International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 14, Issue 9, 2022, pp.-11703-11705.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Research Article

PHOSPHORUS STATUS OF SOILS UNDER DIFFERENT LAND USE SYSTEMS IN NANDURBAR DISTRICT

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Received: June 06, 2022; Revised: September 26, 2022; Accepted: September 27, 2022; Published: September 30, 2022

Abstract: Agriculture, horticulture, forest and pasture land use systems were selected being the most predominant in Nandurbar district of Maharashtra State. Two sampling sites were selected under each land use system at different locations of Nandurbar district. The soil samples were collected at a vertical interval of 20 cm from surface to the bedrock. The available phosphorus in the soils under different land use systems varied from 10.04 to 16.96 kgha^{-1}, indicating that the soils were low to medium in available phosphorus content. The lowest value of 10.04 kgha^{-1} available phosphorus was observed at 80-100 cm depth under horticulture land use system and the highest value of 16.96 kgha^{-1} soil was noticed at 0-20 cm under pasture land use system. All land use systems showed a regular decreasing trend with depth. The amount of available phosphorus at the surface layers was large, and it decreases when depth increases. The increased phosphorus in surface soils was attributed to increased organic carbon, which was further substantiated by a positive relationship between available phosphorus and organic carbon.

Keywords: *Phosphorus, Organic carbon, Land use systems*

Citation: Mohammad Sajid and Sanketkumar Kasetiya (2022) Phosphorus Status of Soils Under Different Land Use Systems in Nandurbar District. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 14, Issue 9, pp.- 11703-11705.

Academic Editor / Reviewer: Er Prabhat Kumar Dhara, Sankar, Sabita Mishra

Introduction

Macronutrients are essential for plant growth as they play major roles in biological processes. These nutrients are the building block of all proteins, including the enzymes, which control the biological processes. A sufficient supply of macronutrients promotes the plant's root growth and development. Uptake of other nutrients is also influenced by the application of macronutrients. Soil macronutrients are important for improving crop growth. Out of sixteen plant nutrients, N, P, K and S are referred as macronutrients as they are required in many physiological processes of the plant.

Phosphorus has a great role in energy storage and transfer. It is closely related to cell division and development. The supply of phosphorus improves the quality of certain fruit, forage, vegetable and grain crops and increase the disease resistance of crops. It enhances the activity of rhizobium and increases the formation of root nodules and thereby helps in fixing more of atmospheric nitrogen in root nodules. The phosphorus deficient plants are dark green, but the lower leaves may turn yellow and dry up. Growth is stunted and leaves become smaller [1-6]. Organic matter acts as a major factor regulating the availability of organic forms of nitrogen, phosphorus, sulphur and trace elements in soils. Organic carbon is an indication of organic fractions in soils formed from the microbial decomposition of organic residues. Organic matter content is often a good expression of natural fertility of the soils as it provides nitrogen, phosphorus, sulphur and other trace elements in soils [7-12].

Material and Methods

The present investigation was undertaken to characterize, classify and evaluate the soils in different land use systems of Nandurbar district Nandurbar has a total geographical area of about 5,955 km^2 (2,299 sqm^2) and comprises of 6 tehsils. (Shahada, Nandurbar, Navapur, Taloda, Akkalkuwa and Dhadgaon). Nandurbar is located at 21.37°N 74.25°E. Two sites under each land use system (Agriculture, Horticulture, Forest and Pasture) at different locations of Nandubar district were selected and two soil sample form each land use system were drawn for laboratory analysis.

In all eight soil sampling sites were studied from the study area. With the assistance of the Global Positioning System (GPS), the exact location of different sampling sites were Agriculture site 1 (21°26'42" N 74°16'34" E), Agriculture site 2 (21°28'7.50" N 74°13'57.6" E), Horticulture site 1 (21°28'03" N 74°14'39" E), Horticulture site 2 (21°28'12" N 74°13'53" E), Forest site 1 (21°37'44.9" N 74°0'56.1" E), Forest site 2 (21°33'44" N 74°13'31" E), Pasture site 1 (21°34'33.1" N 74°09'58.2" E) and Pasture site 2 (21°33'19.4" N 74°01'55.4" E).

Soil the soil pH, electrical conductivity (EC), organic carbon content of the soils and available macronutrients were analysed by following standard procedures.

Results and Discussion

Soil reaction (pH)

The pH of soils under different land use systems varied from 6.63 to 7.86 indicating slightly acidic to slightly alkaline in reaction and pH of soil increased with soil depth. Highest soil pH was recorded at 80-100 cm depth under the horticulture land use system and lowest pH was noticed in 0-20 cm depth under the forest land use system and 20-40 cm depth under agriculture land use system. Increasing trend of pH with depth in these soils might be due to the release of organic acids during decomposition of organic matter and these acids might have brought down the pH in the surface soils. Increasing trend of pH with depth of soils due to accumulation of exchangeable bases and/ or $CaCO_3$ content. Similar results are reported by Naik (2014) [13] and Wani *et al*., (2017) [14].

Electrical conductivity

The electrical conductivity of soil water extract in the different land use systems were varied from 0.11 to 0.32 dSm^{-1} and indicating that soil was non saline and did not show any significant trend with increase in depth of soil. The lowest value 0.11 dSm-1 was registered at 20-40 cm depth under forest land use system and 0-20 cm depth under pasture land use system, whereas, the highest value 0.32 dSm-1 was recorded at 20-40 cm depth under horticulture land use system. Similar results were reported by Ramprasad *et al.,* (2013) [15].

Table-1 *Phosphorus status of soil under different land use systems*

Land use system	Depth(cm)	pH(1:2.5)	EC(1:2.5)	OC(%)	Avil. P ($kgha^{-1}$)
Agriculture 1	0-20	7.22	0.18	0.60	14.96
	20-40	7.51	0.18	0.54	13.01
	40-60	7.57	0.19	0.47	12.71
	60-80	7.51	0.23	0.42	12.32
	80-100	7.63	0.24	0.43	11.16
Agriculture 2	0-20	7.11	0.12	0.62	14.63
	20-40	6.63	0.19	0.59	12.77
	40-60	7.23	0.21	0.47	12.63
	60-80	7.31	0.24	0.43	12.46
	80-100	7.42	0.27	0.43	10.93
Horticulture 1	0-20	7.58	0.19	0.59	13.71
	20-40	7.61	0.18	0.55	13.53
	40-60	7.68	0.17	0.47	12.63
	60-80	7.76	0.19	0.41	11.65
	80-100	7.80	0.21	0.42	10.04
Horticulture 2	0-20	7.05	0.14	0.61	14.13
	20-40	7.52	0.32	0.58	13.73
	40-60	7.62	0.19	0.52	12.43
	60-80	7.73	0.20	0.47	11.26
	80-100	7.86	0.30	0.46	11.19
Forest 1	0-20	6.90	0.16	0.76	16.26
	20-40	7.00	0.18	0.59	15.83
	40-60	7.34	0.19	0.42	15.23
	60-80	7.43	0.20	0.46	13.39
	80-100	7.35	0.22	0.43	12.64
Forest 2	0-20	6.63	0.25	0.73	16.63
	20-40	6.72	0.11	0.65	16.12
	40-60	6.91	0.26	0.46	14.88
	60-80	7.21	0.21	0.44	13.56
	80-100	7.37	0.23	0.43	12.23
Pasture 1	0-20	6.77	0.11	0.66	16.96
	20-40	7.41	0.14	0.50	13.71
	40-60	7.49	0.18	0.46	12.36
	60-80	7.53	0.15	0.39	11.39
Pasture 2	0-20	6.81	0.13	0.60	15.87
	20-40	7.30	0.17	0.54	12.91
	40-60	7.36	0.20	0.43	12.17
	60-80	7.46	0.16	0.36	10.77

The electrical conductivity showed an erratic trend with an increase in soil depth however significantly higher electrical conductivity was recorded in sub-surface soils. Results was in accordance with the findings of Tuba and Kaleem (2016) [16].

Organic carbon

The organic carbon content in different land use systems varied from 0.36 to 0.76 per cent and categories as low to moderately high. The lowest value 0.36 percent are observed at 60-80 cm under pasture land use system while the highest value 0.76 percent was recorded at 0-20 cm under forest land use system. All land use systems showed a decreasing trend in organic carbon with depth, which may be due to the addition of plant residues and farm yard manure to surface horizons which resulted in higher organic carbon content in surface horizons than in the lower horizons. This observation was in accordance with results of Basavaraju *et al*., (2005) [17] in soils of Chandragiri mandal in Chittoor district of Andhra Pradesh. Similar results are reported by Kirmani *et al*., (2013) [18] and Wani *et al*., (2016) [19].

Available Phosphorus

The available phosphorus in the soils under different land use systems varied from 10.04 to 16.96 $kgha^{-1}$, indicating that the soils were low to medium in available phosphorus content. The lowest value of 10.04 $kgha^{-1}$ available phosphorus was observed at 80-100 cm depth under horticulture land use system and the highest value of 16.96 kgha-1 soil was noticed at 0-20 cm under pasture land use system. All land use systems showed a regular decreasing trend with depth.

The amount of available phosphorus at the surface layers was large, and it decreases when depth increases. The increased phosphorus in surface soils was attributed to increased organic carbon, which was further substantiated by a positive relationship between available phosphorus and organic carbon. The other reason for higher phosphorus in surface horizons might possibly be due to the confinement of crop cultivation to the rhizosphere and supplementing the depleted phosphorus by external sources *i.e*., fertilizers and presence of smaller amounts of free iron oxide and exchangeable $Al3+$ in surface soils [20]. The lower phosphorus content in sub-surface soil might be attributed to the fixation of released phosphorus by clay minerals and oxides of iron and aluminium. Similar results were reported by Singh *et al.,* (2013) [21] and Khanday (2017) [22].

Conclusion

The study of soils of the different land use systems (Agriculture, Horticulture, Forest land and Pasture land) of Nandurbar district revealed that the soils are slightly acidic to slightly alkaline in reaction, non-saline and medium to moderately high in organic carbon. Low in available N, low to medium in available P, high in available K and available S ranges from medium to high.

Application of research: All the available macronutrients (N, P, K and S) decreases as the depth increases in all land use systems.

Research Category: Soil Science and Agricultural Chemistry

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Research project name or number: MSc Thesis

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Nandurbar District

Cultivar / Variety / Breed name: Nil

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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