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Distribution of macronutrients (N, P, and K) in *Alfisol* of Balodabazar block in Balodabazar district of Chhattisgarh

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Abstract
Evaluation of the soil fertility status of *Alfisol* group of Balodabazar block of Balodabazar district of Chhattisgarh was carried out during 2016-17. Grid-based surface (0-15 cm) soil samples were collected by systematic survey from 55 villages in Balodabazar block in such that each 10 ha area represented one sampling point and total 251 soil samples covering all soil types out of this, 251 samples were identified from *Alfisol.* These samples were analyzed for pH, EC, organic C, and boron. The pH varied from 5.0 to 7.9 with the mean value 6.4, EC ranged from 0.10 to 0.70 with the mean value 0.25 dS m^{-1}. The variation in organic C content in soil samples was ranged from 0.30 to 0.75 with the mean value 0.25 %. Available N, P, and K status were recorded as 105 to 263 (187 kg ha^{-1}), 2.4 to 32.8 (17.8 kg ha^{-1}) and 156 to 683 (413 kg ha^{-1}), respectively. Available N had a significant positive correlation with organic carbon (r=0.843). EC indicated significant and positive correlated with pH (r=0.254) and available P had a positive nonsignificant correlation with organic carbon (r= 0.081).

Keywords: DTPA-extractable macronutrient, fertility status, *Alfisol*

Introduction

Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have a high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Goovaerts, 1998) [2]. However, major constraints impede wide-scale adoption of soil testing in most developing countries. In India, these include the prevalence of smallholding systems of farming as well as the lack of infrastructural facilities for extensive soil testing (Sen *et al*. 2008) [9]. Under this context, Geographic Information System (GIS)-based soil fertility mapping has appeared as a promising alternative. Use of such maps as a good decision support tool for nutrient management will not only be helpful for adopting a rational approach compared to farmer's practices or blanket use of state recommended fertilization but will also reduce the necessity to elaborate plot-by-plot soil testing activities. However, information pertaining to such use of GIS-based fertility maps are meager in India (Sen *et al*., 2008) [9]. Soil fertility maps are meant for highlighting the nutrient needs, based on fertility status of soils to realize good crop yields. Obviously, a soil fertility map for a particular area can prove highly beneficial in guiding the farmers, manufacturers, and planners in ascertaining the requirement of various fertilizers in a season/year and making projections for increased requirement based on cropping pattern and intensity. Availability of reliable soil fertility map is the bottleneck for providing spatial fertilizer recommendation. If such maps are made available it is possible to transform the fertilizer equations into spatial fertilizer recommendation maps. The recommendations can be obtained by an extension agent/farmer simply by locating his area on the map. The soil fertility maps can be linked with the various parameters to yield a recommendation map. A farmer can find out from such map the correct amount of fertilizer for potential yield. Such maps can also be constructed for different yield levels. The application of soil fertility maps for spatial fertilizer recommendation is described by Grandzinski *et al*. (1998) [3]. The major constraint in the preparation of the spatially variable fertilizer recommendation maps is the availability of reliable fertility maps and expertise in the application of GIS, crop simulation models, and remote sensing. Preparation of reliable soil fertility map is a difficult task. The variability infertility 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 and soil types can account for most of the natural variation in fertility.

Materials and Methods

Balodabazar block is located in Balodabazar district of Chhattisgarh. The nearest major railhead is Bhatapara railway station is 24.8 km away from its district main city. It is located 85.7 km away from capital city Raipur of the Chhattisgarh. A different group of soils covered *viz Inceptisol, Alfisol Entisol,* and *Vertisol* under Balodabazar block. The *Alfisol* group of the soil has been taken for fertility evaluation under various aspects. Soil samples (0-15 cm depth) were collected from Balodabazar block using GPS marked.The scale of 1:4000 has been used as the cadastral map for conducting the field survey works. Soil samples (15 cm) were collected from each grid point using soil auger and local spade with proper labels. Soil samples collected from the study area were dried and crushed with the help of wooden rod and passed through 2 mm sieve and stored in properly labeled plastic bags for analysis by adopting standard laboratory methods. Soil pH was determined by glass electrode pH (Piper, 1967) [8], Electrical Conductivity with Solu-bridge method (Black, 1965) [1], Soil organic C (Walkley and Black, 1934) [14]. Available N was determined by alkaline $KMnO_4$ method (Subbiah and Asija, 1956) [12], available P determined with 0.5 M $NaHCO_3$ described by Olsen, 1954 and Available K was determined by neutral ammonium acetate (Hanway and Heidal, 1952) [4].

Results and Discussion

Physico-chemical properties of soils

The results of soil analysis pertaining to some salient properties under study are presented in Table No 1. The mean values of different parameters indicated that Inceptisol of the area under study was slightly acidic in nature, normal in salinity, low in organic C, available N, P and medium in available K.

Table 1: Salient soil properties of study area

Soil characteristics	Range	Mean
pH (1:2:5, Soil water)	5-7.9	6.4
E.C.(dS m^{-1})	0.10-0.70	0.25
O.C. (%)	0.30-0.75	0.25
Available N (kg ha^{-1})	105-263	187
Available P (kg ha^{-1})	2.4-32.8	17.8
Available K (kg ha^{-1})	156-683	413

Available macronutrient status of soils

The available N content ranges from 105 to 263 kg ha^{-1} with mean values 187 kg ha^{-1} Considering the soil test rating for available N (<280 as low, 280-560 as medium and >560 as high in the status of N), the soil samples i.e. 100% were found as low available N content in Alfisol. In this way, almost all the soil samples tested for available N were found to be deficient in N. Similar results reported by Jatav (2010) The average available P content ranged from 2.4 to 32.8 kg ha^{-1} with an average value of 17.8 kg ha^{-1} Considering the soil test rating for available phosphorus (<12.5 kg ha^{-1} as low, 12.5-25 kg ha^{-1} as medium and > 25 kg ha^{-1} as high) majority of the soils fell under low status. These reactions affect the availability of P and as a result of these reactions, a very small amount of total P is present in soil solution at any time reflected by soil testing. However, a low to medium range of soil available P under study area may be most affected by past fertilization, pH, organic matter content, texture various soil management and agronomic practices. Similar results finding by Shukla (2011) [11]. The results showed that the available potassium content ranges from 156-683 kg ha^{-1} with an average value of 413 kg ha^{-1}. Considering the soils having <135 kg ha^{-1} as low, 135-335 kg ha^{-1} as medium and >335 kg ha^{-1} as high in available potassium content. 74.9% samples were found high available K content. Similar results finding by Vaisnow (2010) [13].

Relationship between soil characteristics and available N, P, and K in *Alfisols*

Available N had a significant positive correlation with OC (r=0.843) as presented in Table No 2. The results indicated that available N increased with the rise in OC. Similar results reported by Kumar *et al.* (2009) [5] and Shukla (2011) [11] in the *Alfisols* orders of Pamgarh block in Janjgir-Champa district (C.G.). N also showed positive and non-significant correlation with EC (r=0.091) and pH (r=0.073). A similar result was found by Sharma *et al*., 2008 [10].

Table 2: Correlation coefficient (r) between physicochemical properties and available N, P, and K in *Alfisols*

	pH	EC	OC	N	P	K
pH						
EC	0.254**					
OC	-0.069	0.009				
N	0.073	0.091	0.843**			
P	0.057	0.050	0.081	0.077		
K	-0.095	-0.045	-0.068	-0.097	0.025	

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