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Evaluating the Soil Fertility Status of Raigarh District of Chhattisgarh

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Abstract

The study was conducted to evaluate the soil fertility status with pH, EC, OC, available N, P, K, S, Zn, Fe, Cu, Mn and B of thesoils and cropping system of Raigarh District of Chhattisgarh. In the study 29704 soil samples were analysed from nine blocks of the district during 2016-17 under soil health card scheme (SHC). The results revealed that 89 percent soil were samples slightly to highly acidic and ranged from 4.20-6.50 in case of pH values, EC values of 100 percent soil samples ranged from 0.15-0.98dSm^{-1}. The 84 percent samples were in medium category and organic matter ranged from 0.12-0.80 percent, 98 per cent soil samples were deficient and ranged from 125.30-556.30kg ha^{-1}in available nitrogen, 100 per cent soil samples were deficient and ranged from 1.41-12.25kg ha^{-1}in available phosphorus, while 99 percent samples were in medium category ranged from 137.19-357.50kg ha^{-1}in available potash. The available sulphur and DTPA extractable Zn in soils ranged from 1.25-81.25 kg ha^{-1} and 0.35-1.64 mg kg^{-1}with 84 and 82 percent soil samples, respectively indicated medium to high in sulphur and zinc content. Among the micronutrients iron, copper and manganese were in sufficient, ranged from 4.50-85.25, 0.20-9.60 and 3.20-71.08mg kg^{-1} with 100 percent while and boron were medium, ranged from 0.45-1.65 mg kg^{-1} with 100 percent in soil.

***Key Words**: Soil fertility, nitrogen, phosphorus, organic matter, micronutrients.*

Introduction

Due to use of imbalanced and inadequate fertilizers, the response of chemical fertilizer has declined tremendously. However, application of NPK fertilizers without supplementing micronutrients has, no doubt, remarkably increased the food production but also resulted micronutrients deficiencies by depleting their soil resources. The trends of micronutrient deficiencies are changing, instead of single nutrient deficiency, cluster of micronutrient deficiencies are emerging fast in vast area[1]. Increasing multi-micronutrient deficiencies in soil and crops not only affect the crop productivity but also create malnutrition and health problems. Therefore, inclusion of micronutrients in balanced fertilization concept is gaining momentum[3]. It is very much relevant for identifying constraints in crop husbandry for attaining sustained productivity and facilitating agro-technology transfer programme. Productivity of a soil depends on its nature and quality as such; knowledge about the physicochemical characteristics of soils is of prime[9].

Materials and Methods

The study area covered nine blocks i.e. Baramkela, Dharamjaigarh, Gharghora, Kharsia, Lailunga, Pussore, Raigarh, Saranggarh and Tamnar of Raigarh district. Soil samples of 0-15 cm depth were collected from 29704 sites of irrigated (2.5 ha.) and rainfed (10.0 ha.) grids of the district during 2016-17 under soil health card scheme (SHC). Collected soil samples were air dried under shade, crushed gently with a wooden roller and passed through 2.0 mm sieve to obtain a uniform representative sample. Samples were properly labeled with the aluminium tag and stored in cloth bags for analysis. The processed soil samples were analysed in soil testing laboratories using standard methods. Correlation coefficients were worked out.

Results and Discussion

Physico-chemical characteristics:

The available nutrients and physico-chemical characteristics of soil are given in table 2 and depicted in fig. 1. pH is another factor in addition to organic matter, soil phosphorous and calcium carbonate that influences the transformation and availability of micronutrients to plants. Acidity increases the availability of iron, manganese and copper, where as alkalinity increases the availability of molybdenum[10]. The pH values of soils ranged from 4.20 to 7.50 with an mean value of 5.85, which indicating that soils are acidic in reaction (Table 2). The data further indicated that 89 percent soil samples showed pH value less than 6.50, rest 11% soil samples had pH ranged from 6.50 to 7.50 (Table 1). Excusive leaching of bases from the soil due to heavy rainfall and low level of correlation with available sulphur (r = -0.7360) and boron (r = -0.634) and significant positive correlation with organic matter might be caused soil acidity in these soils. Soil pH had negatively and significant correlation with zinc (r = 0.505) (Table- 3). The Electrical Conductivity (EC) values of the soils ranged from 0.15 to 0.98 dSm^{-1} with a mean value of 0.56 dSm^{-1}. It was alsoobserved that 100 % soil samples of study area contained EC less than 0.98 dSm^{-1} (Table 2). These results indicated that there was no remarkable accumulation of soluble salts in soils might be due to sufficient leaching and flushing of salts due to higher rainfall in the study area [4,8].

Fertility status:

The Soils of Raigarh district had wide variation in the soil organic carbon status. Organic carbon content of the soils ranged from 0.12 to 0.80 percent with an average of 0.46 percent (Table 2 and Fig. 1).In the study all 29704 soil samples contain 16 % low and 84 % medium amount of organic carbon. A significant positive correlations (r = 0.566), (r = 0.555) and (r = 0.674)were between organic carbon and available nitrogen, phosphorus and potassium, respectively. Available copper was negatively and significant correlated with organic carbon (r = -0.584) and available boron with soil pH (r = -0.634).

The available nitrogen contents of the soils ranged from 125.30 to 556.30 kg ha^{-1} with an average of 340.80 kg ha^{-1}. It was also observed that 98 % and 2 % soil samples possessed in low and medium category of available nitrogen, respectively. Low class of available nitrogen indicating that mineralizable nitrogen fraction, under such type of agro-climatic conditions and low pH prevailing in these soils, is rather low. The available phosphorus contents of the soils ranged from 1.41 to 12.25 kg $ha^{-1}$with an average of 6.83 kg ha^{-1}. The data further revealed that 100 % soil samples belong to low category of available phosphorus, respectively. Low pH value of the soils might because of low phosphorus content in these soils[3,5]. The available potassium and sulphur contents in the soils ranged from 137.19 to 357.50 $kgha^{-1}$ and 1.25 to 81.25 kg ha^{-1} with an average of 247.34 and 41.25 kg ha^{-1},respectively. It was further observed that99 % and 1 % soil samples possessed in medium and high category of available potassium, respectively. It was also clear that 4 %, 84 % and 12 % soil samplescontained low, medium and higher amount of available sulphur, respectively[2]. DTPA extractable zinc content of the soils varied from 0.35 to1.64 mg kg^{-1} with a mean value of 0.99mg kg^{-1}. Data further revealed that 1%, 82% and 17% soil samples possessed in deficient, marginal and sufficient categories of zinc. Zinc content of the soil had significant positive correlation with pH. The DTPA-Fe content in soils ranged from 4.50 to 85.25 mg kg^{-1} with an mean value of 44.87 mg kg^{-1}[6]. It was further observed that soil samples were found 100 percent in sufficient range in available iron. Available copper content in soil samples ranged from 0.20 to 9.60 mg $kg^{-1}$with mean value of 4.90 mg kg^{-1}. Data further revealed that 100 percent soil samples possessed in sufficient categories of available Copper[7]. It had significant and positive correlation with organic carbon. The DTPA-Mn in the soil samples ranged from 3.20 to

71.08 mg kg^{-1} with an mean value of 37.14 mg kg^{-1}.It was also clear that 100 % soil samples contained higher amount of available manganese. It is evident from table 2 that available boron status of soil ranged from 0.45 to 1.65 mg kg^{-1} with a mean value of 1.05 mg kg^{-1}. The 100 percent soil samples contained medium amount of available boron. It had negatively and significant correlation with soil pH.

Table 1 Soil fertility status and physico-chemical characteristics of district:

S.No.	Parameters	Ranges and Area					
		Low	Area (%)	Medium	Area(%)	High	Area(%)
01.	pH	<6.5	89.00	6.5-7.5	11.00	7.5-8.5	00.00
02.	EC(dSm-1)	<1.0	100.00	1.0-2.0	00.00	>2.0	00.00
03.	Organic Carbon (%)	<0.50	16.00	0.50-0.75	84.00	>0.75	00.00
04.	Avail. Nitrogen (kg/ha.)	<280	98.00	280-560	02.00	>560	00.00
05.	Avail.Phosphorus (kg/ha.)	<12.5	100.00	12.5-25.0	00.00	>25	00.00
06.	Avail. Potash (kg/ha.)	<135.0	00.00	135-335	99.00	>335	01.00
07.	Avail. Sulphur (kg/ha.)	<20.0	04.00	20-40	84.00	>40	12.00
08.	Avail. Zinc (mg/kg)	<0.6	01.00	0.6-1.2	82.00	>1.2	17.00
09.	Avail. Iron (mg/kg)	<4.5	00.00	4.5-9.0	00.00	>9.0	100.00
10.	Avail. Copper (mg/kg)	<0.2	00.00	0.2-0.4	00.00	>0.4	100.00
11.	Avail.Manganese(mg/kg)	<3.5	00.00	3.5-7.0	00.00	>7.0	100.00
12 .	Avail. Boron(mg/kg)	<0.5	00.00	0.5-1.0	100.00	>1.0	00.00

Table 2 Available nutrients and physico-chemical characteristics of soil of various blocks

S.No.	Name of Blocks	pH	EC (dSm-1)	OC (%)	Available nutrients (kg ha-1)				DTPA micronutrients (mgkg-1)				B (mg/kg)
					N	P	K	S	Zn	Fe	Cu	Mn	
01.	Baramkela	6.05	0.55	0.45	383.69	6.58	232.52	16.87	1.48	9.36	3.23	8.13	1.10
02.	Dharamjaigarh	5.62	0.45	0.47	365.52	7.50	280.62	31.72	0.88	10.17	3.74	10.42	0.98
03.	Gharghora	6.47	0.56	0.39	294.78	6.56	236.36	18.25	0.96	26.00	4.97	37.72	0.71
04.	Kharsia	6.30	0.57	0.49	361.58	6.51	272.80	20.00	1.19	26.94	2.85	18.59	1.02
05.	Lailunga	5.50	0.56	0.43	289.04	6.08	256.39	24.50	0.93	44.58	2.52	36.51	1.11
06.	Pussore	5.50	0.58	0.45	327.73	6.75	270.47	41.25	0.92	33.92	3.72	17.18	0.99
07.	Raigarh	6.45	0.54	0.51	351.23	7.19	255.84	20.00	1.10	23.73	1.69	31.88	0.77
08.	Saranggarh	5.35	0.63	0.49	341.77	6.53	251.32	28.37	0.84	45.00	2.95	23.59	1.02
09.	Tamnar	5.88	0.46	0.44	365.80	6.32	236.57	25.90	1.16	35.28	1.88	20.50	0.86
Ranges		4.20-7.50	0.15-0.98	0.12-0.80	125.30-556.30	1.41-12.25	137.19-357.50	1.25-81.25	0.35-1.64	4.50-85.25	0.20-9.60	3.20-71.08	0.45-1.65
Mean		5.85	0.56	0.46	340.80	6.83	247.34	41.25	0.99	44.87	4.90	37.14	1.05

Table 3 Correlation coefficient between available nutrients and physico-chemical characteristics of soil:

Available nutrients	pH	EC (dSm-1)	OC(%)
N(kg ha-1)	0.107	-0.378	0.566*
P(kg ha-1)	0.134	-0.385	0.555*
K(kg ha-1)	-0.297	-0.072	0.674**
S(kg ha-1)	-0.736**	-0.031	0.071
Zn(mgkg-1)	0.505*	-0.144	0.057
Fe(mgkg-1)	-0.449	0.484	-0.074
Cu(mgkg-1)	0.035	0.158	-0.584*
Mn(mgkg-1)	0.254	0.297	-0.312
B(mgkg-1)	-0.634**	0.224	0.18

Where * = significant at 5% and ** = significant at 1 %

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