Nutrient status of soil and Farm Yard Manure (FYM) under different agro-climatic regions of Maharashtra

Abstract:

Aim: To gain maximum crop production from a unit area, soil health is one of the major components. It is determined based on the nutritional availability and other parameters like pH, EC, organic carbon, etc. the reports on soil nutrients help farmers in fertilizer application to optimize the yields. The values of these parameters vary from region, soil type, agro-climatic zones, crop, etc. to maintain soil fertility application of organic source of fertilizer such as, FYM plays an important role. It is not only a good source of nutrients but also increases water-holding capacity, soil organic matter, soil physical properties, etc. The study was conducted with an objective to assess nutrient status of soil and FYM from various agro-climatic regions of Maharashtra.

Methodology: Maharashtra state is divided into nine different agro-climatic regions. The study was conducted to understand the region-wise variability in the nutritional composition of both soil and FYM in Maharashtra during the year 2020-21. Samples of soils and dried FYM were collected from farmer's fields from five agro-climatic regions of Maharashtra i.e., Western Maharashtra, Northern Maharashtra, Marathwada, Vidharbha, and Konkan. The samples were analyzed for various parameters at Chemical analytical laboratory, BAIF Central Research Station, Urulikanchan.

Results: The analysis reports of soil samples revealed that soils of the Western Maharashtra region showed maximum values for N, Fe, Mn, Cu, and Zn whereas, soil samples from the Vidharbha region were having high values for P and K content as compared to other regions. The soil samples from the Konkan region showed low nutrients availability than other regions. The soil pH of different agro-climatic regions ranged from 6.3 to 9.0. Similarly, FYM samples of the Western Maharashtra region showed maximum values for N, P, K, Fe, Mn, and Zn content whereas samples of the Marathwada region were comparatively low in all nutrients and organic carbon content. PCA biplot of macro and micro elements of soil and FYM nutrients revealed geographical/spatial structuring based on nutrient content.

Keywords: Nutrient Status, Soil, Farm Yard Manure, Agro-climatic region

Introduction:

Soil is important in crop production as it is the main source of nutrients for the crop. Meeting the demand for food of the ever-increasing human population worldwide and achieving the target of certain stage use of maximum inputs through fertilizers, pesticides, fungicides, insecticides, nematicides, and herbicides were adopted (Kumar *et al*, 2022). Due to the use of chemicals influence the life of beneficial soil microorganisms responsible for maintaining soil health. Soil analysis indicates the availability of soil nutrients which helps in determining the supplementation of nutrients efficiently and economic crop production.

Farmyard manure (FYM), is the organic source of nutrient supply and is applied to soil as usual practice. It has long been considered a desirable soil amendment, and its effect on soil properties is numerous (Shaharan *et al*., 2023). The quality of FYM varies from region to region and the source of livestock dung, as dung is the major component of FYM. Farmyard manures are the major source of nutrient supply also on small farm holdings (Fageria, 2012). The available reports indicated that the organic carbon content of the soil increased over its initial value with the period of incubation irrespective of soil types and the addition of FYM. The increase in organic carbon may be due to decomposition of organic matter and the fine root stubbles which were left in the soil (Antil *et al*., 2011). In this context, the study was conducted to assess the soil and FYM nutrient status of different agro-climatic regions of Maharashtra.

Material and Method:

A. Sample collection:

Explorations were made to the farmer's field and collected 78 samples of soil and 64 samples of FYM were from different districts located in five agro-climatic regions of Maharashtra (Table1).

Table 1: Details of region wise sample collection

Agro-climatic region	Number of soil samples	Number of FYM samples
Western Maharashtra	25	22
Vidarbha	10	10
Northern Maharashtra	16	15
Konkan	16	6
Marathwada	11	11

The climatic and edaphic characteristics of the study area has been showed in supplementary table1. The region-wise districts covered were Western Maharashtra: Pune, Satara, Sangali,

and Kolhapur Northern Maharashtra: Dhule and Nandurbar, Vidarbha: Yawatmal and Wardha Marathwada: Osmanabad, Beed and Latur Konkan: Jawhar and Palghar (Fig.1)

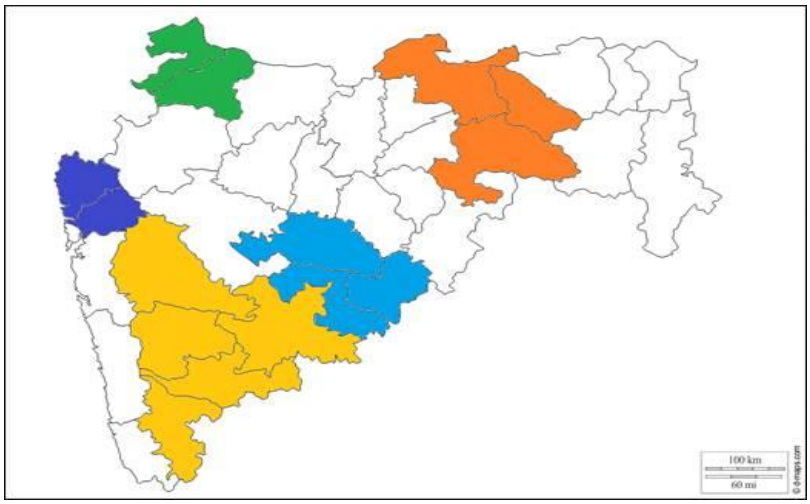

Fig. 1 District wise sample collection in Maharashtra state

Procedure for soil samples:

The soil sampling from the farmer's field was done as per the standard process which is diagrammatically presented in Fig 2. The samples were taken upto 15-20cm depth by adopting pit method of sample collection.

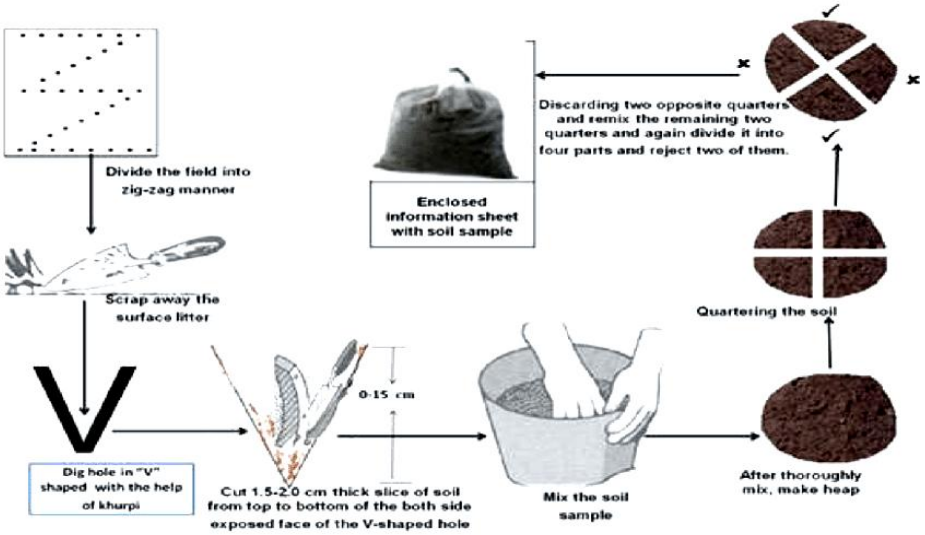

Fig. 2 Procedure for the sample collection from field

B. Analysis of samples in the laboratory:

Collected bulk samples of soil and FYM were analysed for different parameters in the BAIF's NABL accreted chemical analytical laboratory by adopting standard procedures and methods given by the ministry of agriculture Govt. of India -2011 (e.g. estimation of nitrogen by Kjeldahl method, Phosphorus by Olsen's method, Potassium by Flame photometric method, etc.)

C. Data analysis:

The analytical data for soil and FYM samples were partitioned using past 4.11 software. Principal component Analysis (PCA) was drawn scatter plot based on given values.

Results and discussion:

1. Soil Macronutrients:

The values for N, P, and K in different regions were shown in fig.3. The differences in the values were observed region-wise and within the region also. The availability of soil nitrogen was higher in the Western Maharashtra region which was close to the Northern Maharashtra region samples. The average value for nitrogen content was 130.92 kg/ha and 130.82 kg/ha in western Maharashtra and Northern Maharashtra regions respectively. Ghodake *et al., (*2016) also reported that the nitrogen content in the soil of western Maharashtra ranged between 95-328 kg/ha. Soils of the Vidharbha region were higher in Phosphorus and Potassium content as compared to other regions. The Phosphorus content varies from 21 to 42 kg/ha with an average of 27.6 kg/ha and the Potash content varies from 202 to 250kg/ha with an average mean value of 239.6 kg/ha. The soil samples from Konkan and Marathwada regions showed lower nutrient availability than other regions which was 123.81, 27.75, 190.31 kg/ha in the Konkan and 125.50, 20.60, 182.50 kg/ha in Marathwada for nitrogen, phosphorus, and potassium respectively. Chaudhari *et al.,* (2017) also reported that the soil of the Beed district was lower in phosphorus. Hadole *et al., (*2019) also showed similar results that, soils of the

Palghar district of the Konkan region was found to vary from 86.66 to 298.56 Kg ha^{-1} with a mean value of 178.40 Kg ha^{-1}.PCA biplot drawn for soil macronutrients (Fig.4) showed two main groups and also region wised separation. The vectors for NPK demonstrated the influence of individual nutrients on its distribution across the selected regions. The regions containing districts of Ahmednagar, Palghar, Osmanabad and Latur showed relatively lower soil nutrient levels and others. In the biplot, the main influence was found to be Potash. Based on the Phosphorus and Nitrogen content of the soil the regions found to bifurcate.

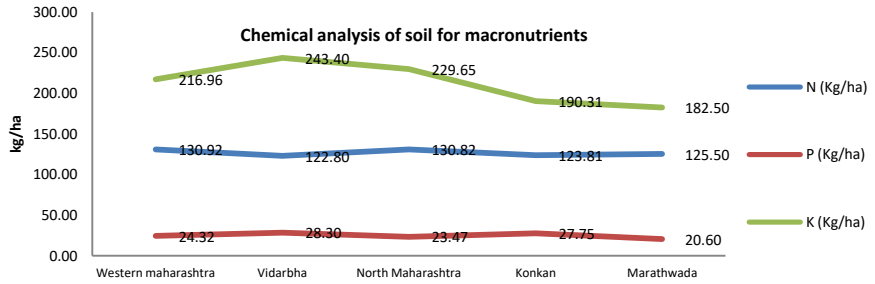

Fig. 3 Chemical analysis of different soil sample for soil for macronutrient

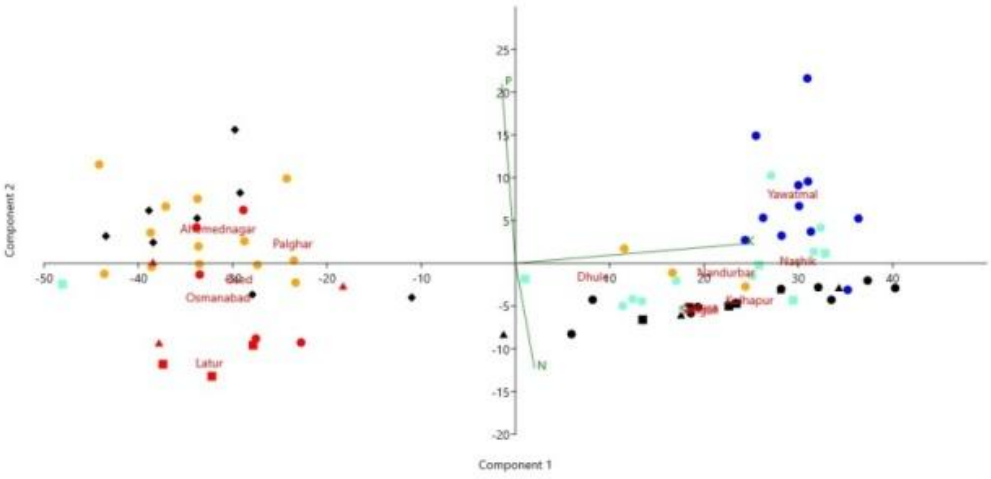

Fig. 4 PCA for soil macronutrients and region wise distribution

Soil Micronutrients: The results of the micronutrient analysis of the study were shown in Fig. 5. It is revealed that region-to-region variability for micronutrients availability in soil was observed. Among the micronutrients soil of Western Maharashtra showed Fe deficiency. Indian soils are extensively deficient in micronutrients and 5.4% soils of in India recorded Cu deficiency (Shukla *et al*., 2014). All the collected soil samples from different regions of Maharashtra were analyzed for micronutrients such as Fe, Cu, Zn, and Mn. Among the agro-

climatic regions soils in the Western Maharashtra region were higher in micronutrient content. The maximum average values for Fe, Cu, and Zn with 3.55, 2.5, and 2.1 ppm respectively were found in the Western Maharashtra region which was followed by the Konkan region with 1.5, 1.7, and 1.9 ppm respectively. Mahale *et al.*, (2019) also stated that the available Fe in the soil ranged from 2.40 to 13.86 mg kg^{-1} with a mean value of 8.36 mg kg^{-1}, Mn ranged from 4.96 to 9.83 mg kg^{-1} with a mean value of 6.99 mg $kg^{-1}$and Zn ranged from 0.43 to 1.78 mg kg^{-1} with a mean value of 1.23 mg kg^{-1}in Konkan region of Maharashtra. Similar findings were also reported by Borkar *et al.*, (2018). The results of the soil sample analysis of pH, EC, and OC have presented in Fig.6.

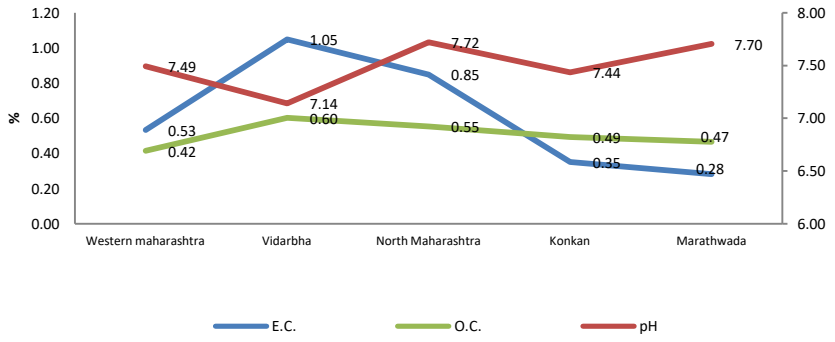

Fig. 5 Chemical analysis of Soil for micronutrients

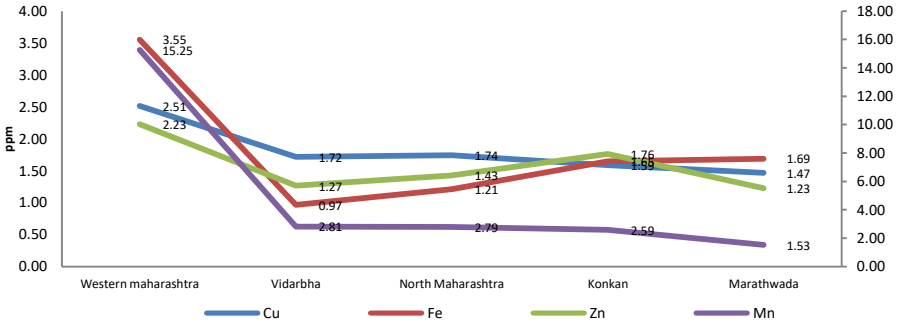

Fig. 6 Chemical analysis of Soil for other parameter

The soil pH of different agro-climatic regions ranged between 6.3 to 9.1. The low pH of 6.3 and the highest pH of 9.1 was observed in the Western Maharashtra region. Sathe *et al.*, (2018) reported that some parts of the Sangli district in western Maharashtra is having lower soil pH value of 6.58. Pawar and Sangale (2019) also stated that the soils were high in pH ranging between 7.16 to 9.56 in some parts Shrirampur block of the Ahmednagar district. The

organic carbon content ranged from 0.20 to 0.70% with a mean value of 0.50%. This variation may be due to different soil types, cropping patterns, and the use of organic manures in soil. The soils from Vidharbha regions were rich in organic carbon content which was 0.57% to 0.66% with a mean value of 0.60% which was followed by North Maharashtra, Konkan, Marathwada, and western Maharashtra regions having an organic carbon content of 0.55%, 0.49%, 0.47%, and 0.40% respectively. The organic carbon of different soil series of Western Maharashtra ranged from 0.15 to 1.42 percent with an average value of 0.54 percent (Ghodke *et al.* ,2016. (Fig.7)

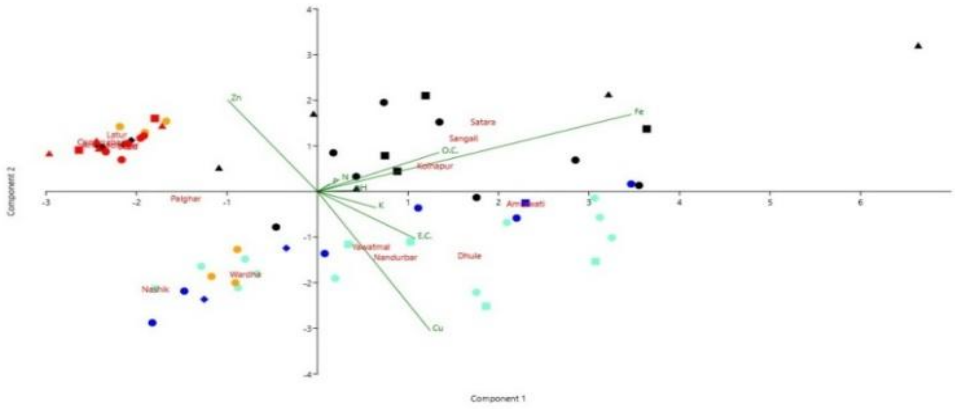

Fig.7 PCA for soil micronutrients

FYM sample analysis: All FYM samples collected from different agro-climatic regions of Maharashtra were analyzed for macro & micronutrients, and other parameters. The results were given in Table 2. Among the various agro-climatic regions, the FYM samples collected from Western Maharashtra were having high values for N, P, K, and Fe content. While the FYM samples collected from the Marathwada region were comparatively lower in macro and micronutrient content except for Zn which was found maximum. The organic carbon content ranged from 18.93 to 20.61 percent in five agro-climatic regions. Lower organic carbon content was found in Konkan regions samples with a value of 18.93% followed by Marathwada, North Maharashtra, Vidharbha, and Western Maharashtra regions with values of 19.03, 19.68, 20.17 and 20.61 percent respectively. Nutrient variation in manures is affected by variations in ratio, composition, and utilization of animal work. Moreover collection, storage, and processing of animal waste and the addition of organic material. Snijders Paul *et al*., (2009).

Table 2: Chemical analysis of FYM for Macro, micro, and other parameters

Agro-climatic Regions	Nutrient content								
	N (%)	P (%)	K (%)	Cu (ppm)	Fe (ppm)	Zn (ppm)	E.C.	pH	O.C. (%)
Western Maharashtra	1.27	0.50	2.27	2.14	5.58	2.17	1.59	8.02	20.61
Vidharbha	1.11	0.33	2.19	3.69	4.58	1.09	2.08	7.44	20.17
North Maharashtra	0.98	0.34	2.24	4.24	5.15	1.11	1.96	7.96	19.68
Konkan	0.94	0.33	1.71	2.32	3.80	2.44	0.86	7.42	18.93
Marathwada	0.93	0.25	1.37	1.50	3.65	3.03	0.52	7.70	19.03

PCA biplot (fig.8) showing differences concerning region-wise nutrient content of FYM. FYM samples from Kolhapur, Sangali, and Satara districts of Western Maharashtra contains higher Fe and OC whereas, Dhule and Nandurbar districts of Northern Maharashtra and Yawatmal from Vidharbha region contain a higher amount of Cu and EC. Samples of FYM from Nashik and Wardha districts were showing lower nutrient content. The rest of the district was rich in Zn content.

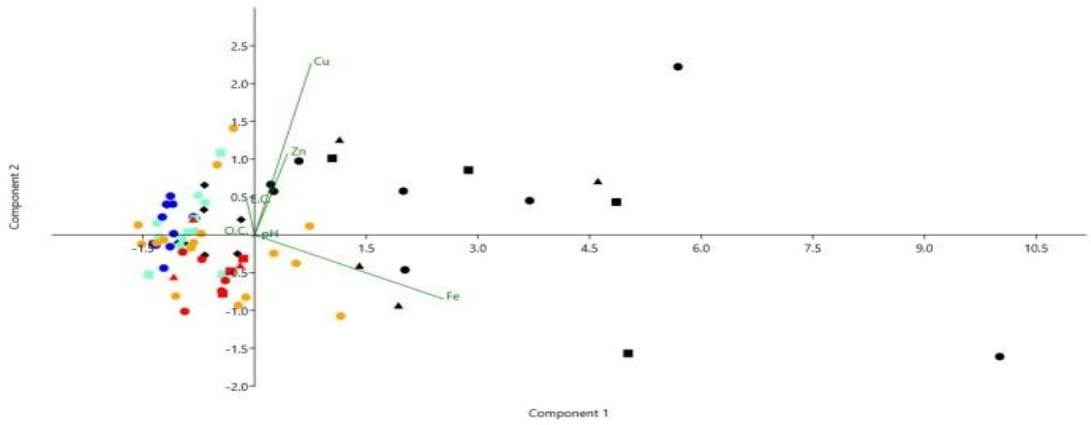

Fig.8 PCA for Macro and Micro nutrient content of FYM

Conclusion:

Soil and FYM samples were analyzed for nutrient content from various regions of Maharashtra. Western Maharashtra and Vidarbha regions contain higher macro and micronutrients compared to other regions. FYM samples from Western Maharashtra and Vidarbha regions are higher in NPK content whereas micronutrients were maximum in Western Maharashtra, Vidarbha regions, and northern Maharashtra regions.

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