

Short Communication

Effect of Residual Sodium Carbonate of Irrigation Water on the Soil Properties and Yield of German Chamomile (*Matricaria chamomilla*)

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In the arid and semi-arid regions, the indiscriminate use of poor quality of irrigation waters has rendered many soils unproductive. The water containing RSC (residual sodium carbonate) more than 2.5 m.e.L⁻¹ has been considered unsatisfactory for irrigation (Wilcox *et al.*, 1954). Moreover, the adverse effect of RSC due to different sources was reported in the relative order of CO₃ > CO₃ + HCO₃ > HCO₃ (Gupta, 1979). The present study reports the effect of levels and sources of RSC in irrigation water on the soil properties and yield of German Chamomile (*Matricaria chamomilla*) on a sandy loam soil. This crop has considerable economic utility. Its essential oil has antiphlogistic properties and is used against stomach ailments and also as flavouring agent in fine liquors and perfumes.

A pot experiment was conducted using sandy loam soil (Ustifluent) at CIMAP, Lucknow. The soil had the following characteristics: pH 8.3, EC 0.13 dS m⁻¹, organic C 0.22% and available N, P and K 67, 6 and 30 ppm, respectively. Three kilogram of air-dried and sieved (> 2 mm) soil was filled in plastic pots. One seedling of *M. chamomilla* was transplanted on 20th December 1991. After a pretransplanting irrigation with tap water (EC 0.8 dS m⁻¹) subsequent irrigations were given with sodic waters of 2.5, 5.0, 10.0 and 15.0 m.e.L⁻¹ RSC each having three combinations of CO₃ and HCO₃ (i.e., CO₃ alone,

CO₃+HCO₃ and HCO₃ alone). An additional treatment of irrigation with deionized water was included as control. A completely randomized design was followed with three replications. A basal dose of 50 mg N, 30 mg P₂O₅ and 30 mg K₂O per kg soil was applied. During the flowering period, the flowers were picked up, their total number counted, air dried and weighed at regular interval. At the end of experiment (17th March 1992), the whole plant was uprooted, the shoot and root were separated carefully, washed with distilled water, oven dried (65°C) and weighed. The soil samples were drawn and analysed for sodicity build-up using standard methods (Richards, 1954).

The soil pH increased gradually with increase in RSC content of irrigation water, however, the source of RSC did not have any perceptible effect on soil pH (Table 1). The E_c of soil increased remarkably with increase in RSC from control to 2.5 m.e.L⁻¹, and declined thereafter. Moreover, the decrease in E_c was comparatively high with CO₃ than the other sources of RSC. Sodium absorption ratio (SAR) also increased sharply from 2.5 in control to 15 with 2.5 m.e.L⁻¹ of RSC treatment and further increase in the RSC consistently increased the SAR values (Table 1). The increase in SAR was relatively higher with CO₃+HCO₃ source of RSC than the CO₃ and HCO₃ alone.

Table 1. Effect of RSC of irrigation water on the soil chemical properties at the end of experiment

Treatments RSC (m.e.L ⁻¹)		pH (1:2.5 Soil water suspension)	ECe (dS m ⁻¹)	SAR (m.e.L ⁻¹)	Cationic composition in saturation extract (m.e.L ⁻¹)		
Level	Source				Na ⁺	K ⁺	Ca ²⁺ + Mg ²⁺
Control	—	8.3	0.50	2.5	1.74	0.10	1.0
2.5	CO ₃	8.4	6.57	14.4	44.34	0.26	19.0
	CO ₃ +HCO ₃	8.4	7.90	16.0	53.03	0.20	22.0
	HCO ₃	8.4	8.05	14.8	52.17	0.24	25.0
5.0	CO ₃	8.5	6.91	16.9	47.82	0.18	16.0
	CO ₃ +HCO ₃	8.5	6.49	15.4	43.47	0.17	16.0
	HCO ₃	8.6	7.53	17.5	53.90	0.14	19.0
10.0	CO ₃	8.9	4.46	23.1	36.51	0.12	5.0
	CO ₃ +HCO ₃	8.9	5.39	24.1	41.73	0.12	6.0
	HCO ₃	8.9	6.22	21.3	45.21	0.13	9.0
15.0	CO ₃	9.3	3.85	23.4	33.04	0.10	4.0
	CO ₃ +HCO ₃	9.3	4.40	29.2	35.64	0.10	3.0
	HCO ₃	9.4	4.10	27.8	33.91	0.12	3.0

A decrease in ECe and increase in SAR with the increase in RSC of irrigation water was due to the reduced concentration of calcium and magnesium and increased proportion of sodium in the soil solution (Table 1). Gupta (1983) reported that in water containing high concentration of bicarbonate, there was a tendency for calcium, and to

some extent magnesium, to precipitate as bicarbonates as the soil solutions became more concentrated. The increase in soil pH with RSC may be ascribed to the greater degree of hydrolysis of sodium ions from the diffused layer in the presence of low electrolytes. With the increased levels of RSC, particularly at and above 10 m.e.L⁻¹, the concentration of

Table 2. Effect of RSC of irrigation water on the yield of *Matricaria chamomilla*

Treatments RSC (m.e.L ⁻¹)		Average number of flowers	Air dry weight of flowers (g pot ⁻¹)	Dry matter yield (g pot ⁻¹)	
Levels	Source			Shoot	Root
Control	—	303	3.16	4.60	1.93
2.5	CO ₃	306	3.16	5.53	2.66
	CO ₃ +HCO ₃	284	3.00	4.90	2.30
	HCO ₃	305	3.46	5.13	2.70
5.0	CO ₃	321	3.16	5.30	2.50
	CO ₃ +HCO ₃	282	3.16	4.90	2.23
	HCO ₃	310	3.03	5.30	2.20
10.0	CO ₃	380	3.66	5.83	2.03
	CO ₃ +HCO ₃	259	3.10	5.30	2.76
	HCO ₃	330	2.83	5.30	2.23
15.0	CO ₃	331	2.90	5.66	1.70
	CO ₃ +HCO ₃	250	2.96	5.40	1.76
	HCO ₃	339	2.80	5.43	1.53
SEm (±)		33.6	0.35	0.63	0.49
CD (5%)		NS	NS	NS	NS

Na in soil saturation extract was low (Table 1). Gupta (1983) also reported the low percentage of absorbed Na in soil even where the irrigation water contains HCO_3 in considerable excess of Ca+Mg. Moreover, the depressing effect of RSC due to CO_3 was more than that of CO_3+HCO_3 and HCO_3 alone on the E_{Ce} and content of Na and Ca+Mg in saturation extract. Similar results were also reported by Kanwar and Kanwar (1971).

The data given in Table 2 show that the source and levels of RSC in irrigation water did not significantly affect the flower and dry matter yield of German chamomile. SAR of soil saturation extract was positively and significantly correlated with the dry weight of shoot ($r = +0.763^{**}$). Although the soil pH and SAR increased with the increase in RSC of irrigation water yet the yield of German chamomile was not significantly affected.

Misra (1987) observed its exceptionally higher sodium uptake and adaptability to higher soil sodicity as compared to traditional agricultural crops.

References

- Gupta, I.C. 1979. *Use of Saline Water in Agriculture in Arid and Semi-arid Zones of India*. Oxford & IBH Publishing Co., New Delhi.
- Gupta, I.C. 1983. Concept of residual sodium carbonate in irrigation waters in relation to sodic hazard in irrigated soils. *Current Agriculture* 7: 97-113.
- Kanwar, B.S. and Kanwar, J.S. 1971. Effect of residual sodium carbonate in irrigation water on plant and soil. *Indian Journal of Agricultural Sciences* 41: 54-66.
- Misra, P.N. 1987. German chamomile. In *Ecodevelopment of Alkaline Land: A Case Study* (Ed. T.N. Khoshoo), pp. 80-82. NBRI, Lucknow.
- Richards, L.A. 1954. *Diagnosis and Improvement of Saline Alkali Soils*. Agricultural Hand Book 60, USDA, Washington DC.
- Wilcox, L.V., Blair, G.Y. and Bower, C.A. 1954. Effect of bicarbonate on suitability of water for irrigation. *Soil Science* 77: 259-266.