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Micronutrient Status of Soils under Jhum and Terrace cultivation in Manipur

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Abstract— **Study was conducted on distribution of micronutrients in surface soils of Jhum, Terrace soils along with the physico-chemical parameters & their co-relation. Soils of Jhum cultivation in Churachandpur District were strongly acidic in reaction (4.10 to 5.38) and heavy in texture. The soils were rich in Organic Carbon (0.327 to 3.00%) and low in Electrical Conductivity (0.060 to 0.517 dSm-1). The distribution of DTPA-Fe were very high ranging from 15.403 to 81.897 mg kg-1, DTPA-Cu were medium to high ranging from 0.55 to 2.10 mg kg-1, DTPA-Mn were medium to very high ranging from 6.333 to 60.367 mg kg-1 and DTPA-Zn were very low to high ranging from 0.203 to 1.9 mg kg-1. pH under terrace cultivation from Senapati district were strongly acidic in reaction (4.62 to 5.38) and heavy in texture and rich in organic carbon (0.55 to 3.20%) and low in electrical conductivity (0.063 to 0.183 dSm-1). Under terrace cultivation distribution of DTPA-Fe were very high ranging from 35.790 to 79.320 mg kg-1, DTPA-Cu were medium to high ranging from 0.680 to 2.930 mg kg-1, DTPA-Mn were medium to very high ranging from 5.900 to 48.933 mg kg-1 and DTPA-Zn were very low to medium ranging from 0.200 to 2.397 mg kg-1. DTPA-extractable micronutrients showed positive correlation with pH and EC under Jhum cultivation and in Terrace cultivation DTPA-extractable micronutrients showed positive correlation with pH except Fe. However, there is irregular pattern of correlation among the micronutrients under different land use systems. The surface horizon contains sufficient amount of DTPA-extractable micronutrients except Zinc. Therefore, Zinc fertilization may be an option for better crop production.**

Key words: *Micronutrients, Zn deficiency, JHUM, Terrace.*

I INTRODUCTION

Out of the total geographical area of north-eastern region (25.5 million hectares), 2.7 million hectares is under Jhum of which 17 per cent is under use at any given time (Manipur Remote Sensing Application Centre, 1995). The topography of the region apart from fertility of the soil can be attributed as one of the factors for widespread practice of Jhum cultivation, with settled terrace farming in foothill or low slope areas, above the adjacent rivers and streams. Some characteristics of Jhum cultivation in Manipur includes cutting and clearing of forest areas and burning of the dried biomass by fire, rotation of Jhum land every four to seven years, use of human labour as the chief input, non-employment of animals implements or machinery, collective ownership of land, reciprocal labour sharing and mixed cropping system. In Churachandpur district of Manipur, about 84.6 per cent of the population depends on Jhum cultivation.

A terrace is a piece of sloped plane that has been cut into a series of successively receding flat surfaces or platforms, which resemble steps, for the purposes of more effective farming. This type of landscaping, therefore, is called terracing. This is a most effective technique as it prevents water clogging and water runoff due to rainfall which can deposit the washed away nutrients in the next step. Senapati District is located in the northern part of Manipur and is located at 24.37 degree north latitude and 93.29 degree east to 94.15 degree east longitude. Senapati District occupies an area of 3271 sqkms.

The continuous use of micronutrient- free high analysis N and P fertilizers in the intensive cropping system with the diminishing use of organic manures has resulted in the depletion of micronutrient cations from the soil reserves (Dhane and Shukla 1995). The micronutrient deficiencies which were sparse and sporadic initially (Takkar and Randhawa 1980) are now widespread. Inventory of the available micronutrient status of the soil helps in demarcating areas where application of particular micronutrient is needed for profitable crop production.

Micronutrients are important for maintaining soil health and also increasing productivity of crops (Ratan*et al*.2009). The improper nutrient management has, led to emergence of multi-nutrient deficiencies in the Indian soils (Sharma 2008). Keeping in view the close relationship between soil properties and micronutrient availability, the present study was undertaken to analyze the influence of soil properties on availability of micronutrients for better land use management.

II MATERIALS AND METHODS

Soil samples from two different depths of 0-20 and 20-40 cm were collected from three different districts of Manipur viz. Churachanpur (jhum), Imphal East (valley) and Senapati (terrace) by Stratified Multistage Sampling. Sub-divisions are randomly selected from the chosen districts with five villages (each in 1 sub-division) and two respondent farmers from one village. The soil samples were analysed for some physicochemical properties following standard laboratory procedures. The pH and EC of the soils were estimated by using soil: water suspension (1:2) as describe by Jackson(1973); Organic Carbon by the Walkley and Black rapid titration method (Gupta, 2006); Cation exchange capacity by ammonium acetate saturation method (Jackson, 1973); Available micronutrients by DTPA extraction (Lindsay and Norvell 1978).

III RESULT AND DISCUSSION

The range and average values of the physico-chemical properties of the soil sample under different land use systems are shown in Table 1.

Table 1: Physico-chemical properties of soils under different land use system at surface soil

	0-20 cm			
Soil properties	**Jhum**		**Terrace**	
	Range	**Mean**	**Range**	**Mean**
pH	4.43 – 5.21	4.73	4.62 – 5.36	4.93
EC(dSm^{-1})	0.070 – 0.517	0.174	0.073 – 0.183	0.124
OC %	0.350 – 3.000	1.291	0.75 – 3.20	1.580
CEC[cmol (p^+) kg^{-1}]	6.100 – 27.533	12.380	8.667 – 23.600	14.089
SAND %	13.600 – 57.833	35.236	6.700 – 36.233	24.538
SILT %	11.900 – 37.500	20.374	16.900 – 39.167	26.438
CLAY %	29.067 – 57.767	44.353	31.633 – 59.733	49.049

The results showed that majority of the soil were slightly acidic to neutral reaction with sufficient amount of organic matter content while most of the soils were clay in texture showed in Table 2. Result showed that soil texture of the studied samples belonged to mostly clay distribution as a function of depth wise is not responding which indicate that these soils are recent developed alluvium soils (Bhattacharyya 2013), some sandy clay loam, clay loam and sandy clay in texture.

Data on depth wise distribution of DTPA- Fe are presented in Table 4.10.Result showed that the studied samples had adequate amount of Fe content with a value varying from 15.403 to 81.897 mg kg^{-1} soil at surface soil with mean values of 36.294 mg kg^{-1} respectively.

Considering critical limit of 4.5 mg Fe kg^{-1} soil (Lindsay and Norvell, 1978; Anonymous, 1990), all the soil samples were highly sufficient in available Fe. This may be attributed to higher Organic Matter because it acts as chelating agent (Kumar *et al*, 2011). Organic matter, organic residues and manure applications affect the immediate and potential availability of micronutrients cations (Rengel, 2007). These cationic micronutrients react with certain organic molecules to form metallic complexes as chelates, and the soluble chelates can increase the availability of the micronutrient and protect it from the precipitation. These chelates may also be synthesized by plant roots and released to the surrounding soil or may be present in soil humus (Brady and Weil, 2002).

Table 2:Textural class under different land use system with surface and sub-surface soil depth

	0-20 cm			
	Sand	**Silt**	**Clay**	**Texture**
Jhum	35.236	20.374	44.353	Clay
Terrace	24.538	26.438	49.049	Clay

DTPA-extractable Cu content varied from 0.55 to 2.10 mg kg^{-1} with mean value of 1.084 in surface layer. Taking into consideration the critical value of 0.20 mg Cu kg^{-1} (Lindsay and Norvell, 1978; Anonymous, 1990), all the soil samples were well supplied with available Cu. Similar findings were also made by Sen*et al.* (1997).

DTPA-Mn content ranged from 6.333 to 60.367 mg kg^{-1} soils in surface layer with mean value of 31.457mg kg^{-1}. Considering 1.0 mg Mn kg^{-1} soil as critical level (Lindsay and Norvell, 1978; Sharma *et al.*, 1985), all the samples were well supplied with available Mn. The abundance of DTPA - Mn in soils of Manipur was also reported by Sen*et al.* (1997); and Sarkar*et al.* (2002).

DTPA-Zn content ranges from 0.203 to 2.948 with mean value of 0.677 in surface soil. Based on critical limit of 0.6 mg Zn kg^{-1} soil most of the soils are deficient in Zn content and required Zn fertilization for better crop production.

Micronutrient status under Terrace cultivation in Senapati district of Manipur:

Result showed that the studied samples had adequate amount of Fe content with a value varying from 35.790 to 79.320 mg kg^{-1} soil at surface layer with mean value of 57.457. Considering critical limit of 4.5 mg Fe kg^{-1} soil (Lindsay and Norvell, 1978; Anonymous, 1990), all the soil samples were highly sufficient in available Fe. This may be attributed to higher organic matter because it acts as chelating agent (Kumar *et al*, 2011). Organic matter, organic residues and manure applications affect the immediate and potential availability of micronutrients cations (Rengel, 2007). These cationic micronutrients react with certain organic molecules to form organo-metallic complexes as chelates, and the soluble chelates can increase the availability of the micronutrient and protect it from the precipitation. These chelates may also be synthesized by plant roots and released to the surrounding soil or may be present in soil humus (Brady and Weil, 2002).

Data on DTPA-extractable Cu content varied from 0.68 to 2.93 mg kg^{-1} with mean value of 1.477 in surface layer. Taking into consideration the critical value of 0.20 mg Cu kg^{-1} (Lindsay and Norvell, 1978; Anonymous, 1990), all the soil samples were well supplied with available Cu. Similar findings were also made by Sen et al. (1997).

DTPA-Mn content ranged from 5.9 to 48.933 mg kg^{-1} soils in surface layer with mean value of 19.302 mg kg^{-1}.. Considering 1.0 mg Mn kg^{-1} soil as critical level (Lindsay and Norvell, 1978; Sharma *et al.* (1985), all the terrace soil samples were well supplied with available Mn. The abundance of DTPA - Mn in soils of Manipur was also reported by Sen*et al.* (1997); and Sarkar*et al.* (2002).

DTPA-Zn content ranges from 0.20 to 2.397mg $kg^{-1}$with mean value of 0.573 mg kg^{-1}. Based on critical limit of 0.6 mg Zn kg^{-1} soil almost all the soils of Terrace cultivation are deficient in Zn content and required Zn fertilization for better crop production.

Table 3 : Micronutrient status of soils under different land use system at surface soils

	0-20 cm			
	Jhum		Terrace	
	Range	Mean	Range	Mean
Fe (mg kg^{-1})	15.403 – 81.897	36.294	35.790 – 79.320	57.457
Cu (mg kg^{-1})	0.550 – 2.103	1.084	0.680 – 2.930	1.477
Mn (mg kg^{-1})	6.333 – 60.367	31.457	5.900 - 48933	19.302
Zn (mg kg^{-1})	0.203 – 1.948	0.677	0.200 – 2.397	0.573

Correlation of DTPA-extractable micronutrients with physical properties and some chemical properties of soils under different land use system:

Correlation between DTPA-extractable micronutrients and physical properties with some chemical properties of soils under different land use system of Jhum and Terrace cultivation exhibited considerable variation with respect to different soil depth.

Correlation between DTPA-extractable micronutrient and soil properties under Jhum cultivation of Churachandpur district: Correlation studies revealed that DTPA-extractable Fe showed a positive and significant correlation with pH (r=0.342**), EC (r= 0.409**), OC (r= 0.144*) and sand (r= 0.236**) and a negative and significant correlation with clay (r=-0.475**) in surface 0-20 cm soil in conformity with the findings of Satisha*et al.,*(2000). Among the micronutrients DTPA-Fe show positive significant correlation with DTPA-extractable Zn and there was a positive correlation in all the samples except with Mn in 0-20 cm depth.

DTPA-Cu was positively and significantly correlated with clay in surface soil with the r value 0.261**‘ and pH in surface soil with the r value 0.402**. There was positive and significant with EC(r=0.151*), OC(r=0.161*) in surface soil. There was a negative and significant correlation with sand with the r value -0.188**. Similar findings were made by Nayak*et al.* (2000). Further, there was positive and significant correlation between DTPA-Cu and DTPA-Mn with r value 0.352**. Similar observation was also given by Datta and Munna Ram (1993).

DTPA-extractable Mn showed a positive and significant correlation with pH (r=0.488**), silt (r=0.237** and clay (r= 0.438**) in surface 0-20 cm depth soil.. However, there was positive and significant correlation between DTPA-Mn and DTPA-Cu with r value 0.352** and 0.446** respectively. Available manganese increased with increased in available copper such similar findings were also made by Datta and Munna Ram (1993),

DTPA-Zn show positive and significant correlation with pH (r=0.210**), EC(r=0.745**) and silt (r=0.420**) in 0-20 cm depth in conformity with the findings of Satisha*et al.* (2000) But there was negative and significant with sand in 0-20 cm depth with the r values -0.157**. Amongs the micronutrients DTPA-Zn show positive significant correlation with DTPA-extractable Fe and there was a negative correlation in 0-20 cm depth.

Correlation between DTPA- extractable micronutrient and soil properties under Terrace cultivation of Senapati district:

Correlation studies revealed that DTPA-extractable Fe showed a positive and significant correlation with EC (r= 0.591**), CEC (r= 0.235**) in 0-20 cm depth. A negative and significant correlation with pH (r=-0.174**), OC (r=-0.289**), sand (r=-0.193**) in surface 0-20 cm depth.

Amongs the micronutrients DTPA-Fe show positive and significant correlation with all the three micronutrients, DTPA-Cu, DTPA-Mn and DTPA-Zn with the r values 0.565**, 0.315** and 0.324** respectively in 0-20 depth.

DTPA-Cu was positively and significantly correlated with pH (r=0.665**), EC (r=0.508**), OC (r=0.165*), CEC (r=0.690**), sand (r=0.195**) and silt (r=0.240**) in 0-20 cm. Similar findings were made by Athokpam*et al.* (2013), Singh *et al.* (2006), Verma*et al.* (2007), Jiang *et al.* (2009) and Bassirani*et al.* (2011). There was a negative and significant correlation with clay (r=-0.410**). Further, there was positive and significant correlation between DTPA-Cu and DTPA-Mn, DTPA-Fe, DTPA-Zn with the r value 0.718*“, 0.565**, 0.393**. Similar observation was also given by Athokpam*et al*. (2013).

Table 4.13(a): Correlation coefficient (r) between soil properties and micronutrients of the soils of Jhum cultivation at 0-20 cm depth

	Fe	Mn	Cu	Zn
pH	0.342**	0.488**	0.402**	0.210**
EC	0.409**	0.108	0.151*	0.745**
OC	0.144*	0.035	0.161*	-0.034
CEC	-0.083	0.016	0.0009	-0.087
SAND	0.236**	-0.405**	-0.188**	-0.157**
SILT	0.137	0.237**	0.027	0.420**
CLAY	-0.475**	0.438**	0.261**	-0.090
Zn	0.541**	-0.188	-0.074	1.000
Cu	0.018	0.352**	1.000	
Mn	-0.346**	1.000		
Fe	1.000			

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

DTPA-extractable Mn showed a positive and significant correlation with pH (r=0.476**), EC (r=0.304**), CEC (r=0.722**) and silt (r=0.176**) in surface 0-20 cm depth soil. However, there was negative and significant correlation between DTPA-Mn and clay with the r value -0.233** at 0-20 cm depth soil. Correlation between DTPA-Mn with DTPA-Fe, DTPA-Cu, DTPA-Zn showed positive and significant correlation with r values 0.315**, 0.718**, 0.205** for 0-20 cm depth.

The r value obtained between Zn and soil pH was 0.114, it means there was positive non-significant correlation between Zn and soil pH. Similar results were studied by Patiram*et al*. (2000). DTPA - Zn show positive and significant correlation with EC(r=0.255**) and sand (r=0.398**) in surface soil. But there was negative and significant with OC (r= - 0.222**), clay (r=-0.320) in surface soil..Amongs the micronutrients DTPA-Zn show positive significant correlation with DTPA –Fe, DTPA-Cu and DTPA-Mn in 0-20 cm depth with r values 0.324**,0.393**, 0.205**. This findings are in agreement with the findings of Bassirani*et al* (2011).

IV CONCLUSION

It may be concluded from the research work conducted that the micronutrients should also considered during fertilization if necessary because of the deficiency in available Zn in almost all the soils of the different land use system. The shifting cultivation will be better if management practices undertaken through increase fallow periods for resilience of soil, a minimum of 1:4 years of cropping and fallow periods, respectively could be the suitable cycle under Jhum cultivation.

Table 4.14(a): Correlation coefficient (r) between soil properties and micronutrients of the soils of Terrace cultivation at 0-20 cm depth

	Fe	Mn	Cu	Zn
pH	-0.1739**	0.4760**	0.665**	0.114
EC	0.591**	0.304**	0.508**	0.255**
OC	-0.289**	-0.059	0.165*	-0.222**
CEC	0.235**	0.722**	0.6898**	-0.029
SAND	-0.193**	0.081	0.195**	0.398**
SILT	0.102	0.176**	0.240**	-0.123
CLAY	0.122	-0.233**	-0.410**	-
Zn	0.324**	0.205**	0.393**	0.3197**
Cu	0.565**	0.718**	1.000	1.000
Mn	0.315**	1.000		
Fe	1.000			

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

REFERENCE

1.Alamgir, M. and Al-Amin, M. (2008).Storage of organic carbon in forest under growth, litter and soil within geoposition of Chittagong (South) forest division Bangladesh.*Int. J. Usufruct Manag*.,9(1): 75-91.

2.Andrabi, S.G.J. and Shah, S.A. (2010).Physico-chemical characteristics and vertical distribution of micronutrients in some soils of Jammu and Kashmir at different altitudes.*Environ. Ecol*., 28(2): 792-796.

3.Anonymous (1990).Annual report, All India Coordinated Schemeof micro and secondary nutrients and pollutant elements in soils and plant. *Indian Institute Soil Sci. Bhopal*, p. 14.

4.Athokpam, H., Wani, S.K., Kamei, D., Athokpam, H.S., Nongmaithem, J., Kumar, D., Singh, Y.K., Naorem, B.S., Devi, T.R. and Devi, L. (2013).Soil macro- and micro-nutrient status of senapati district, Manipur.*African J. Agric. Res*.,8(39):4932-4936.

5.Balpande, H.S., Challa, O. and Prasad, J. (2007). Characterization and classification of grape- growing soils in Nasik district, Maharastra. *J. Indian Soc. Soil Sci*., 55(1): 80-83.

6.Bassirani, N., Abolhassani, M. and Galavi, M. (2011). Distribution of available micronutrients as related to the soil characteristics of Hisar, Haryana (India). *African J. Agric. Res*., 6: 4239-4242.

7.Begum, K., Jahan, I., Rahman, M.H., Chowdhury, M.S. and Elahi, S.F. (2009) Status of some micronutrients in different soils of Gazipur district as related to soil properties and land type.*Bangladesh J. Sci. Ind. Res.*,44(4): 425-430.

8.Behera, S.K. and Shukla, A.K. (2015) Spatial distribution of surface soil acidity, electrical conductivity, soil organic carbon content and exchangeable potassium, calcium and magnesium in some cropped acid soil of India. *Land degrade. Develop*.,26: 71-79.

9.Behera, S.K. and Shukla, A.K. (2014) Total and Extractable Manganese and iron in some cultivated acid soils of India: Status, Distribution and Relationship with some soil properties. *Pedosphere*, 24(2): 196-208.

10.Bhanwaria, R., Kameriya, P.R. and Yadav, B.L. (2011). Available micronutrient status and their relationship with soil properties of Mokala soil series of Rajasthan. *J. Indian Soc. Soil Sci.,*59(4): 392-396.

11.Bhattacharyya,T., Pal, D.K., Mandal, C., Chandran, P., Ray, S.K., Sarkar, D., Velmourougane, K., Srivastava, A., Sidhu, G.S., Singh, R.S., Nagar, A.P. and Nimkhedkar, S.S. (2013). Soils of India: Historical perspective, classification and recent advances. *Current.Sci*., 104(10):1308-1323.

12.Bhogal, N.S., Sakal, R., Singh, A.P. and Sinha, R.B. (1993) Micronutrient status in AquicUstifluvents and Udifluvents as related to certain soil properties. *J. Indian Soc. Soil Sci*., 41(1): 75-78.

13.Bouyoucos, G.J. (1927). The hydrometer as a new method for the mechanical analysis of soils.*SoilSci*., 23: 225-230.

14.Brady, N.C. and Weil, R.R. (2002).The nature and properties of soils.Prentice Hall., New Jersey, USA.

15.Chatterji, S., Sarkar, D., Das, T.H. and Halder, A.K. (1999). Available iron, manganese and copper in different agro-ecological sub-regions of West Bengal in relation to soil characteristics. *J. Indian Soc. Soil Sci*., 47(3): 463-465.

16.Chattopadhyay, T., Sahoo, A.K., Singh, R.S., and Shyampura, R.L. (1996).Available micronutrient status in the soils of Vindhyanscarplands of Rajasthan in relation to soil characteristics.*J. Indian Soc. Soil Sci.,*44(4): 678-681.

17.Chhabra, G., Srivastava, P.C., Ghosh, D. and Agnihotri, A.K. (1996). Distribution of available micronutrient cations as related to soil properties in different soil zones of Gola-Kosiinterbasin. *Crop Res. (Hisar),*11(3): 296-303.

18.Chinchmalatpure, A.R., Brij-Lal, Challa, O. and Sehgal, J. (2000).Available micronutrient status of soils on different parent materials and landforms in a micro-watershed of Wunna catchment near Nagpur, Maharastra.*Agropedology*, 10(1): 53-58.

19.Dahar, G.J., Baloch, P.A. and Abro, B.A. (2014).Distribution of micronutrients in different soil series around Tando Jam, Sindh, Pakistan.*Sci. Tech. Dev*., 33(1): 7-13.

20.Datta, M. and Munna Ram (1993) Status of micronutrients in some soil series of Tripura. *J. Indian Soc. Soil Sci*., 41(4): 776-777.

21.Dhaliwal, S.S., Sharma, B.D., and Singh, B. (2009). Micronutrient status of different land use systems in relation to soil quality and sustainability under different watersheds in sub-mountainous tract of Punjab. *Ann. arid zone*, 48(2): 103-112.