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Evaluation Of Soil Fertility Status Of Research Field, Area Of Industrial Belt And Near Fields, Rasmada, Durg Dist., Chhattisgarh, India

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ABSTRACT

A study was conducted to evaluate the fertility status of soils of five different areas of Rasmada village block of Durg district, India. A total of 05 numbers of surface soil samples (0-15 cm depth), comprising of 5 composite soil samples from each site were collected. The collected soil samples were air dried, sieved and analyzed for different fertility parameters viz., soil pH, electrical conductivity, organic carbon, available nitrogen, available phosphorus, available potassium, available Sulphur and available zinc and boron using standard procedures. Based on calculated nutrient index value soil fertility rating as low, medium and high for each fertility parameter was done. Results revealed that pH of the all soils of study area were found in the acidic range and majority (43%) of the samples lie in the very strongly acidic (4.5 to 5.0) range. Electrical conductivity was normal (<1dS/m). Soil organic carbon varied and recorded in low (15%), medium (57%) and high (28%) category. Nutrient index value for available nitrogen, phosphorus and potassium was low to medium range. Available Sulphur was high to medium in the soils of the study area and zinc content was found low to but available boron was recorded low for most of the soil samples. A systematic survey was used to gather grid-based (GPS) surface (0–15 cm) soil samples from 5 areas Of the Rasmada villages in Durg district that were chosen, 5 samples were found to be Vertisol. According to the standards followed in the soil testing lab, these soil samples were classified as low, medium, and high after being examined for N, P, and K as well as Fe, Mn, Cu, and Zn. A significant and positive association between soil pH and accessible N, P, and K was found based on the coefficient of correlation between macronutrients and micronutrients and soil characteristics. Available N, P, and K were significantly and favorably correlated with electrical conductivity, and available N and K were significantly and favorably correlated with organic C.

Keywords: soil fertility, soil samples, micro nutrients, soil pH

INTRODUCTION

It is an established fact that soil fertility is an inherent capacity of soil to supply nutrients in adequate quantities to plants for proper growth and development and that is being influenced by various physical, chemical and biological properties of soil which are controlled by natural and human being factors. Healthy soil ensures quality food, nutritional security, and critical for achieving sustainable development goals but, there is a large gap between potential and farmers' harvested yield due to decreasing capacity of the soils to support soil functions. (Das et al.,

2022) [16. Soil fertility is a prime factor that controls yields of the crops (Chandrakala et al., 2018) [14. One of the major limitations for achieving higher productive yield, in India, is low fertility status of soil. (SLUSI, 2010) [37. In agricultural soils the soil fertility may be depleted due to continuous cultivation (Ogunjinmi et al., 2017) [28] and intensive cultivation tremendously reduces secondary and micronutrients in soil (Amara et al., 2017) [2. Moreover, agricultural management practices and climate change also changes the fertility of soil (Abdel Rahman et al., 2022) [1]. Depletion of soil fertility also results from indiscriminate use of chemical fertilizers, injudicious application of irrigation and different cropping practices (Medhe et al., 2012) [26]. Soil erosion is a major pathway of soil degradation (Gupta et al., 2021) [18] and effects on soil fertility depletion through nutrient loss (Bashagaluke et al., 2018) [8] Thus there is an increase in trend of land degradation and deterioration of soil health (Basak et al., 2021) [4]. Use of chemical fertilizers without knowing the soil nutrient status and crop need may adversely affect the soil health as well as crop production (Ray et al., 2000) [33 A fertile soil is rich in all availability of macro and micro nutrients with good soil aeration, water holding capacity and good soil texture that governs the high crop yield and sustain plant growth. (Bharti et al., 2017) [10]. For sustainable agricultural production, maintenance of soil fertility is crucial. Nutrient availability in soil depends on soil productivity and soil fertility is determined by the quantity of nutrients present in the soil. Soil fertility evaluation is the key for adequate and balanced nutrition of crops. Among various methods of soil fertility evaluation, soil testing is one of the better, precise and balanced method of soil fertility management. Macronutrients (N, P, K, and S) and Micro nutrients (Zn, Cu, Fe, Mn, and B) are essential soil elements that regulate soil fertility (Tarar et al., 2023) [40]. Based on Spatial variability in nutrient elements in soils estimated by soil testing can be successfully used for further fertilizer recommendation as well as input management as per need of the crops Overview The state of Chhattisgarh is located between latitudes 17°46' and 24°8' N and longitudes 80°15' and 84°24' E. The State has a total area of 1,35,194 square kilometers, which is 136034.28 km2 from north to south and 336 km from east to west. The key to an effective fertilizer program is the balanced utilization of plant nutrients. High production levels are guaranteed by balanced nutrient use, which also contributes to soil health maintenance. Entisols, Inceptisols, Alfisols, and Vertisols are the four main types of soil found in Chhattisgarh State; they are generally classified as red and yellow soils. Nearly all soil has a medium to high potassium content and deficiencies in phosphate and nitrogen. The existence or lack of nutrients determines the fertility of the soil. The soil fertility status in Chhattisgarh is generally considered low, with most soils deficient in nitrogen and phosphorus, while showing medium to high potassium levels; this is due to the predominance of soil types like Entisols, Inceptisols, Alfisols, and Vertisols across the state, with only a few areas having Mollisols with higher fertility. OVERVIEW The fertility of the soil is regulated by the macronutrients N, P, and K. One of the key variables influencing crop productivity is soil fertility. In the context of sustainable agricultural production, soil characterization in connection to assessment of the fertility state of an area or region's soils is a crucial component. Under intensive agriculture, the response (production) efficiency of chemical fertilizer nutrients has drastically decreased in recent years due to both uneven and sufficient fertilizer application as well as low input efficiency. As a result, the findings of multiple field tests conducted throughout India have pointed to "fertilizer-induced un-sustainability of crop productivity." It is a natural occurrence for the availability of nutrients to vary, with some being adequate while others are inadequate. Fertility of Soils The ability of the soil to provide an environment conducive to plant growth is known as soil fertility. It speaks to the soil's capacity to promote plant development and increase agricultural productivity. Applying both organic and inorganic fertilizers to the soil can help with this. Information from nuclear technology reduces environmental effect while increasing crop productivity and soil.

STUDY AREA

Durg district in the state of Chhattisgarh. This district is situated in the southern part of the Chhattisgarh plain. Area of district Durg is 2238. 36sq.km.district lies between20’54’ and21’32’ north latitude and 81’10’ and 81’36 east longitude. Durg district317 meters above mean sea level. The climate is topical with hot summers and mansion rainfall. Winters are dry and cold. The annual rainfalls around1052mm.Durg is generally a dry tropical climate.

MATERIAL AND METHOD

STUDY AREA

The study was carried out at Durg block of Durg district. It is situated in mid-eastern part of Chhattisgarh state. The soils found in the study area are sandy loam to sandy clay loam. It also contains moderate amounts of organic matter, nitrogen, potassium, and phosphorus. Red -yellow soil is common in the Durg district and is ideal for growing crops like sorghum, pulses, millets, and rice.

Sample collection and Analysis

Total 10 soil samples from surface layer(0-15cm) were collected from5 different areas of rasmada, of Durg block, the study area. The areas close to the industries as well as the fields furthest from the enterprises were used to gather soil samples (0–15 cm). Five soil samples were taken from the field close to the industries, while five more were taken from the area further from the enterprises. Prior to analysis, materials were allowed to air dry before being ground using a pestle and mortar and then passed through a 2 mm sieve. The samples were analyzed for 12 chemical parameters by pH meter, (EC)by EC meter, nitrogen(N) using method by Kjeloplus apparatus, available(K), and (Na) by flame photometer.

pH

Take a twenty gram of soil sample was taken in a 100 ml beaker add 50 ml of distilled water it to make a soil: water suspension of 1:2. Mix at regular interval (shake in one direction only). The suspension was stirred with glass rod intermittently and keep for 30 min. Now take the pH of above solution and then pH was measured using pH meter.

EC.

Take 20 gm soil and 50ml d/w in 100 ml beaker, shake by glass rod in one direction only and left for 30 min. shake the above solution regularly at least 3 time within 30min, now take the pH of above solution, left the above solution overnight for sedimentation. Next day celebrate the EC meter by0.01N KCL solution, now take EC of above solution by immersing the EC electrode into the supernatant water above the soil ppt, repeat the above process for different soil samples.

OC

Take one gram soil in 500ML conical flask. Add 10 ml of in K2CR207(1N) (Keep for five minute). Add 20 ml of concentrate Sulphuric acid, keep the mixture for 30 minutes. Add 200 ml of distilled water, add 10 ml Ortho phosphoric acid, Add 2 ml of diphenyl amine indicator. Titrate the above solution by 0.5N FAS (Ferrous ammonium sulfate solution). Take the reading. Repeat the same process with blank solution. No soil. Calculate the % OC (available).

Available Sulphur in soil

Take 10-gram soil in 100 ml conical flask, add 50 ml of calcium chloride solution. Shake for 30 minutes in mechanical Shaker, filter the solution. Take 10 ml of the filtrate and add 1 ml gum acacia solution in 25 mL volume flask. Add 1 gram barium chloride, shake for one minute. Make up the volume with distill water up to 25mL. Take the reading by spectrophotometer at 440 nm. (within 30 min)

Available phosphorus in soil

Take 2.5-gram soil into 50ML conical flask at 50. ML of 0.5N NaHco3(sodium Bicarbonate), Add 0.5 gram activated charcoal, shake for 30 minute in mechanical shaker. Filter the above solution. Take 5ML of the above filtrate in 25ML volumetric flask. Add 0.5 mL of 5N H2So4 to neutralize the remaining base. Left the about mixture for 10 to 15 minutes. Shake regularly in between add 4mL of reagent B in about mixture. Make up the value up to 25mL by distilled water. Left for 10 minutes to develop the color. Take the reading by Spectrophotometer at 882 / 660 nm.

Available Nitrogen in soil

Take 10 grams soil in Kjelhdal tube, add 10 mL Distill water set in kjeldal's plus. It adds 20 ml potassium permagnet (KmnO4) and sodium hydroxide (NaOH). Take 20ML boric acid (automatic) which have been added mixed indicator, run the Kjheldalh plus unit. Boric acid gradually turns green due to the release of NH3 from Kjeldal's tube. Titrate it against 0.02N normality H2So4 solution. Take the reading and calculate. (%N)

Test of micronutrients in soil

Take one gram soil in 150 ml conical flask, add 20ml DTPA (diethylene triamine Penta acetic acid). Shake above solution for two hours in mechanical shaker, filtered through Whatman filter paper no 01. Take the reading by AAS.

Critical limit.

Fe =4.5 ppm, Mn=3.5 ppm, Cu=0.2 ppm Zn=0.6 ppm.

Available potassium

Take 5-gram soil in 100 ml conical flask. Add 25ml of 1N Ammonium Acetate. CH3COONH 4. Shake for 5 minutes in mechanical Shaker, filter through Whatman filter paper number one. Take reading by Flame Photometer.

Results and Discussion

The pH of samples taken away from enterprises ranged between 7.69 and 8.00, while the pH of soils close to industries ranged between 7.95 and 8.30, according to the data evaluated for the chemical characteristics (Tables 1 and 2). It suggests that the soils were alkaline to neutral. The soil samples' electrical conductivity values ranged from 0.228 to 1.90 dSm-1 for soils far from industry and from 1.20 to 2.90 dSm-1 for soils close to industries. Samples taken close to industries had higher EC and pH values than samples taken farther away. This could be because of the accumulation of salt in the soil brought on by the use of wastewater (industrial effluents).

The amount of organic carbon was found to be higher in soil samples taken close to industry than in those taken farther away. This could be because industrial effluents are applied to the soil close to the industries, increasing the soil's organic content. Similar findings were made by Sahare et al. (2014), who discovered that soil that receives industrial effluents had higher pH, EC, and OC than soil that is not getting industrial effluents or is located far from industry. These three land use soils' varying calcium carbonate contents could be caused by pedogenic factors or variations in the amounts of Ca2+ and CO32- in the irrigation water that was applied to the various plots of land.

Soil nutrient status in nearby areas and away from industrial sites Samples for the accessible macronutrients N, P, K, and S status of soils close to and far from companies are shown in Tables 4 and 3, respectively. The results showed that soils close to industries had higher concentrations of N, P, K, and S than soils farther away. Increased levels of N, P, K, and S in soils close to businesses could be the result of these nutrients building up in the soil from wastewater application. Numerous researchers found that applying wastewater, sewage sludge, etc., improved soil fertility (Chakrabarti, 1995; Manicas et al., 1998).

Increases in organic matter under industrial land use may also be the cause of increases in N, P, K, and S. This is most likely caused by the wastewater's high organic matter content. According to other researchers, applying wastewater irrigation increased N, P, and K levels by approximately 4, 10, and 8 times, respectively, over the suggested fertilizer rates for fodder crops (Burns et al., 1985). Similar findings were made by Rajput et al. (2017), who discovered that soils irrigated by industrial effluent had greater levels of total N, P, K, and S, showing that industrial wastewater significantly increased these elements.

Comparison of the nutritional condition of the soils near and far from industry Figure 1 shows the average amount of N, P, K, and S in soil that is close to and far from businesses. It was discovered that soils close to industries had higher concentrations of these nutrients than soils furthest from them. This could be the result of greater organic matter under industrial land use or the application of industrial effluents (Rajput et al., 2017).

Table.1 Properties of soil away from industries

	pH	EC	OC	CaCO3
Site 1	7.69	0.278	0.58	2.15
Site 2	7.58	0.210	1.28	2.05
Site 3	7.60	1.91	0.90	0.02
Site 4	6.20	0.52	0.89	0.00
Site 5	7.75	1.09	1.60	2.45

Table.2 Properties of soil near industries

	pH	EC	OC	CaCO3
Site 1	8.60	1.81	0.75	2.20
Site 2	7.98	1.54	1.50	2.05
Site 3	8.00	2.50	1.25	0.02
Site 4	8.20	1.75	0.90	0.00
Site 5	7.95	2.45	1.90	2.65

Table.3 Properties of soil away from industries

	N	P	K	S
Site 1	114.2	14.02	40.05	27.25
Site 2	240.05	17.02	32.25	18.24
Site 3	170.52	12.75	30.03	25.50
Site 4	213.52	16.00	35.85	32.12
Site 5	190.45	17.02	29.45	14.25

Table.4 Properties of soil near industries

	N	P	K	S
Site 1	190.4	17.02	45.2	30.0
Site 2	270.07	18.02	35.2	20.23
Site 3	195.55	14.04	36.32	28.52
Site 4	250.45	18.05	40.45	34.17
Site 5	210.54	18.45	32.43	17.27

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