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Nutrient Status of Some Soil Series of Bhiwapur and their Relationship with Physico-Chemical Properties

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ABSTRACT

*Forty-six soil samples from nine different soil series of Bhiwapur tahsil of Nagpur district of Maharashtra state were selected for randomly to study the available macro as well as micronutrient status of the soil. The physico-chemical properties like pH, electrical conductivity (EC), organic carbon (OC) and free $CaCO_3$ content of the soils varied from 7.1 to 8.2, 0.10 to 0.36 dS m^{-1}, 3.45 to7.75 g kg^{-1} and 1.58 to 10.75 per cent with the mean value of 7.65, 0.19 dSm^{-1}, 5.75 g kg^{-1} and 4.91 per cent, respectively. Most of the soils were found low in nitrogen (N) and phosphorus (P) and high in potassium (K). Available N status of these soils was in the range of 132 to 278 kg ha^{-1} (mean value of 198 kg ha^{-1}), available P varied from 5.14 to 24.56 kg P_2O_5 ha^{-1} (mean value of 12.56 kg P_2O_5 ha^{-1}) and 94% of the soil samples showed high available K content. The available S content was in the range of 5.23 to 23.15 kg ha^{-1} (mean value of 11.15 kg ha^{-1}). The soils were sufficient in available Mn and Cu, whereas, deficient in Fe and Zn. Soil DTPA-extractable micronutrients, Zn, Cu, Mn and Fe ranged from 0.29 to 1.44, 1.11 to 3.26, 6.62 to 17.44 and 4.10 to 10.17 mg kg^{-1} (mean value of 0.52, 1.89, 11.25 and 5.76 mg kg^{-1}), respectively. Soil pH of the surface layer had a significant and negative correlation with available S and Cu (r=-0.395** and -0.289**). Soil OC showed a significant positive relationship with available N, Mn and Cu (r=o.539**, 0.398** and 0.562**). The free $CaCO_3$ was significantly and negatively correlated with available N, S, Fe, Mn and Zn (r= -0.437**, 0.314**, -0.372**, -0.437** and -0.268**), respectively. The investigation provides preliminary information on fertility status of different soil series of Nagpur district (Maharashtra), which shall help in the formulation of nutrient management schedule in future for the better productivity of different crops.*

Key words: *Macronutrient, Micronutrient, Correlation*

INTRODUCTION

The capacity of soil to produce successful crop depends upon the available nutrient status as well as physico-chemical characteristics of soil, which include texture, pH, soluble salts, organic matter and active calcium carbonate[1]. All these properties are quite important in deciding the management practices for obtaining yield and maintaining the proper soil health.

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It is therefore vital to have knowledge of the above soil properties so as to workout the type and quantity of any fertilizer, manure and amendment needed to improve the productivity of soil. Fertilizer being the costlier input, the scientific approach towards profitable agriculture would imply the use of plant nutrients according to the actual needs of the soil crop situations, which can best be judged through soil testing. Soil characterization in relation to evaluation of fertility status of an area or region is an important aspect in respect to sustainable agriculture production.

The study on status of major and micro nutrients of swell-shrink soils of Maharashtra showed that, the soils were low in available nitrogen, very low to moderate in phosphorus and moderate to very high in potassium. In available micronutrient status, except Zn, all other micronutrients were well supplied[14]. For proper recommendation of fertilizer application in different crops, knowledge of fertility status is essential. Since, no information is available on the nutrient status of different soil series of Bhiwapur tahsil of Nagpur District, the present work was conducted.

MATERIALS AND METHODS

The present investigation was undertaken on nine soil series of Bhivapur tahsil of Nagpur district (Maharashtra). The study area distributed in 137 villages located at 1254 m mean sea level with an average annual rainfall 1377mm. Forty six soil samples from nine soil series of Nagpur district were selected for random soil sampling to study the available macro as well as micronutrient status (fig. 1) The area was surveyed and five to six samples collected from each soil series, air dried, ground with wooden morter and pestle and passed through 2mm stainless steel sieve. These samples were analyzed for pH, electrical conductivity (EC), organic carbon (OC) and free calcium carbonate by standard methods[7]. Available N was determined by alkaline $KMnO_4$ method[16], available P by extraction of soil with 0.5 M $NaHCO_3$ at pH 8.5[13], K by using 1N neutral ammonium acetate solution[7] and available S by turbidimetric method[3]. These soil samples were also extracted with solution consisting of 0.005M DTPA, 0.01M $CaCl_2$ and 0.1M triethanolamine (pH 7.3) as per the procedure described by Lindsay and Norvell[11] (1978) for available micronutrient cations. The Zn, Cu, Fe and Mn content in extract were estimated using atomic absorption spectrophotometer model Z 2300.

RESULTS AND DISCUSSION

Physico-chemical characteristics of soils: The physico-chemical characteristics of soils of nine soil series under study are presented in table 1. The soil pH ranged from 7.1 to 8.2 with the mean value of 7.65 which shows that majority of the soils are slightly to moderately alkaline in reaction. The EC of these soils varied from 0.10 to 0.36 dS m^{-1} with a mean value of 0.19 dS m^{-1}. These values were within the safe limit for the crop growth. The soil OC values ranged from 3.45 to 7.75 g kg^{-1} with the mean value of 5.75 g kg^{-1} indicating that the soils were low to moderately high in organic carbon content. The magnitude of free $CaCO_3$ content in soil ranges from 1.58 to 10.75 % showed that these soils were slightly calcareous to calcareous in nature. Similar observations have been reported by Jhibhkate *et al*[8]., while studying soils of Katol tahsil of Nagpur district.

Nutrient status of soils

Macronutrient status: The macronutrient status of the nine soil series of Nagpur district is presented in table 2. The available N content varied in the soils under study from 132 to 278 kg ha^{-1} with the mean value of 198 kg ha^{-1} indicating that all soils are found to be deficient in respect of available N content. The soil thus needs judicious application of both organic manure and N fertilizer to meet the N requirement of crop in them. Available N showed significant positive relationship with soil OC (r=0.539**) indicating an increase of available N to the crop with an increase in organic matter in the soil (Table 3). However, significantly negative correlation was obtained with free $CaCO_3$ (r= -0.437**). Similar results were recorded by *Meena et al*[12]., and Dhale *et al*[5].

The Present study revealed that the available P content is low to moderately high ranging between 5.14 to 24.56 kg ha^{-1}. These

results were well within the range described by Dhale *et al*[5].

Available K content of the studied soils was high to very high (255-446 kg ha^{-1} with a mean value of 323 kg ha^{-1}). The high potassium content may be attributed to presence of potassium supplying minerals in parent rocks of the area. The available P and K does not show any relationship with soil chemical properties. Similar report was also reported by Kashikar[9] in black soil.

Available S content in the soil is low ranging from 5.23 to 23.15 kg ha^{-1} with the mean value of 11.15 kg ha^{-1}. The most common cause of sulphur deficiency in these soils may be due to use of S free fertilizer like Urea and DAP. Available S found negatively correlated with pH (r= -0.395**) and free $CaCO_3$ (r=-0.314**). Similar values and relation was recorded by Sharma *et al*[15].

Micronutrient status: The DTPA-extractable Zn present in the soil ranged from 0.29 to 1.44 mg kg^{-1} with an average value of 0.52 mg kg^{-1}. Considering the critical limit of 0.5 mg kg^{-1} Zn[6], the soils under study was categorized as low to marginal in available Zn status. The available Zn in soil has been found negatively correlated with free $CaCO_3$ (r= -0.268**). These results are in agreement with Gajbhiye *et al*[6].

No deficiency was observed in DTPA-extractable Cu, as it ranged from 1.11 to 3.26 mg kg^{-1} with the mean value of 1.89 mg kg^{-1}. Negative and significant relation between Cu and soil pH was observed (r= - 0.289**). A decline in pH of the soil leads to significant increase in Cu availability. Similar correlation coefficient were also worked out by Bhandari and Randhawa[2] (1985). The data also indicated that Cu was positively and significantly correlated with soil OC (r= 0.562**). Similar results were reported by Khalifa *et al*[10].

The DTPA-extractable Mn was sufficient in the studied soils, as it varied from 6.62 to 17.44 mg kg^{-1} with the mean value of 11.25 mg kg^{-1}. Similar results were recorded by Chinchmalapure *et al*[4]., while studying micronutrient status of soils from micro watershed of Wunna catchment near Nagpur. Manganese had significantly positive correlation with soil OC (r= 0.398**) and this might be due to the fact that organic matter may supply chelating agent. A significant negative correlation was observed between Mn and free $CaCO_3$ (r= -0.437**). These relations were in conformity with the results of Yadav *et al*[17].

Considering the critical limit of < 0.5 mg kg^{-1} Fe, twenty percent soil samples was observed deficit in DTPA-extractable Fe which varied from 4.10 to 10.70 mg kg^{-1} (mean 5.76 mg kg^{-1}). The DTPA-extractable Fe bears negative and significant relationship with free $CaCO_3$ (r= -0.372**). The negative relationship with $CaCO_3$ might be due to the fact that increase in $CaCO_3$ content favors the precipitation of Fe^{2+} to Fe^{3+} ions into insoluble hydroxides or transformation of available Fe into carbonates by $CaCO_3$ present in the soil. Similar trend was reported by Patil et al[14]., and Chinchmalapure *et al*[4].

Table 1: Physico-chemical properties of different soil series of Bhiwapur tahsil

Soil series association	No. of village covered	No. of sample collected	pH	EC (dS m^{-1})	OC (g kg^{-1})	Free $CaCO_3$ (%)
Linga-Panara	6	6	7.4-7.8 (7.61)	0.12-0.26 (0.17)	3.45-5.85 (5.10)	1.58-4.57 (3.51)
Linga-Karla	5	5	7.7-8.0 (7.86)	0.15-0.23 (0.18)	5.30-7.53 (5.83)	3.25-6.75 (4.57)
Aroli-Linga	6	6	7.3-7.9 (7.7)	0.15-0.34 (0.20)	4.80-7.05 (5.92)	2.36-5.75 (4.37)
Yenwa-Muserkhapa-Pardi	6	6	7.1-8.1 (7.6)	0.10-0.27 (0.16)	4.95-7.75 (6.37)	1.98-8.75 (5.08)
Karla-Muserkahapa	4	4	7.3-7.7 (7.55)	0.17-0.36 (0.18)	5.10-7.36 (6.46)	2.57-5.75 (3.92)
Muserkhapa-Pardi	5	5	7.1-8.2 (7.76)	0.10-0.36 (0.23)	4.35-6.73 (5.45)	3.67-10.75 (5.83)
Borgaon-Ronghha	5	5	7.5-8.0 (7.8)	0.16-0.22 (0.20)	4.50-6.23 (5.01)	4.87-10.25 (6.72)
Rongha-Magarli	4	4	7.5-7.8 (7.62)	0.15-0.32 (0.21)	4.80-7.20 (5.78)	3.25-9.27 (5.61)
Wadhona-Aroli	5	5	7.1-7.7 (7.38)	0.10-0.32 (0.20)	3.90-6.73 (5.31)	2.59-9.38 (4.64)
Overall mean						

Table 2: Macro and micronutrient status of different soil series of Bhiwapur tehsil

Soil series association	No. of village covered	No. of sample collected	Macronutrients (kg ha^{-1})				Micronutrients (mg kg^{-1})			
			N	P	K	S	Fe	Mn	Zn	Cu
Linga-Panara	6	6	163-241 (196)	9.5-17.6 (12.5)	281-376 (321)	6.33-16.98 (13.26)	5.98-10.17 (7.71)	7.75-14.11 (10.45)	0.50-0.90 (0.68)	1.18-2.12 (1.60)
Linga-Karla	5	5	159-275 (205)	7.1-15.2 (11.5)	258-336 (306)	5.23-22.05 (10.74)	4.78-8.71 (6.10)	7.51-13.42 (10.76)	0.39-0.59 (0.48)	1.13-2.97 (2.16)
Aroli-Linga	6	6	169-219 (202)	11.1-21.2 (16.7)	255-371 (305)	8.23-17.88 (11.81)	4.58-8.70 (5.69)	7.33-17.44 (12.52)	0.39-1.03 (0.65)	1.20-2.52 (1.84)
Yenwa-Muserkhapa-Pardi	6	6	183-278 (222)	12.5-24.5 (19.1)	259-425 (331)	6.23-21.45 (14.39)	4.10-8.86 (6.16)	6.67-15.62 (10.04)	0.38-1.44 (0.69)	1.75-3.26 (2.66)
Karla-Muserkahapa	4	4	163-198 (179)	6.5-12.5 (9.2)	280-379 (328)	8.87-15.45 (12.13)	4.98-7.32 (5.62)	8.44-14.42 (11.29)	0.40-1.30 (0.64)	1.50-2.29 (1.85)
Muserkhapa-Pardi	5	5	166-274 (225)	1o.2-23.4 (17.7)	294-446 (342)	6.25-23.15 (15.12)	4.33-5.82 (4.91)	8.58-16.94 (12.81)	0.33-0.75 (0.48)	1.29-2.19 (1.88)
Borgaon-Ronghha	5	5	172-216 (194)	6.3-11.5 (8.6)	256-366 (318)	9.66-13.57 (11.70)	4.10-7.48 (5.38)	7.12-17.12 (12.50)	0.29-0.71 (0.40)	1.36-3.01 (2.20)
Rongha-Magarli	4	4	144-218 (189)	6.1-11.8 (8.9)	313-400 (347)	6.98-12.83 (8.48)	4.33-5.12 (4.73)	7.0-14.56 (10.81)	0.33-0.50 (0.40)	1.29-2.17 (1.88)
Wadhona-Aroli	5	5	132-214 (168)	5.1-12.8 (8.4)	256-373 (310)	8.89-19.23 (13.3)	4.19-7.48 (5.73)	6.62-15.96 (10.27)	0.40-0.66 (0.46)	1.11-2.21 (1.54)

Table 3: Correlation between soil properties and macro and micronutrients

Soil properties	Macronutrients				Micronutrients			
	N	P	K	S	Fe	Mn	Zn	Cu
pH	--	--	--	-0.395**	--	-0.289**	--	--
EC	--	--	--	--	--	--	--	--
OC	0.539**	--	--	--	--	0.562**	0.398**	--
$CaCO_3$	-0.437**	--	--	-0.314**	-0.268**	--	-0.437**	-0.372**

CONCLUSION

The study concludes that the soils of different soil series Bhiwapur tahsil of Nagpur district were low in available nitrogen, phosphorus and sulphur, high to very high in available potassium. The available Mn and Cu are well supplied in these soils but observed some deficiency of available Fe and Zn. The present investigation gives information regarding the fertility status of soils from different soil series of Nagpur district which shall help in the formulation of integrated nutrient management schedule for the better productivity of crops and sustainability of soil fertility.

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