GAU Res. J. 1990 16 (1) : 50-52

Salinity, Sodicity and Boron Status of Soils and Well Waters of Inland Area of Amreli District (Gujarat)

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Boron though essential for plant growth but the amount required is very small. When it crosses a certain limit it becomes toxic and causes plant injury. Significant and positive correlations of water soluble boron with electrical conductivity (Paliwal and Anjaneyuly, 1967), pH (Mathur *et al.* 1964; Kanwar and Mehta, 1970 and Paliwal and Mehta, 1973) and SAR (Paliwal and Anjaneyulu, 1967) have been reported. Gandhi and Mehta (1958) have reported boron content in some arid zone soils of Saurashtra. The present study was taken up to study the boron status of well waters and irrigated soils and its relationship with some important properties of soils and waters under field conditions where saline water is being used.

Samples of ninety seven underground well waters and the same number of surface (0-15 cm) soils irrigated with them were collected from different villages of Amreli, Liliya and Lathi talukas of Amreli district during February, 1984. The medium black soils of this area are of clay texture and calcareous in nature (6.6 to 15.0% $CaCo_3$). The area receives an annual precipitation ranging from 400 to 500 mm. The soils and water properties were determined as described by Richards (1954) Boron content in saturation extract of soil and in irrigation water was determined colorimetrically, using carmine Richards, (1954).

The data showed that the electrical conductivity of well waters ranged from 1 to 13 ds m^{-1} and boron concentration from 0.2 to 5.6 ppm with an average value of 2.1 ppm (Table 1). Boron was positively correlated with EC ($r=0.621$ **) and SAR ($r=0.340$ *) while the correlation with pH and SSP were not significant (Table 1). The higher positive correlation of boron with total salt concentration ($r^2 = 38.6\%$) as compared to pH and SAR showed that the boron was more associated with total salt concentration.

In another study, 97 surface soil samples irrigated with the above well waters were collected and analysed for pH, Ece, SAR, ESP and hot water soluble boron. The soils were found to be of saline-sodic and sodic in nature and their ECe ranged from 0.6 to 16.0 ds m^{-1} and ESP from 16.0 to 53.6. The total salt concentration was approximately 1.2 times as compared to well water (Table 2).

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TABLE 1

Properties of underground well waters and relationship of boron with other properties.

	ECe $ds\ m^{-1}$	*pH*	*SAR*	*SSP*	*Boron* (*ppm*)
Minimum	1.0	8.0	4.6	33.7	0.2
Maximum	13.0	9.1	55.5	97.1	5.6
Average	4.1	8.5	20.9	77.7	2.1
"r" value					
Boron V/S	0.621**	0.090	0.340*	−0.040	

** — Significant at p = 0.01.
* — Significant at p = 0.05.

The water soluble boron in saturation extract of saline-sodic soils varied from 0.25 to 5.6 ppm with an average of 1.64 ppm. In sodic soils, it ranged from 0.65 to 2.90 ppm with an average of 1.55 ppm (Table 2). According to Bingham *et al.* (1985), the threshold concentration for the grain yield of wheat, barley and sorghum was 0.3, 3.4 and 7.4 mg β respectively.

TABLE 2

Properties of irrigated surface soil.

Soil	*No. of samples*	*ECe* $ds\ m^{-1}$	*pH* (1:2)	*SAR*	*ESP*	*Boron* (*ppm*)
Saline –	40	4.1 –	7.2 –	4.5 –	17.1 –	0.25 –
Sodic		16.0	8.8	29.9	52.7	5.60
		(7.1)	(7.6)	(16.0)	(32.8)	(1.64)
Sodic	57	0.6 –	7.2 –	10.6 –	16.0 –	0.65 –
		3.9	9.0	40.4	53.6	2.90
		(2.2)	(8.3)	(19.2)	(32.9)	(1.55)

Figures in parenthesis are the average values.

The relationship between water soluble B and other soil parameters (Table 3) showed that there was no significant correlation between B and ECe and B and SAR of sodic soils. In saline-sodic soils these parameters were significantly correlated with a low degree of determination ($r^2 = 0.16$). This shows that water soluble boron will increase with the enhanced degree of salinisation. Similar results were also reported by Paliwal and Anjaneyulu (1967) and Gajbhiye *et al.* (1980).

TABLE 3

Coefficient of correlation between soil properties and water soluble boron.

Soils	*Boron V/S*			
	ECe	*pH*	*SAR*	*ESP*
Saline—sodic	0.400*	0.290	0.420**	0.400
sodic	0.240	0.220	0.210	0.270*

** — Significant at p = 0.01
* — Significant at p = 0.05

There was no significant correlation between pH and boron content in both types of soil. They may be due to the several soil factors and their interactions influencing the pH and water solube boron simultaneously under field conditions.

There was positive correlation between exchangeable sodium percentage and boron in both the types of soils. However, the predictability was low. Agarwal (1964) also observed that in the range of 1 to 13 ESP, water soluble boron in soils also increased. Singh and Singh (1972) did not observe significant correlation between ESP and water soluble boron.

(*Received on 23rd Sept., 1986*)

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