Available Macro Nutrient Status and their Relationship with Soil Physico-Chemical Properties of Chandauli District of Uttar- Pradesh

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Abstract

In the present investigation Naugarh block was selected in the district Chandauli of Uttar Pradesh and studied the available macronutrient status and their relationship with physico-chemical properties. Results of the study indicated that soils of Naugarh block were Medium to High in organic carbon. Out of 75 collected soil samples, 96% were Low in available nitrogen and medium to high in available phosphorus, potassium and Sulphur Medium to high in soil. Improper agricultural practices, intensive farming, monoculture type of cropping pattern and over irrigation are responsible for degradation of soil fertility from the area. To overcome the adverse effect, complementary use of biofertilizers, organic manures in suitable combination of chemical fertilizers were suggested. Awareness camps, rallies, and training program can be arranged for farmers regarding the benefits of balanced use of chemical fertilizers and use of organic agriculture in crop production in improving soil fertility and nutrition status.
Key words: Macronutrient, Physico-chemical properties, Correlation,

Introduction

The stagnation in crop productivity cannot be boosted without judicious use of macro and micronutrient fertilizers to overcome existing imbalances or deficiencies[1]. Uttar Pradesh, the fourth largest State in the country in terms of geographical area, is located in the northeastern part of the country. The prospects of agriculture in the State largely depend on timely arrival of monsoon. Where rainfall pattern indicates that during the current monsoon season, the State has received 650 mm rainfall in southwest monsoon and 1000 mm southeastern against the normal rainfall of 741 mm. where soils are having low to medium soil fertility, low to medium water holding capacity, medium infiltration rate and shallow in depth in some areas [2]. Due to scarcity of rainfall there is limited availability of ground water. The crops suffer medium to high temperature. The water holding capacity is inadequate in lighter soils. The nitrogen and organic carbon status of the soils, in general is medium. The soils are well supplied with potassium. Micro elemental deficiencies particularly zinc and Sulphur has also been observed in pockets. The present study was conducted to recognize the status of macronutrient and their relationship with physico-chemical properties in the soils of Naugarh block district Chandauli (U.P).

Material and Methods

Surface soil of the farmer's field from different villages of block of Naugarh district, were sampled randomly to a depth of 0-15 cm in V shape with the help of Khurpi. Each soil sample was mixed thoroughly and about a half kilogram of composite sample from farmer's fields was analyzed. The physical properties of soil viz. bulk density by core method, particle density by pycnometer method and porosity was measured by method[4]. Soil pH and electrical conductivity (EC) of the soil samples in soil: water suspension (1:2.5) was measured[5]. Organic carbon was determined by wet digestion[3] method of Walkley and

Black [6], available Nitrogen by Alkaline permanganate method [7], Available Phosphorus by colorimetric method using

Results and Discussion
Physico-chemical properties of Soil

Physico-chemical properties of Soil the data on pH, EC, B.D., P.D. and organic carbon are presented in Table 1 which revealed that the pH of soils ranged varies 5.4 to7.18, with average value of 6.50. Absence of luxuriant vegetation further decreases level of organic matter in these soils. It is expected that a decrease in rainfall or increase in the pH due to precipitation of $CaCO_3$ and also increases soil pH. The soils of Naugarh block were neutral to moderately acidic in reaction. This might be due to medium to high base saturation of soils [11,12] also recorded similar findings.

The electrical conductivity of Naugarh block (Table 2) varied from 0.105 to 0.240 dS m^{-1} with an average value of 0.11 dS m^{-1}. The values indicated that salinity is not a problem in these soils. Similar results were observed earlier[12,13].

Bulk density and Particle density ranged from 1.24 to 1.60 and1.28 to 2.65 Mg m^{-3} respectively with a mean value of 1.42 and 2.23 Mg m^{-3}.

Estimates of organic carbon are used to assess the amount of organic matter in soils. Soil organic matter content can be used as an index of N availability because the N content in soil organic matter is relatively constant. The data on percent organic carbon content ranged between 0.15 to 0.75 percent with a mean value of 0.41 percent (Table 1), Thus majority of the soil samples of Naugarh block were Low to medium in their organic matter status. The high temperatures prevailing in the area might be responsible for rapid decomposition of organic matter[16].

Status of Available Primary Macronutrients in Soil

The status of N, P and K has been shown in Tables 2, 3 and 4. Available nitrogen content of these soils ranged between 38.60 to 113.00 kg ha^{-1}with a mean value of 80.00 kg

sodium bicarbonate[8], Available Potassium by ammonium acetate extraction method[9], Available Sulphur by turbidimetricmethod[10].

ha^{-1}. On the basis of the ratings 96% of the soil samples were found to be low (< 280 kg N ha^{-1}) and remaining 4 % in the category of medium (280 to 560 kg N ha^{-1}) (Table 4). Most of the sample was shown the low availability of nitrogen. The availability of nitrogen is not only an essential part of carbohydrates, fats and oils but also an essential ingredient of proteins. The available nitrogen is an important factor to increase the soil fertility. Low nitrogen status in the soils could be due to low amount of organic carbon in the soils and uncertain rainfall has a major impact on availability of nitrogen. Similar results were observed by earlier[11].

The available phosphorous content in these soils varied from 7.58 to 26.65 kg ha^{-1} with a mean value of 12.83 kg ha^{-1}, On the basis of the limits, most of the soil samples 99% law ($\leq$ 12.5 kg P ha^{-1}) were (12.5 to 25 kg P ha^{-1}) in available phosphorus status and 52% were under high (P >25 kg ha^{-1}) category. It is a constituent of the cell nucleus, essential for cell division and the development of meristematic tissues at the growing points. It makes 0.1 to 0.5% of dry weight of the plant. Higher Phosphorus may be due to fixed phosphorus pool of phosphate contains inorganic phosphate compounds that are very insoluble and organic compounds that are resistant to mineralization by microorganisms in soil. These findings are in agreement with the results reported in soil of Tonk district of Rajasthan[13].

Status of available potassium content in these soils ranged from 156 to436 kg ha^{-1} with a mean value of 296. kg ha^{-1} [17]. Out of 47 soil samples, 63% soil samples were found under medium (135 to 335 kg K ha^{-1}) range and 33.00% soil samples under high (>335 kg K ha^{-1}) available K minerals.[14] observed similar results from soils in Mantagani village of North Karnataka**.**

Status of Available Secondary Macronutrient

The data on status of available S, in soils of Naugarh block of Chandauli district are presented in Tables 2, 3 and 4. The available sulphur content in soils of Naugarh block ranged from 6.51 to 29.4 kg ha^{-1} with an average value of 18.80 kg ha^{-1}. Plant roots absorb sulphur in the form of SO_4^{-2} from the soil solution. Keeping this fact in view, the soil under study may be classified as deficient (20 kg S ha^{-1}) category. According to the categories, 67% samples were found under medium and remaining 29% samples were found under high category. Thus, the soils of Naugarh block of district Chandauli are likely to well respond to Sulphur fertilization. High available sulphur in these soils is due to sulphur bearing minerals[15].

Table 1 Physico-chemical properties of soils of Naugarh block

Soil characteristics	Range	Mean	S.D.
pH(1:2.5)	5.40-7.18	6.55	0.501
E.C. (dS m^{-1})	0.115-0.250	0.18	0.058
B.D.(mg^{-3})	1.24-1.60	1.42	0.129
P.D. (mg^{-3})	1.28-2.65	2.23	0.306
OC (%)	0.15-0.75	0.41	0.068

Table 2 Status of available macronutrients viz. available N, P, K and S in soils of Naugarh block

Soil characteristics	Range	Mean	S.D.
Available N(kg ha^{-1})	38.00-113.0	80.00	21.01
Available P(kg ha^{-1})	7.58-26.65	12.83	5.89
Available K(kg ha^{-1})	156-436	296.00	235.63
Available S(kg ha^{-1})	6.51-29.40	18.80	4.64

Table 3 Rating limits for soil test values used in India (Muhr *et al*. 1965)

Nutrients	Rating of the soil test values		
	Low	Medium	High
Organic carbon (%)	< 0.5	0.5 – 0.75	> 0.75
Available N(kg ha^{-1})	< 280	280 – 560	>560
Available P(kg ha^{-1})	<12.5	12.5 – 25	> 25
Available K(kg ha^{-1})	< 135	135 – 335	>335
Available S(kg ha^{-1})	< 10	10 – 20	>20

Table 4 Classification OC% and available Macro nutrients status content in soils of Naugarh block

Elements	No. of Samples	% of samples	No. of Samples	% of samples	No. of Samples	% of samples
	Low		Medium		High	
OC	47	62.00	20	26.67	8	11.00
N	72	96	3	4	0	0
P	70	93.00	3	4	2	3.00
K	3	4	47	62.00	25	33.00
S	3	4	50	67.00	22	29.00

Correlation between physico-chemical properties and available macro nutrients in the soils of Naugarh block

The data on correlation between soil properties and available nutrients in top soil of Naugarh block are presented in Table 5 revealed the soil Nitrogen was found negatively significant correlation with pH(r= -0.378), and negatively with Bulk density (r=-.095), Partical density (=-0.018), and Organic Carbon (r=-.142). The Nitrogen in soil Positively Non-Significant with EC (=0.313) comparable with the relationship reported in the past [16].

Available phosphorus were found negatively significant correlation with EC (= -0.381)* and pH (=-0.03) non significant. Positively Non-significant correlation With Organic carbon (=0.139)' Bulk density (=0.239) and Partical density (=0.049), also reported the similar results in soil of Mewar region of Rajasthan and Janjgir[17]

Table 5 Correlation between physico-chemical properties and available macro nutrients in the soil of Naugarh block

	N	P	K	S
pH	-0.378*	-0.03	0.160	-0.55
EC	0.313	-0.381	-0.133	-0.052
BD	-0.095	0.239	0.166	0.010
PD	-0.018	0.049	- 0.0005	0.101
OC	-0.142	0.139	0.007	-0.06

Available Potassium was found positively non significant correlation with pH (0.160), Bulk density (=0.166) and Organic Carbon (=0.007). The Potassium in soil Negatively Non- significant Correlation with EC and Particle density (=-0.0005). Available sulphur in these soil show negatively Non significant correlation relationship with pH (r=-0.55), Organic Carbon (r=-.0.06) and EC (-.052). Positively correlation with Bulk density (0.010) and Particle density (=0.101).

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