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Soil Fertility Status of Agriculture College Farm, Nandurbar (Maharashtra)

H. B. Shinde, T. D. Patil and Ritu Thakare*

Department of Soil Science and Agricultural Chemistry, College of Agriculture (Mahatma Phule Agriculture University), Dhule - 424 004 (M.S.) India

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Abstract: The present study was conducted during the year 2015-2016 at Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dhule with aim to know the fertility status of soils of Agriculture College Farm, Nandurbar. The soils were collected and analyzed as per standard procedure for assessing chemical properties and available nutrient status. The pH of soil varied from 6.80 to 7.90, while, EC varied from 0.08 to 0.89 dSm^{-1}. The organic carbon and calcium carbonate content in soil were varied from 3.7 to 9.9 g kg-1 and 0.5 to 12.50 per cent, respectively. The available nitrogen, phosphorus and potassium ranged from 125 to 238, 7.49 to 32.42 and 336 to 459 kg ha^{-1}, respectively. Soils of Agriculture College farm, Nandurbar were very low to low in available nitrogen, low to high in available phosphorus and very high in available potassium. The exchangeable calcium and magnesium and available sulphur were ranged from 20.30 to 32.60, 11.40 to 18.20 cmol (p^{+}) kg-1 and 11.48 to 27.59 mg kg^{-1}, respectively. The 100 per cent soils were sufficient in exchangeable calcium, magnesium and in available sulphur.

Keywords: Macronutrients, soil fertility, GPS-GIS technique.

INTRODUCTION

Soil is a vital resource, can be termed as 'Soul of infinite life'. The essence of life in the soil is its crop producing capacity i.e. the soil productivity largely depends on soil fertility, management practices and climate. These agricultural practices can be managed. The climate is natural factor which influences the soil fertility. Therefore, soil fertility is the major component of productivity which primarily deals with nutrient supplying capacity of the soil to the plant. Therefore, it has been always considered to carry out genetic study as well as to find out fertility evaluation for making best use of the soil for crop production. Systematic study of morphology and taxonomy of soils provides information on nature and type of soil, their constraints, potential, capabilities and their suitability for various uses[1]. According to the Vishwanath[2] the incidence of micronutrient deficiencies in various crops of the Khandesh region has increased markedly in recent years and opinioned that it might be due to continuous and intensive multiple cropping, use of high yielding cultivars which may have higher micronutrient demand, enhanced production of crops on marginal soils that contain low levels of essential nutrients, increased use of high analysis fertilizers with low amount of micronutrient contamination, decreased use of organic manures *viz*; animal manures, composts and crop residues, use of soils that are inherently low in micronutrient reserves and involvement of natural and anthropogenic factors that limit adequate plant nutrient availability and create element imbalances. Soil fertility maps are meant for highlighting the nutrient needs, based on fertility status of soils to realize good crop yields. Obviously, a soil fertility map for a particular area can prove highly beneficial in guiding the farmers, manufactures and planners in ascertaining the requirement of various fertilizers in a season/ year and making projections for increased requirement based on cropping pattern and intensity. Therefore, the present investigation was undertaken to assess the soil fertility status of farm which might be useful for conducting the research trials.

MATERIALS AND METHODS

The College farm is located in $21^0$23" North, 74^0 19‴ East Longitude. The total geographical area of College farm is 40 ha. College farm is situated at Nandurbar district in Khandesh region of northern Maharashtra.Agro-climatically, Nandurbar comes under scarcity zone and is situated at an elevation of 810 m above mean sea level. The average annual rainfall of the place is 597 mm. Total 155 surface soil samples (22.5 cm) from cultivable area of College farm were collected using Global Positioning System (GPS) and Geographical Information System (GIS) at grid of 25 m. The collected soil samples were processed and analyzed for their nutrient status by standard analytical methods at Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dhule.

Soil reaction was determined in 1:2.5 suspension using standard pH meter by potentiometry[3]. The electrical conductivity was determined by 1:2.5 suspension using EC meter by Conductometry[3]. Soil organic carbon was estimated using wet oxidation method[4] and $CaCO_3$ is determined by acid neutralization method by Alison and Moodie[5]. The available nitrogen was estimated by modified alkaline permanganate method[6], available phosphorus was estimated by 0.5M $NaHCO_3$ pH 8.5 method[7], available potassium was estimated by Flame Photometer (Neutral Normal NH_4OAc pH 7.0) by Jackson[3]. The exchangeable cations (Ca and Mg) were estimated by versenate titration[8] and Available Sulphur was estimated by 0.15% $CaCl_2$ extractable method[9] . The soil chemical properties data were statistically analyzed by using standard statistical methods given by Panse and Sukhatme[10].

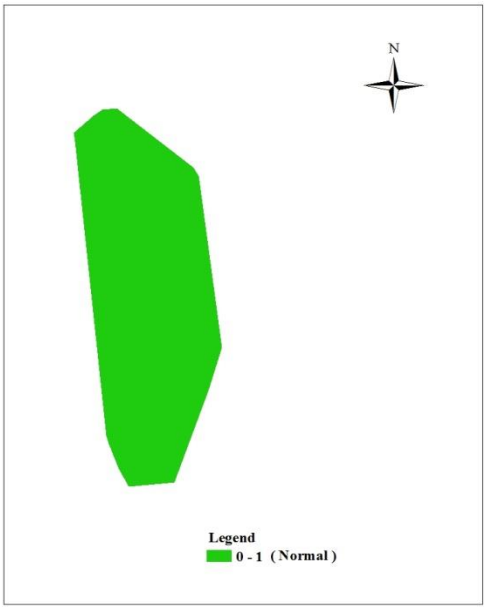
RESULTS AND DISCUSSION

The results presented in (Table 1 and Fig. 1) revealed that the pH of the Agriculture College Farm, Nandurbar ranges from 6.80 to 7.90. The mean of pH was 7.38. The data indicate of that soils were slightly acidic to slightly alkaline in respect of soil reaction which appeared to be influence of parent material, rainfall and topography. The similar natures of observations for soil pH were also recorded by Mahashabde and Patel[11] in soils of Shirpur Tehsil of Dhule District. The EC of soil samples were ranged from 0.08 to 0.89 dSm^{-1}, with an average mean was 0.28 dSm^{-1}. It was observed that all 155 soils (100%) were non-saline in nature. The normal values of EC are recorded for upstream and topographically higher areas can be attributed to the rolling topography relatively higher gradient, seasonal irrigation and alternating cropping pattern. The similar results were reported by Golhar and Chaudhari[12] at Chalisgaon Tehsil of Jalgaon District, Maharashtra. The organic carbon content ranged from 3.70 to 9.90 g $kg^{-1}$with the mean of 6.83 g kg^{-1}. The similar nature of observations were recorded for organic carbon by Chaudhari and Kadu[13] in soils of Dhule Tehsil of Dhule District. The calcium carbonates in soil samples were ranged from 0.5 to 12.5 per cent with an average of 5.02 per cent. The soils were low to high in organic carbon content and very low to very high in calcium carbonate content. The similar nature of observation for $CaCO_3$ in soils by Golhar and Chaudhari[12] at Chalisgaon Tehsil of Jalgaon District, Maharashtra.

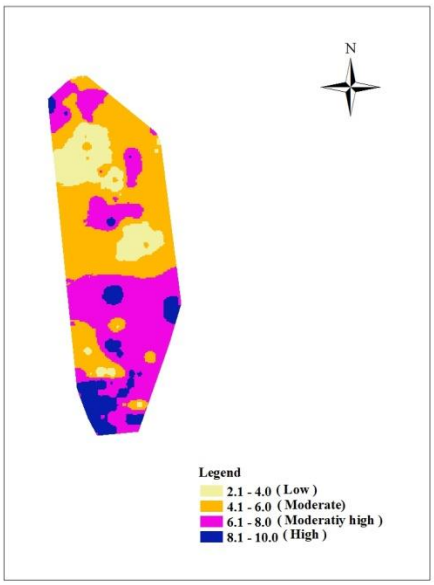
Table 1: Soil pH, EC, Organic Carbon and CaCO3 status of Agriculture College Farm, Nandurbar

Particulars	pH	EC (dSm^{-1})	Organic Carbon (g kg^{-1})	$CaCO_3$(%)
Mean	7.38	0.28	6.83	5.022
Range	6.80-7.90	0.08-0.89	3.70-9.90	0.50-12.5
SE ±	0.03	0.01	0.09	0.19

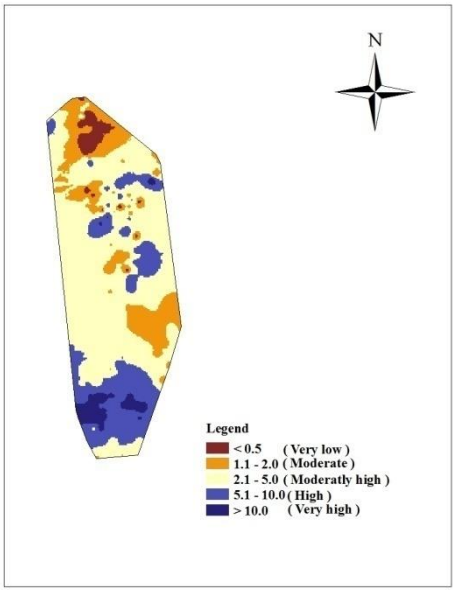
(a).Soil pH



(b). Soil Electrical Conductivity (dsm^{-1})



(c).Soil Organic Carbon (g kg^{-1})



(d). Soil Calcium Carbonate (%)

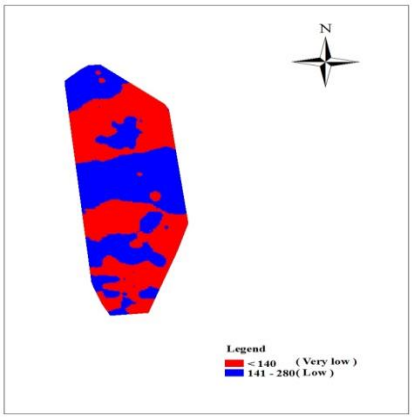
Fig. 1: Soil pH, EC, organic C and calcium carbonate status of Agriculture College Farm, Nandurbar (M.S.)

The data presented in (Table 2 and Fig. 2) revealed that the available nitrogen contents in soils varied from 125 to 238 kg ha^{-1} with an average of 163.98 kg ha^{-1}. The soils were very low to low content in case of nitrogen, the low available nitrogen in most of the soils might be due to the higher temperature in semiarid climate of Nandurbar district, which declined the organic matter status by faster degradation resulted in low status of available nitrogen. This might be due to increased rate of denitrification at lower values. The similar results were recorded by Singh and Rathore[14] in soils of Aravalli mountain ranges and Malwa plateau of Pratapgarh, Rajasthan.

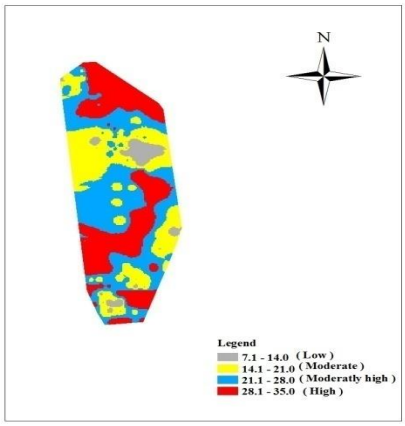
The available phosphorus in soils were ranged from 7.49 to 32.42 kg ha^{-1} with a mean value of 21.38 kg ha^{-1}. The soils were low to high content in available phosphorus. Low to high status of available P in soils of studied area might be due to alkaline soil reaction and high content of $CaCO_3$ in the soil. The range is quite large which might be due to variation in soil properties viz. pH, calcareousness, organic matter content, texture and various management and agronomic practices. The similar trend of available phosphorus were also reported by Ratna kumari *et al.*[15] in soils Guntur District of Andhra Pradesh. The available potassium in soils was ranged from 336 to 459 kg ha^{-1} with an average of 397.41 kg ha^{-1}. The soils were very high in available potassium. The high content of available K in the soil could be attributed due to the dissolution and diffusion of K from internal crystal lattice of silicate clay minerals under the condition of high clay content especially of montmorillonitic clay minerals present in soil[16].

Table 2: Soil Available macro nutrient status of Agriculture College Farm, Nandurbar

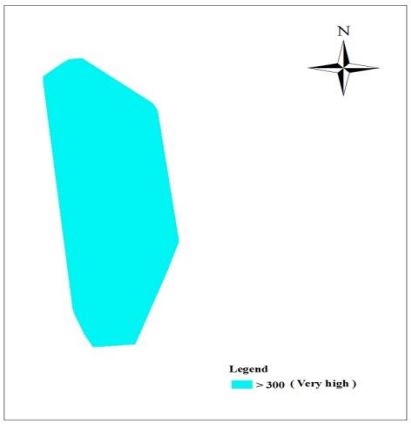
Particulars	Soil available macro nutrients					
	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Ca [cmol(p+)kg^{-1}]	Mg [cmol(p+)kg^{-1}]	S (mg kg^{-1})
Mean	163.98	21.38	397.41	27.15	13.77	20.19
Range	125-238	7.49-32.42	336-459	20.30-32.60	11.40-18.20	11.48-27.59
Critical limit	-	-	-	20	10	10
Sufficient	-	-	-	155 (100)	155 (100)	155 (100)
Deficient	-	-	-	0 (0.00)	0 (0.00)	0 (0.00)
SE ±	2.56	0.27	5.35	0.31	0.30	0.64



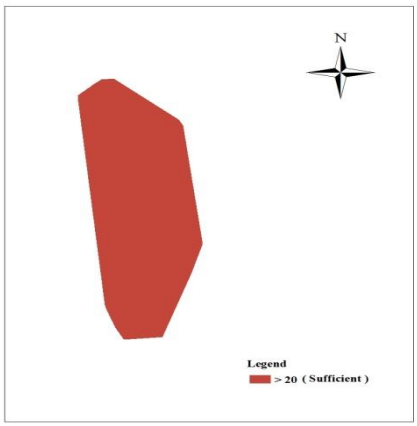
(a).Soil Available Nitrogen (kg ha^{-1})



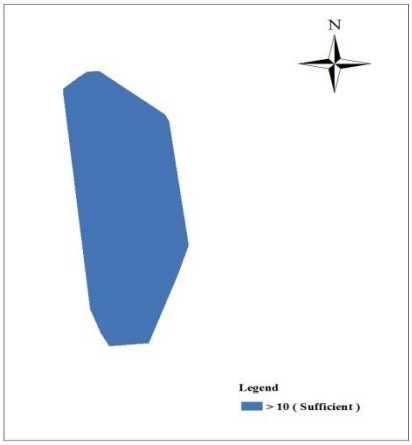
(b). Soil Available Phosphorus (kg ha^{-1})



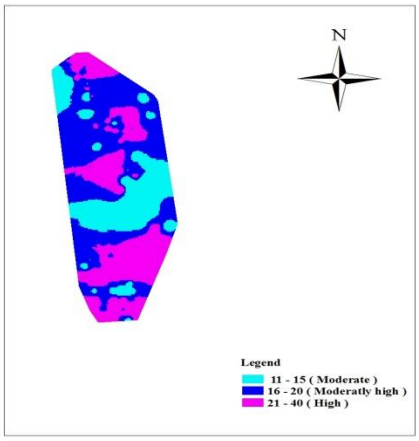
(c).Soil Available Potassium (kg ha^{-1})



(d). Soil Exchangeable Calcium [cmole (p^{+}) kg^{-1}]



(e). Soil Exchangeable Magnesium [cmole (p^+) kg^{-1}]



(e). Soil Available Sulphur (mg kg^{-1})

Fig. 2: Soil Available macro nutrients status of Agriculture College Farm, Nandurbar (M.S.)

The exchangeable calcium in soils ranged from 20.30 to 32.60 cmol (p^+) kg^{-1} with an average of 27.15 cmol (p^+) kg^{-1}. Out of total soil samples all 155 (100 %) samples are sufficient in exchangeable calcium, as the critical limit of available calcium is 20 cmol (p+) kg^{-1}. The higher amount of exchangeable Ca content found in soils under study may be due to high clay content and calcareous nature. The sufficiency of exchangeable Ca is due to no leaching of bases and moderate to high organic carbon values. The similar trend were also recorded by Nayak *et al.*[17] in swell and shrink soils of Vertisol order in Vidarbha region. The exchangeable magnesium in soils were ranged from 11.40 to 18.20 cmol (p+) kg^{-1} with an average of 13.77 cmol (p+) kg^{-1}. All the soil samples (100%) were in sufficient category, as the critical limit of exchangeable magnesium is 10 cmol (p+) kg^{1}. The sufficiency range of Mg may be due to its genesis in the semiarid area. Less leaching because of low precipitation, moderate to high organic carbon and calcareousness of soil responsible for availability of magnesium in soil. This type of soil having high CEC. The similar results were observed in swell-shrink orange cropped soils of Nagpur District by Nayak *et al.*[17] . The available sulphur in soils ranged from 11.48 to 27.59 mg $kg^{-1}$with an average of 20.19 mg kg^{-1}. Out of the total soil samples, 100 per cent was sufficient for available sulphur. This might be due to moderate to high content of organic carbon and fine texture of soils. The moderate soils which are too high in available S may be because of accumulation of SO_4^- in surface layer. At high pH and calcareousness, sulphur availability is greater in the soil and at low OC available sulphur content is low. The similar results were found by Jat and Yadav[18] in soils of Entisols of Jaipur District, Rajasthan.

CONCLUSION

The soils collected from Agriculture College Farm, Nandurbar were slightly acidic to slightly alkaline in reaction and normal in electrical conductivity. The soils were low to high in organic carbon and very low to very high in calcium carbonate. The soils were very low (21.94 %) to Low (78.06 %) in available nitrogen, low (3.87 %), moderate (48.39 %) moderately high (40.00 %) to high (7.74 %) in available phosphorus and very high (100.0 %) in available potassium. The soils of Agriculture College Farm, Nandurbar were sufficient in available calcium, magnesium and available sulphur. Holistic survey and precise use of

analytical techniques in this investigation have enabled the investigator to come out with soil fertility maps of the Agriculture College Farm, Nandurbar. The use of GPS-GIS based technique for soil sampling is new land mark, which will enable the further researchers and University Officials to monitor the changes in soil fertility status for years to come. The soil fertility maps of Agriculture College Farm, Nandurbar will be of great utility for monitoring the fertilization schedule on sound scientific footing for improving the crop yields of Agriculture College Farm, Nandurbar. Moreover, the timely monitoring of soil health deterioration can also be maintained by following appropriate soil reclamation techniques.

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Corresponding author: Ritu Thakare*

Department of Soil Science and Agricultural Chemistry, College of Agriculture (Mahatma Phule Agriculture University),Dhule - 424 004 (M.S.) India