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Determination of Soil Quality under Rice -Wheat Farming System in Soil of Thakurdwara Tahsil of Moradabad District (Uttar Pradesh)

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A B S T R A C T

Nutrients are important soil elements that control its fertility. Soil fertility is one of the important factors controlling yields of the crops. Soil characterization in relation to evaluation of fertility status of soil of an area or region is an important aspect in context of sustainable agriculture production. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs, the response efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent year. In the present investigation, an attempt has been made to examine the chemical properties of soil in rice - wheat farming system. The study area covers Thakurdwara Tahsil of Moradabad district of Uttar Pradesh. Soil samples of 0-15 cm depth were collected from 326 sites covering 21 gram panchayats. Collected soil samples were air dried in shade, crushed gently with a wooden roller and pass through 2.0 mm sieve to obtain a uniform representative sample. The processed soil samples were analyzed by standard methods. The pH varied from 5.2 to 9.2, organic carbon content varied from 3.9 to 6.9 g Kg^{-1} soil. The available N content was varied from 156.96 to 259.32 kg ha^{-1} with an average value of 224.32 kg ha^{-1} The available phosphorus content varied from 21.79 to 56.53 P_2 O_5 kg ha^{-1} with a mean value of 37.18 P_2O_5 kg ha^{-1}.Status of available potassium in the ranged from 158.20 to 283.25 K_2O Kg ha^{-1} with an average value of 211.92 K_2O kg ha^{-1}. Cu in the surface soil was found to sufficient and varied from 0.258 to 1.708 mg kg^{-1} The iron content varied from 3.214 to 16.852, Mn from 1.701 to 8.351 mg kg^{-1}. The available Zn in surface (0-15 cm) in soil ranged from 0.425 to 1.708 mg kg^{-1} soil in rice – wheat farming system. Nutrient status regarding to the available macro and micro nutrient in surface soil indicate that soils are low in available N and medium in available P and K and in general marginal in available Cu, Fe, Mn and Zn. Normal to slightly alkaline in reaction, low to medium in organic carbon content.

Introduction

According to the International Food Policy Research Institute, between 1993 and 2020 A.D. the global demand for cereals is expected to increase by 41%. It has been projected that annual rice production must increase from 556 million tons in 2000 A.D. to 758 million tons by 2020 A.D., a 36% increase. Rice-wheat cropping system (RWCS) is a long-established grain production system in China. The wheat yield following rice was only 0.7 to 1.0 tons ha^{-1} until the 1940s and it increased progressively after the 1950s as a result of improved varieties, better agronomic management, and pest control. RWCS in the Indian subcontinent is quite new and started only in the late 1960s with the introduction of dwarf wheat from CIMMYT, Mexico, which required a lower temperature for good germination than that required for traditional tall Indian wheat. There could be many more variants involving vegetables and other short duration crops. Most rice in the RWCS is transplanted and rice varieties grown are of 90–140 days duration (seed to seed) of which 25–45 days may be spent in nursery. The estimates of area under RWCS in the world vary considerably. In RWCS there is very little turn-around time between rice harvest and wheat sowing. Depending on the time of harvest of the rice crop, conventional tillage requires pre-sowing irrigation on well-drained soils or draining or drying of soil in lowlands followed by one or two disking, two harrowing, and leveling. Wheat in the RWCS belt in Indo-Gangetic Plains (IGP) is an irrigated crop. Considerable research has been conducted in India on the irrigation of wheat. Currently, there is a growing concern in sustainability of RWCS as the growth rates of rice and wheat yields are either stagnant or declining. Studies on socioeconomic and policy factors on the productivity of RWCS will be effective for measuring outcome of RWCS'

With increasing demographic pressure coupled with scarcity of soil and water resources, sustainable agriculture is not synonymous with "low-input" or organic agriculture. In some cases, low-input system may be acceptable for a short time, but in others like major food grain crops it may not be acceptable at all. As there is no alternative to agricultural intensification in our country, we must ensure using soil resources as per their capability and adopting the practices that improve soil quality and maintain a favorable soil condition for plant growth and environmental health (Mishra, 2005).

Use of high yielding varieties, intensive cropping, increase use of high analysis fertilizers and restricted use of organic sources of Nutrients has resulted in the deficiency of macro and micro nutrients in general particularly in the irrigated lands.(Ratan and Sharma 2004).Nutrient removed by crop depends on cultivar, soil moisture status, management levels and residue management. Macro and micro nutrients are important soil elements that control its fertility. Soil fertility is one of the important factors controlling yields of the crops. Soil characterization in relation to evaluation of fertility status of soil of an area or region is an important aspect in context of sustainable agriculture production. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs, the response efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent year. Recent diagnostic survey indicate that in many intensively cultivated area farmers have resorted to use greater than recommended doses of fertilizer, especially N Fertilizer, to maintained the crop productivity at levels attained previously with relatively small fertilization rates. This is an indication of decline in factor productivity. Low fertility of India soil is the major constant in achieving high productivity goals. In both agriculturally advanced irrigated ecosystems, nutrient replenishment through fertilizers and manures remain far below crop removal, thus causing the mining of native nutrient reserves over year. Wide spread deficiencies of macro and micro nutrients have emerged, and significant crop response to application of these nutrients are reported. The deficiencies are so intense and severe that visual symptoms are very often observed in major crops (Kumar et.al. 2013**).** The results of numerous field experiments in different parts of India have, therefore indicated *"Fertilizer-induced unsustainability of crop productivity"* (Yadav 2003). Variation in nutrient supply is a natural phenomenon and some of them may be sufficient where other deficient. The stagnation in crop productivity cannot be boosted without balanced and optimal dose of inorganic fertilizers use of organic such as farm yard manure, compost, green manure, crop residue incorporation use of industrial waste biofertilizer, N fixers both symbiotic and associate and p solubilizers. Variations in nutrient supply are a natural phenomena and some where may be sufficient while some where deficient. Within a soil, variability may exist depending upon the hydrological properties of the soil and cropping system therefore 21 locations will required different management practices to sustained crop productivity and for this full information about the nutrient status is important. Therefore to have sound information about the nutrient status of these soils this study was under taken.

Materials and Methods

Moradabad**,** city, northern Uttar Pradesh state, northern India. It is situated on a ridge along the Ramganga River (a tributary of the Ganges (Ganga) River), about 24 km west-northwest of Rampur. The city, located at a major road and rail junction, is a trade centre for agricultural products. Industries include cotton milling and weaving, metalworking, electroplating, and printing. Moradabad's surrounding region consists of a level plain bounded by the Ganges River on the west and drained by the Ramganga. Grains, cotton, and sugarcane are grown.

The study area covers Thakurdwara Tahsil of Moradabad district of Uttar Pradesh. Soil samples of 0-15 cm depth were collected from 326 sites covering 21 gram panchayats. Collected soil samples were air dried in shade, crushed gently with a wooden roller and pass through 2.0 mm sieve to obtain a uniform representative sample. Samples were properly labeled with the aluminum tag and stored in polythene bags for analysis .The processed soil samples were analyzed by standard methods for pH and electrical conductivity (1:2 soil water suspensions), organic carbon (Walkley and Black, 1934), available nitrogen (Subbiah and Asija, 1956), available phosphorus (Olsen et al.,1954), available potassium (Jackson, 1973) and available micronutrients (Fe, Mn, Zn and Cu) in soil samples with extracted diethylene triamine penta acetic acid (DTPA) solution (0.005M) DTPA+0.01M $CaCl_2$ +0.1M triethanolamine, pH 7.3 as outlined by Lindsay and Norvell (1978).

Results and Discussion

The soil samples collected from different locations of Thakurdwara, Dilari, Bhagatpur Tanda and Chaijlait of Moradabad district at surface and subsurface soil where sugarcane - wheat farming system was followed by farmers usually apply 140-150 kg N^{-1} ha along with 60-75 kg P ha^{-1}. Zinc application in rice-wheat farming system done by 45 percent of farmers while green manuring practiced by 10-12 percent farmers and biofertilizers use was not prevalent. It was noted that 85 percent farmers reported increased use of fertilizers to harvest same quantity of yield at different locations of Thakurdwara Tahsil of Moradabad districts of Uttar Pradesh.

Chemical properties

It was observed that soil pH varied from 5.2 to 9.2 with an average of 7.3 according to classification of soil reaction suggested by Brady (1985), 25 samples were normal (7.2 to 7.3), 47 samples were mildly alkaline (pH 7.4 to 7.8), 70 samples were moderately alkaline (pH 7.9 to 8.2). The minimum value of pH 5.2 was observed in Padla and Maximum value of pH 9.2 was observed in Lalabala, and Ratupura. The relatively high pH of soils might be due to the presence of high degree of base saturation. The electrical conductivity of the soil varied from 0.120to 0.989 dSm^{-1} .

Organic matter content

Organic carbon content of the soil in rice-mentha+wheat varied from 3.9 to 6.9 g Kg^{-1} soil.The organic carbon content was low (<0.50%) in 26 %, medium (0.5 to 0.75%) in 74 % soil samples. High temperature and more tillage practice in the soil increases the rate of oxidation of organic matter resulting reduction of organic carbon content. Agarwal et al., (1990) reported that organic carbon content of some soil Rajasthan ranged from 0.142 to 0.40 percent.

Available nitrogen content

Soil fertility exhibits the status of different soils regard to the amount and availability of nutrients essentials for plant growth. The available N content in rice- wheat varied from 156.96 to 259.32 kg ha^{-1} with an average value of 224.32 kg ha^{-1} (table 1). On the basis of rating suggested by Subbiah and Asija (1956), all samples were low (<250 N kg ha^{-1}) IN available nitrogen. A significant positive correlation (r =0.933) was found between organic carbon and available nitrogen. This relationship was found because most of the soil nitrogen is in organic form. Similar results were also reported by Verma et al. (1980).

Available phosphorous content

The available phosphorus content in rice-wheat varied from 21.79 to 56.53 P_2 O_5 kg ha^{-1} with a mean value of 37.18 P_2O_5 kg ha^{-1}. On the basis of the limit suggested by Muhr et al. (1963), 92 % samples were medium (20 to 50 P_2O_5 kg ha^{-1}) and 10% were high (>50 P_2 O_5 kg ha^{-1}) in available phosphorus. A significant positive correlation (r = 0.683) was observed between organic carbon and available phosphorus. A significant positive correlation (r = 0.684) was observed between organic carbon and available phosphorus. This relationship might be due to the presence of more than 50% of phosphorus in organic form and after decomposition of organic matter as humus is formed which forms complex with Al and Fe and that is positive cover for P fixation with Al & Fe thus reduce phosphorus fixation (Tisdale et.al. 1997).

Available potassium content

Status of available potassium in the soil in rice- wheat ranged from 158.20 to 283.25 K_2O Kg ha^{-1} with an average value of 211.92 K_2O kg ha^{-1}. According to limit suggested by Mahr et al.(1963), all samples were medium (125 to 300 K_2O kg ha^{-1}) in potassium content. A significant positive correlation (r =0.615) was observed between organic carbon and available potassium. This might be due to creation of favorable soil environment with presence of high organic matter. Similar result was also reported by Paliwal (1996)

Table.1 Salient soil properties (weighted mean) under rice –wheat farming system

S.N.	Name of village	No of samples collected	pH	EC (dSm^{-1})	OC ($gmkg^{-1}$)	Available N ($kgha^{-1}$)	Available P_2O_5 ($kgha^{-1}$)	Available K_2O ($kgha^{-1}$)
1	Noorpur	20	7.6	0.318	5.7	195.46	21.79	210.67
2	Adampur	15	7.9	0.660	5.3	219.96	32.85	205.50
3	Bhoor	20	8.0	0.582	6.6	255.90	28.16	190.39
4	BhopurBhaipur	15	8.5	0.365	5.4	208.88	41.83	207.30
5	Dhakia Jatt	15	7.8	0.218	6.5	250.36	45.39	226.60
6	Dharaknagla	20	7.0	0.785	5.8	218.62	36.21	158.20
7	Darapur	15	7.2	0.955	6.7	245.23	29.68	178.60
8	Fatanpur	15	6.6	0.155	5.7	225.00	44.16	205.30
9	Dheengapur	20	6.8	0.631	6.9	235.66	46.53	283.25
10	Fazalpur	12	7.5	0.251	6.5	248.88	38.33	265.60
11	Gamri	10	7.3	0.811	4.9	209.44	45.16	272.80
12	Isapur	15	8.2	0.456	4.8	196.88	42.28	214.72
13	Jatpura	20	8.3	0.254	3.9	156.96	41.81	212.71
14	Malpura	10	5.9	0.531	6.8	259.32	29.69	206.52
15	Manawala	15	6.7	0.765	5.4	226.53	28.23	160.15
16	Lalabala	20	9.2	0.120	5.9	228.78	35.42	189.20
17	Ratupura	12	9.0	0.989	6.8	246.56	38.43	201.32
18	Shivnagar	15	8.4	0.553	5.6	210.52	42.81	198.05
19	Zafrabad	10	6.1	0.456	6.7	246.48	46.21	220.20
20	Rosanpura	20	5.8	0.622	5.3	216.59	38.23	252.60
21	Padla	12	5.2	0.287	4.5	208.72	27.70	190.72
		Range	5.2-9.2	0.120-0.989	3.9 – 6.9	156.96 – 259.32	21.79 – 46.53	158.20 – 283.25
		Mean	7.3	0.512	5.79	224.32	37.18	211.92

Table.2 DTPA- extractable micronutrients (Cu, Fe, Mn and Zn) status of soil under rice –wheat farming system

S.N.	Name of village	No of samples collected	Cu mg/kg	Fe mg/kg	Mn mg/kg	Zn mg/kg
1	Noorpur	20	0.845	16.852	3.485	1.481
2	Adampur	15	0.854	11.258	4.621	0.435
3	Bhoor	20	0.258	8.296	3.426	0.810
4	BhopurBhaipur	15	0.881	13.652	5.514	1.708
5	Dhakia Jatt	15	0.923	6.145	4.156	0.835
6	Dharaknagla	20	0.869	6.253	4.152	0.823
7	Darapur	15	0.748	8.472	5.593	0.543
8	Fatanpur	15	1.028	3.214	1.916	0.781
9	Dheengapur	20	1.312	4.785	2.891	0.798
10	Fazalpur	12	2.415	5.596	2.245	1.839
11	Gamri	10	0.793	4.985	2.561	0.575
12	Isapur	15	2.041	10.581	8.351	1.685
13	Jatpura	20	0.916	5.596	2.856	1.069
14	Malpura	10	1.178	4.543	4.561	0.878
15	Manawala	15	0.620	6.391	5.186	0.595
16	Lalabala	20	1.541	4.045	5.170	0.583
17	Ratupura	12	0.623	6.379	2.267	0.861
18	Shivnagar	15	1.216	11.273	5.061	0.425
19	Zafrabad	10	1.368	3.738	1.701	0.768
20	Rosanpura	20	0.869	7.560	2.746	0.756
21	Padla	12	1.708	4.746	3.216	0.665
		Range	0.258- 1.708	3.214 - 16.852	1.701 – 8.351	0.425 - 1.708
		Mean	1.095	7.350	3.889	0.900

Micronutrients

Copper

The DTPA extractable Cu in the surface soil in rice- wheat of 21 grame panchayat was found to sufficient and varied from 0.258 to 1.708 mg kg^{-1} soil in surface (0-15cm) with a mean value of 1.095. All the observed values were well above the critical limit of 0.20 mg kg^{-1} as proposed by Lindsay and Norvell (1998).

Iron

The DTPA -extractable Fe in the surface soil in rice- wheat of 21 gram panchayat was to be sufficient and varied from 3.214 to 16.852 mg kg^{-1} with a mean value of 7.350 mg kg^{-1} . According to critical limit of 4.5 mg kg^{-1} soil as suggested by Lindsay and Norvell (1978).

Mn

The DTPA- extractable Mn in surface soil varied from 1.701 to 8.351 mg kg^{-1} soil of 326 locations under rice- wheat farming system and is sufficient to high since are well above according to critical limit of 1.0 mg kg^{-1} as proposed by Lindsay and Norvell (1978).

Zn

The available Zn in surface (0-15 cm) in rice- wheat ranged from 0.425 to 1.708 mg kg^{-1} soil. According to critical limit 0.6 mg kg^{-1} as proposed by Lindsay and Norvell (1978**)** all the surface soils with exception of Adampur, Gamri and Manwala, Lalabala and Shivnagar were sufficient in Available Zn content.

The study of soil samples reveals that the soil of Thakudwara Tahsil of Moradabad district were did not followed a particular pattern with different gram panchayat which may be due to variation in management practices and yield potential. Nutrient status regarding to the available macro and micro nutrient in surface soil indicate that soils are low in available N and medium in available P and K and in general marginal in available Cu,Fe, Mn and Zn. Normal to slightly alkaline in reaction, low to medium in organic carbon content (Kumar et.al. 2013**).**

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