

MICRONUTRIENT STATUS AND THEIR CORRELATION WITH PHYSICO-CHEMICAL PROPERTIES OF AGRICULTURAL SOILS IN SOME VILLAGES OF BARBHAG REVENUE CIRCLE, NALBARI DISTRICT, ASSAM

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ABSTRACT

An investigation was conducted to assess the micronutrient status and their relationship with soil properties of agricultural fields in some villages of Barbhag revenue circle of Nalbari district. A total 90 numbers soil surface soil samples (0-15 cm depth) from six villages, comprising 15 composites from each site were collected during the period of 2018-2020. Various physico-chemical parameters and micronutrients viz., soil pH, electrical conductivity (EC), organic carbon (OC), iron (Fe), copper (Cu), manganese (Mn), zinc (Zn) and available boron (B) were analyzed using standard analytical methods. The soil of the study area were acidic in nature ranging of pH from 4.91- 5.92 with normal electrical conductivity (< 1 dSm⁻¹). Further soil had medium to high organic carbon ranging from 0.53-0.85 %. The available micronutrients as Cu, Fe, Mn, Zn and available B were found in the range of 0.84 to 1.55 mg kg⁻¹, 18.30 to 40.71 mg kg⁻¹, 7.32 to 20.17 mg kg⁻¹, 0.24 to 0.72 mg kg⁻¹ and 0.24 to 0.62 mg kg⁻¹ respectively. The study revealed soils had sufficient amount of Cu, Fe and Mn. However 30% and 72 % soil samples were deficient in connection with Zn and available B respectively. Soil pH and EC showed negative correlation with micronutrients and positive correlation with OC in our investigation.

(Key words: Micronutrient, Barbhag, soil properties, physico-chemical)

INTRODUCTION

Soil is one of the vital components in nature. All living things depend on plants and plant grown in soil for day to day need. For enhancing the crop production, sufficient amount of nutrients plays a vital role. Soil nutrients are classified as primary, secondary, and micronutrients. Plant required a little amount micronutrients, but their role is significant regarding for proper growth, development and quality production (Li *et al.*, 2007). Due to over use of synthetic fertilizer, the status of micronutrients may degraded in soil (Siddhu and Sharma, 2010). The deficiency of micronutrients has become major constraints to productivity, stability and sustainability of soil (Bell and Dell, 2008). Various physico- chemical parameters including pH, electrical conductivity, organic carbon, etc. control the status of micronutrients. Although micronutrient increases the macronutrients use efficiency of crop, but excessive use of micronutrient may impact the toxic and hazardous effect of plant (Sarkar *et al.*, 2018). The enzymatic systems of plants are stimulated by most of micronutrients. Again severe deficiency of micronutrients reduces the flowering and fruiting. The low fertility of about 20% of the total cultivable land leads to difficulties in earning livelihood for one fourth population of the world (Thombe *et al.*, 2020). Barbhag revenue circle is located in southern part of Nalbari

district, Assam. Rice, vegetables and mustard oil are major crops in this area. Farmers used lots of chemical fertilizers without any prior knowledge on the limits of their uses which may degrades the quality of soil and impacts on environment. To enhance crop productivity, sufficient amount of nutrients should be applied in the soil to make it fertile so that crop production can meet the demand of increasing population of Assam. So, it is essential to acquire adequate knowledge of distribution of micronutrients in soil for increasing the fertility and productivity. Study on micronutrients status of soils of Barbhag revenue circle is very scarcity. Therefore, present study was undertaken to assess the micronutrient status of soil and correlation with physico-chemical properties for sustainable crop production by maintaining soil health.

MATERIALS AND METHODS

Study site

Nalbari district lies between 20° N latitude and 91° E longitudes. The climate of the site is basically subtropical in nature with warm and humid summer followed by cool and dry winter. The average rainfall of the district is 2050 mm. Temperature in winter ranges from 11° C to 23.2° C and summer temperature lies from 23.7° C to 35° C. There are seven revenue circles of Nalbari district. Barbhag revenue

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circle is situated in the southern part of the district. As per the census India, 2011, the circle has 13494 house holders with the population of 67522. The geographical area of the circle is 6681.9 hectares and 5629.0 hectares comprises total cropped area (Anonymous, 2022).

Sample collection

Soil samples were collected from six different villages after harvesting the crop during the period of 2018-2020. These six villages were Marowa, Bala, Arikuchi, Kahikuchi, PaschimKamarkuchi and Ulabari.

A total of 90 numbers of surface soil samples (0-15 cm depth) were collected from six villages (15 no. of samples from each village) with the help of core sampler. During the collection of samples, composite samples were prepared. To obtain a composite sample, 10-15 different soil samples were collected randomly and mixed thoroughly. All composite soil samples were dried at room temperature and passed through 2 mm sieve and preserved in colorless polythene bags for analyzing eight number of various physico-chemical parameters and micronutrients viz., soil pH, EC, OC, Cu, Fe, Zn, Mn and available B. All physico-chemical parameters and micronutrients were analyzed according to standard procedure. The pH was determined by using method followed by Piper (1950) and electrical conductivity was recorded as per method detailed by Jackson (1973) and organic carbon by Walkley and Black (1934). Available micronutrient cations ie., Fe, Mn, Cu and Zn were determined by DTPA method by using Atomic Absorption Spectrophotometer (Lindsay and Norvell, 1978) and available B content was analyzed by hot water method given by Berger and Truog, (1939). Different statistical analyses such as mean, standard deviation, maximum and minimum were carried out for all soil samples (Gupta, 2023).

RESULTS AND DISCUSSION

Physico chemical properties of soil

Soil pH

The soil pH of the study area varied from 4.95 - 5.92 with the mean value of 5.56. From Table 1, it is observed that the highest and lowest value was recorded in villages of Bala and Kahikuchi with the mean value of 5.85 and 5.13. Soil samples of all villages were found to be acidic in nature. The decreasing of soil pH was due to application of long term inorganic fertilizer instead of farmyard manure, green manure, and rice straw residue (Tiwari, 2003). Similar type of results were reported by Bhuyan *et al.* (2024), who also recorded pH in the range of 4.1 to 5.4 with the mean value of 5.2 in soils of organic tea garden of upper Brahmaputra valley zone of Assam. Assam soils having alluvial flood plains under high rain fall possess acidic in nature having 5.0 pH (Chakravarty *et al.*, 1987).

Electrical conductivity (EC)

The EC content in our investigation ranged from 0.09 - 0.29 dSm⁻¹ with the mean value of 0.18 dSm⁻¹. In all villages EC content is less than 1 dsm⁻¹, which indicates

that soil has no salinity effect. The maximum and minimum content of EC was recorded in villages of Kahikuchi and Marowa with the mean value of 0.29 and 0.11 dSm⁻¹ respectively. The normal EC of soil arises due to washed away of salts to lower horizon. Similar type of results was reported by Karmakar (2014), who noticed that the electrical conductivity was 0.04 to 0.32 dSm⁻¹ in different land forms of north bank plain of Assam.

Organic carbon (OC)

The organic carbon content ranged from 0.53 - 0.85 % with the mean value of 0.71%. From this observation it was found that 50% soil samples were found under high (> 0.75 %), 25% under medium (0.5-0.75 %) and remaining 23% under low (< 0.5 %) category. Results in Table 1, revealed that the highest value was recorded in village of Kahikuchi with the mean value of 1.07 %. Again lowest value was recorded in village of Bala with the mean value of 0.39 %. This type of results were confirmed by Baishya and Thakuria (2024), who reported that 60% soil samples were under high (> 0.75%) category, 24% under medium (0.5-0.75%) and remaining 16% under low category (< 0.5%) in some villages of Barbhag revenue circle of Nalbari District, Assam. High crop removal due to continuous and intensive cultivation in soils leads to low organic content (Barooah *et al.*, 2020).

Micronutrient content in soil and correlation study with physico-chemical properties

Copper (Cu)

From the Table 2, it was observed that the available Cu content in soil ranged from 0.84- 1.15 mg kg⁻¹ with the mean value of 1.10 mg kg⁻¹. Based on limitation suggested by Lindsay and Norvell (1978), all soil samples in the study area were found high amount of available Cu. The maximum and minimum content of Cu was observed in the villages of Arikuchi and Bala with the mean value of 1.58 and 0.77 mg kg⁻¹ respectively. Higher content of Cu in soil occurs due to higher content of organic carbon, as organic matter is linked with Cu to form stable chelating complex (Basumutarey *et al.*, 2019).. In this study we also observed a positive and highly significant correlation (r=0.950) with organic carbon in soils of the study area. Talukdar *et al.* (2009) also reported that Assam soil has no deficiency of Cu content. Moreover negative and highly significant correlation (r= -0.932) was observed with pH and EC (r=-0.491). This indicates the concentration of Cu is low under acidic condition.

Iron (Fe)

The available Fe content in the study area ranged from 18.3- 40.71 mg kg⁻¹ with the mean value of 29.95 mg kg⁻¹ (Table 2). On the basis critical limit suggested by Lindsay and Norvell (1978), all soil samples content high amounts of Fe. The maximum and minimum content of Fe was recorded in the villages of Kahikuchi and Bala with the mean value of 42.95 and 20.17 mg kg⁻¹ respectively. This type of results confirms the present findings. This was sustained that a significant positive correlation (r= 0.926) was noticed with organic carbon. This kind of results supported by

Basumutary *et al.* (2014), who stated that Fe content increased with the increasing of organic carbon. Again sufficient concentration of Fe in soil arises under acidic condition. This was sustained that negative and highly significant correlation was obtained with pH ($r = -0.904$) but EC was negatively correlated ($r = -0.468$) with Fe. Identical type of observation was found by Basumutary *et al.* (2021), who stated that Fe content was negatively correlated with soil pH ($r = -0.302$) and EC ($r = -0.177$) of fertility status in soils of DimaHasao district of Assam.

Manganese (Mn)

Results in Table 2, revealed that the manganese content ranged from 7.32 - 20.17 mg kg⁻¹ with the mean value of 13.5 mg kg⁻¹. Among the villages, the highest and lowest mean Mn were recorded in soils from Paschim Kamarkuchi (21.2 mg kg⁻¹) and Morowa (9.2 mg kg⁻¹). Based on critical limit suggested by Lindsay and Norvell, (1978) that all soil samples contains sufficient amount of available Mn. This sufficiency may causes due to low pH and high OC. The availability of Mn was high due to higher biological activity and chelation of organic molecules, which are produced during the time of decomposition of organic matter left behind after harvesting of crops (Haritha *et al.*, 2024). Available Mn was positively correlated with OC ($r = 0.661$), which was earlier recorded by Basumutary *et al.* (2014) in fertility status of soils of upper Brahmaputra valley zone of Assam. A negative correlation was observed with pH ($r = -0.650$) and EC ($r = -0.680$).

Zinc (Zn)

The Zn content ranged from 0.24 - 0.72 mg kg⁻¹ with the mean value of 0.46 mg kg⁻¹ (Table 3). Maximum content was observed in Arikuchi village (0.55 mg kg⁻¹), while the minimum value was recorded in Ulabari village (0.38 mg kg⁻¹). According to Baruah and Barthakur (1997), 70% of soil samples were found in medium (0.3 to 2.3 mg kg⁻¹) and remaining 30% of the samples in low (< 0.3 mg kg⁻¹). Reza *et al.* (2021) also observed deficiency of Zn in soils of Nalbari district. In the present study highly positive

correlation ($r = 0.846$) was obtained with organic carbon. But Zn was negatively and highly correlated with pH ($r = -0.865$) and EC ($r = -0.849$).

Available Boron (B)

Available B content of the study area ranged from 0.24 to 0.62 mg kg⁻¹ with the mean value of 0.44 mg kg⁻¹ (Table 3). As per rating suggested by Berger and Truog's (1939), 72 % soil samples remained in the deficient range (< 0.5 mg kg⁻¹) and remaining 28% samples were found under sufficient (> 0.5 mg kg⁻¹) category of available boron. Maximum and minimum content of available B was recorded in the villages of Pashim Kamarkuchi (0.54 mg kg⁻¹) and Marowa (0.36 mg kg⁻¹) respectively. Similar type of results were observed by Chakravarty *et al.* (2023), who reported 70% soils under deficient category in available B content for rice fallow cultivation and uncultivable soils of Nalbari, Assam. Soil acidity, leaching loss due to high rainfall area are the major reasons for low and medium range of available B in the soils. (Chaitanya *et al.*, 2014). Moreover, correlation study revealed a negative correlation between available B and soil pH ($r = -0.606$) and EC ($r = -0.382$). Similarly a positive correlation ($r = 0.646$) was obtained between available boron and OC.

The present findings revealed that all soil samples were acidic in nature with normal electrical conductivity. Medium to high amount of organic carbon also observed in present investigation. Among the micronutrients, Fe, Cu and Mn were sufficient in all villages. However, 30% and 72 % soil samples were deficient in respect to zinc and boron of all study sites. So to maintain the sustainable crop productivity and soil health, recommended application of boron and zinc fertilizers are essential. In connection with correlation, soil pH and EC has negative influence on micronutrients. Moreover, OC impacts positive influence on micronutrients. Therefore, to enhance the crop productivity, sustainable soil fertility etc, various best practices including soil test based micronutrient management practices, use of organic green manures are necessary.

Table 1. Range and mean value of physico-chemical properties (pH, EC and OC) of soils of different villages

Village	pH		EC(dSm ⁻¹)		OC (%)	
	Range	Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD
Morowa	5.19-6.07	5.75 \pm 0.24	0.18-0.43	0.29 \pm 0.03	0.31-0.62	0.44 \pm 0.25
Bala	5.25-6.13	5.83 \pm 0.27	0.12-0.39	0.21 \pm 0.06	0.29-0.55	0.39 \pm 0.31
Arikuchi	4.72-5.81	5.17 \pm 0.25	0.06-0.29	0.19 \pm 0.08	0.65-1.12	0.97 \pm 0.42
Kahikuchi	4.62-5.73	5.13 \pm 0.29	0.18-0.43	0.29 \pm 0.21	0.72-1.17	1.01 \pm 0.38
Pashim Kamarkuchi	5.03-5.92	5.65 \pm 0.31	0.07-0.23	0.15 \pm 0.13	0.68-0.88	0.79 \pm 0.19
Ulabari	4.93-5.91	5.47 \pm 0.21	0.06-0.29	0.19 \pm 0.07	0.51-0.77	0.65 \pm 0.22
Average range	4.95-5.92	5.56 \pm 0.27	0.09-0.29	0.18 \pm 0.09	0.53-0.85	0.71 \pm 0.29

and
(mean \pm SD)

Table 2. Range and mean value of micronutrients (Cu, Fe and Mn) of soils of different villages

Village	Cu(mg kg ⁻¹)		Fe (mg kg ⁻¹)		Mn (mg kg ⁻¹)	
	Range	Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD
Morowa	0.75-0.98	0.82 \pm 0.62	10.91-35.78	25.12 \pm 12.18	4.5-15.6	9.2 \pm 8.56
Bala	0.68-0.86	0.77 \pm 0.71	9.82-26.17	20.17 \pm 18.19	5.2-16.2	11.3 \pm 8.14
Arikuchi	1.05-2.62	1.58 \pm 0.56	28.15-51.65	39.18 \pm 13.27	9.7-21.6	15.3 \pm 5.06
Kahikuchi	1.01-2.38	1.42 \pm 0.95	31.62-59.17	42.78 \pm 10.05	8.5-20.7	13.6 \pm 7.92
Pashim Kamarkuchi	0.85-1.38	1.12 \pm 0.84	16.78-39.62	28.95 \pm 11.18	12.17-28.12	21.2 \pm 6.35
Ulabari	0.71-1.12	0.91 \pm 0.90	12.74-31.92	23.55 \pm 14.26	3.9-18.8	10.2 \pm 6.03
Average range and (mean \pm SD)	0.84-1.55	1.10 \pm 0.76	18.3-40.71	29.95 \pm 13.18	7.32-20.17	13.5 \pm 7.01

Table 3. Range and mean value of micronutrients (Zn and B) of soils of different villages

Village	Zn (mg kg ⁻¹)		Available B (mg kg ⁻¹)	
	Range	Mean \pm SD	Range	Mean \pm SD
Morowa	0.35-0.72	0.52 \pm 0.17	0.21-0.58	0.36 \pm 0.14
Bala	0.25-0.65	0.43 \pm 0.12	0.28-0.51	0.40 \pm 0.08
Arikuchi	0.29-0.85	0.55 \pm 0.22	0.17-0.62	0.48 \pm 0.17
Kahikuchi	0.21-0.69	0.47 \pm 0.18	0.20-0.86	0.45 \pm 0.10
Pashim Kamarkuchi	0.18-0.78	0.40 \pm 0.15	0.34-0.80	0.54 \pm 0.15
Ulabari	0.19-0.65	0.38 \pm 0.25	0.22-0.56	0.30 \pm 0.12
Average range and (mean \pm SD)	0.24-0.72	0.46 \pm 0.18	0.24-0.62	0.44 \pm 0.13

Table 4. Correlation coefficient (r) between soil properties and available micronutrients

Parameters	pH	EC	OC
Cu	-0.932**	-0.491	0.950**
Fe	-0.904*	-0.468	0.926**
Mn	-0.650	-0.680	0.661
Zn	-0.865*	-0.849*	0.846*
B	-0.606	-0.382	0.646

**significant at 1% level, * significant at 5% level

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Rec. on 25.11.2024 & Acc. on 10.12.2024