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Relationship and distribution of various forms of boron with different physico chemical properties of soil in bikaner district

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ABSTRACT

This study investigated the distribution of soil boron and its relationship with some soil properties in the soil collected from different locations in Bikaner. Soil samples were air dried and grinded so as to pass through 2mm sieve. The prepared soil samples were analyzed for PH, electrical conductance and organic carbon, as per the standard methods. Co-relation coefficients among soil properties and various forms of boron were worked out statistically. A significant co-relation was found among available boron content and E.C., PH and organic carbon. On the basis of the physico chemical parameters, the suitability of soil of the above locations was adjudged.

Key words: Soil, physico chemical parameters, available boron, total boron, sampling.

INTRODUCTION

Modern research has demonstrated the vital importance of the inorganic plant nutrients known as trace elements. Boron is needed in the trace amount to normal plant life [1]. Boron is both an essential micronutrient required for optimum crop performance and a toxicant at elevated concentration. It is an element of great concern because for many plants the ration of toxic to adequate B concentrations is smallest among the essential micronutrients [2]. Boron may cause injury to plants even when in very low concentration in soil solution. Boron is essential to the normal growth of all the plants, but the concentration required is very small, and if exceeded, may cause injury.

Boron is a semi metal with the valance of +3 in all its compounds. The special character of boron derives principally from the relatively small size of boron atom. In the soil, boron is found only in combination with oxygen in the form of insoluble tourmaline $H_2 Mg\ Na\ Al_3 (Bo)_2\ Si_4O_{20}$.

Because of the extreme insolubility of the native compounds of boron, the total content of boron in soil is of little value as an index of availability. Water soluble boron is generally low in acid soil under high rainfall conditions. Much higher amounts are present in neutral and saline alkaline soil under low rain fall conditions [3].

Boron is held in organic combinations for which it may be released for crop use. The contents of this nutrient in the top soil is generally higher than the noticeable greater boron deficiency in period of dry weather. When the rain comes, plant roots can absorb boron again from the top soil, when its concentration is highest [4].

The inorganic forms in which boron occurs in soils are chiefly borates of calcium, magnesium and sodium, which result from the slow dissolution of boron containing minerals, namely, tourmaline [5].

Many soil factors influence the up take: PH or degree of acidly or alkalinity of the soil, organic matter content moisture, properties of clay and silt etc.

The availability of utilization of boron are determined to a considerable extent by PH. Boron is most soluble under acid conditions. This occurs in acid soils in part as Boric acid (H_3 BO_3) which is readily available to plants. At higher PH, boron is less easily utilized by plants. This may be due to lime induced fixation of the element by clay and other minerals, since the calcium and sodium borates are reasonably soluble [6].

EXPERIMENTAL SECTION

Study Area: The study was conducted in Bikaner region of the state of Rajasthan, India. The soil of Bikaner region mainly consist of flood plain, desert plain and sierozem complex soil groups. The underlying geology is complex but most of the area is covered with sand which has concealed the solid geology of the area.

Soil Sampling: Soil samples from the various locations of the Bikaner district were collected for the purpose of the study. All the samples were air dried in the laboratory at room temperature. After drying the soil samples, they were grinded in pastel mortar and passed through 2mm sieves. The sieved samples were preserved for the analytical work in polythene bags.

All the soil samples collected for this purpose of study were analyzed for various physico chemical properties [7] , which are described as under:-

(i) Soil pH: The most important chemical property of soil as a medium of plant growth is its pH. The effective concentration of hydrogen ions indicates all sources such as those arising by dissociation of soluble acids and those dissociated from soil particles.

Soil pH was taken in soil water suspension. For this purpose 1:5, soil: water suspension was prepared [8]. Soil samples were taken in a bottle and added with the required amount of water and then agitated on a mechanical shaker for 15 minutes. The pH of the soil suspension was measured on pH meter using glass electrode.

(ii) Electrical Conductance:
Electrical conductivity was measured for various soil samples in 1:5, soil water suspension[(9]. The conductivity cell was filled and rinsed by suspension. The conductivity was recorded in mili mhos per centimeter at room temperature with the help of conductivity meter.

(iii)Organic Carbon:
Organic carbon is the chief element of soil organic matter that is readily measured quantitatively [10].

Organic carbon in the soil is given by the following equation:-

$$\text{Percent organic carbon} = \frac{10\,(S-T) \times 0.003 \times 100}{S \qquad \text{Weight of soil}}$$

Since 1 gm of soil is used, than equation simplifies to

$$\text{Percent Organic Carbon} = \frac{3\,(S-T).}{S}$$

Where S = amount of $FeS0_4$ solution in ml required for blank.

T = amount of $FeS0_4$ Solution in ml required for sample.

(iv)Total Boron in soil:
Minute amounts of boron are usually separated by distillation from an acid solution, preferably by strong acid solution. Sample is condensed and collected in excess of Na0H solution in a platinum dish, dried sample is used for the colorimetric determinations.

(v) Available Boron in Soil:
The water-soluble boron is considered to be the form which is readily available to plants. At higher pH values boron is less easily utilized by plants (This may be due to lime induced fixation of this element). Boron is most soluble under acid conditions. It apparently occurs in acid soils in part as boric acid, which is readily available to plants [11].

Boron in soil was determined as follows:-

ppm B in soil = U gm B per ml in solution tested X 12.5.

The boron extracted in a 1:2 soil: water ratio Experiments were performed in batch systems. The colour was read with the help of colorimeter.

RESULTS AND DISCUSSION

Physico chemical properties of the soil under study and distribution of various forms of Boron aregiven in Table: 1. The data indicates that pH value ranged from 8.2 to 8.6 with a mean value of8.33. The soils are slightly to moderately alkaline in nature. The soil conductivity varies from 0.38 to 0.60 m.mho/cm with a mean value of 0.415 m mho/cm. Almostall the samples are non saline.

The organic carbon content varied from 0.13% to 0.25% which indicates low nitrogen content in all the soil samples.

TABLE:1: **Physico Chemical Properties of Soil**

Sl. No	Location	PH 1:2	E.C. m mho/cm	O.C. %
01.	Lalgarh	8.2	0.38	0.20
02.	Shivbari	8.3	0.32	0.23
03.	Kolayat	8.4	0.60	0.22
04.	Napaser	8.3	0.32	0.20
05.	Deshnoke	8.5	0.45	0.25
06.	Khajuwala	8.3	0.42	0.13

The available boron ranged from 0.27 to 2.00 ppm with a mean value of 0.66 ppm as shown in Table:2.

TABLE:2: **Distribution of various forms of Boron in the soil of Bikaner**

Sl. No	Location	Available Boron (ppm)	Total Boron (ppm)
01.	Lalgarh	0.33	21.33
02.	Shivbari	0.27	18.75
03.	Kolayat	0.47	21.30
04.	Napaser	0.27	19.38
05.	Deshnoke	0.30	17.25
06.	Khajuwala	2.00	28.15

The result of the present study indicate that with the increasing concentration of soluble salts available boron content increases. A significant positive correlation was also obtained between available boron content and EC as shown in Table:3 [12]. It appears that salinization is accompanied with accumulation of boron in available form.

TABALE:3: Correlation between soil characteristics & (available and total) Boron

Factors	Available B	Total B
PH	y = +0.59	y = + 0.52
EC	y = +0.83	y = + 0.44
OC	y = +0.48	y = + 0.14

CONCLUSION

A significant positive correlation was found among available Boron contents and E.C., pH and organic carbon. All findings indicate that the soil under study are deficient in available Boron content.

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