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Soil Fertility Status of Patarghat Block in Saharsa District of Agro-Climatic Zone-II of Bihar

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

A soil nutrient status inventory work was carried out in some villages of Patarghat block in Saharsa district. Results shows that soil texture of the soil under investigation was loamy land. Soil pH value ranged between 6.12 to 7.57 and electrical conductance remained less than 0.38 dSm^{-1}. Soil organic carbon ranged between 4.25 to 7.12 g kg^{-1}. Available nitrogen content in these soil was found to be between 185 to 292 kg ha^{-1}. Available phosphorus content varied from 20.10 to 37.26 kg ha^{-1}. Available potash content varied from 138 to192 kg ha^{-1}. $CaCl_2$ extractable soil sulphur varied from 0.70 to 10.25 mg kg^{-1} renders the soil deficient in S. Hot water soluble boron content ranged from 0.22 to 0.47 mg kg^{-1}. All the figures in lower range was found in upland soils while the higher value of all the parameters were found in low land. There was an increasing trend with respect to soil reaction, soil organic carbon, N, P, K, S and B from upland which is due the washing down of basic cations, organic matter and plant nutrients from upland and subsequent deposition in low land give rise to the higher value in low lying areas. Clay content was found to be positivity correlated with all the parameters except phosphorus. Significant positive correlation of organic carbon, nitrogen, potassium, and boron with soil pH. Similarly, soil organic carbon was positively correlated with clay, macro and micro nutrients.

Keywords: Soil testing; Agro-climate; Patarghat block; soil fertility; Bihar.

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1. INTRODUCTION

Saharsa is one of the important district in the eastern part of the state of Bihar, India. It is located near the eastern banks of the Koshi river with a geographical area of 1687 square kilometre. It is considered as the heart of whole Mithila region. It is the place which gave birth too many legends like Mandan Mishra. Saharsa district is bounded on the west by river Koshi, an abundance of fish and makhana [1, 2]. It is the major producer of best quality of corn and makhana in India. Rice, bamboo, wheat, mustard, sugarcane and sagwan trees are now grown on a large scale. Soil and water are essential resources for the sustained quality of human life and the basis of agricultural development [3]. In any agricultural operations, soil is the utmost significance as it is the cradle for all crops and plants. This is the reservoir of nutrients that play an important role in providing the growth of crops, keeping the environment clean [4]. Fertilizer with specified dose for a certain crop is always recommended in order to increase its pollution. The fertilizer application by farmers in the field without knowledge of soil nutrient status and nutrient requirement of different crop ordinarily leads to adverse effect on soil as well as crop [5]. Sound knowledge about soil fertility status is very much relevant for identifying constraints in crop production for attaining sustained productivity. Indian agriculture is operating on a net negative balance of plant nutrients at the rate of 10 million tonnes per annum [6]. Long term experiments indicated that imbalanced use of nutrients through fertilizer has a deleterious effect on soil health leading to unsustained productivity. It is therefore important to regularly monitor the fertility status of soil from time to time with a view to sustain the soil health [7]. A soil resource inventory provides an insight into the potentialities and limitations of soil for its effective explanation [8]. Keeping the above facts in view a soil resource inventory work was undertaken to study the soil fertility status of three villages of Patarghat block in Saharsa district of Bihar. The study has generated a lot of information related to the soil physico-chemical properties and their interrelationship for better understanding of soil fertility which would provide the basis for implementing the advanced technologies for sustainable crop production with higher profitability.

2. MATERIALS AND METHODS

Surface (0-15 cm) soil samples were collected from the randomly selected villages namely Bishunpur, Kishunpur and Lachhmipur of Patarghat block of Saharsa district under agro-climatic zone-II of Bihar. As per modern system of soil classification the soils comes under Entisols. Collected samples were air-dried, grind with wooden pastel and mortar and sieved through 2.00 mm sieve (0.2 mm sieve for organic carbon) labelled and stored. The samples were analyzed the chemical parameters *viz*., pH and electrical [9]; organic carbon [10], available nitrogen [11], available P [12], available K [13], available ($CaCl_2$ extractable) soil sulphur [14] and hot water soluble boron [15], soil textural classes [16] was also determined. The analytical methods were followed as per the procedure laid down by Jackson [9].

3. RESULTS AND DISCUSSION

3.1 Physico-chemical Properties

Most of the soil of these villages are waterlogged in rainy season because of inundation of standing water from flood. Soil texture of Bishunpur and Kishunpur village was sandy loam but in Lachhmipur soil texture varied from loamy sand to sandy clay loam. High amount of clay content was found in low land as clay particles are washed down from the up and medium land during rainfall and their subsequent deposition in low land because of the pedogenic process of colluviation [3].

Surface soils of Bishunpur village were slightly active to slightly saline which varied from 6.45 to 7.72 (Table 1). In Kishunpur soil pH varied from 6.81 to 7.78 which come under moderately neutral to saline. Similarly in Lachhmipur soil pH ranged from 6.23 to 7.60 which indicates that soils are slightly acidic to neutral. Soil pH is significantly and negatively correlated with sand but positively with silt, clay, organic carbon and nitrogen [17]. The electrical conductivity values of soil of Bishunpur village ranged from 0.28 to 0.56 dSm^{-1}. The low land generally have higher electrical conductivity values in comparison to upland and medium land but the value remains within the safe limit for crop production [18]. In Bishunpur village soil organic carbon content was found to vary 0.39 to 0.48 %, 0.51 to 0.59 per cent and 0.67 to 0.78 per cent in upland, medium land and low land respectively (Table 1). Similarly, in Kishunpur village it ranged from 0.39 to 0.77 per cent in different land type. The soil of Lachhmipur village varied 0.46 to 0.75 per cent. Higher soil organic carbon content in low land soils of all the villages is because of the lower topographical position due to which they receive runoff washing of upland and a medium land soils which is decomposed by microorganisms giving rise to higher content soil organic carbon [19]. Soil organic carbon is negatively correlated with sand but significantly and positively correlated with N, available K.

3.2 Macro Nutrients

An increasing trend of average soil nitrogen content was observed in all the villages from upland to low land. Soils of low land contained more N in comparison to the medium and upland. Soils available nitrogen is negatively correlated with sand but positively correlated with pH, K, S and B. the P_2O_5 content in all soils of Bishunpur village was found to be low to high. Soils of Kishunpur village were medium in P_2O_5 content. Similarly, soils of Lachhmipur were medium to high which indicate a very good index of soil fertility. Mean available P_2O_5 content in soils of all the villages increased from upland to lowland. Higher value of available phosphorus in low land soil may be due to higher content of soil organic carbon as phosphorus is released from the organic matter slowly. Soil available phosphorus is negatively correlated with clay but

Fig. 1. Map of Saharsa district

Table 1. Soil physico-chemical properties and fertility status of Bishunpur Village

Land type	Soil texture	pH	EC (dSm^{-1})	OC (%)	Avail N ($Kg\ ha^{-1}$)	Avail P ($Kg\ ha^{-1}$)	Avail K ($Kg\ ha^{-1}$)	Avail S ($Kg\ ha^{-1}$)	Avail B ($Kg\ ha^{-1}$)
Upland	Sandy Loam	6.45	0.28	0.39	230	23.98	138	5.83	0.30
Upland	Sandy Loam	6.73	0.30	0.42	242	26.85	145	5.13	0.36
Upland	Sandy Loam	6.62	0.30	0.48	248	28.36	148	6.07	0.31
Medium Land	Sandy Loam	6.89	0.33	0.57	250	36.18	152	7.14	0.39
Medium land	Sandy Loam	7.10	0.37	0.59	263	35.85	167	8.56	0.41
Medium land	Sandy Loam	7.17	0.35	0.58	276	31.80	182	8.96	0.42
Low land	Sandy Loam	7.28	0.37	0.67	288	35.90	187	9.92	0.46
Low land	Sandy Loam	7.39	0.42	0.73	295	37.10	189	11.00	0.47
Low land	Sandy Loam	7.53	0.44	0.78	310	36.73	192	17.00	0.49
Low land	Sandy Loam	7.72	0.56	0.75	302	37.12	196	21.25	0.45

Table 2. Soil physico-chemical properties and fertility status of Kishunpur Village

Land type	Soil Texture	pH	EC (dSm^{-1})	OC (%)	Avail N ($Kg\ ha^{-1}$)	Avail P ($Kg\ ha^{-1}$)	Avail K ($Kg\ ha^{-1}$)	Avail S ($Kg\ ha^{-1}$)	Avail B ($Kg\ ha^{-1}$)
Upland	Sandy Loam	6.81	0.28	0.42	230	26.32	177	9.17	0.38
Upland	Sandy Loam	6.87	0.31	0.45	255	27.20	188	11.20	0.35
Upland	Sandy Loam	6.92	0.38	0.39	250	26.96	190	10.92	0.35
Medium Land	Sandy Loam	7.01	0.44	0.49	285	28.55	211	11.32	0.40
Medium land	Sandy Loam	7.17	0.49	0.56	278	30.16	207	14.17	0.42
Medium land	Sandy Loam	7.33	0.51	0.58	292	30.57	202	15.21	0.39
Low land	Sandy Loam	7.41	0.53	0.56	305	31.60	235	16.37	0.46
Low land	Sandy Loam	7.52	0.57	0.67	300	31.85	258	16.90	0.48
Low land	Sandy Loam	7.55	0.54	0.73	328	32.00	249	17.52	0.49
Low land	Sandy Loam	778	0.59	0.77	332	32.08	265	17.05	0.52

Table 3. Soil physico-chemical properties and fertility status of Lachhmipur Village

Land Type	Soil Texture	pH	EC (dSm^{-1})	OC (%)	Avail N (Kg ha^{-1})	Avail P (Kg ha^{-1})	Avail K (Kg ha^{-1})	Avail S (Kg ha^{-1})	Avail B (Kg ha^{-1})
Upland	Loamy Sand	6.23	0.39	0.49	217	25.56	180	10.10	0.40
Upland	Loamy Sand	6.33	0.41	0.46	230	25.94	217	12.20	0.38
Upland	Loamy Sand	6.50	0.38	0.50	228	26.39	192	11.92	0.41
Medium Land	Loamy Sand	6.62	0.41	0.53	245	27.02	195	14.32	0.46
Medium land	Loamy Sand	6.45	0.45	0.55	252	28.15	235	14.96	0.43
Medium land	Loamy Sand	6.78	0.45	0.59	249	28.82	207	16.00	0.45
Low land	Sandy Clay Loam	7.02	0.54	0.63	301	30.00	258	16.25	0.48
Low land	Sandy Clay Loam	7.22	0.51	0.67	332	31.52	246	16.92	0.48
Low land	Sandy Clay Loam	7.45	0.58	0.72	330	30.96	262	17.12	0.52
Low land	Sandy Clay Loam	7.60	0.61	0.75	347	31.70	267	17.29	0.50

Table 4. Correlation study on different physic-chemical properties

	Sand	Silt	Clay	pH	EC	OC	N	P_2O_5	K_2O	S	B
Sand	1.00										
Silt	-0.86**	1.00									
Clay	-0.92**	0.78**	1.00								
pH	-0.70*	0.57*	0.62*	1.00							
EC	-0.42	0.25	0.39	0.75*	1.00						
OC	-0.49	0.46	0.47	0.72*	0.83**	1.00					
N	-0.46	0.32	0.46*	0.80*	0.70	0.90**	1.00				
P_2O_5	-0.29	-0.21	-0.20	-0.01	0.38	0.56*	0.53**	1.00			
K_2O	-0.38	0.43	0.36	0.50*	0.76**	0.82	0.82**	0.78*	1.00		
S	-0.02	0.01	0.01	0.38	0.72**	0.71	0.71**	0.60*	0.73**	1.00	
B	-0.25	0.10	0.28	0.60*	0.75**	0.70	0.73*	0.49*	0.65*	0.70*	1.00

positively correlated with organic carbon, N, K, S and B (Table 4). Available soil potassium content in all the villages increased according to land situation from upland to lowland. Comparatively higher content of potassium in the low land soils may be due to the presence of higher content of clay in the low land surface soil. Soil available potassium was negatively correlated with sand but positively correlated with clay, organic carbon, N, P_2O_5, S and B [20]. The results shows that the soil under investigations were low to medium in S content which can limit the crop production specially oil seed crops. Comparatively higher amount of available sulphur in low land soils may be attributed to the higher amount of organic carbon in the low land soil [21]. Lower correlation of S in upland soils may be characterized by the leaching of surface runoff loss and subsequent accumulation of sulphur in low land [22]. Available S was positively correlated with pH, organic carbon, N, P_2O_5, K and B. Similar significant positive correlation of S was also observed by Ali et al. [23] and Das et al. [21]. Mean hot water soluble B content was found to be increased from upland to low land situation. Thus, higher level of B was found in low land soil compared to the upland and medium land soils. This might be attributed to the higher amount of organic carbon present in low land soil and washing down of B from up to medium land. Hot water soluble boron was positively correlated with pH, organic carbon, N, P, K and S. similar finding was observed by Behera et al. [24].

4. CONCLUSION

The present study help to build up the data base evaluation, planning and monitoring of soil fertility status which can serve the farming community for higher profitability with a balanced recommendation of fertilizer in sustainable manner for present and in future.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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