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Cationic composition in plant under irrigated fields of Bilara tehsil of Jodhpur district

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Abstract

The present investigation "cationic composition in plant under irrigated fields of Bilara Tehsil of Jodhpur district" was undertaken to assess the cationic composition of plant leaves. Forty crop plant samples from respective irrigated fields were collected. In general, of the sodium, potassium, calcium and magnesium cations of plant samples varied from 0.90 to 2.26, 1.27 to 5.06, 0.23 to 0.67 and 0.32 to 0.64 with mean values of 1.52, 2.85, 0.49 and 0.46 per cent, respectively. The sodium and calcium content in plant increased with EC and potential salinity of irrigation water while potassium and magnesium content decreased. The Na/K, Ca/Mg and Na/Ca ratio in plant samples varied from 0.24 to 1.66, 0.44 to 1.88 and 1.55 to 9.83 with mean values of 0.62, 1.11 and 3.46, respectively. Based on quality of ground water and status of salinity and alkalinity of soils, nine management units were identified and accordingly management practices were suggested for better utilization of soil and water in study area.

Key words: Farmer field, Cations, Plant leaves, potassium and magnesium

Introduction

The salt content of soil closely related to salt content of irrigation water (Khandelwal and Lal, 1991) therefore, quality of irrigation water in relation to its impact on soil properties is of interest in arid and semi arid areas. In Rajasthan, arid and semi-arid tract occupy about three fourth of the state and ground water which is dubious quality is the main source of irrigation in this belt. Presence of dissolved salts in higher proportion is a common feature of ground water in western Rajasthan (Garg, 2011). In general, the chemical quality of ground water is fresh in the eastern part except in the localized area of Bharatpur district. However, chemical quality in the major parts of western Rajasthan is brackish to saline. The arid districts of western Rajasthan viz., Barmer, Bikaner, Churu, Ganganagar, Hanumangarh, Jaisalmer, Jalore, Jodhpur, Nagaur and Pali have ground waters. Majority of the ground water in the western arid districts have EC up to 10 dSm^{-1} whereas in semi arid and humid districts waters have EC up to 5 dSm^{-1} and 2.2 dSm^{-1}, respectively. A systematic study on quality of water and soil is necessary for better utilization of water and soil resources to tackle water and soil problems. The semi- arid and arid area of Rajasthan necessitates the application of supplemental water for optimizing crop production. Majority of the tube well waters contain high concentration of salts and their continuous use for irrigation adversely affects the crop production and causes soil deterioration. It is necessary to increase the better crop production in that area. It necessitates continuous monitoring of ground water for assessing the possible damage on salinity and alkalinity induced soil health (Sharma, 2011). Salinity and sodicity are known to influence physiological, biochemical and morphological changes in plants, which reflect on overall performance of the plant. Generally, these changes due to salinity stress may adversely affect the plant growth and metabolism. However, under such conditions some plant species may thrive and yield better than other species by effectively adjusting or modifying their metabolism. Since, the characterization of soil health parameters is lacking in the study area under the influence of underground irrigation water

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which is essential for better utilization of soil and irrigation water to obtain satisfactory yield by modifying the cultural practices in accordance with the nature of soil and quality of water. The majority of soils of the Bilara tehsil were loamy sand in nature, with mild salinity and moderate alkalinity problem. According to the classification suggested by Sehgal (1987) majority of the soils (67.5%) of the Bilara tehsil found under the class Vs.M. (very slight salinity and moderate alkalinity), (15%) S.M. (slight salinity and moderate alkalinity), (10%) Vs.St. (very slight salinity and strong alkalinity) and (7.5%) Vs.S.(very slight salinity and slight to negligible alkalinity). In the plant samples Na+ and Ca^{+2} content increased with increase of EC of irrigation water and Mg^{+2} with increase in pH of irrigation water. Based on quality of ground water and status of salinity and alkalinity of soils, nine management units were identified and accordingly management practices were suggested for better utilization of soil and water in study area. Soil properties are greatly influenced by the quality of ground irrigation water. A water containing excessive soluble salts is unsuitable for irrigation. If sodium is the dominating cation, frequent application of such water deteriorates the physical conditions of soil causing soil dispersion, which reduce infiltration rate and soil aeration. On the other hand, presence of Ca^{2+} and Mg^{2+} in excess, increase the osmotic pressure of soil solution thereby causes disturbance in the mechanism of the uptake of nutrients and water by plants.

Materials and Methods

The investigation reported here in "cationic composition in plant under irrigated fields of Bilara Tehsil of Jodhpur district" was undertaken in the year 2016-17. The Bilara Tehsil is situated in the south-eastern part of the Jodhpur district between latitudes of 26°20'54.243" and 260 25'53.695" N and Longitudes of 73°22'55.33" and 73°53'19.113" E. It occupies an area of 1451.89 sq. km and bounded by Pali district in the east-south and north-west and Nagaur district touches in the north-east. It falls under region 2nd of the agro-ecological map (Hot arid eco-region with desert and saline soils) and in the IIB zone, named as transitional plain of Luni Basin.

Climate

The Tehsil experiences semi-arid to sub humid type of climate. Mean annual rainfall (1971-2016) of the district is 374 mm. Rainy days are limited to maximum 15 in a year. Almost 80 per cent of the total annual rainfall is received during the southwest monsoon, which enters the district in the first week of July and withdraws in the mid of September. As the Tehsil lies in the desert area, extremes of heat in summer and cold in winter are the characteristic of the desert. Both day and night temperatures increase gradually and reach their maximum in May and June respectively. The temperature varies from 49°C in summer to 1^0C in winter. The annual maximum potential evapotranspiration in the district is quite high and is highest (264.7 mm) in the month of May and lowest (76.5 mm) in the month of December.

Vegetation

Vegetation is the main component of the organic matter which sustains soil fertility status and microbial population in soil and balancing to the natural environment. It is therefore essential to add information on natural vegetation of the study area. In the study area, common trees are khejri (*Prosopis cineraria*), babool (*Acacia arabica*), vilayati babul (*Prosopis juliflora*), khair (*Acacia catechu*), kumat (*Acacia senegal*), neem (*Azadirachta indica*) and sisam (*Dalbergia sissoo*), common shrubs and bushes are munja (*Saccharum munja*), aak (*Calotrophis procera*), dhatura (*Datura metel*), kheep (*Leptadenia pyrotechnica*) and kair (*Capparis dessidua*). Main crops of the study area are: (i) Cotton (*Gossypium spp.*), bajra (*Pennisetum glaucum)*, guar (*Cyamopsis tetragonoloba*), sesamum (*Sesamum indicum*), moong (*Vigna radiat*a) and Sorghum (*Sorghum bicolor*) in kharif season. (ii) Wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), mustard (*Brassica juncea*), gram (*Cicer arietinum*), fennel (*Foeniculum vulgare*) and fenugreek (*Trigonella foenum-graecum*) in *rabi*season. Main fruit trees and vegetables are ber (*Zizyphus mauritiana*), pomegranate (*Punica granatum*), guava (*Psidium guajava*), onion (*Allium cepa*), garlic (*Allium sativum*), chilli (*Capsicum annum*), cumin (*Cuminum cymium*) and coriander (*Coriandrum sativum*).

Crop/plant samples (Table 1 and 2)

Results and Discussion

Sodium (Na^+)

Data presented in table 3 indicated that the Na+ content in leaves of plant samples ranged from 0.90 to 2.26 with an average value of 1.52 per cent. The minimum value of Na^+ (0.90 %) was observed in the plant samples of BLw9 and BLw36 sites, whereas, maximum (2.17 %) was observed in plants sample of BLw34 site. These results get support from the findings of Chhipa and Lal (1985), and Yousufinia *et al*. (2013).

Table 1: Plant samples were also collected from the farmer fields

S. No.	Sample Code	Plant sample	Main crops in irrigated field	
			Kharif	Rabi
1.	BLw1	Cotton	Cotton, sorghum, chilli	wheat, barley
2.	BLw2	Cotton	Cotton,	Wheat, barley
3.	BLw3	Sorghum	Sorghum, vegetables	Wheat, barley, mustard
4.	BLw4	Sorghum	Sorghum, guar, veg.	Wheat, barley, mustard
5.	BLw5	Cotton	Cotton,	Wheat, barley
6.	BLw6	Cotton	Cotton,	Wheat, barley
7.	BLw7	Sorghum	Cotton, sorghum, veg.	Wheat, Lucerne,
8.	BLw8	Sorghum	Cotton, sorghum	Wheat, mustard
9.	BLw9	Cotton	Cotton	Wheat, barley, mustard
10.	BLw10	Cotton	Cotton	Wheat, mustard
11.	BLw11	Cotton	Cotton	Wheat, mustard
12.	BLw12	Cotton	Cotton	Wheat, Lucerne
13.	BLw13	Cotton	Cotton	Wheat, mustard
14.	BLw14	Cotton	Cotton, Sorghum	Wheat, barley
15.	BLw15	Cotton	Cotton	Wheat, barley, veg.
16.	BLw16	Cotton	Cotton	Wheat, Lucerne
17.	BLw17	Cotton	Cotton, sorghum	Wheat, Lucerne
18.	BLw18	Cotton	Cotton, sorghum	Wheat, Lucerne
19.	BLw19	Cotton	Cotton	Wheat, mustard
20.	BLw20	Sorghum	Sorghum	Wheat, Lucerne
21.	BLw21	Sorghum	Sorghum, cotton, guar	Wheat, mustard, barley
22.	BLw22	Cotton	Cotton	Wheat,
23.	BLw23	Cotton	Cotton	Wheat, mustard, barley
24.	BLw24	Cotton	Cotton	Wheat, Lucerne
25.	BLw25	Cotton	Cotton	Wheat, mustard, barley
26.	BLw26	Cotton	Cotton	Wheat, Lucerne
27.	BLw27	Cotton	Cotton, bajra	Wheat, Lucerne
28.	BLw28	Cotton	Cotton	Wheat, mustard, barley
29.	BLw29	Cotton	Cotton	Wheat, Lucerne
30.	BLw30	Cotton	Cotton	Wheat, Lucerne
31.	BLw31	Sorghum	Sorghum	Wheat, Lucerne, barley
32.	BLw32	Sorghum	Sorghum, cotton	Wheat, mustard, Lucerne
33.	BLw33	Sorghum	Sorghum, cotton	Wheat, Lucerne, mustard
34.	BLw34	Cotton	Cotton, sorghum	Wheat
35.	BLw35	Sorghum	Sorghum, cotton	Wheat, barley
36.	BLw36	Cotton	Cotton	Wheat, Lucerne, mustard
37.	BLw37	Cotton	Cotton	Wheat, Lucerne, mustard
38.	BLw38	Cotton	Cotton	Wheat, mustard, veg.
39.	BLw39	Cotton	Cotton	Wheat, mustard
40.	BLw40	Cotton	Cotton	Wheat, mustard

Potassium (K^+)

The data presented in table 3 revealed that the K^+ content in plant leaves varied from 1.27 to 5.06 with an average value of 2.83 per cent. The minimum (1.27 %) and maximum (5.06 %) value of K^+ was observed in plant samples of BLw33 and BLw40 sites, respectively. These results are in conformity with the findings of Girdhar and Yadav (1982), Chhipa and Lal (1985), Shamsi and Kobraee (2013).

Calcium (Ca^{2+})

It is evident from the data presented in table 3 that the Ca^{2+} content in plant samples ranged from 0.23 to 0.67 with an average value of 0.49 per cent. The minimum (0.23 %) and maximum value of Ca^{2+} (0.67 %) was observed in plant samples of BLw23 and BLw7 sites, respectively. These results are in

Table 2: Methods used for plant, analysis

S. No.	Properties	Procedure	Reference
A.	Plant Analysis		
1	Digestion of plant sample	Di acid digestion using HNO3 and $HClO_4$ in 9:4 ratio.	Bhargava and Raghupati (1993)
2.	Potassium content	Potassium content will be measured on digested aliquot using flame photometer	Richard (1954)
3.	Calcium content	Calcium content will be measured on digested aliquot using flame photometer	Richard (1954)
4.	Magnesium content	Magnesium content will be measured on digested aliquot using flame photometer	Bhargava and Raghupati (1993)
5.	Sodium content	Sodium content will be measured on digested aliquot using flame photometer	Bhargava and Raghupati (1993)

conformity with the findings of Khandelwal (1986)

Magnesium (Mg^{2+})

The Mg^{2+} content of plant samples ranged from 0.32 to 0.64 with an average value of 0.46 per cent. The minimum (0.32 %) and maximum (0.64 %) value of Mg^{2+} in plant was observed in plant samples of BLw24 and BLw19 sites, respectively table 3. These results get support from the findings of Girdhar and Yadav (1982).

Sodium / Potassium (Na^+/K^+) ratio

Data in table 3 indicated that the Na^+/K^+ ratio in plant samples ranged from 0.24 to 1.66 with an average value of 0.62. The minimum value of Na^+/K^+ ratio (0.24) was found in plant samples of BLw24 site and maximum (1.66) was found in plant samples of BLw33 site. These results are supported by the findings of Shamsi and Kobraee (2013) and Yousufinia *et al*. (2013).

Calcium / Magnesium (Ca^{2+}/Mg^{2+}) ratio

The data presented in table 3 indicates that the Ca^{2+}/Mg^{2+} ratio in plant samples ranged from 0.44 to 1.88 with an average value of 1.11. The minimum value of Ca^{2+}/Mg^{2+} ratio (0.44) in plant sample was observed at BLw34 whereas, maximum (1.88) at BLw24 plant sample. These results are supported by the findings of Girdhar and Yadav (1982), Somani (1982), Bali *et al.* (2015).

Sodium /Calcium (Na^+/Ca^{2+}) ratio

Data presented in table 3 shows that the Na^+/Ca^{2+} ratio in plant samples ranged from 1.55 to 9.83 with an average value of 3.46. The minimum (1.55) and maximum (9.83) value of Na^+/Ca^{2+} ratio in plant samples was observed at BLw31 and BLw34 plant samples, respectively. These results are in conformity with the work of Chhipa and Lal (1985).

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Table: 3: Cationic composition of plant samples of Bilara Tehsil in irrigated fields by groundwater

S. No.	Sample code No.	Na^+ (%)	K^+ (%)	Ca^{2+} (%)	Mg^{2+} (%)	Na/K ratio	Ca/Mg Ratio	Na/Ca ratio
1	BLw1	2.18	2.53	0.30	0.44	0.86	0.68	7.27
2	BLw2	2.17	1.90	0.37	0.44	1.14	0.84	5.86
3	BLw3	1.17	2.80	0.47	0.60	0.42	0.78	2.49
4	BLw4	1.81	3.38	0.33	0.52	0.54	0.63	5.48
5	BLw5	2.02	2.12	0.53	0.42	0.95	1.26	3.81
6	BLw6	0.99	2.85	0.55	0.44	0.35	1.25	1.80
7	BLw7	1.72	1.58	0.67	0.50	1.09	1.34	2.57
8	BLw8	2.02	2.16	0.43	0.34	0.94	1.26	4.70
9	BLw9	0.90	2.85	0.50	0.40	0.32	1.25	1.80
10	BLw10	1.17	3.75	0.53	0.34	0.31	1.56	2.21
11	BLw11	1.53	3.80	0.47	0.42	0.40	1.12	3.26
12	BLw12	0.96	2.22	0.60	0.32	0.43	1.88	1.60
13	BLw13	1.17	1.27	0.57	0.44	0.92	1.30	2.05
14	BLw14	1.79	1.27	0.56	0.60	1.41	0.93	3.20
15	BLw15	1.08	1.90	0.54	0.56	0.57	0.96	2.00
16	BLw16	1.10	1.58	0.57	0.38	0.70	1.50	1.93
17	BLw17	2.17	4.75	0.43	0.56	0.46	0.77	5.05
18	BLw18	1.63	2.22	0.53	0.52	0.73	1.02	3.08
19	BLw19	1.74	2.85	0.50	0.64	0.61	0.78	3.48
20	BLw20	1.17	3.75	0.32	0.36	0.31	0.89	3.66
21	BLw21	1.08	3.16	0.33	0.64	0.34	0.52	3.27
22	BLw22	1.01	1.58	0.43	0.40	0.64	1.08	2.35
23	BLw23	1.44	1.90	0.57	0.52	0.76	1.10	2.53
24	BLw24	1.08	4.43	0.60	0.32	0.24	1.88	1.80
25	BLw25	1.17	2.22	0.50	0.52	0.53	0.96	2.34
26	BLw26	2.04	3.16	0.50	0.36	0.65	1.39	4.08
27	BLw27	1.90	5.06	0.63	0.44	0.38	1.43	3.02
28	BLw28	1.72	2.85	0.43	0.46	0.60	0.93	4.00
29	BLw29	1.17	2.22	0.37	0.64	0.53	0.58	3.16
30	BLw30	1.17	4.38	0.53	0.48	0.27	1.10	2.21
31	BLw31	0.93	2.85	0.60	0.50	0.33	1.20	1.55
32	BLw32	1.17	2.48	0.57	0.48	0.47	1.19	2.05
33	BLw33	2.11	1.27	0.57	0.36	1.66	1.58	3.70
34	BLw34	2.26	4.43	0.23	0.52	0.51	0.44	9.83
35	BLw35	2.19	3.16	0.23	0.44	0.69	0.52	9.52
36	BLw36	0.90	2.53	0.57	0.34	0.36	1.68	1.58
37	BLw37	1.70	2.22	0.43	0.52	0.77	0.83	3.95
38	BLw38	1.79	5.06	0.60	0.34	0.35	1.76	2.98
39	BLw39	1.72	1.58	0.61	0.38	1.09	1.61	2.82
40	BLw40	1.72	5.06	0.40	0.55	0.34	0.73	4.30
Mean	1.52	2.83	0.49	0.46	0.62	1.11	3.46	
Maximum		2.26	5.06	0.67	0.64	1.66	1.88	9.83
Minimum		0.90	1.27	0.23	0.32	0.24	0.44	1.55

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