Original Research Article

Soil Characteristics of Kumbhi Block under Lakhimpur (Kheri) District of Uttar Pradesh, India

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A B S T R A C T

A study was carried out to assess the available nutrient status in soils of Kumbhi block under Lakhimpur (Kheri) district (U.P.). In that context 60 soil samples were collected from the different locations of Kumbhi block. Collected soil samples taken for laboratory analysis and analyzed the physico-chemical properties viz. pH, Electrical conductivity, Bulk density, Particle density, Water holding capacity, Organic carbon and status of available nutrients *viz.* nitrogen, phosphorus, potassium and sulphur. The results shows that soil pH of Kumbhi block found majorly acidic in nature in 43.44% of soils, organic carbon (0.12-0.65) content is low in 65 %. EC, BD, PD, WHC were ranged between 0.11-1.05 dSm^{-1}, 1.20-1.56 Mg m^{-3}, 1.24-2.43 Mg m^{-3}, 24.00-77.66% respectively. Status of available nutrients viz. Nitrogen, Phosphorus, Potassium and Sulphur were ranged between 123.25-484.07 kg ha^{-1}, 12-33 kg ha^{-1}, 235-384 kg ha^{-1} and 10.5-30.9 kg ha^{-1} respectively.

Introduction

Soil fertility management will ultimately consider all aspects of soil – plant relationship and pollution of the environment as well. Soil fertility may be defined as the soil system's nutrient supplying capacity. It helps in adopting appropriate measures for overcoming various limitations and at the same time ensures optimum crop production. Soil micro nutrients are an essential as primary and secondary nutrients for the development of crop growth. The addition of micro nutrients to fertilizers in the optimum amounts and in degraded soils ensures the

sustainability of cropping through balanced nutrition and ultimately sustainable development of the fertilizer industry. Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Goovaerts, 1998). However, major constraints impede wide scale adoption of soil testing in most developing countries. In India, these include the prevalence of small holding systems of farming as well as lack of

infrastructural facilities for extensive soil testing (Sen *et al.,* 2008). The variability in fertility caused by application of fertilizers in individual farms is one factor that is difficult to account. However, it is possible to measure the natural variation in soil fertility by considering the factors which influence it. Slope, topography, relief and soil types can account for most of the natural variation in fertility. It will be of great significance if soil test crop response based recommendation can be provided even on this basis. More site specific recommendations can still be provided on the basis of field soil testing to farmers who are applying very high doses of fertilizer and who show interest on testing their soils. The soil testing results indicate nothing about the potential of soil to produce or amount of nutrients to be added to achieve a desired yield (Melsted and Peck, 1977).Our aim of optimizing the utilization of land resources with intensification of agriculture resulted either in the fast depletion of nutrients or occasionally in their accumulation. It is therefore important to monitor the fertility status of soil from time to time with a view to monitor the soil health. The intensively cultivated soil is usually deficient in macro and micronutrients. This study was carried out to find out nutrient status of area and the fertility constraints which hinder the growth of crops. Soil samples were collected and analyzed for various physicochemical properties of studied area were developed according to the nutrient availability in soils of Kumhi block of Lakhimpur District (U.P.).

Materials and Methods

Gola Gokaran Nath tehsil is one of the sixth tehsils of Lakhimpur District, U.P, India. It is located in northern area of the district 40 Km towards eastern from District headquarters Lakhimpurkheri. The study area comes under semi-arid to arid type of climate and Agro-climate Zone's Irrigated north - western plain of U.P. generally experiences arid to semi-arid climate, having average rainfall of 1275.3 mm with erratic pattern of distribution, mostly concentrated in the month of June to September. The climate of Kumbhi varies to extreme limits. The summer temperature reaches up to 45°C and winter temperature falls just around 4°C.Rainfed agriculture is the tradition farming practice followed in the region. The crops cultivated under rainfed conditions are mustard, gram, sugarcane and rapeseed in *Rabi* season, while wheat, barely, mustard, sugarcane and gram are cultivated under irrigated condition and Cotton, Cluster bean, bajra and sorghum are cultivated under Kharif season. Total geographical area of the district is 772.8 ha. Out of this 164.8 ha comes under forest. Total cropped area of the district was recorded 3800 ha. Surface soil of the farmer's field from different villages of Kumbhi block of Lahkimpur district, were sampled randomly from the depth of 0-15 cm in the soil under V shape pit with the help of khurpi from different village of Lahkimpur district. The Soil samples were mixed thoroughly and about a half kilogram of composite samples from farmer's field were taken for analysis. Collected soil samples (0-15 cm depth) were brought into laboratory and dried and at room temperature. Dried soil samples were kept in a polythene bag for further physico-chemical analysis. Soil pH was determined by pH meter, EC by conductivity meter, bulk density and particle density by pycnometer (Black, 1965), water holding capacity was measured by keen box (Black, 1965). The organic matter content was determined by wet digestion method (Walkey and Black, 1934), available nitrogen was estimated by alkaline $KMnO_4$ method (Subbiah and Asija, 1956), available phosphorus was extracted by 0.5 M $NaHCO_3$ solution pH 8.5 (Olsen *et al.,* 1954), and color developed by ascorbic acid method (Watanable and Olsan, 1965). Available

potassium was determined by neutral normal ammonium acetate method (Jackson 1973), with the help of flame photometer. Available sulphur was estimated by turbidimetrically method (Chesnin and Yien, 1950).

Results and Discussion

Lakhimpur district has different types of soils and subjected to intensive agriculture programmes with variety crop of varying nutrient uptake characteristics since a long, which leads to nutritional imbalance particularly in N, P, K and S. Kumbhi block is one of the developing blocks of Lakhimpur district of U.P, with varied soil type.

Physico-chemical properties and Status of available nutrients viz. N, P, K and S in surface soil

The results shows that the pH of these soils was ranged 5.3–8.4 with average value of 6.94. 43.33 % soil samples were found acidic in nature, 25% soil samples were neutral, 25% soil samples were moderately saline and 6.0% soil samples were alkaline in reaction (Table 1). The soils of Kumbhi block were neutral to moderately alkaline in reaction. The electrical conductivity of Kumbhi block was varies from 0.11-1.05 dSm^{-1} with an average value 0.40 dSm^{-1}.

Bulk density and Particle density were ranged from 1.20-1.56 to 1.24-2.43 Mg m^{-3} respectively with a mean 1.41 and 2.20 Mg m^{-3} respectively. Water holding capacity of soil was range from 24.00 to 77.66%, with an average of 41.81%. The data on percent organic carbon content were ranges from 0.12 to 0.65 with an average value 0.36. Out of total soil samples (33) collected from Kumbhi block of Lakhimpur district 18.33% samples were medium, 65% samples were found low in organic carbon. Majority of the soil samples of Kumbhi block are low in their organic carbon status.

Available nitrogen content of these soils was ranged from 123.25 to 484.07 kg ha^{-1} with a mean value of 213.51 kg ha^{-1}, soil samples collected from Kumbhi block 51.66% soil samples were found medium and 48.33% were found in low range (Table 1). Climate has a major impact on availability of nitrogen, maximum soil samples were found in low category it may be due to uncertain rainfall. The available phosphorous content in these soils were varied from 12 to 33 kg ha^{-1} with a mean value of 25.43kg ha^{-1}. 68.33% samples were found medium, 30% soil samples found in high P content. The potassium content in these soils was ranged from 235 to 384 kg ha^{-1} with a mean value of 322.48 K kg ha^{-1}. 65% soil samples were found medium, 35% soil samples were found high in K content. The higher value of K may be due to high use of potassic fertilizer.

The available sulphur content in soils of Kumbhi block ranged from 10.5 to 30.90 kg/ha with an average value of 21.71 kg/ha. 68.33% soils samples were found medium, 31.66% soils samples were found high in sulphur content in soil of Kumbhi block. Sulphur in these soils is due to use of sulphur rich complex fertilizers.

Correlation between soil properties and available nutrients in soil of Kumbhi block

Soil moisture showed (Table 2) positive correlation with EC (r = 0.229) and negatively correlated with pH (r=-.078), Bulk density (r = -0.087), Particle density (r = -0.092), WHC (r = -0.153), organic carbon (r= -0.045), available nitrogen (r = -0.277*), phosphorus (r = 0.047), potassium (r = -0.063), sulphur (r = -0.124). Soil moisture was found negatively significant at the 0.05 level with available nitrogen (r = -0.277*) and positively non-significant with phosphorus (r = 0.047) but pH, BD, PD, EC, WHC, O.C, K, and S were negatively non-significant.

Table.1 The range and mean physico-chemical properties and Status of available nutrients

Soil characteristics	Range	Mean
Moisture (%)	10-90	36.33
pH (1:2.5)	5.3-8.40	6.94
E.C.(dSm^{-1})	0.11-1.05	0.40
B.D.(Mg m^{-3})	1.20-1.56	1.41
P.D.(Mg m^{-3})	1.24-2.43	2.20
W.H.C. (%)	24.00-77.66	41.81
O.C. (%)	0.12-0.65	0.36
Available N (kg ha^{-1})	123.25-484.07	213.51
Available P (kg ha^{-1})	12-33	25.43
Available K (kg ha^{-1})	235-384	322.48
Available S (kg ha^{-1})	10.5-30.9	21.71

Table.2 Correlation coefficient (r) between available nutrients and physicochemical properties of soil

	Moist	pH	EC	BD	PD	WHC	OC	N	P	K	S
Moist	1										
pH	-.078	1									
EC	.229	.179	1								
BD	-.087	-.356**	-.256*	1							
PD	-.092	-.293*	-.007	.003	1						
WHC	-.153	-.094	-.187	.138	.026	1					
OC	.045	.065	-.030	.072	.062	-.118	1				
N	.103	-.052	-.093	.201	-.013	-.026	.152	1			
P	.094	-.060	.118	-.117	.062	-.295*	.040	-.015	1		
K	-.063	.121	.135	.064	.128	-.179	-.046	-.072	-.051	1	
S	-.124	-.469**	.063	.186	.077	.055	-.159	.057	.089	-.068	1

** Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level

The soil pH is negatively correlation with EC (r = -0.179), BD was negatively significant correlate at the 0.01% level (r = -0.356**), PD was negatively significant correlate at the 0.05 level (r = -0.293*), WHC (r = -0.094), O.C (r = -0.65), N (r = -0.052), P (r = -0.060), K (r = 0.121), S (r = -0.187). pH is positive non-significant correlation with K and S negatively significant at 0.01 level. The soil EC is negatively correlated with BD (r = -256*), PD (r = -0.007), WHC (r = - (r = -0.030), N (r = -0.093), P (r = 0.118), K (r = 0.135 and S (r = 0.063). EC is positive non – significant correlation P, K and S. But BD is negatively significant correlated with EC. The soil BD is positively correlated with PD (r = 0.003), WHC (r = 0.138), O.C (r = 0.072), N (r = 0.201), P (r = -0.117), K (r=0.064) and S (r = 0.186). BD was correlated positively and non - significant but P negatively non - significant relationship. The soil PD was found positive correlation with WHC (r = 0.026), O.C (r = 0.062), N (r = -0.013), P (r = 0.062), K (r = 0.128), S (r = 0.077). PD was positively non - significant correlated with WHC, O.C, P, K and S but N is negative non - significant show. The soil WHC is found negative correlation with O.C (r = -0.118), N (r = -0.026), P (r = -0.295*), K (r = -0.179), S (r = 0.055). WHC was negatively non - significant correlation but P was negatively and significant at the 0.05 level correlation. Organic carbon was found positively correlated with N (r = 0.152), P (r = 0.040), K (r = -0.046) and S (r = -0.159). Organic carbon was positively and non - significant correlation with N and P but K and S is show negatively non - significant correlation. The soil nitrogen was found negative correlation with phosphorus (r = -0.015), K (r = -0.072) and S (r = 0.057). Nitrogen was negatively and non - significant correlation P and K but S is positively and non - significant. The phosphorus found negatively correlation with potash (r = -0.051) and S (r = 0.089). P was negatively and non - significant and S was

positively non - significant correlation. Potash is negatively correlated with S (r = -0.068).

It can be concluded that, the soils of Kumbhi block under Lakhimpur District is categorized under neutral to moderately saline and alkaline in reaction. Soil sample taken from Kumbhi block were found 43.33% acidic, 25% neutral and 6% alkaline in nature. Out of 60% soil sample 18.33% medium, 65% low and remaining soil sample were found in higher range of organic carbon. The content of available nitrogen was found medium in 51.66% and low in 48.33% soil sample. The available phosphorus and potassium were found 68% medium, 30% high, 65% medium and 35% higher in range, respectively. On the basis of these findings it is suggested that the farmers of Kumbhi block should incorporate organic matter in the soil to improve their soil quality.

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