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Effect of Acidic Coal Mine Drainage on Soil Fertility Status of Rice Soils of Jaintia Hills District of Meghalaya

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Analysis of soil samples collected from rice fields of three different coal mining areas of Jaintia Hills district, Meghalaya, namely, Dkhlah, Lad Rymbai and Bapung revealed that soils were highly acidic (pH 3.3-4.1) with inadequate availability of N (210-272 kg/ha), P_2O_5 (21-33 kg/ha), K_2O (145-210 kg/ha) and organic carbon (0.21-0.67 %). The soil fertility status was found to be not congenial to sustain plant growth and development in long term.

Key words : Mine drainage, Nutrient, pH

INTRODUCTION

The Jaintia Hills district of Meghalaya is the most extensively exploited in terms of coal, among all the districts of the state[1]. Coal mining operations in Jaintia Hills are small scale ventures controlled by individuals who own the land. Coal extraction is done following primitive mining method known as 'rat hole' mining. This extensive surface excavation of sloping land damages the ecosystem within the periphery of mined area[2].

Agriculture is the main occupation of the people of Jaintia Hills. Rice is the main crop of this region occupying 50.5 % of total net sown area[3]. But during recent years large number of paddy fields are left barren by the farmers due to degradation of fields through deposition of coal particles[4] and contamination of soils due to inundation by highly acidic mine water[5]. Rectification of such problem is possible only if inherent properties of such soils with respect to crop growth is studied. This paper attempts to focus on some basic properties of soils of paddy fields located in different coal mining sites of Jaintia Hills District.

Experimental

STUDY AREA AND METHODS

Jaintia Hills district is situated in the eastern part of the state of Meghalaya and lies between 25°5′ to 25°4′ N latitudes and between 91°51′ to 92°45′E longitudes. Coal fields of Jaintia Hills are small and spread out in different patches, namely, Bapung, Lakadong, Lumshnong, Malwar-Musiang Lamare, Mutang, Sutnga, Jarain-Tkentalang and Ioksi. Although there is large-scale exploitation of coal in the district but for the purpose of study three representative coal mining sites, namely, Lad Rymbai, Bapung and Dkhiah have been selected.

Surface soil samples (0-15 cm depth) collected from paddy fields were mixed, sieved and homogenized for determining various physico-chemical characteristics. Geographical locations of the sampling sites are depicted in Table 1.

Soil pH was determined by glass electrode pH meter (1:2.5 :: Soil: water). Organic carbon[6], available N[7], available P and available K[8] were determined by following standard chemical analytical procedures.

RESULTS AND DISCUSSION

Soil pH and organic carbon status of experimental soils have been presented in Table 2. Soil pH of coal mining sites ranged from 3.3 to 4.1 indicating strongly acidic nature. This is below the optimum pH (5.5 to 6.0) required for rice[9]. Among all the sites pH was lowest in

Table1: Geographical locations of sampling sites

Location	Altitude (above msl*)	Latitude (N)	Longitude (E)
Lad Rymbai	1,200 m	25°22'14"	92°19'4"
Dkhiah	1,200 m	25°22'18"	92°21' 32"
Bapung	1,262 m	25°23'45"	92°18'24"

*msl: mean sea level

Bapung. The upper range of organic carbon for proper growth and development of crop is 0.75%[10]. The data shows that this limit is not attained at all sampling sites. Moreover both pH and organic carbon of experimental soils were lower than pH (4.7-5.4) and organic carbon (0.9-7.41%) of rice soils of non-mining areas of Jaintia Hills[11]. Low level of organic carbon (0.21 to 0.67%) indicates poor soil physical properties which ultimately results in poor growth and development of crop grown in such soils[12].

Table 3 indicates that available N, P_2O_5 and K_2O in all the experimental soils were in the ranges of 210-272, 21-33 and 145-210 kg/ha, respectively. Availability of all these nutrients were in medium range which is not sufficient to sustain optimum growth and development of crops. Moreover availability of N, P_2O_5 and K_2O of Bapung soil were lowest among all the sampling sites as compared to rice soils of unmined areas of Jaintia Hills (246-268 kg/ha N, 21-32 kg/ha P, 164-169 kg/ha K)[11]. Lower availability of nutrients to plants is responsible for decreased vegetative growth which causes reduced development of photosynthetic area and thereby lower translocation of photosynthates towards sinks which ultimately results in poor growth and yield of crops[13].

Table 2: Soil pH and organic carbon of experimental soils

Soil Parameters	Dkhiah		Lad Rymbai		Bapung	
	Mean*	SD	Mean	SD	Mean	SD
pH	3.80	0.36	4.10	0.38	3.30	0.26
Organic C (%)	0.53	0.08	0.67	0.15	0.21	0.05

*Mean of three samples

Table 3: Available major nutrients of experimental soils

Soil Parameters	Dkhiah		Lad Rymbai		Bapung	
	Mean*	SD	Mean	SD	Mean	SD
Available N (kg/ha)	247.43	32.86	272.87	23.38	210.73	19.81
Available P_2O_5 (kg/ha)	33.23	4.61	25.40	5.60	21.53	1.62
Available K_2O (kg/ha)	176.50	20.79	210.13	11.87	145.00	11.36

*Mean of three samples

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The results of the investigation suggest that the ,is collected from paddy fields located in coal mining ,ites of Jaintia Hills district, Meghalaya were highly acidic with inadequate availability of major plant nutrients and organic carbon. The soils can not sufficiently support proper growth and development of crops. It needs immediate attention before the soil productivity is deteriorated irreversibly.

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