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Macro and Micro Nutrient Status of Instructional Farm, College of Agriculture and Research Station Raipur, District Raipur, Chhattisgarh

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A B S T R A C T

The current study was conducted at Instructional farm of IGKV, Raipur district, Chhattisgarh, 2021 to assess the macro and micro nutrient status of the soil. A random sampling procedure was used to gather surface (0-15 cm) soil samples, yielding a total of 126 samples for analysis of soil chemical characteristics. Soil response (pH), electrical conductivity (EC), organic carbon (OC), available macro-nutrients (e.g. N, P, K, S), & DTPA-extractable micro-nutrients (e.g. Iron, Manganese, Copper, Zinc, and hot water extractable Boron) were all tested in the soil samples. The soil pH of the study region ranged from 6.51 to 7.78. It indicates that the pH of the soil is in the neutral to slightly alkaline range. The electrical conductivity found to be fall under the normal category with average value of 0.25 dS/m. Organic carbon in this soil was found to be around 0.38%. Available Nitrogen content was found between 163 to 278 kg ha^{-1}. The available Phosphorus content varied from 2.6 to 28.9 kg ha^{-1}. Available Potassium content ranged from 201.23 to 443.96 kg ha^{-1}. The available Sulphur content ranged from 9.32 to 36.67 kg ha^{-1}. DTPA extractable micronutrient anions content was found that the Iron content varied from 4.1 to 31.4 mg kg^{-1}. The Manganese content ranged between 2.2 to 22 mg kg^{-1}. Copper content varied from 0.4 to 1.7 mg kg^{-1}. Zinc content ranged from 0.4 to 2.3 mg kg^{-1}. Hot- water extractable Boron content found to be between 0.1 to 0.8 mg kg^{-1}.

Introduction

Soil fertility is one of the important factors controlling yields of the crops. Soil characterization in relation to evaluation of fertility status of the soils of an area or region is an important aspect in context of sustainable agriculture production. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs, the response (production) efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent years. Balanced use of organics, fertilizers and biofertilizers plays an important role to maintain soil fertility in long run. The availability of macro and micronutrients to plants is influenced by several soil characteristics. Land use pattern also plays a vital role in governing the nutrient dynamics and fertility of soils (Venkatesh *et al.*, 2003). Similarly, different cropping systems are suitable for different soil groups as regards to production and productivity. Texture, structure, color, etc are important physical parameters of the soil. Similarly the soil reaction (pH), EC, organic matter, macro and micro-nutrients, etc are important chemical parameters of the soil. These soil properties play an important role in soil fertility and these are determined after soil testing (Brady and Weil, 2004). Soil fertility is the inherent capacity of the soil to supply nutrients to plants in adequate amounts and in adequate proportions. Soil productivity is the capacity of a soil to produce a certain yield of agricultural crops or other plants using a defined set of management practice. Soil fertility and productivity are the key factors for food production and soil quality is just as important in the context of soil degradation caused by many factors. All productive soils can be fertile, but all fertile soils cannot be productive due to some factors of influence, such as water logging, salinity or alkalinity conditions, unfavorable weather conditions etc.

Materials and Methods

The study area was carried out at Instructional Farm, College of Agriculture and Research Station Raipur, District Raipur, Chhattisgarh is located at latitude 22°33'N and 21°14'N, and the longitudes of 82°6'E and 81°38'E with an altitude is 280 *M.A.S.L.* The farm has a total area of 71.24 acres, which is mainly *Vertisols* and *Inceptisols* soils.

Sample collection

Surface soil samples (0-15cm depth) were obtained from several instructional, horticultural, and KVK farms of IGKV, Raipur based on the handheld GPS device. Total of 126 soil samples were obtained from the farm area for examination of soil chemical characteristics. The collected soil samples were air dried after grinding with wooden pestle and mortar, than sieved through 2 mm sieve, labelled and stored.

Laboratory analysis

The collected soil samples were analyzed at laboratory of soil science department. The different soil parameters tested as well as method adopted to analyze is shown on the table below

Results and Discussion

Soil reaction

The soil pH of the study region ranged from 6.51 to 7.78, it indicates that the pH of the soil is in the neutral to slightly alkaline range. Majority of soil samples (94.44%) had a neutral soil reaction, while the remaining 5.56% had a slightly alkaline reaction (Table 1). It might be due to barren nature of the field with *Vertisols* dominant soil (Mandal *et al.*, 2018).

Electrical conductivity

The electrical conductivity of the soil water suspension ranged from 0.15 to 0.52 dS/m in soil of study area with a mean value of 0.25 dS/m.

Most of the 100% collected soil samples fall under normal E.C. (<1.0 dS/m) category (Table 2). It indicated that there is no soil limitation for crop production from soluble salt content in soil. Similar results were also reported by like Balakrishna *et al.*, 2017 in Palari Block soil and Dameswar *et al.*, 2017 in Kasdol Block soil in Chhattisgarh.

Organic carbon

Organic Carbon content in study area ranged from 0.15 to 0.63% with a mean value of 0.38%. From all collected soil samples 85.71 % of the 126 samples gathered had a poor rating, while the remaining 14.29 % had a medium fertility category (Table 3). It may be ascribed due to low input of FYM and crop residues as well as rapid rate of decomposition due to high temperature (Sathish *et al.*, 2018).

Available nitrogen

Available N content in soil of study area ranged from 163 to 278 kg ha^{-1} with mean value of 202.39 kg ha^{-1}. It has been revealed that 100 % of the study area was deficient in available N (Table 4). It may be ascribed to the nitrogen is lost through various mechanisms like ammonia volatilization, nitrification, chemical and microbial fixation, leaching, runoff and these soils had a very low content of organic carbon. (vaisnow *et al.*, 2010)

Available phosphorus

Available P content in the study area found to be varied from 2.60 to 28.9 kg ha^{-1} with average content of 16.21 kg ha^{-1}. It was revealed that 24% samples fall under deficient category, 72% samples in medium range and 4% falls under high range of available P content (Table 5). It might be due to the mostly affected by past fertilization, pH, Organic matter content, texture various soil management and agronomic practices (Balakrishna *et al.*, 2017).

Available potassium

Soil available K status ranged from 201.23 to 443.96 kg ha^{-1} with mean value of 296.42 kg ha^{-1}. As 82% samples falls into the medium category and the remaining 18% samples fall into the high category (Table 6), indicating no K deficient area within the study area. These findings were similar to those of Balakrishna (2017) in the Palari block.

Available sulphur

Available S status was found to be ranged between 9.32 to 36.67 kg ha^{-1} with a mean content of 22.16 kg ha^{-1}. Also it was found that out of all collected samples 56.34% were classified as low, 39.68% as medium, and the remaining 3.98% as sufficient (Table 7).

Available boron

Hot water extractable B content in the study area found to be ranged between 0.10 to 0.80 mg kg^{-1} with a mean value of 0.28 mg kg^{-1}. Out of 100% samples collected 88.88% samples reported in deficient and rest 11.12% samples in sufficient B content category (Table 8).

DTPA extractable micronutrients

Available Fe content in the study area found to be ranging from 4.1 to 31.4 mg kg^{-1} with mean value of 10.66 mg kg^{-1}. The majority of soil samples were determined to be sufficient (61.90%), with the remaining 37.30% in the high range and 0.8% in the poor deficient range (Table 9).

Table.1

S.N.	Parameters	Methods
1	Soil pH	Glass Electrode pH Meter (Piper, 1967)
2	EC	Conductivity Bridge (Black, 1965)
3	Organic matter	Walkely and Black (1934)
4	Available N	Alkaline permanganate method (Subbiah and Asija, 1956)
5	Available P	Olsen's method (Olsen *et al.*, 1954)
6	Available K	Ammonium acetate extract method (Jackson,1967)
7	Available S	$CaCl_2$-Extractable method (Williams and Steinbergs, 1969)
8	Available B	Hot water soluble (Berger and Truog, (1977)
9	Available Fe	DTPA extraction method (Lindsay and Norvell, 1978)
10	Available Zn	DTPA extraction method (Lindsay and Norvell, 1978)
11	Available Cu	DTPA extraction method (Lindsay and Norvell, 1978)
12	Available Mn	DTPA extraction method (Lindsay and Norvell, 1978)

Table.2 Distribution of Soil Samples under different pH rating

Classes	Range	No. of Samples	% of Samples
Strongly acidic	< 4.5	0	0
Moderately acidic	4.5 - 5.5	0	0
Slightly acidic	5.5 - 6.5	0	0
Neutral	6.5 - 7.5	119	94.44
Slightly alkaline	7.5 - 8.5	7	5.56
Moderately alkaline	8.5 - 9.5	0	0
Strongly alkaline	> 9.5	0	0

Table.3 Distribution of Soil Samples under different E.C. rating

Classes	Range (dS/m)	No. of Samples	% of Samples
Low	< 1	126	100
Medium	1.0 – 2.0	0	0
High	2.0 – 3.0	0	0
Very High	> 3.0	0	0

Table.4 Distribution of Soil Samples under different Organic Carbon rating

Classes	Range (%)	No. of Samples	% of Samples
Low	< 0.5	108	85.71
Medium	0.5 – 0.75	18	14.29
High	> 0.75	0	0

Table.5 Distribution of Soil Samples under different Nitrogen rating

Classes	Range (kg/ha)	No. of Samples	% of Samples
Low	< 280	126	100
Medium	280 – 560	0	0
High	> 560	0	0

Table.6 Distribution of Soil Samples under different Phosphorus rating

Classes	Range (kg/ha)	No. of Samples	% of Samples
Low	< 12.5	30	23.80
Medium	12.5 – 25	91	72.22
High	> 25	5	3.98

Table.7 Distribution of Soil Samples under different Potassium rating

Classes	Range (kg ha^{-1})	No. of Samples	% of Samples
Low	< 135	0	0
Medium	135 – 335	103	81.75
High	> 335	23	18.25

Table.8 Distribution of Soil Samples under different Sulphur rating

Classes	Range (kg ha^{-1})	No. of Samples	% of Samples
Low	< 22.5	71	56.34
Medium	22.5 – 35	50	39.68
High	> 35	5	3.98

Table.9 Distribution of Soil Samples under different Boron rating

Classes	Range (mg kg^{-1})	No. of Samples	% of Samples
Deficient	< 0.5	112	88.88
Sufficient	0.5 – 1.0	14	11.12
High	> 1.0	0	0

Table.10 Distribution of Soil Samples under different Iron rating

Classes	Range (mg kg^{-1})	No. of Samples	% of Samples
Deficient	<4.5	1	0.8
Sufficient	4.5-9.0	78	61.90
High	>9.0	47	37.30

Table.11 Distribution of Soil Samples under different Copper rating

Classes	Range (mg kg^{-1})	No. of Samples	% of Samples
Deficient	<0.2	0	0
Sufficient	0.2-0.4	2	1.59
High	>0.4	124	98.41

Table.12 Distribution of Soil Samples under different Manganese rating

Classes	Range (mg kg^{-1})	No. of Samples	% of Samples
Deficient	<3.5	6	4.77
Sufficient	3.5-7.0	72	57.14
High	>7.0	48	38.09

Table.13 Distribution of Soil Samples under different Zinc rating

Classes	Range (mg kg^{-1})	No. of Samples	% of Samples
Deficient	<0.6	0	0
Sufficient	0.6-1.2	94	74.60
High	>1.2	32	25.40

Available Mn content found to be within 2.2 to 22 mg kg^{-1} with a mean value of 7.09 mg kg^{-1} of soil in the study area. Out of 126 samples collected, 57.14% fall into the sufficient fertility category, while the remaining 38.09% and 4.77% fall into the high and insufficient Mn fertility categories, respectively (Table 10).

Available Cu content in study area found to be ranges from 0.4 to 1.7 mg kg^{-1} with a mean value of 0.92 mg kg^{-1}. There were no samples in the low rating category among the 126 samples collected, 1.59% samples were sufficient, and the remaining 98.41% samples were in the high rating category (Table 11).

Available Zn content in study area found to be ranges from 0.40 to 2.30 mg kg^{-1} with a mean value of 1.04 mg kg^{-1}. Also it was found that 74.60% samples were in sufficient and 25.40% samples in high fertility category (Table 12). In case of available Cu, Fe and Mn, 100 % samples were under high level. Similar results were reported by Dixit (2014) and Singh *et al.,* (2014). The soil of the area was found to be neutral to slightly alkaline in reaction with electrical conductivity less than 1 dS/m of KVK, horticulture and instructional farms, IGKV, Raipur. Organic carbon levels in soil were determined to be low to medium. Macro nutrient analysis results shows that the soils were low in available nitrogen and sulphur content. The status of available phosphorus and potassium in soil were found to be in medium range. In case of micronutrients, zinc and manganese were found to be in sufficient condition but boron content of the soil was low. Iron and copper status in soils of the farms were high.

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