wheat rotation, Pathan *et al.* (2000) [4] in clusterbean crop, Prasad *et al.* (2010) in lemongrass and revealed that the higher sodicity build up in soils irrigated with sodic water significantly decreased the yield of the crop.

Straw yield

The straw yield was significantly affected by increasing sodicity levels of irrigation water. Results showed that the straw yield per plant was decreased with increased SAR levels of irrigation water. The highest straw yield (7.70 g plant^{-1}) was observed in S_1 (SAR-5.0), but it was found at par with S_2 (SAR-10.0) and further S_2 (SAR-10.0) was found at par with S_3 (SAR-15.0), where as significantly the lowest straw yield (7.43 g plant^{-1}) was recorded at S_4 (SAR-20.0) level of sodicity. The per cent reduction in straw yield of wheat was 0.90, 1.88 and 3.50 per cent as levels of sodicity of irrigation water increased from S_2, S_3 and S_4 levels over S_1 level, respectively. These results are similar with Prasad *et al.* (2010) on lemongrass crop, Balasubramanium *et al.* (2017) [2] on vegetable crops and concluded that the plant mortality with sodic water might be attributed to the excess accumulation of sodium and imbalance of ions in shoot tissue

Effect of levels of sodic irrigation water on quality parameters

The data regarding with quality parameters like Test weight – 1000 seed weight (g) and protein content (%) were influenced significantly by saline and sodic irrigation water along with statistical interpretation and these are depicted in table-3

Table 3: Effect of different levels of sodic irrigation water on growth and yield attributing characters of wheat crop

Treatment	Yield attributing characters								
	Germination percentage	Days to heading	Plant height (cm)	No. of tillers per plant	Length of main spike (cm)	No. of grains per spike	No. grains per spikelet	No. of spikelets per spike	Days to maturity
Sodicity levels (S)									
S_1: 5.0 SAR	100.0	59.6	53.56	2.03	9.42	41.98	2.76	15.73	104.5
S_2: 10.0 SAR	97.1	59.3	52.93	1.95	9.37	41.70	2.72	15.37	104.5
S_3: 15.0 SAR	93.0	58.8	52.33	1.88	9.28	41.07	2.68	15.00	104.5
S_4: 20.0 SAR	91.7	58.2	51.34	1.82	9.13	39.70	2.64	14.95	104.5
S.Em.±	5.6	0.18	0.43	0.05	0.08	0.40	0.04	0.16	0.00
C.D. (P=0.05)	NS	0.51	1.24	0.13	NS	1.16	NS	0.47	NS

Test weight - 1000 seed weight (g)

Test weight of grain was significantly affected by increasing sodic irrigation water levels. Significantly the highest test weight (46.92 g) was observed in S_1 (SAR-5.0) and it was at par with S_2 (SAR-10.0) and S_3 (SAR-15.0) with 46.48 and 45.85 g, respectively and significantly the lowest test weight (45.11 g) was observed with S_4 (SAR-20.0). The same trend was observed by Bajwa *et al.* (1992) [1] in cotton-wheat rotation, Pathan *et al.* (2000) [4] in clusterbean crop, Prasad *et al.* (2010) in lemongrass and concluded that the higher salinity and sodicity build up in soils irrigated with sodic water significantly decreased the yield of the crop there by 1000 grain weight

Protein content

Application of sodic irrigation water produce significant effect on protein content in grain of wheat. Significantly the highest protein content (23.13%) was observed with S_1 (SAR-5.0). However, decreased in protein content observed with increasing sodicity level, the lowest protein content (22.15%) was observed with S_4 (SAR-20.0) sodicity level. Each levels of sodic irrigation water decrease the protein content in wheat grain significantly and the reduction was 0.82, 2.46 and 4.42 per cent with S_2, S_3 and S_4 levels, respectively over S_1 level of sodicity.

References

1. Bajwa MS, Choudhary OP, Josan AS. Effect of continuous irrigation with sodic and saline-sodic waters on soil properties and crop yields under cotton-wheat rotation in North-Western India. Agricultural Water Management. 1992; 22(4):345-356.
2. Balasubramaniam P, Baskar M, Pandiyarajan P, Kaledhonkar MJ. Effect of canal and alkali water under cyclic mode on performance of rice and residual vegetables. 5th National Seminar –Climate Resilient Saline Agriculture: Sustaining Livelihood Security January Indian Society of Soil Salinity and Water Quality, Karnal, Haryana. 2017; 44:21-23.
3. Minhas PS, Bajwa MS. Use and management of poor quality waters for the Rice-Wheat based production system. Journal of Crop Production. 2001; 4(1):273-306.
4. Pathan ARK, Chhipa BR, Lal P, Vyas KK. Response of clusterbean to saline and sodic waters under different soils. Annals of Agriculture Research. 2000; 21(1):42-47.
5. Wallace JS. Increasing agricultural water-use efficiency to meet future food production. Agriculture Ecosystems & Environment. 2000; 82:105-119.
6. Wilcox LY, Blair OY, Bower CA. Effect of bicarbonates on the suitability of water for irrigation. Soil Science. 1954; 77(4):59-276.