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The soil nutrient status of Shirpur taluka of Dhule district, Maharashtra

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Abstract

Soil and water are the most important natural resources and all the basic needs of human beings and plants depend on these natural resources. Soil testing is an essential method for evaluating the soil's nutrient-supplying capacity. In the present study, 37 soil samples were collected from different locations of Tajpuri and Hisale villages of Shirpur Taluka, Dhule district. The chemical parameters such as soil pH, EC, organic carbon, available nitrogen, phosphorus and potassium from soil were determined by using standard procedures. The result shows that the pH of all the soil samples from both the villages was reported in the neutral to alkaline range with mean values of both the villages Hisale and Tajpuri were 7.47 and EC were in normal range with mean values of 0.27 dSm^{-1} and 0.25 dSm^{-1} and fit for crop production. The organic carbon content in both villages found in the medium range with the mean of Hisale and Tajpuri villages were 0.59 % and 0.60 %. In Hisale village the available nitrogen and a greater number of samples were in low range, available phosphorus and potassium in medium range. Concern to Tajpuri village most of the samples of available nitrogen, phosphorus and potassium were in medium range.

Keywords

nutrient; nitrogen; organic carbon; phosphorus and potassium

Introduction

Healthy soil functions as a dynamic living system that provides numerous ecosystem services, including supporting water quality, enhancing plant productivity, regulating nutrient recycling and decomposition and mitigating greenhouse gases by removing them from the atmosphere (1). India plants about 142 million hectare of which about 67 million hectare are problematic and nutrient deficient. Soil analysis provides nutrient availability index for judicious crop planning. Soil-test based nutrient management maximizes farm profitability and reduces environmental pollution. Major nutrients in soil like nitrogen, phosphorus and potassium have a pilot role in crop growth and production. Understanding the nutrient status of farms will enable farmers and land managers to optimize crop yield through efficient fertilizer management. The nutrient content of soil is influenced by various factors such as parent material, climate and land management practices. For instance, nutrient availability depends upon the weathering of parent material, decomposition of organic matter and microbial activity. Assessing and monitoring soil nutrient status is crucial for sustainable agricultural practices. It helps identify nutrient deficiencies, prevent over-fertilization and mitigate environmental impacts, thereby promoting balanced nutrient management for long-term soil health and productivity. This study aims to analyze the nutrient status of soil in specific regions to provide a framework for sustainable agricultural recommendations.

Materials and Methods

The Shirpur tehsil study area spans 1,106 square kilometres and is located between 19 ^{0}2' to 22 ^{0}3' North latitude and 74 ^{0}10' to 75 ^{0}11' East longitude. Situated in the Khandesh region of Maharashtra, Shirpur is the northernmost tehsil of Dhule district, bordering Madhya Pradesh to the north. The tehsil lies within the Tapi basin, with the Tapi River flowing westward through its southern part. The river is joined by tributaries from the north, including the Aner, Arunawati, Kordiand Nandi rivers, depositing alluvial soil along its banks. The climate of Shirpur tehsil is predominantly dry, except during the southwest monsoon season. It falls within the assured rainfall zone, receiving 700 to 900 mm of rainfall annually, with 75 % of the total precipitation occurring during the monsoon, which supports Kharif crop cultivation.

The surface soil samples (0-22.5 cm depth) were collected from 37 locations in two villages (Fig. 1). 19 soil samples from Hisale village and 18 samples from Tajpuri village of Shirpur taluka were collected based on soil variation and the exact sample location was recorded using a GPS. Soil samples were analyzed by using standard procedures. Soil pH and Electrical conductivity were determined in 1:2.5 suspension using a standard pH meter and EC meter by potentiometry and conductometry (2) respectively. Soil organic carbon was analysed by using the wet oxidation method (3). Soil available N was determined by the modified alkaline permanganate method (4), available P by 0.5M $NaHCO_3$ method (5) and available K by flame photometer (1N NH_4OAc pH 7) method (1).

Results

Status of soil pH and EC

The soil pH range of selected samples from Hisale village ranges from 6.50 to 8.45 with a mean value 7.47 and Tajpuri village ranges from 6.40 to 8.50 with a mean value 7.47 (Table 1). Most of the samples from both the villages were found in between neutral to slightly alkaline range. The pH value is affected by various factors such as parent material, climatic conditions, type of fertilizer used and management practices during crop production. The EC of various soil samples of both the villages were ranged from 0.10 to 0.75 dS m^{-1} with averages 0.27 dS m^{-1} in Hisale and 0.25 dS m^{-1} in Tajpuri village (Table 1).

Status of organic carbon and available NPK

The organic carbon ranges from 0.27 % to 0.88 % in both the villages with mean of Hisale and Tajpuri villages were 0.59 and 0.60 respectively (Table 2). The organic carbon most of the samples were found in medium range in both the villages (Fig. 2 and 3). The available nitrogen of Shirpur taluka was varied from 125 to 439 kg ha^{-1} with averages of 245 and 303 kg ha^{-1} in Hisale and Tajpuri villages, respectively. In Hisale village the available nitrogen status as 68 % of samples are in low and 32 % in medium category and in Tajpuri village the available nitrogen status are 39 % samples are in low, 61 % medium, 0 % are in high category (Fig. 1 and 2). The range of available phosphorus 26.88 to 69.44 kg ha^{-1} with average 47.91 kg ha^{-1} and 33.60 to 67.20 kg ha^{-1} with average 51.02 kg ha^{-1} in the villages of Hisale and Tajpuri respectively (Table 2). Out of 19 samples, 5 % in low, 79 % medium, 16 % high samples were found in Hisale village and 0 % in low, 67 % medium and 33 % high samples were found in Tajpuri village. Concerning potassium, most of the samples were found in the medium range (32 % low, 68 % medium, 0 % high in Hisale village and 6 % low, 83 % medium, 11 % high in Tajpuri village).

Table 1. The status of pH and EC in the soils of Hisale and Tajpuri village of Shirpur taluka

Village name	Parameter	Range	Mean
Hisale	pH (1:2.5)	6.50 - 8.45	7.97
	EC (ds m^{-1})	0.10 - 0.75	0.27
Tajpuri	pH	6.40 - 8.50	7.86
	EC (ds m^{-1})	0.11 - 0.49	0.25

Table 2. The status organic carbon, available Nitrogen, available P_2O_5 and available K_2O in the soils of Hisale and Tajpuri village of Shirpur taluka

Village name	Parameter	Range	Mean
Hisale	Organic carbon (%)	0.27-0.88	0.60
	Available Nitrogen (kg ha^{-1})	125-376	245
	Available P_2O_5 (kg ha^{-1})	26.88-69.44	47.91
	Available K_2O (kg ha^{-1})	96.32-239.68	157.98
Tajpuri	Organic carbon (%)	0.42-0.78	0.60
	Available Nitrogen (kg ha^{-1})	125-439	303
	Available P_2O_5 (kg ha^{-1})	33.60-67.20	51.02
	Available K_2O (kg ha^{-1})	123.20-338.24	230.10

Fig. 1. Map of Hisale and Tajpuri villages.

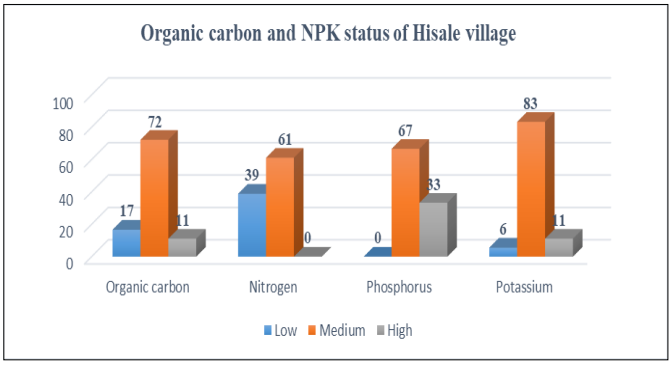

Fig. 2. Organic carbon and NPK status of Hisale village of Shirpur taluka.

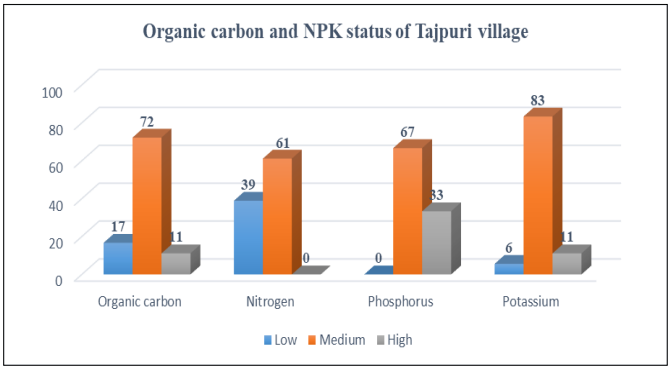

Fig. 3. Organic carbon and NPK status of Hisale village of Shirpur taluka.

Discussion

The pH of both the villages was found neutral to alkaline range. Generally, soils were alkaline in nature might be due to medium black soil with well-irrigated conditions and pH less than 8 because of soils were light in texture. Similar result was reported in soils of Parola tehsil of Jalgaon District (6) and (7) in soils of Sindkheda tehsil of Dhule district. Concern to EC all 100 % samples were in non-saline range and fit for crop production. This may be due to the basaltic type of parent material with a high content of basic cations. Similar observations were found in previous works (8), from Andhra Pradesh (9), Gujarat (10) and in Maharashtra (11) black soil regions. The organic carbon in most of the samples was low to medium range. This might be due to the rapid decomposition of organic matter as attributed to high temperatures during the summer season of Shirpur tehsil. Similar findings were reported in early findings(12, 13). In available nitrogen, most of the samples from both villages fall under the low to medium category. This might be due to the semi-arid climate of Shirpur taluka with high temperatures which favour faster decomposition of organic matter and decline of organic matter, resulting in low to medium status of available nitrogen. Similar results were found in soils of Guntur District of Andhra Pradesh (7, 14, 15) . The higher number of samples of available phosphorus from both the villages were found in the medium category. This might be due to the soil of both the villages being alkaline in nature and the high pH of the soil the calcium precipitate with phosphorus as Ca-phosphate and reduce phosphorus availability in soil. (9, 16, 17) were found similar results. The medium to high level of available potassium content in the soil can be attributed to the dissolution and diffusion of potassium from the internal crystal lattice of silicate clay minerals, particularly in soils with a high clay content, notably montmorillonite clay minerals (18). The similar result was also explained in early works of available potassium (8, 19, 20, 21).

Conclusion

The pH is neutral to slightly alkaline and EC are safe for all the selected samples, so no need to add any amendments. The overall status of organic carbon, available nitrogen, phosphorus and potassium in Hisale and Tajpuri villages of Dhule district were low to medium category. Thus, the need to increase the recommended dose of fertilizer by 25 %, the site where the soil samples were reported to have a low level of nutrient status. Along with chemical fertilizer, adequate organic fertilizers such as FYM, compost and vermicompost need to be added for improvement of nutrient status as well as organic matter status of soils for sustainable crop production.

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Authors' contributions

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Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

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