Original Research Article

Assessment of Soil Fertility of Some Villages of Mahishi Block, Saharsa, Bihar

ABSTRACT

Assessment of soil fertility is essential to help identify strategies for sustainable agricultural production system that decreases the negative environmental impact. The experiment was conducted to investigate the soil fertility status of soils of five different villages of Mahishi block of Saharsa district, Bihar, India. A total of 100 numbers of surface soil samples (0-15 cm) comprising of 20 composite soil samples from each site were collected. Collected soil samples were analyzed for pH, electrical conductivity, organic carbon, available nitrogen, phosphorus, potassium, sulphur, zinc, iron, copper and manganese. Results revealed that pH, electrical conductivity, organic carbon, available N, P, K and S ranged with a mean value of (7.20, 7.23, 7.33, 7.41 & 7.45), (0.52, 0.53, 0.54, 0.49 & 0.55 dSm^{-1}), (0.53, 0.48, 0.51, 0.56 & 0.54 per cent), (315, 320, 280, 361 & 325 kg ha^{-1}), (30.92, 30.12, 28.30, 29.08 & 27.53 kg ha^{-1}), (217, 234, 190, 204 & 210 kg ha^{-1}) and (15.79, 16.05, 16.26, 17.37 & 17.89 mg kg^{-1}) under Sonkurthua, Ghoghpur, Baghaud, Naharwar and Maina villages. Hence, various effects viz. use of biofertilizers, organic manure and balanced chemical fertilization were suggested for farmers regarding the benefits of improving soil fertility.

Key Words: *Fertility Status, testing, Macro nutrients, Micro nutrients*

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INTRODUCTION

Soil fertility plays a key role in increasing crop production in soil. It comprises not only in supply of nutrients but also their efficient management (Kothyari *et al.* 2018). Soil fertility is dynamic natural property and it can change under the influence of natural and human induced factors (Singh *et al.* 2018). At present, the greatest challenges before Indian agriculture is to boost food production and productivity as well as agricultural sustainability. There are problems that impose limits on these objectives or goal which raise serious concern about national food security. Soil fertility is one of the major constraints in achieving high productivity goals (Patidar *et al.* 2017). The most important constituent of soil is organic matter, an appreciable amount of organic matter in soil tremendously increase soil fertility. Decay organic matter release nitrogen, phosphorus and mineral nutrients in a form available to plants. Availability of macro, secondary and micro nutrients induce better germination of

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seed and hence subsequent better growth and stronger root development. Soil fertility is the result of interaction among physical, chemical and biological properties of soil which is directly related to agricultural production (Rakesh *et al.* 2012). Soil fertility depletion is a major concern worldwide, because it affects the sustainable agricultural production (Barooah *et al.* 2020). Soil fertility deterioration mostly occurs due to increased population density, land use, adverse climatic conditions and intensive cropping without adequate use of nutrients and improper soil management practices may decline soil fertility. Imbalanced and inadequate use of fertilizers may also deplete soil fertility. Seasonal variation of different soil fertility parameters like organic carbon, major nutrients exchangeable cations may be affected by factors like climatic pattern, cropping pattern and farming system. The availability of macro and micro nutrients in the soil determines the fertility level which in turn govern the crop productivity of that soil. Evaluation of soil fertility is essential to provide nutrients for optimum crop growth. It also helps in judicious and efficient use of nutrients in local as well as the regional level. Therefore, it is necessary to assess the fertility status of soil before crop planning. The objective of present investigation was evaluating the soil fertility status in five villages of Mahishi block of Saharsa district in Bihar.

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Materials and Methods

Study Area

Mahishi is a block situated in the Saharsa district of northern Bihar. It is located 15 km toward west from district headquarter, Saharsa at 25°86' N, 86°46' E and 47 meter above the mean sea level. Mahishi consist of 83 villages and 20 Panchayat. It occupies a flat alluvial plain forming part of Koshi river basin. It is the major producer of best quality of corn and makhana.

Collection of soil sample

Geo-reference soil samples were collected from farmers' field of different villages namely Sonkurthua, Ghoghpur, Baghaud, Naharwar and Maina village at a depth of 0-15 cm. Twenty geo-referenced soil sample from each village were collected using GPS by adopting the standard procedures of soil sample collection. The collated soil samples were air dried, gently crushed, sieved using a 2 mm sieve for all analysis except organic carbon analysis, wherein the sample was sieved using a 0.5 mm sieve. The processed soil samples were preserved in polythene bag for further analysis.

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The soil samples were analyzed for organic carbon content (Walkley and Black, 1934), available N (Subbiah and Asija, 1956), available P (Olsen *et al.*, 1954), available K (Piper, 1966), available S (Chesnin and Yien, 1950), DTPA extractable Zn, Cu and Fe (Lindsay and Norvell, 1978), pH (1:2 Soil: Water suspension), electrical conductivity (1:2 Soil: Water suspension) (Jackson, 1973).

Results and Discussion

The analyzed soil data indicated the fertility status of soil of five villages of Mahishi block was presented in different tables.

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Physical-chemical properties of soil

Soil pH of the soils of Sonkurthua village varied from 6.80 to 7.60 with the mean value 7.20 (table-2). Similarly, the pH of Ghoghpur, Baghaud, Naharwar and Maina varied from 7.01 to 7.45 with a mean value 7.23, 6.90 to 7.77 with a mean value of 7.33, 7.33 to 7.50 with a mean value of 7.41 and 7.23 to 7.68 with a mean value of 7.45, respectively. Electrical conductivity as a measure of current carrying capacity, gives a clear idea of the soluble salt present in the soil. The electrical conductivity of soil water suspension ranged from 0.45 to 0.59 dSm^{-1} with a mean value of 0.52 dSm^{-1}, 0.51 to 0.56 with a mean value of 0.53 dSm^{-1}, 0.49 to 0.60 with a mean value of 0.54 dSm^{-1}, 0.41 to 0.58 with a mean value of 0.49 $dSm^{-1}$and 0.54 to 0.57 with a mean value of 0.55 dSm^{-1} in different villages of study area. High conductivity are usually associated with clay rich soil and low conductivities are associated with sandy soil (Singh *et al.* 2018). Data presented in the table 2 shows that the mean value of organic carbon recorded under the village Sonkurthua, Ghoghpur, Baghaud, Naharwar and Maina were 0.53, 0.48, 0.51, 0.56 and 0.54 per cent, respectively. Low status of organic carbon in some soils of the area is indicating that adequate nitrogen fertilization through organic manure are required.

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Macro nutrient status of the soil

Available nitrogen content were ranged from 300 to 330 with a mean value of 315, 305 to 335 with a mean value of 320, 255 to 305 with a mean value of 280, 230 to 492 with a mean value of 361 and 305 to 345 kg ha^{-1} with a mean value of 325 kg ha^{-1} in Sonkurthua, Ghoghpur, Baghaud, Naharwar and Maina villages, respectively (table-3). As the organic matter content in the study area was found to low medium range, the plant available nitrogen content in soil was observed consequently low to medium. The medium nitrogen status was

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notice in some area may be due to application of N fertilizer coupled with high vegetative cover. Phosphorus exists in soils in both inorganic and organic forms. A small portion of the total P is present in plant available form. The status of available phosphorus varied from 30.10 to 31.75 kg ha^{-1}, 28.56 to 31.69 kg ha^{-1}, 26.44 to 30.16 kg ha^{-1}, 27.20 to 30.96 kg ha^{-1} and 26.82 to 28.25 kg ha^{-1} in Sonkurthua, Ghoghpur, Baghaud, Naharwar and Maina villages, respectively. The original natural source of phosphorus is the mineral apatite and P released from organic matter low to medium range of soil available P under study area may be mostly affected by past fertilization, pH, organic carbon content and various soil management practices. The data on available potassium content in the soil were ranged from 199 to 235 with a mean value of 217 kg ha^{-1}, 211 to 250 with a mean value of 234 kg ha^{-1}, 178 to 207 with a mean value of 190 kg ha^{-1}, 188 to 221 with a mean value of 204 kg ha^{-1} and 190 to 230 with a mean value of 210 kg ha^{-1} under the village Sonkurthua, Ghoghpur, Baghaud, Naharwar and Maina, respectively. Medium ranged of potassium in the analyzed soil samples may be due to absence of potash bearing minerals (Kothyari *et al.* 2018). Majority of the soil samples were found under medium category of sulphur (S) content. The coarse textured sandy soils generally have low total S-content as compared to fine textured soils, however no opinion that sufficiency of available S is directly proportional to the organic matter content of the soil. Intensive cropping, without S fertilization may lead to sulphur depletion in soil (Patra *et al.* 2012).

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Micro nutrients status of the soil

The results of available micro nutrient status of the study area are furnished in table-4. The available Zn content of Sonkurthua, Ghoghpur, Baghaud, Naharwar and Maina villages varied in between 0.12 to 1.70 ppm, 0.66 to 3.15 ppm, 0.23 to 1.53 ppm, 0.31 to 1.21 ppm and 0.90 to 1.18 ppm, respectively. Zinc sufficiency in the study area may be due to low pH of the soil. Likewise, available Cu content varied with a mean value of 2.03, 1.93, 2.75, 1.85 and 2.41 ppm under different villages of Mahishi block. The available Fe content varied in between 16.56 to 62.46 ppm with a mean value of 39.51 ppm, 16.58 to 54.48 ppm with a mean value of 37.53 ppm, 19.50 to 80.40 ppm with a mean value of 49.95 ppm, 27.76 to 85.22 ppm with a mean value of 56.49 ppm and 35.16 to 46.56 ppm with a mean value of 40.86 ppm in Sonkurthua, Ghoghpur, Baghaud, Naharwar and Maina villages, respectively. Similarly, available Mn content under different villages of the study area ranged with a mean value of 11.85, 8.08, 11.32, 8.49 and 6.25 ppm, respectively.

Conclusion

It is observed from the study area that soils of all the villages of the study area was neutral in reaction with normal electrical conductivity and soil organic carbon varied from low to medium. Available nitrogen, phosphorus, potassium and sulphur were found in medium category. On the category, available zinc, copper, iron and manganese was medium to high in all the soils of the study area. Therefore, regular and site specific nutrient management practices, application of balanced organic and inorganic nutrients, proper cropping system and adequate agronomic are essential to enhance the soil fertility as well as for sustainable crop production.

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Table 1: Methods adopted for estimation of different soil properties

Sl. No.	Parameters	Applied Methods
1.	Soil pH	Jackson (1973)
2.	Electrical Conductivity	Jackson (1973)
3.	Organic Carbon	Walkley and Black (1934)
4.	Available N	Subbiah and Asija (1956)
5.	Available P_2O_5	Olsen *et al.* (1954)
6.	Available K_2O	Piper (1966)
7.	Available S	Chesnin and Yien (1950)
8.	Available Zn	Lindsay and Norvell (1978)
9.	Available Fe	Lindsay and Norvell (1978)
10.	Available Cu	Lindsay and Norvell (1978)
11.	Available Mn	Lindsay and Norvell (1978)

Table 2: Physico-chemical properties of soil of the study area

Name of village	pH		Electrical Conductivity (dSm^{-1})		Organic Carbon (%)	
	Range	Mean	Range	Mean	Range	Mean
Sonkurthua	6.81 - 7.60	7.20	0.45 - 0.59	0.52	0.50 - 0.56	0.53
Ghoghpur	7.01 - 7.45	7.23	0.51 - 0.56	0.53	0.42 - 0.55	0.48
Baghaud	6.90 - 7.77	7.33	0.49 - 0.60	0.54	0.49 - 0.53	0.51
Naharwar	7.33 - 7.50	7.41	0.41 - 0.58	0.49	0.54 - 0.59	0.56
Maina	7.23 - 7.68	7.45	0.54 - 0.57	0.55	0.51 - 0.58	0.54

Table 3: Macro nutrient content of soil of study area

Name of village	Available N ($kg\ ha^{-1}$)		Available P_2O_5 ($kg\ ha^{-1}$)		Available K_2O ($kg\ ha^{-1}$)		Available S ($mg\ kg^{-1}$)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Sonkurthua	300 - 330	315	30.10 - 31.75	30.92	199 - 235	217	15.20 - 16.38	15.79
Ghoghpur	305 - 335	320	28.56 - 31.69	30.12	211 - 258	234	15.50 - 16.60	16.05
Baghaud	255 - 305	280	26.44 - 30.16	28.30	173 - 207	190	15.00 - 17.52	16.26
Naharwar	230 - 492	361	27.20 - 30.96	29.08	188 - 221	204	16.90 - 17.85	17.37
Maina	305 - 345	325	26.82 - 28.25	27.53	190 - 230	210	17.10 - 18.69	17.89

Table 4: Micro nutrients content of soil of study area

Name of village	Available Zn (ppm)		Available Cu (ppm)		Available Fe (ppm)		Available Mn (ppm)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Sonkurthua	0.12 - 1.70	0.91	0.98 - 3.09	2.03	16.56 - 62.46	39.51	6.68 - 17.01	11.85
Ghoghpur	0.66 - 3.15	1.90	1.41 - 2.45	1.93	16.58 - 58.48	37.53	4.16 - 12.00	8.08
Baghaud	0.23 - 1.56	0.89	1.35 - 4.16	2.75	19.50 - 80.40	49.95	6.04 - 16.61	11.32
Naharwar	0.31 - 1.21	0.76	0.91 - 2.79	1.85	27.76 - 85.22	56.49	3.40 - 13.58	8.49
Maina	0.90 - 1.18	1.04	1.81 - 3.01	2.41	35.16 - 46.56	40.86	4.73 - 7.78	6.25

Fig. 1 : Map of Saharsa district