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Studies on Depth Wise Distribution of Available Nutrients of Soil under Different Land Use Planning of Kanpur Nagar (U. P.), India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An investigation was carried out during 2021-22 at various land use planning of Kanpur Nagar (U.P.) to evaluate the availability of nutrients effect of various land use planning on soil. The 504 representative soil samples with 3 depths viz. 0-15, 15-30, and 30-60 cm soil samples were taken with manually driven post hole auger and processed for soil analysis from different land use planning of Kanpur Nagar. Available nitrogen, phosphorus, potassium, Sulphur, micro nutrients (Fe, Cu, Mn and Zn) and notable available Nitrogen in different lands low in ranged from 112.4 – 199.3 kg ha^{-1}. The Phosphorus availability was found in ranged from 8.40 - 19.90 kg ha^{-1}, while Potassium was found in ranged from 111.30 - 192.10 kg ha^{-1}. However the availability of Sulphur, was found in ranged from 7.40 - 23.80 mg kg^{-1} and the availability of micro nutrients like - available Iron ranged from 4.34- 16.9 mg kg^{-1}, available Manganese ranged from 1.10- 10.9 mg kg^{-1}, available Copper ranged from 0.47 – 3.76 mg kg^{-1}, and available Zinc ranged from 0.33- 2.54 mg kg^{-1}.

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1. INTRODUCTION

Soil fertility and soil quality are the two important properties which have direct effect on plant nutrition. Soil fertility is a balance of forces that brings forth yield. It mainly involves the assessment of capacity of soil to continuously provide available plant nutrients. The regular assessment of the soil quality is of paramount importance to assess the crop production level for which the soil physical (soil texture, bulk density, total density, porosity, rooting depth, colour, infiltration rate etc.), chemical (pH, EC, SOC, CaCO3, exchangeable cations and anions, ESP, CEC, SAR, available macro and micro nutrients and biological (soil microbial biomass, enzyme activity) properties are determined. Presence of carbonates and bi-carbonates may lead to rise in pH and due to which availability of many plant nutrients like P, Fe, Ca, N, Mg, Cu, Zn is reduced. Irrigation with poor quality water is also a major constraint in these areas. Provision of adequate drainage, removal of sodium ions from soil exchange complex is essential. With increasing population, the cultivable land is decreasing gradually by 1-2%. Therefore, there is a urgent need for reclamation of sodic/alkaline areas with physical, chemical and biological measures. Indian Government is keen to restore 26 m ha of degraded lands by year 2030.

The availability of nutrients in soils plays a pivotal role in the determination of fertility status and sustainable productivity of the soils. Imbalanced fertilization and mismanagement are the root causes of soil health deterioration in the soil [1]. All soils having different properties and working with them requires an understanding of these properties. The knowledge of the physical and chemical properties of soils helps in managing resources while working with a particular soil. They need to be studied for agricultural purposes, to increase productivity, and have to improve the workability of soil mass. The study of the up-to-date status of soil properties is a very important tool to enhance production on a sustainable basis [2]. The proper use of soil is the most vital and precious natural resource that sustains all kinds of the existence of life system and socio-economic development of any country in the world [3]. To achieve soil resource management in agro-ecological regions needs knowledge on morphological, physical, and chemical characteristics and classification is an essential requirement [4].

Soil differs in its morphology, Physico-chemical characteristics, inherent productivity, and fertility and their responses to management practices differ accordingly. Thus, it is imperative to study the soils of a particular area for genesis, classification and to evaluate the soils of a particular area for their sustainable land use [5]. Soil could also be a non-renewable resource but a pivot for agriculture, food security, nutritional security, environmental security, and quality of life. A dynamic system of soil management requires knowledge of all the sciences, bearing on the nature of problems that the soil scientists are called upon to handle and technologies that can be put to use. Soil and society are undoubtedly two inseparable entities on this planet earth. 'Soil scientists move from field to the laboratory to diagnose and develop a technology for solving the soil-related problem and gets back from the laboratory to the field to evaluate his strategy'. It is the secret key that leads to becoming successful (Tripathi, 2009).

2. MATERIALS AND METHODS

Kanpur Nagar is an agrarian district of the middle gangetic plains zone of U.P. It lies between 80°20'00'' East longitude and 26°27' 39''N North latitude with geographical areas of 1605 km^2.The altitude of Kanpur Nagar 126 meter. Initially district was divided into four sub-divisions and 10 blocks for administrative and development purposes. There are 1011 villages in Kanpur Nagar district. The experiment was conducted in two blocks namely Kalyanpur and Chaubepur of Kanpur Nagar Uttar Pradesh. Kanpur Nagar is a major industrial town of Uttar Pradesh, the northern state of India. This town is situated on the south bank of river Ganga, located 80 km west of Lucknow, the state capital. It is also known as the industrial capital of the state.

In the present investigation total 504 soil samples were collected from 2 blocks, and 7 different lands uses system to study the Fertility status of soil. For this purpose 504 soil samples were collected with GPS system from 3 depth viz. 0-15 cm , 15-30 cm, and 30-60 cm of different land use viz., Fallow land, Crop cultivated land (Rice-Wheat), Horticulture based land use, Grass land use, Barren land, Agro- forestry land use, Vegetable land.

3. RESULTS AND DISCUSSION

3.1 Available Primary Nutrients in Different Land Use System

The maximum available nitrogen 199.3 kg ha^{-1} was recorded with the depth of 0-15 cm where the land is Agro forestry and minimum Nitrogen 112.4 kg ha^{-1} was found at with the depth of 30-60 cm where the land is Barren. The maximum available phosphorus 19.90 kg ha^{-1} was recorded under the depth of 0-15 cm and the land is fallow whereas minimum available phosphorus 8.40 kg ha^{-1} was found under the depth of 30 -60 cm where the land is Barren. As far as the Potassium level are concerned the maximum available potassium 192.10 kg ha^{-1} was recorded at the depth of 0-15 cm where the land is Fallow and minimum available potassium 111.30 kg ha^{-1} was found under the depth of 30-60 cm where the land is barren.

The available nitrogen was ranged from 112.4 – 199.3 kg ha^{-1}, available phosphorus ranged from 8.40-19.90 kg ha^{-1} and available potassium ranged from 111.30- 192.10 kg ha^{-1}. Nitrogen, Phosphorus and Potassium decreases with increases depth of soil in all land use system. The increase in nitrogen and phosphorus availability might be due to the high organic matter in surface soil which favored the decomposition and accumulation of organic matter, solubilisation of insoluble phosphorus and also supplementing the depleted phosphorous through external sources which releasing more quantity of nutrients. The higher availability of Nitrogen, phosphorus and potassium in forest land followed fallow land may be because of higher amount of organic matter in agro - forest land due to leaf litters decomposition which ultimately improves the availability of Nitrogen, Phosphorus and Potassium in the soil. Less amount of Nitrogen, Phosphorus and Potassium found in barren land because no tree found in that farm and kankar of calcium carbonate were found in the soil horizon. Sarkar, et al., (2002), Raghubansi et al., [6], Liding et al., [7], Gautam et al., [8] and Dhaliwal et al., [9].

Table 1. Descriptive statistics of various characteristics

Land use system	Soil Depth (cm)	Available Nitrogen (kg/ha)	Available Phosphorous (kg/ha)	Available Potassium (kg/ha)	Available Sulphur (mg kg -1)	Available Iron (mg kg -1)	Available Manganese (mg kg -1)	Available Copper (mg kg -1)	Available Zinc (mg kg-1)
Crop cultivated land	0-15	186.8	18.6	180.9	16.4	15.7	06.8	3.76	2.34
	15-30	155.4	15.8	162.5	14.7	14.6	04.5	3.69	1.96
	30-60	164.6	09.3	154.0	13.8	13.9	01.1	2.53	1.40
	Mean	**168.93**	**14.56**	**165.8**	**14.96**	**14.73**	**4.10**	**3.32**	**1.90**
Horticulture land	0-15	173.9	15.0	183.7	12.8	9.76	7.3	2.65	1.65
	15-30	143.8	13.8	159.8	09.5	7.75	6.7	2.23	1.53
	30-60	138.4	12.4	151.9	07.4	4.34	5.9	1.65	1.35
	Mean	**152.03**	**13.73**	**165.1**	**9.90**	**7.28**	**6.63**	**2.17**	**1.51**
Fallow land	0-15	187.7	19.9	192.1	17.5	16.5	9.0	2.64	2.23
	15-30	159.3	15.2	150.6	13.3	14.3	8.6	2.23	1.64
	30-60	145.1	12.7	140.4	11.1	11.5	7.3	1.54	1.32
	Mean	**164.03**	**15.93**	**161.0**	**13.96**	**14.10**	**8.3**	**2.13**	**1.73**
Grass land	0-15	194.6	17.0	165.8	18.7	16.9	9.8	2.65	1.64
	15-30	166.1	15.21	154.3	14.3	12.6	8.7	1.35	1.35
	30-60	154.8	13.8	145.6	12.8	10.8	7.6	1.65	1.32
	Mean	**171.83**	**15.33**	**155.23**	**15.26**	**13.43**	**8.7**	**1.88**	**1.43**
Agro-forestry land	0-15	199.3	17.9	165.9	13.8	15.7	10.9	1.56	2.54
	15-30	156.7	16.3	154.3	12.4	14.9	8.5	1.35	0.70
	30-60	134.2	12.6	146.2	10.6	13.6	7.1	1.45	0.61
	Mean	**163.53**	**15.6**	**155.46**	**12.26**	**14.73**	**8.83**	**1.45**	**1.28**
Vegetables land	0-15	194.5	16.9	164.6	17.8	13.8	9.0	2.32	0.62
	15-30	165.6	13.3	154.8	13.5	12.4	8.4	1.56	0.48
	30-60	148.6	12.8	146.4	12.3	10.8	7.1	1.35	0.33
	Mean	**169.56**	**14.33**	**155.26**	**14.53**	**12.33**	**8.16**	**1.74**	**0.48**
Barren land	0-15	176.9	17.8	168.4	16.9	14.5	8.5	0.98	1.87
	15-30	167.8	16.5	145.2	12.5	13.4	7.3	0.47	1.33
	30-60	112.0	08.4	111.3	10.4	11.9	6.2	0.76	1.67
	Mean	152.23	14.23	141.86	13.26	13.26	7.33	0.73	1.62
	Total Mean	163.16	14.81	157.10	13.447	12.837	7.435	1.917	1.421
	Standard Deviation	8.099	0.810	8.131	1.872	2.595	1.663	0.789	0.461

3.2 Available Sulphur and Micro Nutrients (Fe, Mn, Cu & Zn) Different Land Use System

The status of soil sampling site for available Sulphur and Micro Nutrients (Fe, Mn, Cu and Zn) status that the maximum available Sulphur 23.80 mg kg^{-1} was recorded with the depth of 0-15 cm and the land is Fallow whereas minimum available Sulphur 7.40 mg kg^{-1} was found at depth 30-60 cm where the land is horticulture. The maximum available Iron 16.90 mg kg^{-1} was recorded with the depth of 0-15 cm where the land is grass based and minimum available Iron 04.34 mg kg^{-1} was found with depth 30-60 cm where the land is horticulture. The maximum available Manganese 10.90 mg kg^{-1} was recorded in the depth of 0-15 cm where the land is agro- forestry and minimum available Manganese 1.10 mg kg^{-1} was found with the depth 30-60 cm where the land is crop. The maximum available Copper 3.76 mg kg^{-1} was recorded in the depth of 0-15 cm where the land is crop (wheat - rice) and minimum available Copper 0.47 mg kg^{-1} was found under the depth of 15-30 cm and the land is barren. The maximum available Zinc 2.54 mg kg^{-1} was recorded with the depth of 0-15 cm where the land is agro - forestry and minimum available Zinc 0.33 mg kg^{-1} was found under the depth of 30-60 cm and the land is vegetables areas [10-12].

The available Sulphur was ranged from 7.40 - 23.80 mg kg^{-1}, available Iron ranged from 4.34-16.9 mg kg^{-1}, available Manganese ranged from 1.10- 10.9 mg kg^{-1}, available Copper ranged from 0.47 – 3.76 mg kg^{-1}, and available Zinc ranged from 0.33- 2.54 mg kg^{-1}. The various plantations of tree species provides the litter fall and turn over root and root exudates which decomposed and accumulate as organic matter, solubilization of insoluble nutrients and also supplementing the depleted nutrients as external sources which released more quantity of nutrients in soil and enhanced the availability of nutrients. More content of available micronutrient in agro-forestry as well as fallow for soils might be due the addition of organic matter with decomposition of leaves and root of trees and solubilization of the nutrients in surface soil. Najar et al., [13] Srivastava et al., [14], Madhu and David [15], Gowthamchand et al. [16] and Barala et al. [17].

4. CONCLUSION

Addition of organic matter, FYM and some chemical fertilizers to maintain soil productivity, fertility and soil health. Barren land need to be reclaimed with Gypsum as per Gypsum Requirement (GR) values and after reclamation, Paddy crop with salt tolerant varieties should be grown with Green manure, addition of FYM and chemical fertilizers as per requirements for better productivity, fertility and soil health. Fallow land need to start crops with leguminous crops. There is need to apply balances doses of nutrients on soil test basis, application of organic manures. On the basis of present investigation it may be concluded that for the maintenance of soil health, availability of nutrients and sustainability of soil may be possible with the adoption of leguminous crops with other crops for their profitability and productivity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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