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Physicochemical Characteristics and Nutrient Status of Hilly Soils of Dimapur district of Nagaland

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Abstract

In the present investigation, physicochemical properties, lime requirement, fertility status and DTPA extractable Zn of soils of Dimapur district of Nagaland were studied. The soils of study area were strong to moderate acidic in reaction with pH ranged from 4.12 to 5.30 and were normal in total soluble salts. The CEC of the soils was quite low, varied from 10.4 to 14.0 cmol (P^+) kg^{-1} . The average sand, silt and clay contents of the soils were 39.4, 35.6 and 24.1 %, respectively. Lime requirement of soils was quite high and ranged between 10.00 to 21.50 t ha^{-1} to raise the pH of soils to 6.4. The soils were high in organic carbon, medium to high in available nitrogen and potassium and low to medium in available phosphorus. Available sulphur and DTPA extractable Zn of soils varied from 9.5 to 48.0 kg ha^{-1} and 0.08 to 5.94 mg kg^{-1}, respectively indicated low to high in sulphur and sufficient in zinc content.

Key words: Physicochemical characteristics, lime requirement, available sulphur, DTPA extractable

Introduction

The study about physicochemical properties and nutrient status of the soils today assumed an increased importance due to rapidly declining land area under agriculture, declining soil fertility and increasing soil degradation through unbridled population increase, improper land use practices, urbanization and irrational and imbalance use of agro-chemicals. It is very much relevant for identifying constraints in crop husbandry for attaining sustained productivity and facilitating agro- technology transfer programme. Productivity of a soil depends on its nature and quality as such; knowledge about the physicochemical characteristics of soils is of prime importance for the optimum use of land for enhancing crop production. Soil nutrients play a vital role in the growth, development and yield of plant and the information on the nutrient status of an area can go a long way in planning judicious fertilizers and soil management practices to develop economically viable alternatives. Role of sulphur and micronutrients in balanced plant nutrition are well established. Secondary and micronutrients play a vital role for the growth and development of plants. Availability of macro and micro nutrients is influenced by their distribution in soil and other physicochemical characteristics of soils [8]. Scanty information is available

on secondary and micronutrient as well as macro nutrient status of the hilly soils of Dimapur district of Nagaland. Therefore an attempt has been made to generate information regarding physicochemical properties along with available NPKS and DTPA extractable Zn status of the soils of the district.

Material and Methods

For the present study, twenty five soil samples (0-20cm) were collected from different locations of the Dimapur district, Nagaland. Collected soil samples were air dried, grinded and passed through a 2 mm sieve for analysis. Processed soil samples were analysed for pH, EC, cation exchange capacity [3], sand, silt and clay contents and lime requirement following standard method of analysis[2]. Organic carbon, available nitrogen, available phosphorus and available potassium were analyzed using standard methods of analysis [5]. Available sulphur was also determined using the standard method [4] .The DTPA extractable zinc was extracted with diethelene tri-amine penta acetic acid (DTPA) solution [6], and subsequently analyzed with the help of atomic absorption spectrophotometer. Correlation coefficients were worked out to see whether different soil characteristics are related to another.

Results and Discussion

Physicochemical characteristics:

The pH values of soils varied from 4.12 to 5.30 with an average value of 4.68, which indicating that soils are acidic in reaction (Table 1). The data further indicated that 12 percent soil samples showed pH value more than 5.0, rest 88% soil samples had pH value less than 5.0. Excusive leaching of bases from the soil due to heavy rainfall might be caused soil acidity in these soils. Soil pH had significant positive correlation with available phosphorus and significant negative correlation with zinc (Table- 3). The EC of the soils varied from 0.12 to 0.25 dSm^{-1} with a mean value of 0.18 dSm^{-1}. Most of the soil samples possessed EC 0.12 to 0.20 dSm^{-1}. It was also observed that 28% soil samples of study area contained EC more than 0.20 dSm^{-1}. These results indicated that there was no remarkable accumulation of soluble salts in soils might be due to sufficient leaching and flushing of salts due to higher rainfall in the study area [7, 9]. The cation exchange capacity of the soils of study area was quite low and varied from 10.4 to 14.0 cmol (p^+) kg^{-1} with a mean value of 12.2 cmol (p^+) kg^{-1}. The data further revealed that the soils of four pedons had CEC more than 13.0 cmol (p^+) kg^{-1}, while rest soil samples contained CEC less than 13.0 cmol (p^+) kg^{-1}. Low values of CEC have also been reported by earlier workers. Significant positive correlation was observed between CEC of the soils and available potassium. The sand, silt and clay contents of the soils ranged from 19.0 to 59.4, 22.9 to 56.0 and 13.9 to 36.6 percent with an average of 39.4, 35.6 and 24.1 percent, respectively. Clay content had significant positive correlation with available potassium content of the soil. It is evident from the data that lime requirement of the soils of study area was very high. Lime requirement of the soils of Dimapur district varied from 10.00 to 21.50 t ha^{-1} to increase resultant pH of soils to 6.4. High value of lime requirement might be due to high level of

acidity [7]. Lime requirement had available phosphorus and significant positive correlation with Zn content of soil.

Fertility status:

Soils of the Dimapur district had wide variation in the soil organic carbon status. Organic carbon content of the soils ranged from 0.61 to 2.22 percent with an average of 1.45 percent (Table-2). All the samples contained high amount of organic carbon except one sample. Out of twenty five soil samples, seven (28%) soil samples contained more than 2% organic carbon. Organic carbon had significant positive correlation with available nitrogen, available phosphorus and available sulphur of the soils. The available nitrogen contents of the soils ranged from 288.6 to 583.0 kg ha^{-1} with an average of 425.8 kg ha^{-1}. It was also observed that 84% and 16% soil samples possessed in medium and high category of available nitrogen, respectively. Medium class of available nitrogen indicating that mineralizable nitrogen fraction, under such type of climatic conditions and low pH prevailing in these soils, is rather low. The available phosphorus contents of the soils ranged from 6.0 to 14.5 kg $ha^{-1}$with an average of 9.8 kg ha^{-1}. The data further revealed that 56% and 44% soil samples belong to low and medium category of available phosphorus, respectively. Low pH value significant negative correlation with of the soils might because of low phosphorus content in these soils [1]. The available potassium and sulphur contents in the soils varied from 142.8 to 317.0 kg ha^{-1} and 9.5 to 48.0 kg ha^{-1} with an average of 226.3 and 27.2 kg ha^{-1}, respectively. It was further observed that 24% and 76% soil samples possessed in high and medium category of available potassium, respectively. It was also clear that 28%, 56% and 16% soil samples contained low, medium and higher amount of available sulphur, respectively. DTPA extractable zinc content of the soils varied from 0.08 to 5.94 mg kg^{-1} with a mean value of 2.37 mg kg^{-1}. Data further revealed that 12%, 16% and 72% soil samples possessed in deficient, marginal and sufficient categories of zinc. Zinc content of the soil had significant negative and positive correlation with pH and lime requirement of the soil, respectively.

Conclusion

The results lead to a conclusion that the soils of study area differ in nutrient status. Soils are rich in organic matter, medium in available nitrogen and potassium but highly deficient in available phosphorus. Soils of study area were low to high in available sulphur and sufficient in zinc content. The soils have a major problem of acidity and to improve soil fertility and productivity, lime addition is essential.

Soil Pedon	pH	EC (dSm^{-1})	CEC [cmol(P$^+$)kg^{-1}]	Sand (%)	Silt (%)	Clay (%)	LR at pH-6.4($t\ ha^{-1}$)
1	4.20	0.13	10.4	50.6	35.0	14.0	20.90
2	4.50	0.24	14.0	19.8	56.0	24.0	17.00
3	4.44	0.20	11.5	37.5	43.0	19.0	20.52
4	4.60	0.12	11.9	59.4	22.9	17.3	14.50
5	4.69	0.15	12.8	27.0	45.4	27.6	16.20
6	4.55	0.16	12.7	29.5	46.0	24.5	14.30
7	4.12	0.14	11.7	56.7	26.0	17.0	21.50
8	4.80	0.23	11.2	19.0	45.0	36.0	14.50
9	4.30	0.18	10.5	43.0	36.2	20.5	20.16
10	5.26	0.12	11.9	57.6	25.6	16.8	10.92
11	5.14	0.21	11.0	27.5	42.3	29.8	15.60
12	4.75	0.15	12.0	43.7	34.0	22.0	16.30
13	4.66	0.17	12.2	56.5	24.0	19.2	15.12
14	5.30	0.20	13.6	22.0	45.0	33.0	11.00
15	4.92	0.19	13.5	38.3	36.0	25.0	14.40
16	4.42	0.12	12.8	45.5	31.8	22.4	15.40
17	4.88	0.23	13.4	21.8	43.2	35.0	14.00
18	4.58	0.13	12.3	31.0	41.0	27.7	16.32
19	4.31	0.15	12.0	56.9	26.5	16.6	14.60
20	4.54	0.25	12.2	29.0	34.0	36.6	15.10
21	4.58	0.22	12.7	38.5	35.3	26.0	14.02
22	4.67	0.20	11.7	54.0	25.0	21.0	15.54
23	5.30	0.22	12.4	28.0	40.5	31.3	10.00
24	4.89	0.15	12.2	34.0	40.2	25.6	15.10
25	4.62	0.16	12.0	57.0	29.0	13.9	12.13
Range	4.12-5.30	0.12-0.25	10.4-14.0	19.0-59.4	22.9-56.0	13.9-36.6	10.00-21.50

Table 2: Organic carbon, available nitrogen, phosphorus, potassium, sulphur and DTPA extractable zinc status of the soils

Soil Pedon	Organic carbon (%)	Available nutrients (kg ha^{-1})				DTPA extractable Zn (mg kg^{-1})
		N	P	K	S	
1	1.10	375.7	8.6	150.8	21.9	5.94
2	2.22	568.0	12.0	288.2	46.4	2.78
3	1.73	425.0	8.6	170.0	31.8	1.75
4	2.10	485.6	11.4	200.0	30.0	2.48
5	2.12	565.8	10.4	300.0	40.0	2.55
6	2.13	570.0	12.6	200.7	44.0	4.02
7	1.71	465.7	9.8	178.8	33.0	5.80
8	2.10	422.8	14.5	280.0	48.0	0.91
9	1.95	412.8	11.2	200.5	36.0	2.65
10	1.00	370.6	9.2	195.4	20.2	0.90
11	2.13	530.0	14.0	301.8	41.4	1.12
12	1.38	438.5	10.8	198.4	27.0	2.45
13	0.61	296.0	6.4	200.7	9.5	0.08
14	1.23	341.3	9.1	285.8	21.0	3.50
15	1.00	344.0	10.0	210.4	14.6	1.20
16	0.82	288.6	7.7	217.8	10.0	0.12
17	2.11	583.0	13.8	295.4	27.0	2.94
18	1.26	415.9	9.8	254.0	16.6	3.75
19	0.81	380.0	6.0	185.8	16.4	1.30
20	1.72	463.5	10.0	317.0	32.0	2.84
21	1.22	398.8	7.0	260.0	25.2	1.98
22	0.77	341.2	7.2	153.8	17.4	1.35
23	1.25	430.0	9.8	290.5	30.0	4.00
24	1.12	395.1	9.0	179.0	25.4	2.80
25	0.76	337.0	7.2	142.8	14.0	0.09
Range	0.61-2.22	288.6-583.0	6.0-14.5	142.8-317.0	9.5-48.0	0.08-5.94
Average	1.45	425.8	9.8	226.3	27.2	2.37

Table-3: Correlation coefficient of available nutrients with soil properties

Soil properties	Available nutrients				
	N	P	K	S	Zn
Organic carbon	0.775**	0.567*	0.231	0.724**	0.453
pH	0.399	0.560*	-0.010	0.481	-0.565*
EC	-0.067	0.154	0.473	0.411	0.324
Clay	0.349	0.061	0.736**	0.140	0.465
CEC	0.323	-0.324	0.565*	0.461	0.287
LR	0.102	-0.561*	0.442	0.218	0.568*

* Significant at 5% level ** Significant at 1% level

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