Distribution pattern of available nutrients in different location of Muzaffarnagar and Ghaziabad districts of Uttar Pradesh under rice - sugarcane cropping sequence

Abstract

An attempt was made to assess the macro and micronutrient content of the soil under sugarcane – wheat sequence and their rotation with soil characteristics. For judicious use of macro and micronutrients it is essential to have the idea of their status in soil as wide spread macro and micronutrients deficiency is being observed in the soils of Uttar Pradesh. Rice - sugarcane cropping sequence is one of the most prevalent cropping sequences in the north western plains of Uttar Pradesh and Uttarakhand occupying 10-11% of net cropped area in the regions. It has been observed during the past years that yield of sugarcane and wheat has reached a plateau in these regions due to declining factor productivity. Soil samples of 0-15, 15-30 and 30-45 cm depth were collected from four different locations of Muzzafarnagar and Ghaziabad districts under rice - sugarcane cropping sequence. The available Zn in surface (0-15 cm) and sub surface soil (30-45 cm) ranged from 0.605 to 0.883 and 0.111 to 0.629 mg kg-1 soil with an average value of 0.083 and 0.435 mg kg-1 soil, respectively. Correlation coefficient among the different soil properties of rice - sugarcane cropping sequence of various locations in Muzaffarnagar and Ghaziabad districts at 3 soil depth viz 0-15, 15-30 and 30-45 cm were work out. As far as nutrient status in concerned on the basis of mean value, the soils are low in available nitrogen, low to medium in available phosphorus and potassium and in general sufficient in available Cu, Fe, Mn and Zn in surface soil.

Keywords: macro and micronutrient, cropping sequence, sugarcane

Introduction

Sugarcane based crop sequences are being practiced extensively all over India. Sugarcane is an important cash crop of India and cultivated on 4.02 m ha with an average productivity of 58.98 t ha^{-1} (Fertilizer Association of India [FAI] 2005). The crop is a heavy feeder of plant nutrients and removes about 1.2 kg N, 0.22 kg P, and 2.83 kg K for each tones of cane production (Menhi Lal and Singh 2002). rice - sugarcane cropping sequence is one of the most prevalent cropping sequences in the north western plains of Uttar Pradesh and Uttarakhand occupying 10-11% of net cropped area in the regions. It has been observed during the past years that yield of sugarcane and wheat has reached a plateau in these regions due to declining factor productivity (Yadav *et al.*1998). The loss in organic matter has been assigned as the prime reason for this decline in the productivity. Soil organic matter influences almost all the component of soil linked with crop production. Macro nutrient (N, P, & K) and micronutrients (Cu, Fe, and Mn & Zn) are important soil elements that control its fertility. Soil fertility is one of the factor controlling yields of the crops. Soil characterization in relation to fertility evaluation of the soil of an area of region is an important aspect for sustainable crop production. Because of imbalance and inadequate fertilizer use efficiency of chemical fertilizer has decline tremendously under intensive cropping system in recent year (Chandra *et al.* 2008).

The stagnation in crop productivity can not be boosted without judicious use of macro and micronutrients. Therefore, an attempt was made to asses the macro and micronutrient content of the soil under sugarcane – wheat sequence and their rotation with soil characteristics. For judicious use of macro and micronutrients it is essential to have the idea of their status in soil as wide spread macro and micronutrients deficiency is being observed in the soils of Uttar Pradesh.

Materials and method:

Soil samples of 0-15, 15-30 and 30-45 cm depth were collected from four different locations of Muzzafarnagar and Ghaziabad districts under rice - sugarcane cropping sequence. Collected 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 for physico – chemical properties using standard procedure.

Result and discussion

Chemical properties

Soil pH estimated for soil of various depths was usually found normal to alkaline in reaction (Table-1). It was observed that soil pH ranged from 8.1 to 8.8 for surface soil (0 -15 cm) 8.0 to 8.8 and 8.0 to 8.8 in 15-30 and 30 - 45 cm depth in subsurface. The soil EC ranged from 0.189 to 0.428 dSm^{-1} for surface soil while 0.170 to 0.223 dSm^{-1} in subsurface soil with an average value of 0.172 and 0.216 dSm^{-1} for surface & subsurface soil respectively. The CEC ranged from 10.13 to 14.82 cmol (p^{+}) kg^{-1} for surface soil (0-15 cm) while 7.43 to 13.47 cmol (p^{+}) kg^{-1} in subsurface soil (30-45cm) with an average value of 9.69 and 17.47 cmol (p^{+}) kg^{-1} soil. The organic carbon was higher at surface and it decline with soil depth. The organic carbon in surface (0-15cm) and subsurface soil (30-45cm) varied from 6.6 to 7.9 and 1.4 to 4.6 g kg^{-1} soil with an average value of 1.8 and 3.6 g kg^{-1}, respectively.

Nutrients status and soil fertility

Soil fertility represents the status of different soils with regard to the amount and availability of nutrients essential for plant growth. The available nitrogen content in surface (0-15cm) and subsurface soil (30-45cm) varied from 93.72 to 127.11 and 63.09 to 83.98 with an average value of 38.44 and 74.73 kg ha^{-1} (Table-1) suggesting that all soils were low in available nitrogen. Available nitrogen was found maximum in surface soil and decrease regularly with increasing depth which is due to decreasing trend of organic carbon with depth and second by as cultivation of crops is mainly confined to the surface soil only regular depletion of nitrogen is supplemented by the external sources of nitrogen during crop cultivation **(Prasuna Rani *et al.* 1992).**

The available phosphorus in surface (0-15cm) and sub surface soil (30-45cm) varied from 4.12 to 12.53 and 2.65 to 8.38 with an average value of 1.31 and 5.82 kg ha^{-1}, respectively. The highest available phosphorus was observed in the surface soil and decrease with increasing depth. It might be due to the confinement of crop cultivation to the rhizosphere and supplementing the depleted P by external sources. The lower P

content in sub surface soil could be attributed to the fixation of released phosphorus by clay minerals **(Leelavathi *et al.* 2009).**

The available potassium in surface (0-15cm) and sub surface soil (30-45cm) varied from 126.71 to 664.20 and 100.23 to 609.60 with an average value of 90.04 and 589.05 kg ha^{-1}, respectively. The available potassium was higher in surface soil and it declined with increasing soil depth.

Micronutrients

The DTPA extractable Cu varied from 0.65 to 1.75 mg kg^{-1} soil in surface (0-15cm) and 0.47 to 1.44 mg kg^{-1} soil in sub surface soil (30-45cm) with an average value of 0.17 and 0.93 mg kg^{-1} soil for surface and subsurface soil, respectively. All the observed values were well above the critical limit of 0.20 mg kg^{-1} as proposed by **Lindsay and Norvell (1998)**

The DTPA -extractable Fe in surface (0-15cm) and sub surface soil (30-45cm) varied from 2.69 to 7.03 and 2.15 to 5.35 mg kg^{-1} soil with an average value of 1.95 and 4.58 mg kg^{-1} soil, respectively. According to critical limit of 4.5 mg kg^{-1} soil as suggested by Lindsay and Norvell (1978) all the surface soils (0-15cm) with exception of Khandawali (M) were sufficient in available Fe. A decreasing trend with depth was noticed in all four locations.

The DTPA- extractable Mn in surface (0-15cm) and subsurface soil (30-45cm) varied from 1.80 to 5.10 and 1.64 to 4.51 mg kg^{-1} soil with an average value of 1.51 and 3.35 mg kg^{-1} soil. According to critical limit of 1.0 mg kg^{-1} as proposed by Lindsay and Norvell (1978), all the soils were sufficient in available Mn.

The available Zn in surface (0-15 cm) and sub surface soil (30-45 cm) ranged from 0.605 to 0.883 and 0.111 to 0.629 mg kg^{-1} soil with an average value of 0.083 and 0.435 mg kg^{-1} soil, respectively. According to critical limit 0.6 mg kg^{-1} as proposed by Lindsay and Norvell (1978) all the surface soils with exception of Khandawli (M) were sufficient in Available Zn content.

Correlation study

Correlation coefficient among the different soil properties of rice - sugarcane cropping sequence of various locations in Muzaffarnagar and Ghaziabad districts at 3 soil depth viz 0-15, 15-30 and 30-45 cm were work out. Simple correlation coefficient of soil

properties with various elements revealed that organic carbon is correlated with available N ($r = 0.876^{**}$), total N ($r = 0.725^{**}$) positively and highly significantly, microbial biomass carbon ($r = 0.752^{**}$), Cu ($r = 0.651^{**}$) and Zn ($r = 0.865^{**}$), positively & significantly with available P ($r = 0.747^{*}$), Fe ($r = 0.768^{*}$), Mn ($r = 0.615^{*}$), positively with CEC (r = -0.010), available K (r = 0.322) and negatively with bulk density (r = -0.578).

The soil pH has negative correlation with Fe (r = - 0.385) and Zn (r = - 0.147) and significant & positive correlation with Mn ($r = - 0.071^{*}$). Soil pH is positively correlated with Cu (r = 0.258). CEC of soil is negatively correlated with sand (r = - 0.668) and silt (r = 0.623) and negative and highly significantly with clay ($r = -0.235^{**}$). Available soil nitrogen is significantly and positively correlated with total N ($r = 0.556^{*}$) and microbial biomass carbon ($r = 0.752^{*}$).

Table-1: Physico-chemical properties of soil under rice – sugarcane cropping sequence Muzaffarnagar and Ghaziabad district

Locations	Depth (cm)	pH	EC	CEC	O.C. g/kg	Available macronutrients($kgha^{-1}$)			Available micronutrients ($mgkg^{-1}$)			
						N	P	K	Cu	Fe	Mn	Zn
Jansath (M)	0-15	8.4	0.201	14.82	7.9	114.96	12.53	664.20	1.75	2.69	2.94	0.645
	15-30	8.8	0.185	12.00	4.1	83.98	8.38	609.60	1.44	2.64	2.23	0.551
	30-45	8.8	0.210	12.47	2.6	74.73	3.38	589.05	0.50	2.15	1.98	0.083
Morna (M)	0-15	8.2	0.189	10.13	6.6	93.72	4.12	126.71	0.87	3.34	1.80	0.765
	15-30	8.4	0.170	7.43	2.4	63.09	2.65	100.23	0.47	2.15	1.64	0.271
	30-45	8.4	0.186	10.80	1.8	38.44	1.31	90.04	0.36	1.95	1.51	0.084
Bhojpur (G)	0-15	7.5	0.303	10.78	6.7	127.11	5.33	243.77	0.65	7.03	5.10	0.605
	15-30	7.6	0.223	13.47	4.2	80.53	3.99	244.67	0.46	5.35	4.51	0.111
	30-45	7.9	0.172	9.69	3.5	71.46	2.07	207.67	0.17	4.58	3.35	0.100
Muradnagar (G)	0-15	8.1	0.428	14.21	6.6	99.65	10.70	185.21	1.56	4.84	4.61	0.883
	15-30	8.0	0.192	12.08	4.6	71.93	6.55	101.04	1.02	4.10	3.06	0.629
	30-45	8.0	0.216	17.47	3.6	60.46	5.82	125.98	0.93	3.30	2.66	0.435
Mean	0-15	-	0.195	12.48	7.2	106.35	8.20	260.34	1.20	5.65	3.45	0.725
	15-30	-	0.185	10.42	3.8	74.30	5.40	280.63	0.88	3.54	2.74	0.420

	30-45	-	0.192	12.30	2.8	58.24	2.80	235.20	0.48	2.50	2.85	0.156

In parentheses M denotes Muzaffarnagar and G for Ghaziabad.

Conclusion:

The study of soil samples of Muzzafarnar and Ghaziabad districts revealed that the soils are normal to moderately alkaline in reaction, low to medium in organic carbon. As far as nutrient status in concerned on the basis of mean value, the soils are low in available nitrogen, low to medium in available phosphorus and potassium and in general sufficient in available Cu, Fe, Mn and Zn in surface soil.

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