Assessment of Physico-Chemical Properties of Soil from Different Blocks of Sahibganj district, Jharkhand, India

ABSTRACT

An evaluation of physico-chemical properties of 27 soil samples from 3 different blocks *ie.*, Sahibganj, Borio and Taljhari of Sahibganj district (Jharkhand) in different depths (0–15, 15–30 and 30–45 cm) was carried out during of 2022-2023. The present investigation was objectified as determination of soil Physico-chemical properties to analyse the soil fertility status with finding out the deficiency and toxicity of different soil nutrients. Soil samples were analyzed using standard laboratory techniques and statistical analysis. The treatments in them study were arranged in a Completely Randomized Design. The bulk density of the soils varied from 1.13 to 1.53 Mg m^{-3}, while the particle density ranged from 2.24 to 2.69 Mg m^{-3}. The percentage of pore space was between 36.88 and 49.55% and water holding capacity was between 31.11 and 44.71%. Soil pH varied from 6.28 to 7.90 which was neutral to slightly saline with soil EC ranged 0.02-0.64 dS m^{-1} that would significantly affect crop production. In the case of the organic carbon, nitrogen and phosphorus content of research area was found to be low to medium while the range of Potassium was sufficient ranging from 176.34 to 271.77 kg ha^{-1}. In these areas recommended fertilizer doses should be applied as per soil test crop response to prevent yield losses due to deficiency of nutrients.

Keywords: Borio, Sahibganj, Soil fertility, Physico-chemical, Properties, Taljhari

INTRODUCTION

Soil is a dynamic, three-dimensional natural body of the landscape formed by the weathering of rocks by various pedogenic processes, consisting of mineral and organic constituents processing a specific set of physical, chemical, and biological properties, with a variable depth covering the earth's surface and serving as a medium for terrestrial plant growth (Verma et al., 2019). The global movement toward sustainable agriculture systems entails maximizing agricultural resources to meet human needs while also preserving the environment's quality and natural resources. With a greater understanding of soils and their qualities, the idea of soil health and soil

quality has continually changed. According to Chaudhary et al. (2013), the lack of nutrients has become a significant barrier to soil productivity, stability, and sustainability. Soil quality comprises various qualities and activities, such as aggregate structural stability, water retention capacity, and nutrient cycling capability. Out of the many elements known to be important for plant growth, the macronutrients nitrogen, phosphorus, and potassium (N, P, K) have experienced a sharp decline in response (production) efficiency under intensive agriculture in recent years. This is due to imbalanced and inadequate fertilizer combined with low efficiency of other inputs. Singh et al. (2017).

Sahibganj district extends from the northern Gangetic plains to the borders of Bengal in the south. This district comprises the Rajmahal hills and other mountains, and a substantial portion of the district is mountainous. [32] Damin-I-koh, a Persian word that means "hill skirts," was given to the wide area of territory encompassed between hill ranges. The Ganges riverbank region is fertile and well-cultivated. The district can be separated into two natural areas based on geographical position and cultivable terrain. Borio, Mandro, Barhait, Pathna, and Taljhari are part of the first region, which is included of the Damin-I-koh area. The hills and slopes are covered with forests and valleys have cultivable lands yielding mostly paddy. The second region consists of Sahibganj, Udhwa and Barharwa blocks. The Ganges, Gumani and Bnsloi rivers flow through this region. This area has plenty of fertile lands and is richly cultivated. Clayey loam type alluvial soil occurs near Sahibganj plains. The study aimed to evaluate the physico-chemical properties of 27 soil samples from 3 different blocks of Sahibganj, Borio and Taljhari of Sahibganj district (Jharkhand) in different depths.

MATERIALS AND METHODS

Sahibganj is located on the north-east of Jharkhand and situated on the banks of Ganges. It lies between 25°23’81’’N latitude and 87°64’54” E longitude and is located at an average elevation of 77 m above the mean sea level. The total land area of the district is 1599.00 sq. km. The area for the research study involved 3 blocks of Sahibganj district *i.e.*, Sahibganj, Borio and Taljhari. “Soil

samples were collected during kharif season of 2021 from 9 different villages of 3 blocks of Malda district in 3 different depths *i.e.,* 0-15 cm, 15-30 cm and 30-45 cm by the help of augar and khurpi. Soil samples were analysed using different standard laboratory techniques and statistical analysis in the Completely Randomized Design (CRD)". [32]

In physical, parameters like bulk density, particle density, porosity and water retaining capacity were measured by the help of Muthuaval *et al.,* (1992), method using graduated measuring cylinder. Colours of soil samples were determined by using Munsell Colour Chart and Textural classes were assessed by using Bouyoucos Hydrometer.

"In chemical, properties such as soil pH (1:2) and Electrical Conductivity (1:2) were determined by Digital pH Meter and Digital Conductivity Meter respectively. Soil organic carbon was evaluated by Wet Oxidation method given by Walkley and Black (1947). Estimation of nitrogen was done by Alkaline KMnO4 Method of Subbiah and Asija (1956). Assessment of Phosphorus was completed by using Photometric Colorimeter (Olsen *et al.,* 1954) and Potassium by Flame Photometer". [32]

RESULT AND DISCUSSION

Physical properties of soil:

Bulk density

Table 1 depicts the maximum bulk density was recorded in Rampur village of Taljhari blocks (B_3V_2) 1.51, 1.53 and 1.53 Mg m^{-3} at depth 0-15, 15-30 and 30-45 cm and minimum bulk density recorded in Makhmalpur village of Sahibganj blocks (B_1V_3) is 1.13, 1.17 and 1.18 Mg m^{-3}. Similar result has been recorded by Singh *et al.* (2016).

Particle density

Table 1 depicts the maximum particle density was found in Lilatanr (B_2V_1) is 2.65, 2.67 and 2.69 Mg m^{-3} with depth 0-15,15-30 and 30-45 cm and the minimum particle density found in Makhmalpur (B_1V_3) is 2.24, 2.26 and 2.30 Mg m^{-3} with depth 0-15,15-30 and 30-45 cm. Similar result has been recorded by Singh *et al.* (2017).

Percent Pore Space

The table 1 depicts that the maximum percent pore space found in village Hajipur (B_1V_2) is 49.55, Kodarjana (B_1V_1) is 48.47 and Makhmalpur (B_1V_3) is 49.14 % at depth 0-15, 15-30 and 30-45 cm. The minimum percent pore space found in village Rampur (B_3V_2) 37.60, 37.29 and 36.88% with depth 0-15, 15-30 and 30-45 cm. Similar result has been recorded by Singh *et al.* (2014).

Water Holding Capacity

The table 1 depicts the maximum water holding capacity (%) found in Hajipur (B1V2) is 44.71, 43.29 and 42.96 % at depth 0-15, 15-30 and 30-45 cm. The minimum value of water holding capacity (%) found in Gutibara (B3V3), Rampur (B3V2) and Rampur (B3V2) 31.18, 31.23 and 31.11 % at depth 0-15, 15-30 and 30-45 cm respectively. Similar result has been recorded by Sharma *et al*. (2016).

Table 1: Bulk density (Mg m^{-3}), particle density (Mg m^{-3}), pore Space (%) and water holding capacity (%) of soil at different depth

Name of Village and Farmer's Field		Bulk density (Mg m^{-3})			Particle density (Mg m^{-3})			Pore Space (%)			Water holding capacity (%)		
		0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Sahibganj (B_1)	**B_1V_1**	1.15	1.18	1.20	2.27	2.29	2.32	49.33	48.47	48.27	43.97	42.51	42.13
	B_1V_2	1.19	1.22	1.22	2.35	2.36	2.39	49.36	48.30	48.05	44.71	43.29	42.96
	B_1V_3	1.13	1.17	1.18	2.24	2.26	2.30	49.55	48.23	49.14	42.79	41.49	40.48
Borio (B_2)	**B_2V_1**	1.51	1.52	1.52	2.65	2.67	2.69	43.01	41.41	40.89	40.14	40.78	39.48
	B_2V_2	1.36	1.38	1.38	2.56	2.57	2.57	46.87	46.30	46.30	40.30	39.28	39.03
	B_2V_3	1.31	1.35	1.37	2.54	2.56	2.61	48.42	47.26	47.05	39.09	38.28	38.07
Taljhari (B_3)	**B_3V_1**	1.49	1.51	1.52	2.51	2.52	2.55	40.63	40.07	40.03	35.52	34.27	34.16
	B_3V_2	1.51	1.53	1.53	2.42	2.44	2.47	37.60	37.29	36.88	32.12	31.23	31.11
	B_3V_3	1.47	1.49	1.50	2.52	2.53	2.53	41.66	41.10	40.71	33.18	32.22	32.08
F- test		S	S	S	S	S	S	S	S	S	S	S	S
S.Em. (±)		0.035	0.023	0.026	0.024	0.035	0.038	0.044	0.903	0.671	0.717	0.525	0.464
C. D. (P =0.05)		0.106	0.069	0.077	0.073	0.106	0.113	0.131	2.684	1.996	2.131	1.140	1.379

Chemical properties

Soil pH

The table 2 depicted that the maximum pH values with recorded in Makhmalpur (B_1V_3), Lilatanr (B_2V_1) and Lilatanr (B_2V_1) is 7.53, 7.90 and 7.90 at the depths of 0-15, 15-30 and 30-45 cm and the maximum pH values with recorded Pathlahra (B_2V_3), Rampur (B_3V_2) and Kodarjana (B_1V_1) is 6.30, 6.55 and 6.58 at the depths of 0-15, 15-30 and 30-45 cm respectively. Similar result has been recorded by Singh and Singh (2018).

EC (dS m^{-1})

The table 2 depicted that the soil sample from Hajipur (B_1V_2) had the highest EC values which is 0.61, 0.64 and 0.65 ds m^{-} at depths of 0-15, 15-30 and 30-45 cm respectively and the soil sample from Pathlahra (B_2V_3) had the lowest EC values which is 0.02, 0.05 and 0.05 ds m^{-1} at depths of 0-15, 15-30 and 30-45 cm respectively. Similar result has been recorded by Singh and Singh (2017).

Organic carbon

Table 2 shows the maximum value of organic carbon percent recorded in soils of Jetkumarjori (B_2V_2) 0.483, Jetkumarjori (B_2V_2) 0.477 and Jetkumarjori (B_2V_2) 0.471 % in depth of 0-15, 15-30 and 30-45 cm and minimum values were recorded in soils of Pathlahra (B_2V_3) 0.416, Pathlahra (B_2V_3) 0.409 and Brindaban (B_3V_1) is and 0.347 % respectively. Similar result has been recorded by Yadav *et al.* (2017).

Table 2: pH(w/v), EC (dS m^{-1}) and organic carbon (%) of soil at different depth.

Name of Village and Farmer's Field		pH(w/v)			EC (dS m^{-1})			Organic carbon (%)		
		0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Sahibganj (B_1)	**B_1V_1**	6.44	6.65	6.58	0.36	0.38	0.33	0.457	0.451	0.448
	B_1V_2	6.70	6.80	6.80	0.61	0.64	0.65	0.425	0.419	0.414
	B_1V_3	7.53	7.68	7.61	0.22	0.27	0.25	0.449	0.442	0.433
Borio (B_2)	**B_2V_1**	7.70	7.90	7.90	0.06	0.07	0.07	0.427	0.421	0.417
	B_2V_2	6.28	7.31	7.49	0.10	0.10	0.11	0.483	0.477	0.471
	B_2V_3	6.30	6.90	6.90	0.02	0.05	0.05	0.416	0.409	0.406
Taljhari (B_3)	**B_3V_1**	6.60	6.80	6.80	0.07	0.09	0.08	0.458	0.453	0.347
	B_3V_2	6.35	6.55	6.62	0.41	0.39	0.38	0.438	0.434	0.428
	B_3V_3	6.46	6.67	6.73	0.34	0.29	0.27	0.441	0.433	0.430
F- test		S	S	S	S	S	S	S	S	S
S.Em. (±)		0.110214	0.903	0.671	0.903	0.671	0.717	0.717	0.903	0.671
C. D. (P =0.05)		2.684	1.996	2.131	2.684	1.996	2.131	2.131	2.684	1.996

Available Nitrogen

The table 3 depicts that the maximum value of nitrogen is found in soil of Lilatanr (B_2V_1) is 407.80, 397.30 and 294.20 kg ha^{-1} respectively with depth 0-15, 15-30 and 30-45 cm and minimum value in soil of Brindaban (B_3V_1), Gutibara (B_3V_3) and Gutibara (B_3V_3) is 223.78, 214.52 and 208.97 kg ha^{-1} with depth 0-15, 15-30 and 30-45 cm respectively. Similar result has been recorded by Arya *et al.* (2018).

Available phosphorus

The table 3 depicts the maximum value of phosphorus is found in soil of Makhmalpur (B_1V_3) is 43.79, 39.37 and 38.68 kg ha^{-1} with depth 0-15, 15-30 and 30-45 cm respectively and minimum value in soil of Kodarjana (B_1V_1), Rampur (B_3V_2) and Jetkumarjori (B_2V_2) is 21.45, 21.03 and 23.20 kg ha^{-1} 0-15, 15-30 and 30-45 cm respectively. Similar result has been recorded by Gyawali *et al.* (2016).

Available Potassium

The table 3 depicts the maximum value of potassium is recorded in soil of Pathlahra (B_2V_3) Jetkumarjori (B_2V_2) Makhmalpur (B_1V_3) is 277.45, 271.84 and 266.23 kg ha^{-1} with depth 0-15, 15-30 and 30-45 cm and minimum value in soil of Kodarjana (B_1V_1) Gutibaram (B_3V_3) Gutibara (B_3V_3) is 186.12, 179.45 and 176.34 kg ha^{-1} with depth 0-15, 15-30 and 30-45 cm respectively. Similar result has been recorded by Arya *et al.* (2018).

Table 3: Available nitrogen (kg h^{-1}), available phosphorus (kg h^{-1}) and available potassium (kg h^{-1}) of soil at different depth.

Name of Village and Farmer's Field		Available Nitrogen (kg h^{-1})			Available phosphorus (kg h^{-1})			Available Potassium (kg h^{-1})		
		0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Sahibganj (B_1)	**B_1V_1**	309.64	297.13	292.46	21.45	23.62	27.73	229.16	247.45	243.57
	B_1V_2	286.26	277.83	275.27	39.32	35.83	34.37	245.47	239.63	235.45
	B_1V_3	313.73	308.28	303.82	43.79	39.37	38.68	271.77	267.12	266.23
Borio (B_2)	**B_2V_1**	407.80	397.30	394.20	31.62	37.37	35.36	246.89	239.85	237.27
	B_2V_2	376.38	369.82	362.03	26.70	23.39	23.20	263.52	271.84	235.56
	B_2V_3	398.39	387.08	384.26	38.27	35.39	34.32	277.45	265.78	259.37
Taljhari (B_3)	**B_3V_1**	241.86	238.54	236.76	35.76	32.73	31.27	219.78	214.74	209.75
	B_3V_2	254.85	249.74	246.85	24.37	21.03	23.87	226.85	219.42	214.86
	B_3V_3	223.78	214.52	208.97	31.17	28.84	26.28	186.12	179.45	176.34
F- test		S	S	S	S	S	S	S	S	S
S.Em. (±)		3.130899	0.903	0.671	0.717	0.903	0.671	0.717	0.903	0.671
C. D. (P =0.05)		9.302378	2.684	1.996	2.131	2.684	1.996	2.131	2.684	1.996

Conclusion

It is concluded that the soils from the Sahibganj, Borio and Taljhari blocks of Sahibganj district texture displayed clay loam, silty clay and sandy clay loam. bulk density, particle density, percentage pore space and water holding capacity were found to be suitable for crop production. The pH was found slightly acidic to saline in nature and the percentage organic carbon and available

nitrogen is high in Kodarjana, Phosphorus was highest in Makhmalpur and potassium is high in Pathlahra. To avoid yield losses due to nutrient deficiencies, recommended fertilizer doses should be given based on the results of the soil test and crop response.

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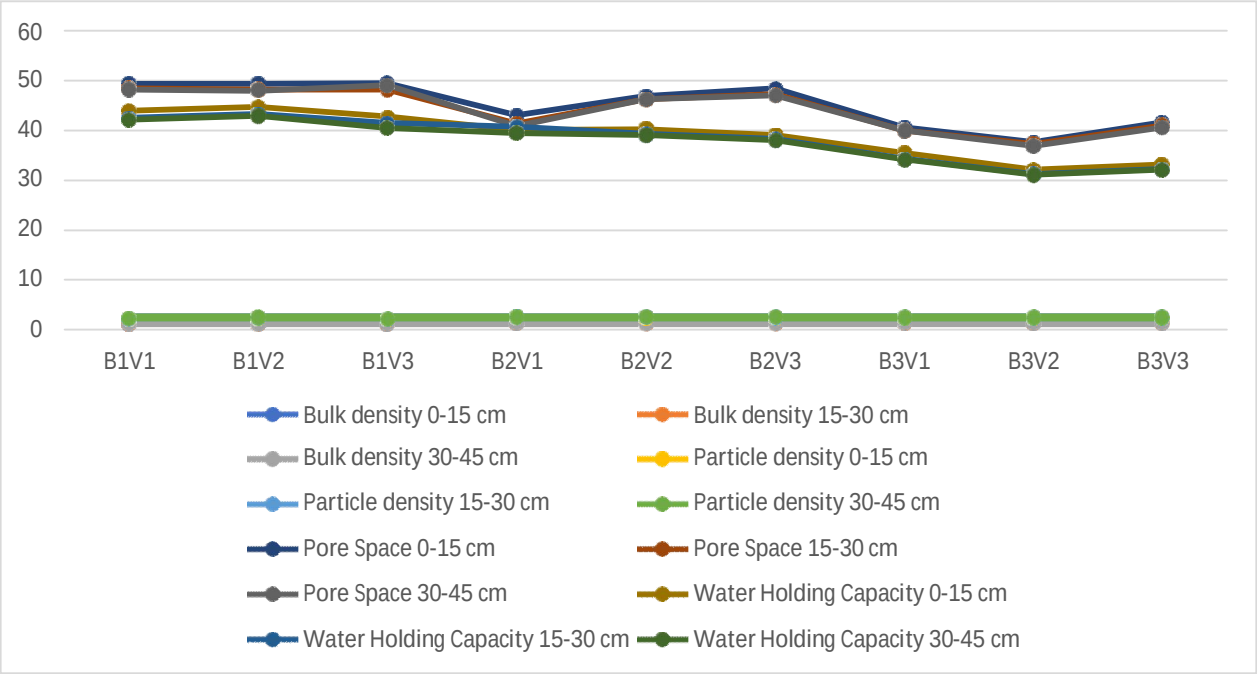

Fig. 1. Bulk density (Mg m^{-3}), particle density (Mg m^{-3}), pore Space (%) and water holding capacity (%) of soil at 0-15, 15-30 and 30-45 cm depth

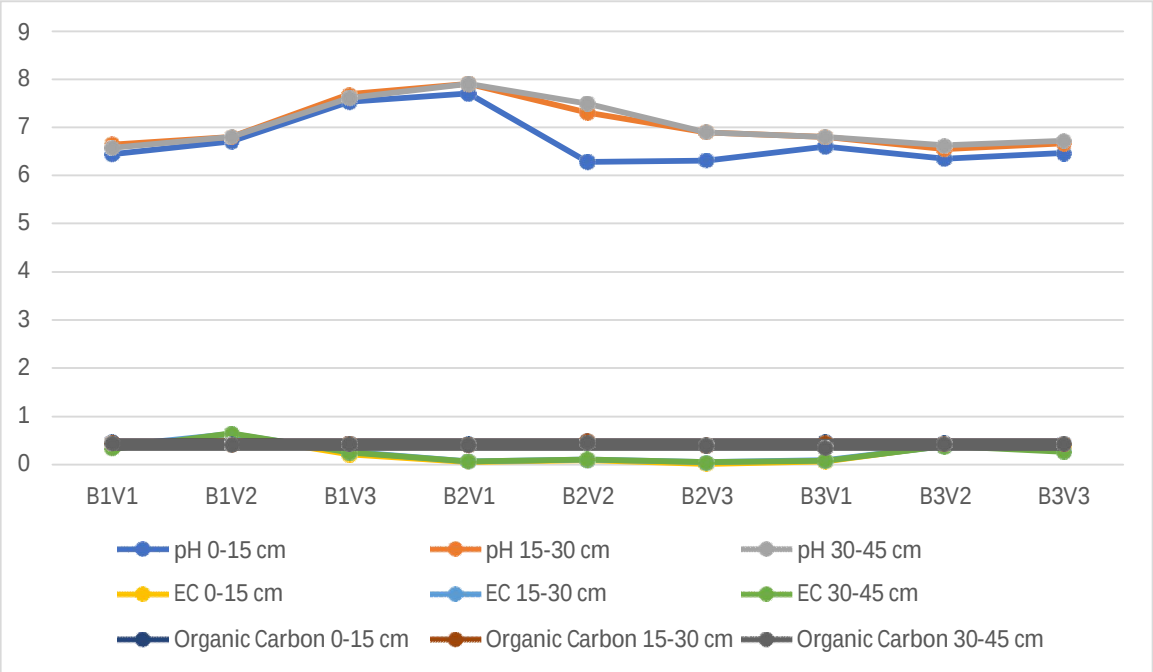

Fig. 2. pH(w/v), EC (dS m^{-1}) and organic carbon (%) of soil at 0-15, 15-30 and 30-45 cm depth.

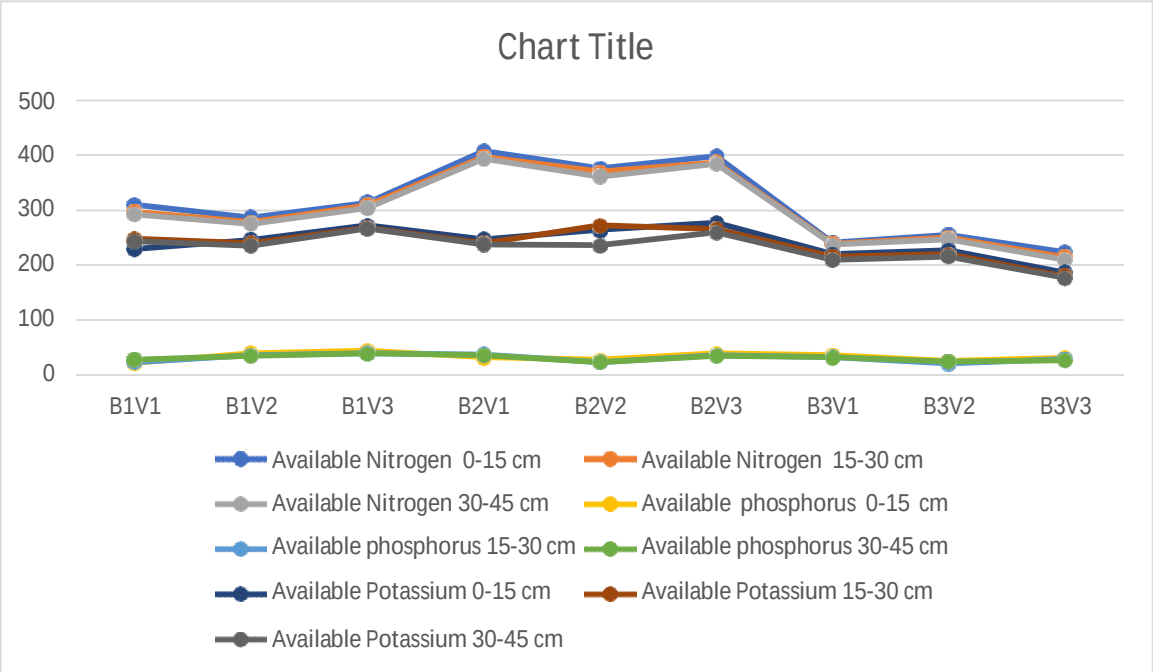

Fig. 3. Available nitrogen (kg h^{-1}), available phosphorus (kg h^{-1}) and available potassium (kg h^{-1}) of soil at 0-15, 15-30 and 30-45 cm depth.