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; Macro nutrients; Micro nutrients; Testing*

INTRODUCTION

Soil fertility plays a key role in increasing crop production. It is important 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 are to boost food production and productivity as well as agricultural sustainability. There are problems that impose limits on these objectives or goals 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 higher amount of organic matter in soil tremendously increases soil fertility. Decay of organic matter releases nitrogen, phosphorus and mineral nutrients in a form available to plants. Availability of macro, secondary and micro nutrients induce better germination of 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. Imbalanced and inadequate use of fertilizers may also deplete soil fertility. Seasonal variation of different soil fertility parameters like organic carbon, major nutrients and exchangeable cations may be affected by factors like climatic variation, 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.

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^{o}86’ N, 86^{o}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. 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.

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 has been presented in tables 1-4.

Physical-chemical properties of soil

Soil pH or soil reaction is an indication of the acidity or alkalinity of soil and each measured in pH unit. The supply of plant nutrients and thus fertility of the soil are affected by pH. The pH of soil samples of Sonkurthua village varied from 6.80 to 7.60 with the mean value 7.20 (table-2). Similarly, the pH of soil samples 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 is usually associated with clay rich soil and low conductivities are associated with sandy soil (Singh et al. 2018). The importance of organic matter in the soil is implied in the definition of soil, which recognized fertility status of the soil. it increases the soil fertility / nutrient status of soil besides it is a measure determinanat of improved soil structure (Ravikumar and Somashekar, 2013). 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. Continuous and intensive cultivation leading to high crop removal might be responsible for the low organic carbon content indicative of samples of these villages. in addition, low input of FYM, crop residue, low vegetative cover could further exactable the situation Low status of organic carbon in some soils of the area is indicates that adequate nitrogen fertilization through organic manure is required.

Macro nutrient status of the soil

Available nitrogen content 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 noticed in some areas most likely 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 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 range 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 there is meagre opinion related to 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).

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.

Nutrient index value is the measure of nutrient supplying capacity of soil to plants (Singh et al. 2016). The soil nutrient index of the study area was calculated. Nutrient index analysis for the study area revealed that organic carbon was low to medium, available N, P & K were medium and micro nutrients were medium to high in all villages.

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 contrary, 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.

References:

Barooah Aradhana, Bhattacharyya Hiranya Kumar and Chetri Karma Bahadur 2020. Assessment of soil fertility of some villages of Lahowal block, Dibrugarh, India. *International Journal of Current Microbiology and Applied Sciences* 9(8): 1438-1450.

Chesnin L and Yien CH 1950. Turbidimetric determination of available sulphates. *Soil Science Society of America Proceedings* 15: 149-151.

Jackson ML 1973. Soil Chemical Analysis. Prentice Hall Inc. Englewood Cliffs, New Jersey, USA.

Kothyari Hukam Singh, Meena KC, Meena BL and Meena Ramkishan 2018. Soil fertility status in Sawai Madhopur district of Rajasthan. *International Journal of Pure and Applied Bioscience* 6(4): 587-591.

Lindsay WL and Norvell WA 1978. Development of a DTPA Soil Test for Zinc, Iron, Manganese, and Copper. *Soil Science Society of America Journal* 42: 421-428.

Olsen SR, Cole CV, Watanable FS and Dean LA 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate U. S. D. A. *Cric*. 939.

Patidar Narendra Kumar, Patidar Rohit Kumar, Rajput Archana, Sharma SK and Thakur Rahul 2017. Evaluation of basic properties of soil and major nutrient in soils of Jhabua district of Madhya Pradesh. *International Journal of Agriculture, Environment and Biotechnology* 10(1): 45-52.

Patra Paritosh, Mondal Suchhanda and Ghosh Goutam Kumar 2012. Status of available sulphur in surface and sub-surface soils of red and lateritic soils of West Bengal. *International Journal of Plant, Animal and Environmental Science* 2(2): 276-281.

Piper CS 1966. Soil and Plant Analysis (Asia Edition), Hans Publishers, Bombay, India.

Rakesh K, Rakesh KUS and Brijesh Y 2012. Vertical distribution of physico-chemical properties under different topo-sequence in soils of Jharkhand. *Journal of Agricultural Physics* 12(1): 63-69.

Ravikumar P and Somashekar RK 2013. Evaluation of nutirent index using organic carbon, available P and available K concentation as a measure of soil fertility in Varahi river basin, India. *Proceedings of the International Academy of Ecology and Environment Science* 3(4): 330-343.

Singh G, Sharma M, Manam J and Singh G 2016. Assessment of soil soil fertility status under different cropping sequence in district Kapurthala. *J. Krishi Vigyan* 5(1): 1-9.

Singh Shishu Pal, Singh Shivraj and Kumar Rajesh 2018. Soil fertility evaluation for macronutrients using parkers nutrient index approach in soils of Varanasi district of eastern Uttar Pradesh, India. *International Journal of Current Research* 10(12): 75875-75879.

Subbiah BV and Asija CL 1956. A rapid procedure for the determination of available nitrogen in soils. *Current Science* 25: 259-262.

Walkley A and Black CA 1934. An examination of Degtjareff method for determining soil organic matter and a proposed modifications of the chromic acid titration method. *Soil Science* 37(1): 29-38.

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

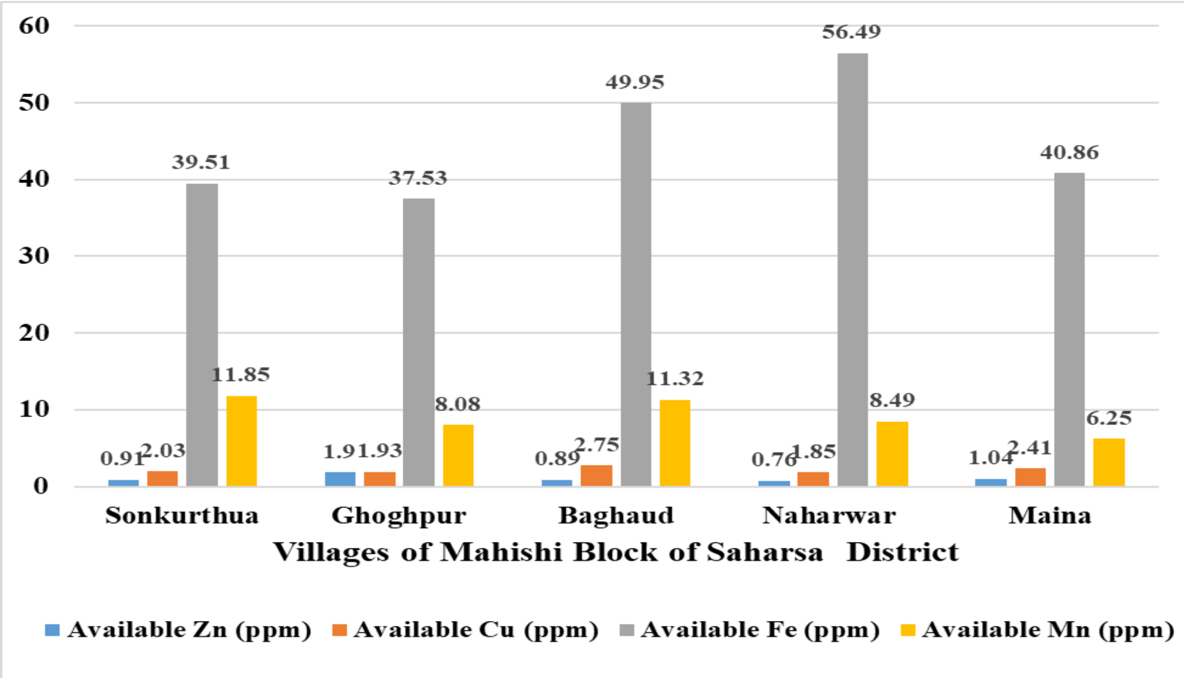

Fig 1: Graphical representation of the micro nutrient status of Villages of Mahishi block of Saharsa district

Fig. 2: Map of Saharsa district