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Assessment of the Soil Chemical Properties, Macro and Micro Nutrients using Soil Test Kit and Soil Health Card Distribution in Zunheboto District of Nagaland, India

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ABSTRACT

This investigation was undertaken to evaluate the status of soil chemical properties, macro and micro nutrients in the zunheboto district of Nagaland under Krishi Vigyan Kendra, Nagaland University. Altogether 16 villages were covered comprising of 240 farmers under this survey. The soil samples were collected from the jhum fields and further analysis of soil pH, EC, OC, N, P, K, Zn, B and S were done using the mini soil test kit - Mridaparikshak. Soil Health Cards were issued for a period of 2 years and thereafter renewed. It was observed that the soils were mostly red sandy loam to clay loam in texture, pH is moderately acidic varying between 6.0-6.4, EC is non-saline ranging between 0.24-0.44 dSm^{-1}, OC ranged from low to medium between 0.27-0.63%, available nitrogen varied from low to medium between 229-293 kg ha^{-1}, available phosphorus varied from low to medium between 8.89-21.21 kg ha^{-1}, medium in available potassium ranging from 187.23-257.81 kg ha^{-1}, low to medium in available Sulphur varying between 10.30 to 24.1 kg ha^{-1}, low in available Zn ranging between 0.03-0.26 mg kg^{-1} and low in available B varying between 0.01-0.19 mg kg^{-1}.

Introduction

Soil health and fertility plays an important role for sustainable crop yield and productivity. Soil analysis and its interpretations are important to assess the status of soil fertility for accurate fertilizer recommendation and soil reclamation. Shifting cultivation is mainly practiced in the hilly terrain of North eastern region of India and it is one of the main sources of cultivation in Nagaland too. The total area under paddy jhum cultivation in Zunheboto district is 9410 ha (Anonymous, 2017). Leaching out of the nutrients and erosion due to heavy rainfall in the hilly areas and nutrient removal by the crop governs the crop nutrient dynamics in the shifting cultivation areas (Tulaphitak *et al.,* 1985). The practice of monoculture in spite of its soil potentialities, intensive cropping without addition of chemical fertilizers and organic manure also erosion due to intense rainfall leads to soil degradation in the jhum lands (Lal, 2005).

Severe problem of soil degradation is caused by indiscriminate and intensive land use based on monoculture regardless of soil capability, introduction of pastures with high stocking rate and uncontrolled grazing, or intensive cropping without input of chemical fertilizers or compost at the required rates. The problem of soil degradation is exacerbated by harsh climate characterized by intense rains of high erosivity and structurally weak soils. Soil testing is an important tool to assess the status of soil fertility of a particular soil and accordingly recommend appropriate nutrient management practices based on the soil and crop.

In February 2015, a soil health card scheme was launched by the government of India to provide awareness and issue soil health card to the farmers which help them in enhancing the soil health and fertility by recommending crop specific nutrient management.

Materials and Methods

This soil testing enables the farmers to know the status of the soil nutrient and how much amount of fertilizers, micronutrient and soil amendment to be applied in their field. This soil testing can be done in the soil testing laboratory and also through mini soil testing kit–Mridaparikshak which is developed by ICAR: IARI, New Delhi and this is very much useful in places where soil testing laboratory is unavailable or far away.

The Krishi Kigyan Kendra of Nagaland University under Zunheboto District facilitate free of cost soil testing facilities and provide soil health card to the farmers through the use of mini soil testing kit - Mridaparikshak. The soil health cards are provided to the farmers for a period of two years and thereafter it is renewed. GPS was used during soil sampling in the jhum fields of the farmers. The soil health card consisted of the recommendation of the crop specific nutrients based on the soil fertility status. The soil chemical properties and soil fertility parameters viz., pH, OC, EC, macro nutrients viz., N, P, K & S and micro nutrients viz., Zn and B were tested and their status were obtained. Altogether soil samples of 16 villages comprising of 240 farmers were tested and soil health cards were issued.

The slash and burning of the jungles in jhum fields for cultivation leads to gradual decrease in the soil base contents and the continuous disruption through human activities also affected soil health leading to lower yield and productivity. Ultimately the soil becomes less fertile for crop production. Therefore this present investigation was undertaken to analyse the soil chemical properties, macro and micro nutrients of the farmers jhum fields using soil testing kit and distribute soil health card to the farmers.

Results and Discussion

The soil testing survey was carried out in various jhum fields under zunheboto district during 2017-18 using GPS for soil collection and soil testing was done using mini soil testing kit Mridaparikshak. This soil testing was done free of cost at KrishiVigyan Kendra, Nagaland University, Lumami and soil health cards containing the fertility status with specific crop nutrient management were provided to all the farmers whose soils were tested. All together16 villages were covered comprising of 240farmers.

Chemical properties

The soil chemical properties such as pH, OC and EC were analysed as shown in table 1. The results obtained from the soil analysis showed that the soil pH is moderately acidic in reaction varying from 6.0-6.4. These acidic soils might be due to intense rainfall in the hilly regions leading to leaching out of the basic cations from the topsoil (Zhang *et al.*, 2019). Nutrient losses from the jhum field are also found to be heavy during the cropping period through runoff and percolation (Saha *et al.*, 2012) leading to accumulation of acids and poor soil health. Therefore soil pH which is being described as the "master soil variable" plays an important role in nutrient solubility, mobility, plant growth and yield (Neina Dora, 2019). The Organic Carbon (OC) ranged from 0.27 – 0.63% indicating low to medium in its content. This may be due to the rapid loss of the organic carbon content through burning of jungles in shifting cultivation leading to oxidation of un-humified materials (Mishra *et al.,* 2007). The Electrical Conductivity (EC) was ranged from 0.22-0.44 dSm^{-1}, which indicates low quantity of salts in the soil solution.

EC levels in soil water is a good indicator for available nutrients in the soil (Jayanthi *et al.*, 2015), therefore this finding shows that these soils have low quantity of ions to transport nutrients to the crops.

Table.1 Soil chemical properties of Jhum lands under Zunheboto District

Villages	Location(GPS)	pH	OC (%)	EC (dSm^{-1})
Alaphumi	N26˚11'38" E94˚30'01"	6.3	0.39	0.30
Aotsakilimi	N26˚08'22" E94 ˚31'07"	6.0	0.44	0.29
Ghathashi	N25˚51'14" E94 ˚20'14"	6.2	0.44	0.22
Khetoi	N25˚57'33" E94 ˚32'39"	6.2	0.29	0.39
Krimtomi	N26˚06'35" E94 ˚27'23"	6.2	0.57	0.36
Litta new	N26˚09'48" E94 ˚22'58"	6.0	0.34	0.29
Litta old	N26˚10'24" E94 ˚23'15"	6.2	0.32	0.24
Lumami	N26˚11'40" E94 ˚27'13"	6.0	0.32	0.24
Lumsthami	N26˚10'36" E94˚30'34"	6.1	0.27	0.28
Maromi	N26˚10'49" E94˚24'37"	6.4	0.61	0.36
Philimi	N26˚06'19" E94 ˚23'16"	6.2	0.59	0.29
Phishumi	N26˚08'43" E94 ˚24'37"	6.0	0.38	0.31
Rotomi	N26˚05'04" E94 ˚27'32"	6.0	0.63	0.26
Sumi settsu	N26˚14'49" E94 ˚29'42"	6.0	0.60	0.44
Sutemi	N26˚09'57" E94 ˚28'59"	6.1	0.41	0.33
Zaphumi	N26˚13'09" E94˚30'07"	6.3	0.39	0.32
Range **Mean** **S.D.±** **C.V.**		**6.0-6.4** **6.14** **0.13** **0.02**	**0.27-** **0.63** **0.44** **0.12** **0.28**	**0.22-0.44** **0.31** **0.06** **0.19**

Table.2 Status of macro and micro nutrients available in Soil of jhum lands under Zunheboto District

Village	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	Available S (kg ha^{-1})	Available Zn (mg kg^{-1})	Available B (mg kg^{-1})
Alaphumi	249	10.72	187.23	10.3	0.18	0.05
Aotsakilimi	261	14.50	201.23	21.0	0.20	0.01
Ghathashi	253	17.34	234.12	18.7	0.13	0.19
Khetoi	229	12.68	215.10	15.4	0.09	0.06
Krimtomi	296	21.21	194.56	24.1	0.16	0.09
Litta new	252	11.13	212.10	12.6	0.25	0.16
Litta old	246	9.78	193.65	17.1	0.14	0.11
Lumami	257	9.67	196.23	23.1	0.06	0.19
Lumsthami	241	12.15	231.10	14.1	0.23	0.09
Maromi	283	19.45	261.12	17.3	0.09	0.06
Philimi	293	13.56	234.12	21.0	0.16	0.13
Phishumi	265	17.24	257.81	11.9	0.26	0.01
Rotomi	284	13.24	198.45	20.8	0.03	0.04
Sumi settsu	292	10.93	221.10	16.6	0.10	0.16
Sutemi	252	10.12	272.34	21.3	0.22	0.12
Zaphumi	261	8.89	252.31	19.4	0.18	0.09
Range	**229-296**	**8.89-21.21**	**187.23-272.34**	**10.3-24.1**	**0.03-0.26**	**0.01-0.19**
Mean	**263.34**	**13.29**	**222.66**	**17.79**	**0.16**	**0.10**
S.D.±	**20.30**	**3.72**	**27.32**	**4.10**	**0.07**	**0.06**
C.V.	**0.08**	**0.27**	**0.12**	**0.23**	**0.44**	**0.60**

Soil fertility status of macro and micro nutrients

The available N, P, K, S, Zn and B are analyzed and the data are shown in table 2. The available nitrogen content of the soils from the farmer's field varied from low to medium between 229) to 296 kg ha^{-1} with an average content of 263.34 ± 20.30 kg ha^{-1}. This may be due to heavy rainfall in the region causing loss of nutrient due to leaching and also due to removal of the nutrients by the crop continuously (Patel *et al.*, 2017).

The available phosphorus content in the farmer's field varied from low to mediumbetween8.89 to 21.21kg ha^{-1} with an average content of 13.29 ± 3.72 kg ha^{-1}. Low availability of phosphorus in these soils may be due to the fixation of P by Fe and Al oxides in acidic soils (Sentimenla *et al.*, 2012). The available potassium content in the soil was medium varying from 187.23 to 272.34 kg ha^{-1}with an average content of 222.66 ± 27.32 kg ha^{-1}.This might be due to potassium containing clay mineral in the soil (Patel *et al.*, 2017).

The available Sulphur in the soil ranged from low to medium between 10.3 to 24.1 kg ha^{-1} with an average content of 17.79 ± 4.10 kg ha^{-1}. The low availability of sulphur in some locations may be due to the low soil pH, low organic matter content and also through continuous removal by the crops. Similar findings were also reported by Singh *et al.*, (2019).

The available zinc content in the soil is low varying from 0.03 to 0.26 mg kg-^{1}with an average content of 0.16 ±0.07mg kg^{-1}. The low zinc availability in the soil may be due to leaching out of the water soluble zinc in acidic upland soils. Kumar *et al.*, (2018) also reported loss of zinc in acid soils due to heavy rainfall in the jhumlands. The available boron content in the soil is low varying from 0.01 to 0.19 mg kg^{-1}with an average content of 0.10± 0.06 mg kg^{-1}.The low content of available boron in the soil might be due to coarse texture soil and leaching. Similar findings were also reported by Takkar (1996) in the acidic up-land soils of Meghalaya.

Results of soil testing from the jhum fields community showed that pH of the soils are moderately acidic, low to medium In organic carbon and EC. The available nitrogen, phosphorus and sulphur content in the soil varied from low to medium. The micronutrients such as zinc and boron content in the soil ranged from low to medium. From the analyses of soil chemical properties and fertility parameters from the farmers jhum field, it is observed that the soil is low in nutrient content and needs improvement in soil health and fertility so as to ensure increase in crop productivity. From the above observations, it is therefore concluded that soil testing and acquiring soil health card should be considered an important tool for good crop nutrient management and to ensure higher productivity and restore soil health and fertility.

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