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SOIL NUTRIENT STATUS OF ANNUALLY FLOOD AFFECTED RICE GROWING AREAS OF VILLAGE SALCHAPRA-I OF CACHAR DISTRICT, ASSAM

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ABSTRACT

A study on soil fertility status was made at an annually flood affected village Salchapra-I in the Cachar district of Assam. The objective of the experiment was to study the variation of macro, secondary and micronutrient status of soil due to annual flooding and its subsequent deposition of highly fertile river sediments. All total 100 soil samples were collected at a depth of 0-15cm and analysed for pH, OC, av. N, P, K, S, DTPA extractable Fe, Cu, Zn and Mn. pH ranged from 4.4-6.7 (average 5.0), OC ranged from 0.38-2.32% (average 1.07%), av. N ranged from 145-597.2 kg/ha (average 329.4 kg/ha), av. P_2O_5 ranged from 10.2-139.7 kg/ha (average 32.0 kg/ha), av. K_2O ranged from 87.4-645.1 kg/ha (average 181.0 kg/ha), Sulphur ranged from 87.5-360.0 mg/kg (average 209.6 mg/kg). The micronutrient Fe, Cu, Zn and Mn ranged from 39.17-111.64 (average 78.49), 1.46-7.72 (average 4.95), 0.34-6.37 (average 2.16) and 24.73-64.42 (average 54.99) mg/kg respectively. OC status was found high while NPK status was medium to high but the status of Fe, Cu, Zn, Mn and S was found high. So, the overall fertility status of the village soil was found to be higher as compared to the soils of other villages of the district.

Key words: soil nutrients, soil fertility, flood, Barak valley, micronutrients.

INTRODUCTION

About 4.75 lakh hectares of land are chronically flood affected in Assam. Flood is a regular and annual feature in Barak Valley Zone of Assam. A number of villages of Cachar district under Barak valley zone of Assam are worst affected in terms of frequency and duration of flood every year and after the recession of floodwater, a thin layer of river sediments gets deposited over a large area, adversely affecting cultivation of crops and also habitation but indirectly increasing fertility status of the soil. Interpretation of remote sensing data, toposheets and ground truth checking showed that the district was severely affected by sediment deposition from the river Barak and its tributaries *viz.*, Jatinga, Ghaghra, Katakhal, Madhura etc.

This type of annual flood would spell disaster for the district if immediate steps were not taken to check the menace. How can these lands be used during summer is the question in the minds of everyone. But, till date scientific approaches for managing this aspect were meagre. Considering the importance of bringing these sediment deposited areas into immediate agricultural use, the present investigation was carried out at Salchapra-I village of Cachar district which represents the entire flood affected areas of the district.

Soil testing helps farmers for selecting their crop varieties and applying required amounts of fertilizer. Most of the farmers in the plains of Cachar district still practice the mono-crop system where one major crop *i.e.*, rice is grown annually. Ignorance in terms of manure and fertilizer application with respect to the soil fertility status is one of the major factors leading to the low productivity of the crops. In order to formulate the requirement of balanced crop nutrition and nutrients to be applied in the field, analysis of soil for available nutrients is highly necessary. With this objective in mind, a study was undertaken to find out the soil fertility status of annually flood affected village Salchapra-I under Cachar district during the year 2011-12, where soil fertility status and nutrient requirement for crops may vary every year based on flood and sedimentation.

MATERIALS AND METHODS

All total 100 surface soil samples (0-15 cm depth) were collected randomly using GPS reading from the fields of 100 farmers of village Salchapra-I, Block Salchapra, Sub-division Silchar, Cachar district during *rabi* season 2011 and soil samples were analyzed for pH, OC, N, P, K, Fe, Cu, Zn, Mn and S in collaboration with Soil Testing Laboratory, NBSS & LUP, Regional Centre, Jorhat, Assam.

The pH of the soil was determined in a suspension of soil to water ratio of 1: 2.5 using glass electrode (Jackson, 1973). Organic carbon content in the soil was estimated by Walkley and Black procedure (Walkley and Black, 1934). Samples were analyzed for available N by modified Kjeldahls method (Subbiah and Asija, 1956). Available P_2O_5 was analyzed colorimetrically by Brays I method using an extracting solution of 0.03 *N* NH_4F + 0.02 N HCl (Jackson, 1973). Available K_2O was analyzed by equilibrating the soil with an exchanging cation made of solution of neutral normal ammonium acetate in a given soil:solution ratio. K content in the equilibrium solution was estimated flame photometrically (Jackson, 1973). Micronutrients Fe, Cu, Zn and Mn (DTPA Extractable) were estimated by Atomic Absorption Spectrophotometer and available Sulphur was estimated by Turbidimetric procedure.

RESULT AND DISCUSSIONS

Data presented in Table 1 showed that on an average the soil of the village is strongly acidic in reaction with a few places being moderately acidic. The soil pH ranged from 4.4 to 6.7. The pH of the soils collected from the banks of Katakhal river which is on the southern side of the village was found to be higher than that of the entire village perhaps due to nearness to the river water. Relatively higher pH of the affected areas than that of other soils of Assam might be due to high base saturation and deposition of base rich sediments during siltation, which was in confirmatory with the findings of Kakati *et al.* (1986) and Diwakar and Singh (1994).

The OC content of the soil ranged from 0.38 to 2.32% (average of 1.07%) indicating high status of the soil with respect of organic carbon. The higher status of OC was mainly due to recurring flood by which addition of organic matter takes place in the village as has also been reported by Karmakar (1985) that OC content of the alluvium-derived soils of Assam was high because of deposition of OM in it.

Available N content of the soil ranged from 145.0 to 597.2 kg/ha (average of 329.4 kg/ha) indicating medium status of the soil with respect to available Nitrogen. The higher available N content is found in the southern side of the village as annual sediment deposition is higher in that side due to nearness to the river. Organic sources also release organic acid and other microbial products during decomposition which solubilizes the insoluble

compounds (Patrick *et al*., 1965) and enhance the nitrogen availability in soil (Bhandari *et al*., 1992; Hegde and Dwivedi, 1992).

The available P_2O_5 content of soils ranged from 10.2 to 139.7 kg/ha (average of 32.00 kg/ha) exhibiting medium status of the soil with respect to available P. Incorporation of P in soil through organic sources during flood along with inorganic sources caused such increase in the level of available P (Powlson and Johnston, 1992; Babhulkar *et al*., 2000; Bharadwaj and Omanwar, 1994). Mineralization of organic P and release of P from insoluble forms by production of organic acids due to flood also resulted in increased level of available P in soils (Patel *et al*., 1979). In this study organic matter content of soil was found to be more which is another reason for better status of phosphorus.

The available K_2O content of soil ranged from 87.4 to 645.1 kg/ha (average of 181.0 kg/ha) indicating medium status of the soil with respect to available K. Application of organic amendment was even effective in keeping available K content at medium to higher level. Higher level of available K in southern side of the village could be a result of increased organic carbon content and subsequent solubilizing action of organic acids and also its greater capacity to hold K in the available form. In soil under natural condition ionic form of K gets easily leach down to lower depth of soil but higher level of K in studied area is due to recurring flood by which addition of organic matter takes place and help in holding the ions (Powlson and Johnston, 1992; Mishra and Sharma, 1997).

The data presented in table 2 showed that the available Fe content of soil ranged from 39.17 to 111.64 mg kg^{-1} (average 78.49 mg kg^{-1}), the available Cu content of soil ranged from 1.46 to 7.72 mg kg^{-1} (average 4.95 mg kg^{-1}), the available Zn content of soil ranged from 0.34 to 6.37 mg kg^{-1} (average 2.16 mg kg^{-1}), the available Mn content of soil ranged from 24.73 to 64.42 mg kg^{-1} (average 54.99 mg kg^{-1}) and the available Sulphur (S) content of soil ranged from 85.5 to 360 mg kg^{-1} (average 209.6 mg kg^{-1}). By comparing these micronutrients and secondary nutrient with the established criteria of Soltanpour (1985) and Johnson and Fixen (1990) in Table 3, all the soil samples (100%) were found high in Iron, Copper, Manganese and Sulphur contents. It was found that 96% samples had high and 4% had low Zn content.

The high organic matter present in the soil increased the availability of micronutrients in soils due to formation of soluble complexing agents resulting decrease in the fixation of micronutrients in soils. Grewal *et al.* (1969) observed increase in exchangeable cations in soil

with an increase in the OM content of the soils and recorded a significant positive correlation between OM and exchangeable cations.

From the above experiment, it can be concluded that the annual occurrence of flood in the village play an active role in improving the soil fertility. Soil parameters like OC, N, P and K and micronutrient like Fe, Cu, Zn and Mn and secondary nutrient S increased due to the deposition of river sediments with the occurrence of flood in the village soil. The flooding of soil and its consecutive drying caused oxidation of S and this condition increases S fertility in soil (Wind and Conrad, 2006).

The present investigation showed an encouraging result of soil fertility in the village due to flood. The annual flood in the village regularly deposits highly fertile sediments in the soil which on the other hand converts the agriculture land to fertile.

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REFERENCE

Babhulkar P S, Wandile R M, Badole W P and Balpande S S. (2000). Residual effect of long-term application of FYM and fertilizers on soil properties (vertisols) and yield of soybean. *J. Indian Soc. Soil Sci*. **48**(1):89-92.

Bhandari A L, Sood A, Sharma K N and Rana D S. (1992). Integrated nutrient management in a rice-wheat system. *J. Indian Soc. Soil Sci*. **40**:742-747.

Bharadwaj V and Omanwar P K. (1994). Long-term effects of continuous rotational cropping and fertilization on crop yields and soil properties-II. Effect on EC, pH, organic matter and available nutrients of soil. *J. Indian Soc. Soil Sci*. **42**(3):387-392.

Diwakar D P S and Singh R N. (1994). Characterization of soils of diaraland occurring in Gangetic plains of Bihar. *J. Indian Soc. Soil Sci.* **43**(3):420-445.

Grewal J S, Randhawa N S and Bhumbla D R. (19690. *J. Res. Punjab Agric. Univ.*, **6:**38-45

Hegde D M and Dwivedi B S. (1992). Nutrient Management in rice-wheat cropping system in India. *Fert. News*. **37**(2):27-41.

Johnson G V and Fixen P E. (1990). Testing soils for Sulfur, Boron, Molybdenum and Chlorine. In:Westermann, R L. ed. Soil testing and plant analysis. 3rd Ed. Madison, WI (USA). Soil Science Society of America. Pp.265-273

Jackson M L. (1973). Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi.

Kakati N N, Saikia P D, Sharma A K, Borthakur H P, Khound J N, Chamuah G S, Shadeque A, Gogoi H N, Bezbarua J. and Dutta T. (1986). Report on the Agricultural development in char areas of Brahmaputra Valley, Assam.

Karmakar R M. (1985). Genesis and classification of soils of Northern Brahmaputra Valley of Assam. Ph.D. Thesis, IARI, New Delhi.

Mishra V K and Sharma R B. (1997). Influence of INM on soil health and energy requirement of rice based cropping systems. *Oryza*. **34**(2):165-170

Patel R B, Rajashekarrappa B J, Viswanth O P and Shantaram M V. (1979). Solubilization and immobilization of phosphate by some microorganisms and P availability to plant. *J. Indian Soc. Soil Sci.* **12**:550-556.

Patrick W H, Mahapatra J R and Jorawar I C. (1965). Transformation and availability of rice to nitrogen and phosphorus in waterlogged soils. *Adv. Agron*. **20**:331-338.

Powlson D S and Johnston A E. (1992). Long-term field experiments: their importance in understanding sustainable land use. In Proceedings of a Symposium on Soil Resilience and Sustainable Land Use, Budapest, Hungary, 28th September and 2nd October, 1992. pp.367-393.

Soltanpour P N. (1985). Use of AB-DTPA soil test to evaluate elemental availability and toxicity. Communication in Soil Science and Plant Analysis. **16**(3):323-338

Subbiah B V and Asija G L. (1956). A rapid procedure for the determination of available nitrogen in soils. *Curr. Sci.* **25**:259-260.

Walkey A. and Black L R. (1934). An examination of Degtyreff method for determination of soil organic matter and a proposed modification of the chromic and titration method. *Soil Sci.* **37**:29-38.

Wind T and Conrad R. (2006). Sulfur compounds, potential turnover of sulfate and thiosulfate and number of sulfate reducing bacteria in planted and unplanted paddy soil. *Microbiology Ecology*. **18**(4):257-266.

Table 1: Range and average values of Physio-chemical properties of 100 tested soil samples of Salchapra-I village, Cachar district.

S.N.	Physio-chemical properties		
	Parameters	**Range**	**Average**
1	Soil pH	4.4 - 6.7	5.0

2	Organic carbon (%)	0.38 – 2.32	1.07
3	Available Nitrogen (kg/ha)	145.0 – 597.2	329.4
4	Available P_2O_5 (kg/ha)	10.2 – 139.7	32.0
5	Available K_2O (kg/ha)	87.4 – 645.1	181.0

Table 2: Range and average values of Micronutrients of 100 tested soil samples of Salchapra-I village, Cachar district.

S.N.	Micronutrients		
	$mgkg^{-1}$ (ppm)		
		Range	Average
1	Iron (Fe)	39.17 – 111.64	78.49
2	Copper (Cu)	1.46 – 7.72	4.95
3	Zinc (Zn)	0.34 – 6.37	2.16
4	Manganese (Mn)	24.73 – 64.42	54.99
5	Sulphur (S)	87.50 – 360.00	209.60

Table 3: Critical soil test values of Physio-chemical properties of soil by Johnson and Fixen, 1990 and Soltanpour, 1985.

S. N.	Parameters	Critical ranges		
		Low	Medium	High
1	Organic carbon (%)	< 0.50	0.50 – 0.75	> 0.75
2	Available N (kg/ha)	< 272	272 – 544	> 544
3	Available P_2O_5 (kg/ha)	< 22.5	22.5 – 56.0	> 56.0
4	Available K_2O (kg/ha)	< 136.0	136 – 337.5	> 337.5
6	Fe (mg/kg)	< 3.0	3.0 – 5.0	> 5.0
7	Cu (mg/kg)	< 0.3	0.3 – 0.5	> 0.5
8	Zn (mg/kg)	< 0.9	0.9 – 1.5	> 1.5
9	Mn (mg/kg)	< 0.6	0.6 – 1.0	> 1.0
10	S (mg/kg)	< 5.0	5.0 – 10.0	> 10.0