International Journal of Agricultural Sciences ☞DOI:10.15740/HAS/IJAS/18.2/780-785
Volume **18** | Issue 2 | June, 2022 | 780-785 ■ ISSN : 0973-130X Visit us : *www.researchjournal.co.in*

Research Paper

Soil properties as influenced by use of irrigation water having variable RSC and different varieties of groundnut (*Arachis hypogea* L.)

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Abstract : A pot experiment was conducted during summer-2019 at Net House, Department of Agricultural Chemistry and Soil Science, Junagadh Agricultural University, Junagadh to study the "Soil properties and different varieties of groundnut as influenced by variable RSC of irrigation water". The pot experiment comprising of four RSC levels (0, 2.5, 5.0 and 7.5 meq L^{-1}) and four different groundnut varieties (V_1- TG-37-A, V_2- TPG-41, V_3- GJG-31 and V_4- GG-6) by adopting completely randomized design (Factorial) replicated three times. The available P_2O_5, organic carbon and available Mn of soil after harvest of the crop were found maximum with RSC- 0 meq L^{-1}. Remaining micronutrients were not affected by RSC water and varieties.The water soluble cations like Ca, Mg, Na and K, exchangeable cations like Ca, Mg and CEC and EC2.5 and ECe were found maximum with irrigation water having RSC -0 meq L^{-1}. Water soluble CO_3^{2-} and HCO_3^- exchangeable cations like Na and ESP, $pH_{2.5}$ and pHs were observed highest with RSC value 7.5 meq L^{-1}. The highest value of available K_2O and organic carbon, water soluble cations like Mg and K, exchangeable K and $EC_{2.5}$ were observed with the variety V_2- TPG-41. Exchangeable Na and ESP and available N were observed highest with variety V_1- TG-37-A. The combined effect of RSC of irrigation water and variety was found significant on available N, water soluble Ca, Mg, K and ESP of soil after harvest of the groundnut crop.

Key Words : Groundnut, Sodicity, RSC, Variety, Available macronutrients, Available micronutrients, Wtaer soluble, Exchangeable cations, soil properties

View Point Article : Kumari, Dewanshi, Ranpariya, K. B., Davara, M. A. and Polara, J. V. (2022). Soil properties as influenced by use of irrigation water having variable RSC and different varieties of groundnut (*Arachis hypogea* L.). *Internat. J. agric. Sci.*, **18** (2) : 780-785, **DOI:10.15740/HAS/IJAS/18.2/780-785.**

Article History : Received : 30.03.2022; **Revised :** 13.04.2022; **Accepted :** 16.05.2022

Introduction

In arid and semi-arid regions, ground water is either the major or the only source of irrigation. Most of the ground water has high residual sodium carbonate (RSC) which is a very serious problem. The sodic water containing residual sodium carbonate (RSC) more than 2.5 meq L^{-1} has been considered unsatisfactory for the irrigation (Wilcox *et al*., 1954). The use of sodic water for irrigation adversely affects productivity of soil by influencing the uptake of nutrients and many physico-chemical soil properties. High RSC irrigation water is characterized by low total salt concentration. Consequently, the concentration of sodium in the soil

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solution and exchange complex increases and leads to the development of alkali (sodic) conditions. High carbonate and bicarbonate concentration in irrigation water leads to precipitation of calcium and magnesium as carbonate and bicarbonate in the soil solution. This results in loss of calcium and magnesium ions and increase of sodium ion on the exchange complex. The soils acquire unusual hardness. These changes lead to osmotic and ion- specific effects as well as imbalances in plant nutrition, which may range from deficiencies in several essential nutrients to toxic levels of sodium (Na^+).

The area under irrigated summer groundnut accounts for about 16 % of the total area and it contributes to about 28% of the total production.

Material and Methods

The important physical and chemical characteristics of the soil under study and experimental techniques followed for the present investigation have been described in the first part of this paper (Kumari *et al.*, 2022).

The soil samples were collected from each pot of experiment after harvest of crop. All the soil samples were air dried and powdered with a wooden mortar and pestle and passed through 2 mm sieve. Available N, P_2O_5,K_2O and OC at initial and at harvest and $EC_{2.5}$, ECe, $pH_{2.5}$. pHs and ESP as well as water soluble and exchangeable cations of soil after harvest of the crop were determined using standard procedure (Jackson, 1973).

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of variable RSC of irrigation water on available macro nutrients :

The data presented in Table 1 clearly indicated that the available macronutrients and organic carbon content in soil after harvest of the crop significantly decreases as increase in RSC levels of irrigation water from 0 meq L^{-1} to 7.5 meq L-1. The highest OC (7.40 g kg^{-1}) and available P_2O_5 (34.98 kg ha^{-1}) were obtained with RSC levels of irrigation water at 0 meq L^{-1}. Similar results were found by Dogra (2016) in barley. This decrease in soil OC may be due to fact that at higher sodicity conditions were becoming increasingly detrimental to microbial community and this was demonstrated by

Table 1: Effect of variable RSC levels of irrigation water and groundnut varieties on organic carbon and available macronutrients of soil

Treatments	Organic carbon (g kg^{-1})	Available macronutrients (kg ha^{-1})		
		N	P_2O_5	K_2O
RSC levels (A)				
A0 : 0 meq L^{-1}	7.40	191	34.98	493
A1 : 2.5 meq L^{-1}	6.86	183	32.81	473
A_2: 5.0 meq L^{-1}	6.29	182	32.06	467
A3 : 7.5 meq L^{-1}	5.28	177	31.22	465
S.E.+	0.18	5.3	0.52	7.9
C.D. (P=0.05)	0.52	NS	1.49	NS
Variety (V)				
V_1: TG-37-A	6.54	200	31.88	486
V_2: TPG-41	7.13	186	33.30	494
V_3: GJG-31	6.51	169	32.36	462
V_4: GG-6	5.65	178	33.53	456
S.E.±	0.18	5.3	0.52	7.9
C.D. (P=0.05)	0.52	15.3	NS	22.7
A×V interaction				
S.E.+	0.36	10.6	1.04	15.8
C.D. (P=0.05)	NS	30.6	NS	NS
C.V.%	9.74	10.0	5.48	5.8

NS= Non-significant

decline in percentage of organic carbon present as microbial biomass carbon. Available N and K_2O were not affected by RSC levels of irrigation water. Similar results were found by Jakhar *et al.* (2013). Significantly the highest (Table 2) Mn content (6.80 mg kg^{-1}) was observed with irrigation water having RSC 0 meq L^{-1}. The Fe, Zn and Cu content were remain unaffected. Increasing levels of RSC of irrigation water from 0 meq L^{-1} to 7.5 meq L^{-1} decreased the water soluble and exchangeable cations and exchangeable Ca, Mg, K (Table 3) and soil properties like CEC, $EC_{2.5}$ and ECe (Table 4). While water soluble anions like CO_3^{2-} and HCO_3^- , exchangeable Na, ESP, $pH_{2.5}$ and pHs were significantly increased with the increase of RSC value of irrigation water. Significantly the highest water soluble Ca^{++} (0.86 me/100 g), Mg^{++} (0.61 me/100 g), Na+ (36.55 me/100 g), exchangeable Ca^{++} (43.75 me/100 g), Mg^{++} 5.28 me/100 g) and CEC (58.24 c mol (p^+) kg^{-1}) were observed with irrigation water having RSC 0 meq L^{-1}. Significantly the highest exchangeable Na^+ (9.35 me/100 g) was observed with RSC value 7.5 meq L^{-1}. This increase in Na concentration occurred due to increasing levels of NaCl, Na_2SO_4 and $NaHCO_3$ in irrigation water applied to soil. The decrease in soluble sodium is to an increased adsoption on exchange complex as an evident to increase the ESP of soil. Similar results were obtained by Kumari *et al.* (2015).The highest water soluble K^+ (0.17 me/100 g) was observed with RSC value RSC 0 meq L^{-1}, whereas the exchangeable K^+ of soil was non-significant with increase in RSC levels of irrigation water. Significantly the highest CO_3^{2-} and HCO_3^- (0.73 me/100 g) was observed with RSC value 7.5 meq L^{-1}. The highest ESP (17.81) was observed with A_3 (RSC- 7.5 meq L^{-1}). Increase in ESP of the soil due to the use of different RSC of water may be attributed to an increased sodicity and decreased activity of calcium providing more opportunity for Na to be adsorbed on the exchange complex. Similar results were reported by, Girdhar (1996). Significantly the highest $EC_{2.5}$ (1.75 dS m^{-1}) and ECe (5.38 dS m^{-1}) of the soil were observed with the application of Ao (RSC- 0 meq L^{-1}), whereas the highest $pH_{2.5}$ (8.77) and pHs (8.15) of the soil were observed with the application of A_3 (RSC- 7.5 meq L^{-1}) levels of irrigation water. Similar results were also reported by Girdhar (1996), Kumawat and Yadav (2012) and Dogra (2016).

Effect of different groundnut varieties :

The availability of macronutrients and organic carbon (Table 1) content in soil as well as water soluble and

Table 2 : Effect of variable RSC levels of irrigation water and groundnut varieties on available micronutrients content (mg kg^{-1}) in soil after harvest of crop

Treatments	Micro nutrient content (mg kg^{-1})			
	Fe	Mn	Zn	Cu
RSC levels (A)				
A0 : 0 meq L^{-1}	5.83	6.80	0.532	0.88
A1 : 2.5 meq L^{-1}	5.78	6.54	0.530	0.85
A_2: 5.0 meq L^{-1}	5.78	6.03	0.525	0.83
A3 : 7.5 meq L^{-1}	5.60	5.48	0.522	0.85
S.E.±	0.12	0.16	0.008	0.03
C.D. (P=0.05)	NS	0.46	NS	NS
Variety (V)				
V_1: TG-37-A	5.66	5.97	0.528	0.84
V_2: TPG-41	5.75	6.55	0.528	0.86
V_3: GJG-31	5.77	6.08	0.526	0.83
V_4: GG-6	5.81	6.26	0.528	0.89
S.E.+	0.12	0.16	0.01	0.03
C.D. (P=0.05)	NS	NS	NS	NS
A×V interaction				
S.E.±	0.24	0.32	0.02	0.05
C.D. (P=0.05)	NS	NS	NS	NS
CV%	7.21	8.87	5.01	10.34

NS= Non-significant

Table 3: Effect of variable RSC levels of irrigation water and groundnut varieties on water soluble and exchangeable (net exchangeable) cations, CEC and ESP of soil after harvest of crop

Treatments	Water soluble cations (me/100 g)					Exchangeable cations (me/100 g)				CEC (c mol (p+) kg^{-1})	ESP
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{2+}+ HCO_3^{-}	Ca^{++}	Mg^{++}	Na^{+}	K^{+}		
RSC levels (A)											
A0: 0 meq L^{-1}	0.86	0.61	36.55	0.17	0.45	43.75	5.28	8.75	0.47	58.24	15.04
A1: 2.5 meq L^{-1}	0.44	0.56	29.00	0.10	0.54	42.04	5.01	8.86	0.45	56.36	15.78
A_2: 5.0 meq L^{-1}	0.37	0.47	27.25	0.09	0.70	38.54	4.79	9.02	0.45	52.80	17.14
A3: 7.5 meq L^{-1}	0.37	0.40	25.04	0.08	0.73	38.17	4.70	9.35	0.44	52.66	17.81
S.E.$\pm$	0.01	0.01	0.77	0.002	0.02	0.87	0.13	0.12	0.01	0.90	0.26
C.D. (P=0.05)	0.04	0.04	2.21	0.01	0.07	2.51	0.38	0.35	NS	2.59	0.76
Variety (V)											
V_1: TG-37-A	0.51	0.50	28.91	0.12	0.59	39.92	4.79	9.27	0.46	54.44	17.16
V_2: TPG-41	0.52	0.55	29.21	0.12	0.61	39.54	5.14	8.85	0.47	54.00	16.51
V_3: GJG-31	0.51	0.48	28.75	0.11	0.64	42.50	4.85	8.81	0.44	56.60	15.62
V_4: GG-6	0.50	0.50	30.98	0.10	0.59	40.54	5.00	9.04	0.44	55.02	16.48
S.E.$\pm$	0.01	0.01	0.77	0.002	0.02	0.87	0.13	0.12	0.01	0.90	0.26
C.D. (P=0.05)	NS	0.04	NS	0.01	NS	NS	NS	0.35	0.02	NS	0.76
A×V interaction											
S.E.+	0.03	0.03	1.53	0.004	0.05	1.74	0.27	0.24	0.02	1.80	0.53
C.D. (P=0.05)	0.07	0.08	NS	0.01	NS	NS	NS	NS	NS	NS	1.52
C.V.%	8.58	8.87	9.01	6.66	14.23	7.42	9.36	4.70	5.76	5.65	5.55

NS= Non-significant

Table 4 : Effect of variable RSC levels of irrigation water and groundnut varieties on $EC_{2.5}$, EC_e, $pH_{2.5}$ and pH_s of soil

Treatments	$EC_{2.5}$ (dS m^{-1})	EC_e (dS m^{-1})	$pH_{2.5}$	pH_s
RSC levels (A)				
A0: 0 meq L^{-1}	1.75	5.38	8.10	7.80
A1: 2.5 meq L^{-1}	1.10	3.95	8.27	8.00
A_2: 5.0 meq L^{-1}	0.91	3.25	8.30	8.01
A3: 7.5meq L^{-1}	0.78	3.08	8.77	8.15
S.E.+	0.04	0.11	0.15	0.05
C.D. (P=0.05)	0.11	0.32	0.42	0.13
Variety (V)				
V_1: TG-37-A	1.13	3.86	8.30	7.94
V_2: TPG-41	1.25	4.03	8.51	8.01
V_3: GJG-31	1.07	3.78	8.26	8.01
V_4: GG-6	1.09	3.99	8.37	7.99
S.E.$\pm$	0.04	0.11	0.15	0.05
C.D. (P=0.05)	0.11	NS	NS	NS
A×V interaction				
S.E.+	0.08	0.22	0.29	0.09
C.D. (P=0.05)	NS	NS	NS	NS
C.V.%	11.64	9.81	6.04	1.98

NS= Non-significant

exchangeable cations, ESP, soil $EC_{2.5}$ (Table 3) were significantly affected by different groundnut varieties. Micronutrients remain unaffected (Table 2). Significantly the highest organic carbon (7.13 g kg^{-1}), available K_2O (494 kg ha^{-1}), water soluble Mg^{++} (0.55 me/100 g), K^+ (0.12 me/100 g), exchangeable K^+ (0.47 me/100 g), $EC_{2.5}$

Table 5: Interaction effect between variable RSC levels ofirrigation water and groundnut varieties on available nitrogen (kg ha^{-1}) in soil

	A0 (0 meq L^{-1})	A1 (2.5 meq L^{-1})	A2 (5.0 meq L^{-1})	A3 (7.5 meq L^{-1})	Mean
V1: TG-37-A	222	222	187	172	200
V2: TPG-41	202	168	191	183	186
V3: GJG-31	174	157	171	174	169
V4: GG-6	168	187	181	179	178
Mean	191	183	182	177	
S.E.+	10.6		C.D. (P=0.05)	30.6	

Table 6 : Interaction effect between variable RSC levels of irrigation water and groundnut varieties on water soluble Ca^{+2} (me/100 g) of soil

	A0 (0 meq L^{-1})	A1 (2.5 meq L^{-1})	A2 (5.0 meq L^{-1})	A3 (7.5 meq L^{-1})	Mean
V1: TG-37-A	0.92	0.47	0.30	0.37	0.51
V2: TPG-41	0.82	0.47	0.42	0.37	0.52
V3: GJG-31	0.83	0.47	0.30	0.43	0.51
V4: GG-6	0.87	0.35	0.45	0.32	0.50
Mean	0.86	0.44	0.37	0.37	
S.E.+	0.03		C.D. (P=0.05)	0.07	

Table 7: Interaction effect between variable RSC levels ofirrigation water and groundnut varieties on water soluble Mg^{+2}(me/100 g) of soil

	A0 (0 meq L^{-1})	A1 (2.5 meq L^{-1})	A2 (5.0 meq L^{-1})	A3 (7.5 meq L^{-1})	Mean
V1: TG-37-A	0.60	0.50	0.43	0.47	0.50
V2: TPG-41	0.68	0.67	0.42	0.45	0.56
V3: GJG-31	0.57	0.43	0.62	0.32	0.47
V4: GG-6	0.60	0.65	0.40	0.37	0.40
Mean	0.61	0.56	0.47	0.40	
S.E.±	0.03		C.D. (P=0.05)	0.08	

Table 8 : Interaction effect between variable RSC levels of irrigation water and groundnut varieties on water soluble K^+ (me/100 g) of soil

	A0 (0 meq L^{-1})	A1 (2.5 meq L^{-1})	A2 (5.0 meq L^{-1})	A3 (7.5 meq L^{-1})	Mean
V1: TG-37-A	0.184	0.118	0.109	0.081	0.12
V2: TPG-41	0.188	0.100	0.090	0.085	0.12
V3: GJG-31	0.152	0.096	0.090	0.083	0.11
V4: GG-6	0.152	0.100	0.085	0.079	0.10
Mean	0.17	0.10	0.09	0.08	
S.E.+	0.004		C.D. (P=0.05)	0.01	

Table 9: Interaction effect between variable RSC levels of irrigation water and groundnut varieties on ESP of soil

	A0 (0 meq L^{-1})	A1 (2.5 meq L^{-1})	A2 (5.0 meq L^{-1})	A3 (7.5 meq L^{-1})	Mean
V1: TG-37-A	14.80	15.93	19.03	18.90	17.16
V2: TPG-41	15.38	15.51	16.57	18.58	16.51
V3: GJG-31	14.76	14.66	16.24	16.83	15.62
V4: GG-6	15.21	17.03	16.72	16.95	16.48
Mean	15.04	15.78	17.14	17.81	
S.E.+	0.53		C.D. (P=0.05)	1.52	

(1.25 dS m^{-1}) were observed with groundnut variety V_2- TPG-41. Significantly the highest available N (200 kg ha^{-1}) in soil was obtained with V_1 (TG-37-A). It is contrary to the findings of Vadaliya (2018) on sesame and Bhorania (2018) on chickpea crop. The effect of different groundnut varieties was found non-significant for the available P_2O_5 content in the soil. Similar results were found by Vadaliya (2018) on sesame and Bhorania (2018) on chickpea. The available micronutrients (Fe, Zn, Mn and Cu) content of the soil was not influenced significantly with different groundnut varieties. Similar results were obtained by Vadaliya (2018) on sesame, Ribadiya (2018) on pearl-millet and Bhorania (2018) on chickpea crop. Exchangeable Na^+ (9.27 me/100 g) and ESP (17.16 %) were observed with V_1: TG-37-A.

Interaction effect of variable RSC levels of irrigation water and groundnut varieties:

The interaction effect between variable RSC levels of irrigation water and varieties on available N (Table 5), water soluble Ca^{2+} (Table 6), Mg^{2+} (Table 7), K^+ (Table 8) and ESP (Table 9) were observed significant after the harvest of crop, while remaining parameter found non- significant. The available nitrogen (222 kg ha^{-1}) was found maximum with treatment combination $A_0 \times V_1$ (RSC- 0 meq $L^{-1} \times V_1$- TG-37-A) and $A_1 \times V_1$ (RSC- 2.5 meq $L^{-1} \times V_1$- TG-37-A). The highest water soluble Ca^{2+} (0.92 me/ 100 g) was observed with $A_0 \times V_1$ (RSC- 0 meq $L^{-1} \times V_1$- TG-37-A). The highest value of water soluble Mg^{2+} of soil (0.68 me/100 g) was observed with $A_0 \times V_2$ (RSC- 0 meq $L^{-1} \times V_2$- TPG-41). The highest water soluble K^+ (0.188 me/100 g) was found with $A_0 \times V_2$ (RSC- 0 meq $L^{-1} \times V_2$- TPG-41). The highest ESP (19.03) was observed with $A_2 \times V_1$ (RSC- 5.0 meq $L^{-1} \times V_1$- TG-37-A).

Conclusion:

The organic carbon, available P_2O_5, available Mn, water soluble Ca^{2+}, Mg^{2+}, K^+ and exchangeable Ca^{2+}, Mg^{2+}, CEC, $EC_{2.5}$ (dS m^{-1}) and ECe (dS m^{-1}) were found the highest with irrigation water having RSC 0 meq L^{-1} and groundnut variety V_2: TPG-41. The exchangeable Na^+, ESP, $pH_{2.5}$ and pHs found maximum with irrigation water having RSC 7.5 meq L^{-1}. Available N, exchangeable Na and ESP were found the highest with variety V_1- TG-37-A.

REFERENCES

Bhorania, N.C. (2018). Effect of salinity on bio-chemical parameters, nutrient composition and yield of chickpea (*Cicer aritinum* L.) varieties. M.Sc. (Ag.) Thesis, Junagadh Agricultural University, Junagadh, Gujarat (India).

Dogra, P. (2016). Effect of FYM and Zinc Application on Soil Properties, Nutrient Availability and Yield of Barley (*Hordeum Vulgare* L.) under Irrigation with Different RSC Water. Ph.D. Thesis submitted to Sri Karan Narendra Agricultural University, Jobner, Raja.

Girdhar, I. K. (1996). Effect of leaching with waters of varying residual sodium carbonate, SAR and electrolyte concentration on properties of a Haplusalf. *J. Indian Society of Soil Science,* **44** : 495-499.

Jackson, M. L. (1973). *Soil chemical analysis.* Prentice Hall of India Pvt. Ltd., New Delhi, India.

Kumari, Dewanshi, Ranpariya, K.B., Davara, M.A. and Polara, J. V. (2022). Influence of variable RSC levels of irrigation water and groundnut varieties on growth, yield and yield attributes and quality. *International J. Plant Sciences.*

Kumari, S., Yadav, B. L., Verma, H. P., Meena, J. S. and Pancholi, P. (2015). Effect of sodic water, biofertilizer and phosphorus on physical properties of soil, yield attributes and yield of mungbean. *Ann. Agric. Res.,* **36** (4) : 394-399.

Kumawat, S. R. and Yadav, B. L. (2012). Effect of zinc and vermicompost on fenugreek (*Trigonella foenum graecum* L.) under irrigation with different RSC water. *J. Food Legumes*, **25** (2) : 156-158.

Ribadiya, T. R. (2018). Effect of salinity on bio-chemical parameters, nutrient composition and yield of pearl millet (*Pennisetum glaucum* L.) varieties. M.Sc. (Ag.) Thesis, Junagadh Agricultural University, Junagadh, Gujarat (India).

Vadaliya, B. M. (2018). Effect of salinity on bio-chemical parameters, nutrient composition and yield of sesame (*Sesamum indicum* L.) varieties. M.Sc. (Ag.) Thesis, Junagadh Agricultural University, Junagadh, Gujarat (India).

Wilcox, L.V., Blair, G.Y. and Bower, C. A. (1954). Effect of bicarbonate on suitability of water for irrigation. *Soil Science*, **77** (4) : 259-266.

Yaduvanshi, N.P.S. (2015). Nutrient management strategies for sustaining crop production with sodic water. *Annals of Plant & Soil Research*, **17**: 114-124.