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VERTICAL DISTRIBUTION OF AVAILABLE MACRO AND MICRONUTRIENTS IN NAGALVADI MICRO - WATERSHED OF WARDHA DISTRICT, MAHARASHTRA

Nilima S. Sadanshiv[1], M.S.S. Nagaraju[2] and Sonal I. Thelkar[3]

ABSTRACT

Studies undertaken to assess the nutrient status of soils of Nagalvadi micro-watershed is located in Karanja tehsil of Wardha district, Maharashtra during the year 2014-2015. Nutrient status in soil profiles of Nagalvadi micro-watershed area revealed that the soils were low in available nitrogen (185 to 260 kg ha^{-1}), very low to medium in available phosphorus (1.4 to 14.8 kg ha^{-1}), low to very high in available potassium (123 to 504 kg ha^{-1}). The DTPA extractable available micronutrients Fe, Mn, Cu and Zn ranged from 9.8 to 32.7 mg kg^{-1}, 17.9 to 87.9 mg kg^{-1}, 3.9 to 6.6 mg kg^{-1} and 0.31 to 0.97 mg kg^{-1} soil, respectively. Available micronutrients were deficient to sufficient in Zn and sufficient in available Cu, Fe and Mn in the surface and sub-surface layers of the soil profiles.In general, the decreasing trend of these macro and micronutrients content down the profile was observed in all the soils.

(Key words: Available N,P,K, available micronutrients, nutrient status)

INTRODUCTION

Soil fertility has a direct relation with the crop yields, provided other factors are in optimum level. Soil fertility must be periodically estimated as there is continuous removal of macro and micro nutrients by the crop intensively grown in every crop season. In order to achieve higher productivity and profitability, every farmer should realize that fertility level must be measured as there measurements can then be used to manage soil fertility. Balanced nutrient use ensures high precaution levels and helps to maintain the soil health. Fertilizing the soils to bring all the deficient elements at high levels as to provide sufficient ionic activity in soil solution for crop uptake is one of the most important consideration for maximization of the crop yield (Hadiyal *et al.*, 2016). The soil fertility status exhibits the status of different soils with regard to amount and availability of nutrients essential for plant growth. The crop growth and yield largely depend upon potential of soil resources and their characteristic provides water, nutrients and anchorage for the growth and yield of crops. The available macro and micronutrients in the soil profiles aid in determining the soil potential, which are essential for better scientific utilization of crop growth (Rajeshwar and Ramulu, 2016). Such soils database is of limited availability, In order to provide a base line data and information, the present study was undertaken to study the soils of Nagalvadi micro-watershed of wardha district, Maharashtra.

MATERIALS AND METHODS

The present study was undertaken to assess the nutrient status of soils of micro-watershed during the year 2014-2015. Geographically, the study area Nagalvadi micro-watershed is located in Karanja tehsil of Wardha district, Maharashtra and lies between 78°26' to 78°27'E longitudes and 21°8' to 21°10'N latitudes in part of Survey of India (SOI) toposheet (55 K/8) with an area of 572.3 ha.The geology of the area is basalt. The elevation ranges from 460 to 500 m above mean sea level (MSL). The climate is sub-tropical dry sub-humid with mean annual maximum and minimum temperature is 32.6°C and 19.4°C respectively. The mean annual rainfall is 1134.40 mm. The area qualifies for ustic soil moisture regime and hyperthermic soil temperature regime.

Horizon-wise soil samples were collected from representative pedons of soil series (Nagalvadi 1 to Nagalvadi 5). Soil samples were air dried, processed, passed through 2 mm sieve for analysis of nutrients. The pH and EC were measured in 1:2.5 soil water suspension using pH meter and EC meter respectively. Soil organic carbon content was estimated by Walkley and Black (Jackson, 1967) method.The available N was determined by using alkaline potassium permanganate ($KMnO_4$) solution and determining the ammonia liberated (Subbiah and Asija, 1956). Available phosphorus was determined by using sodium bicarbonate $NaHCO_3$ (0.5M) extractant as per Watanabe and Olsen (1965) method. The available K was determined by using neutral ammonium acetate method and the potassium in extract was

1 and 3. Ph.D Scholar, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
2. Principal Scientist, NBSS & LUP, Nagpur, Maharashtra

determined by flame photometer (Jackson, 1967). The micronutrients (Fe, Mn, Cu, Zn) from soils were extracted with 0.005 Diethylene Triamine Penta Acetic acid (DTPA) as per method out lined by Lindsey and Norvell (1978).

RESULTS AND DISCUSSION

Physico-chemical properties of study area

The data presented in table1 indicate that the soils of the watershed are neutral to strongly alkaline with pH values ranging from 7.3 to 8.6. Based on pH values, the soils of the area have been grouped as neutral (NG-1, NG-3, NG-4), moderately alkaline (NG-2) and strongly alkaline (NG-5). The higher pH in soils of valley (NG-5) may be due to the accumulation of calcium carbonate and soluble salts which are being washed down from upper elevation and basaltic parent material (Chinchmalatpure *et al.*, 2000). Similar results were reported by Bante *et al.,*(2012) that soils are neutral to slightly alkaline pH 6.4 to 8.2. Higher pH in soils of lower elevations may be due to more accumulation of bases removed from soils of upper elevations. The relative high value of pH of these soils might be due to high degree of base saturation (Mali and Raut, 2001).

The low EC values of these soils were in safe range from 0.06 to 0.27 dSm^{-1}, which are within the acceptable limit and the soils have no salinity hazard at present. The low EC values were observed in these soils may be due to leaching of salts from surface layer soils.

Organic carbon content in soils ranged from 0.32 to 0.91 per cent in different horizons. Soils of NG-2 and NG-5 have higher organic carbon content whereas, soils of NG-1, NG-3 and NG-4 have lower organic content. The decreasing trend of organic carbon content with increasing depth was noticed, which may be attributed to reduced biological activity. Similar results were reported by Bante *et al.* (2012) that organic carbon content of soils ranged from 0.26 to 1.35 per cent in general, decrease with depth. These findings are in conformity with the findings of Likhar and Prasad (2011), who noticed that the soils of Nagpur district showed the higher organic carbon in surface layers than underlying horizons.The variation in the organic carbon content of soil may be attributed to the factor like high temperature of Wardha district (32.6^{0}C) which was responsible to hasten the rate of oxidation as well as very little amount of organic matter and crop residues are added in the soil (Malewar , 1995).

Nutrient status and soil fertility

Available macronutrients

The soil fertility status exhibits the status of different soils with regard to amount and availability of nutrients essential for plant growth. The available soil nitrogen content of the surface and sub-surface soils ranges from 185 to 260 kg ha^{-1} and found low in all the pedons throughout the depth. However, available N content was found to be maximum in surface horizon and decreased regularly with soil depth, which might be due to the confinement of falling of plant residues and debris and rhizosphere of plants and might be due to decreasing trend of organic carbon with depth (Prasuna *et al.* 1992).Similar results were reported by Verma *et al.,*(2013) that 99.56 per cent soil samples were found as low in available N content in inceptisol of Malkharauda block in Janjgir district of Chhattisgarh.

The available phosphorus content of the surface soils varied from 1.4 to 14.8 kg ha^{-1}. The soils of NG-1, NG-3, NG-4 and NG-5 are very low, whereas, soils of NG-2 are medium in available P. However, the highest available P was observed in the surface horizons and decreased regularly with depth. The reason for higher P in surface horizon might possibly be the confinement of crop cultivation to the rhizosphere and supplementing of the depleted phosphorus through external sources *i.e.* fertilizers. Similarly, Gajare *et al.* (2014) reported that available phosphorus in soils of Latur district was varied from 0.20 to 21.15 kg ha^{-1} out of 140 soil samples 66.43 per cent were low and 33.57 per cent samples were found medium in available phosphorus content. Similar results were reported also by Verma *et al.,* (2013) that 88.13 per cent samples of study area were categorized under low status in available phosphorus.

The available potassium content of the surface and sub-surface soils varied from123 to 504 kg ha^{-1}. The soils of NG-4 are low, soils of NG-3 are medium and soils of NG-1 are moderately high, whereas, soils of NG-2 and NG-5 are very high in available K. However, the highest available K was observed in the surface horizons and showed decreasing trend with depth. Similarly, Paramasivan and Jawahar (2014) reported that available K was high in all soils with the range of 388 to 432 kg ha^{-1}. Similar results were reported by Verma *et al.,* (2013) that the soils having 3.55 per cent in low, 66.83 per cent medium and 29.62 per cent samples had high in available K content.This could be attributed to more intensive weathering, release of labile-K from organic residues, application of K fertilizers and upward translocation of K from lower depths along with capillary rise of ground water.

Available micronutrients

The DTPA extractable Fe ranges from 9.8 to 32.7 mg kg^{-1} and found to be much higher than the critical level of 4.5 mg kg^{-1}(Lindsey and Norvell, 1978) in all the soils. This high Fe content in soil was due to the presence of minerals like feldspar, magnetite, hematite and limonite which together constitute bulk of trap rock in these soils. Pharande *et al.* (1996) also recorded the available Fe in Vertisol of Maharashtra in the similar range from 3.52 to 19.44 mg kg^{-1}. The results are also in accordance with the findings of Abrahim *et al.* (2011), they reported that soils of Billari local area were adequate in iron content. Patil *et al.* (2004) reported 40 and 34.7 % soils deficient in zinc and iron in Vidarbha. The deficiency of iron in pre-dominantly clay black soils of Wardha can also be attributed to their alkaline nature (Patil and Kharche, 2006).

Table 1. Soil physico-chemical properties and available nutrient status of the study area

Horizon	Depth (cm)	pH (1:2.5)	EC (dSm^{-1})	OC (%)	Available macronutrient ($kg\ ha^{-1}$) N	P	K	Available micronutrient ($mg\ kg^{-1}$) Fe	Mn	Cu	Zn
NG-1 Series (Very gently sloping plateau):Clayey, smectitic, hype rthermic Lithic Ustorthents											
Ap	0-18	7.4	0.06	0.38	185	1.4	224	32.7	87.9	6.6	0.94
NG-2Series (Very gently sloping plateau): Fine, smectitic, hyperthermic, VerticHaplustepts											
Ap	0-15	7.8	0.20	0.91	259	14.8	157	16.1	39.9	5.5	0.97
Bw1	15-40	8.2	0.17	0.52	172	10.1	179	12.7	30.0	4.0	0.62
Bw2	40-73	8.3	0.14	0.44	160	9.6	504	13.4	26.3	3.9	0.35
NG-3 Series (Very gently sloping plateau):Clayey -skeletal, smectitic, hyperthermic Lithic Ustorthents											
Ap	0-20	7.3	0.13	0.32	222	2.7	168	32.3	50.3	5.9	0.63
NG-4 Series (Very gently sloping pediment):Clayey, smectitic, hyperthermic Lithic Ustorthents											
Ap	0-19	7.3	0.21	0.38	260	2.0	123	28.8	49.2	6.2	0.61
NG-5 Series (Level to nearly level valley):Very -fine, smectitic, hyperthermic Calcic Haplusterts											
Ap	0-19	8.4	0.26	0.73	247	12.0	470	15.7	39.1	6.4	0.53
Bw1	19-45	8.5	0.19	0.48	169	11.9	302	12.8	26.8	4.7	0.39
Bss1	45-78	8.5	0.23	0.44	143	10.8	190	10.8	21.2	4.7	0.31
Bss2k	78-106	8.6	0.27	0.45	117	8.6	157	10.6	18.2	4.6	0.37
Bss3k	106-150	8.6	0.24	0.41	104	6.4	190	9.8	17.9	5.6	0.37

*NG= Nagalvadi

The DTPA extractable Mn content varies from 17.9 to 87.9 mg kg^{-1} and found to be much higher than the critical level of 3.0 mg kg^{-1} (Takkar *et al.,* 1989) in all the soils. Mn deficiency usually does not occur in black soils because a sizeable portion of Mn is bound with manganese oxide which may be readily available. This high status of Mn might be due to the fact that lower oxidation states of Mn were more soluble than higher oxidation state at normal pH range of soils and oxidation of divalent Mn^{++} to trivalent Mn^{+++} by certain fungi and bacteria. The similar range of available Mn was reported in the soils from Rajasthan (Mahesh kumar *et al.,* 2011), the Mn varied from 6.1 to 31.6 mg kg^{-1} and decreased with depth in all the pedons.

Cu content of the soils varies from 3.9 to 6.6 mg kg^{-1} and decreased with depth. The Cu content is higher than the critical value of 0.2 mg kg^{-1} (Katyal and Randhawa, 1983) in all the soils. This Cu content could be attributed to the difference in geology, physiography and degree weathering in these soils. The similar range of available Cu also observed by Patil and Meisheriq (2004). Similarly, Kirmani *et al*. (2011) also reported high copper content in soils of Budgam district. Similar results also reported by Mahesh kumar (2011) that the cu in different soils ranged from 0.22 to 3.4 mg kg^{-1} and decreased with depth.

Zn content of the soils ranged from 0.31 to 0.97 mg kg^{-1}. The soils of NG-1, NG-2 and NG-3 are sufficient in Zn content. The soils of NG-4 and NG-5 showed zinc deficiency against critical level of 0.6 mg kg $^{-1}$ (Katyal and Randhawa, 1983) and need to be supplemented.This is might be due to the fact that in well drained, aerated, calcareous soils, zinc exits in oxidized state and their availability becomes very low (Malewar, 1995). Patil and Shingte (1982) also observed the available Zn content of soils in the similar range of 0.15 to 2.00 ppm in Pune region. Some Alfisols from Meghalaya, Inceptisol from Maharashtra, Vertisol and Alfisol in Maharashtra also showed the content of Zn in the similar range (Pharande *et al*., 1996).Patil and Kharche (2006) reported widespread deficiency of zinc in intensively cultivated districts of Western Maharashtra having pre-dominantly alkaline, calcareous, black clay soils.

Physico-chemical characteristics of soils in Nagalvadi micro-watershed of Wardha district, Maharashtra have been studied to assess the profile wise nutrient status regarding to the macro and micronutrients in soil profiles. Soils were low in available N, very low to medium in available P, low to very high available K in all the profiles and deficient to sufficient in Zn and sufficient in available Cu, Fe and Mn in the surface and sub-surface layers of the profiles.

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