Soil Fertility Status Using Nutrient Index Approach

Dr. Anubhuti Hitesh Ghoadake
Research Student Shivaji University Kolhapur

Abstract

A detailed soil survey was undertaken in all tehsils in Kolhapur district of Maharashtra with the aim of evaluating the fertility status of soils using nutrient index method. A total of 9426 surface samples were collected analyzed for pH, electrical conductivity, organic carbon, available nitrogen, P2O5 and K2O and available micronutrients (Zn, Mn, Fe & Cu) using standard analytical methods. Based of fertility ratings, pH of soils was acidic to alkaline. Electrical conductivity was normal (<1.0 dS/m). Soil organic carbon was very low to very high, with more than 70% of study area falling in the high category. Exchangeable water class contents were C1S1 to C4S4. Available macronutrient status (N, P, and K) were very low to very high. The availability of micronutrients was highly variable. Zinc (Zn) was deficient to medium, iron (Fe) was deficient, while manganese (Mn) and copper (Cu) were low to high. Based on the nutrient guides, the study that the pH is low to medium, electrical conductivity is high, nitrogen is low to medium, phosphorus is medium to high and potassium is high. Soil reaction, available N, K, P, Zn & Fe were observed as the most important soil fertility constraints that could affect sustainable crop production in the study area. The situation therefore demands the adoption of appropriate management practices in order to improvement the fertility status. These practices may include such practices as site specific nutrient management, increased use of organic nutrient sources, sustainable land use and cropping structures, and appropriate agronomic practices.

Key words: *Nutrient index, fertility status and quality macronutrients, micronutrients*

Introduction

Soil is a natural mix of organic matter and weathered rock that forms on the Earth's surface. It is the basis or foundation for all crop production. It is biologically active and capable and home to a large range of living organisms including earthworms, soil microbes, and growing plant roots. Present chapter deals with the study of fertilizer recommendation as an important part of agricultural technology. Macronutrient and micronutrient are important for plant growth. The present study analyzed the spatial variation in utilization of NPK nutrients and to examine the relationship between fertilizer use and type of soil and pH and EC. Beside these and attempt has also been made here to examine the distribution of salinity and alkalinity in Kolhapur district.

Soil is composed of minerals, air, water, and organic matter that are important for healthy plant growth. The ability of soil to provide essential nutrients is called fertility. (John Lamb, Sheri Huerd, Kristine Moncada, 2000)

The term fertility is used differently in different context as there is no absolute scale of fertility. Soil fertility is the capabilities of soil of producing a plant yield under define conditions. (De,1981).Whereas the capability to plant yield more or less depend on nutrient content availability and accessibility in the soil inviting the study of nutrient content in the soil along with other consideration. Apart from the physical support and moisture a boost of element like Nitrogen, Phosphorus, Potassium, Sulfur, Calcium, Iron, Magnesium, Boron, Manganese, Copper, Zinc and Molybdenum are taken by plants as nutrients from soil. But important element described as "Big Three" are Nitrogen, Phosphorus, Potassium (NPK) Iron, Manganese, Copper and Zinc. Usually soil fertility is evaluated by determining these big three element (Penchalaiah, 1993).

Soil organic matter is promoted by crop residue, diverse rotations, conservation tillage and cover crops. Organic matter is beneficial to agricultural land or soils because it enhances water infiltration, fertility and microbial activity, soil water holding capacity. Farming techniques that preserve and improve organic matter content promote long-term soil fertility and produce healthy crops. (Dr J Floor Anthoni (2000)

In recent year's development of lift irrigation, co-operative societies have accelerated the place of agriculture production. There by directly affecting the quality of soil in Panchaganga Basin. In particular excess use of irrigation and over doses of chemical fertilizers has directly affected the soil quality. (Patil, 1987).The fertility status of soil is largely related to the nutrient availability in the soil which varies from place to place. An attempt is made hence forward to focus an attention on the spatial pattern of NPK content in the soil.

Objective-

To assess soil fertility status and soil quality in Kolhapur district

Study Region

The Kolhapur district is one of the southernmost districts of Maharashtra state. The district's courtiers a total area of 7,685 sq. kms. It lies between 16° 0' 0"N to 17° 0' 0" North latitude and 74° 0' 0" to 75° 0'0" East longitude. The length of the district south to north is 160 Kms. and east to west is 60 Kms. The Sahyadri ranges to the west and Warna river to the north, the river Krishna and Belgaum district to the south and east, forms the natural boundaries of the district. The region receives average rainfall 1900 mm.

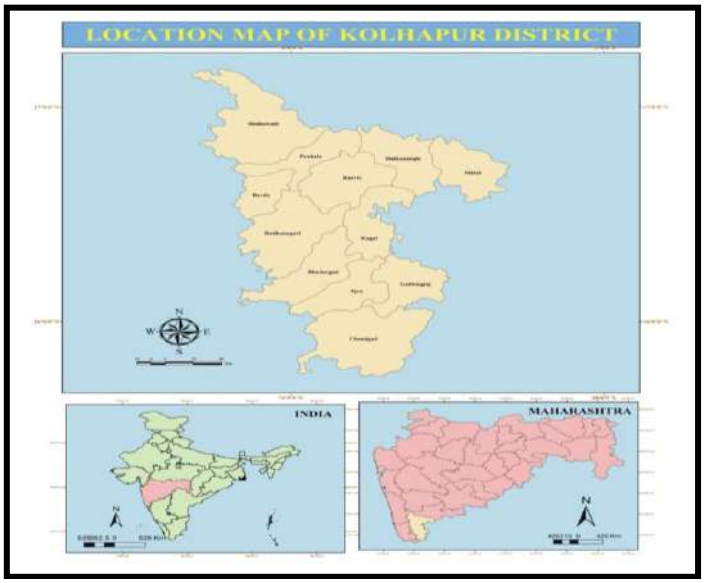

Fig. 1

Methodology

The study is based on data collected from primary and secondary sources. To evaluate the fertility status of soils in the study area, different soil physico-chemical properties that affect nutrient availability including pH, electrical conductivity, available N, P, K and S and available micronutrients (Zn, Mn, Fe and Cu) were calculated based on the specific rating chart (Table 1).

In order to compare the levels of soil fertility of one area with those of another it was necessary to obtain a single value for each nutrient. Here the nutrient index introduced by Parker et al. (1951). **Parker's nutrient index** is a six tier system used to evaluate the fertility status of soils based on the percentage of samples in each of the six classes, that is, very low, low, medium, medium high, high and very high and multiplied by 0.50, 1.00, 1.50, 2.00,2.50, and 3.00 respectively. The sum of the figures thus obtained is divided by 100 to give the index or weighted average as given in the equation below:

Nutrient Index = {(0.50 X A) + (1.00 X B) + (1.50 X C)(2.00X D)(2.50X E)(3.00X F)}/ TNS

Where A = Number of samples in very low category; B = Number of samples in low category; C = Number of samples in medium category, D= Number of samples in medium high category; E=Number of samples in high category; F= Number of samples in very high category; TNS = Total number of samples. The nutrient index with respect to soil pH, organic carbon, available N, P and K were used to evaluate the fertility status of soils in the Kolhapur district. The rating chart is given in Table 2.

Table 1.
Rating chart for soil test values and their nutrient indices.

Soil property	Unit	Range		
Soil pH	pH unit	< 4.5 (extremely Acidic)	6.6 – 7.5 (Neutral)	>9.0 (extremely Alkaline)
Electrical conductivity	dS/m	<1.0 (Normal)	1.0-2.0 (Critical)	>2.0 (Injurious)
Organic Carbon	%	<0.5 (Low)	0.5-0.75(Medium)	>0.75 (High)
Available Nitrogen	kg/ha	<280 (Low)	280-560 (Medium)	>560 (High)
(N)				

Available Phosphorus (P2O5)	kg/ha	<10 (Low)	10-25 (Medium)	>25 (High)
Available Potassium (K2O)	kg/ha	<110 (Low)	110-280 (Medium)	>280 (High)
Available Zinc (Zn)	ppm	<0.6 (Low)	0.6-1.0 (Medium)	>1.0 (High)
Available Manganese (Mn)	ppm	<2.0 (Low)	2-3 (Medium)	>3.0 (High)
Available Iron (Fe)	ppm	<0.2 (Low)	0.2-0.6 (Medium)	>0.6 (High)
Available Copper (Cu)	ppm	<4.5 (Low)	4.5-5.5 (Medium)	>5.5 (High)

Source-District Soil Survey and Soil Testing Laboratory, Kolhapur.

Table 2.
Nutrient index with range and levels.

Sr.no	Fertility index range	level
A	0.50- 0.75	Very low
B	0.76- 1.25	Low
C	1.26- 1.75	Medium
D	1.76- 2.25	Medium high
E	2.26- 2.75	High
F	2.75-3.00	Very high

Source-District Soil Survey and Soil Testing Laboratory, Kolhapur.

Table 3
Soil Fertility Status Samples Analyzed during the Period (2013-2014)

MICRO-NUTRIENT	VL	L	M	MH	H	VH	TOTAL
A) ORGANIC CARBON	74	560	1326	2027	2046	3393	9426
B)AVAILABLE P205	393	955	1134	997	741	5206	9426
C)AVAILABLE K20	206	512	877	895	1094	5842	9426
	S		NEUTRAL		ALK		TOTAL
D) pH	3009		3627		2790		9426
	NEUTRAL		CTIT		INJU		
E) EC	9404		12		10		TOTAL

Source-District Soil Survey and Soil Testing Laboratory, Kolhapur.

Soil fertility status-

Soil fertility status of 9426 no. of samples analyzed during 2013-14 given below:

I) Organic Carbon:

The data of analysis of 9426 soil samples for soil fertility status of organic carbon reveals that 3393 soil samples are very high organic carbon fertility status in Kolhapur district.

II) P205:

Phosphorus has been called the “Master key to agriculture” because low crop production is attributed mainly to the deficiency of phosphorus, except nitrogen, than the deficiency of other elements (Singh et al., 2016). The data of analysis of 9426 soil samples for soil fertility status of P205 reveals that 5206 soil samples are very high phosphorus fertility status in Kolhapur district.

III) K2O :

The data of analysis of 9426 soil samples for soil fertility status of K20 reveals that 5842 soil samples are very high potassium fertility status in Kolhapur district.

pH:

The pH and alkalinity are important factors influences factors the suitability of water for irrigation purpose. The water samples of the study area having pH range between 6.62 to 8.23, indicating its suitability for irrigation purpose Soil pH describes the concentration of hydrogen ions (H+) in a soil. The pH scale runs from 0 to 14. A pH of 7 is neutral, less than 7 is acidic, and greater than 7 are alkaline or basic. (District Soil Survey and Soil Testing Laboratory). Soil pH is critical because plants vary in the required pH range for best growth and yields. Most important field crops grow best at a pH of 6–7. Additionally, pH influences the availability of nutrients to plants. pH affects

the growth of beneficial soil organisms that facilitate biological nitrogen fixation with legumes and of microbes mineralizing nitrogen from organic matter.

The data of analysis of 9426 soil samples for soil reaction (pH) reveals that 38.47 % soils are neutral in reaction whereas 29.59 % and 31.92 % soils are alkaline and acidic in reaction respectively Kolhapur district.

EC :

The most significant water quality guideline on crop productivity is the water salinity hazard as measured by electrical conductivity (Johnson and Zhang, 1990). The electrical conductivity (EC) is the measure of the soluble salts present in the soil and is affected by cropping sequence, irrigation, land use and application of fertilizers, manure, and compost (Singh et al., 2016). The data of analysis of 9426 soil samples for Electrical Conductivity (EC) reveals that, 99.76 % soils are neutral in reaction i.e. suitable for all crops whereas 0.10 % soils are injurious for crops in Kolhapur district.

Conclusion

Soil fertility refers to the original capacity of the soil to supply nutrients in sufficient amounts and in suitable proportions for crop yield and crop growth. The trend in increasing the crop productivity or crop yield by adopting high yielding varieties has resulted in deficiency or lack of nutrients in land and has reflected as deficiency symptoms in plants growth. Hence, it is required to know the fertility (NPK) status of the soils of the district for applying the necessary dosage of fertilisers and preparation the regional distribution of fertilisers. For this purpose, the soil samples collected from all over the district were analysed for pH, Ec., organic carbon, available phosphorus and potassium in study region. The available NPK index status presented show that about 2.33 %, 2.19 % and 2.54 % of the soils in the district fall under the high category in Kolhapur district.

A pH value is ranging from 6.5 to 7.5 are considered to be normal soil. A pH value neutral is best for most plants. About 38.48% of the soils are in normal category in study area. The high percentage of this soil is observed in the circle of Gaganbavada, Karvir and Panhala. In general soil with pH value is ranging from 7.5 to 9.0 are considered to be slightly alkaline soil. About 29.60 % of the soil is in alkaline soil category in study area. In general soil with pH value is ranging from less than 4.5 to 6.5 are considered to be acidic soil. About 31.92 % of the soil is in acidic soil category in study area. The high percentages of this category of soil are observed in the circle of Panhala, Gadhinglaj, Gaganbavada, Chandgad, Radhanagari, Shahuwadi and Ajra. To study of soil fertility and quality as a significant part of health and growth of plant. With its soil fertility index characteristic and distribution samples of its impact on crop productivity and soil improvement.

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