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Soil fertility status in Taluks of Chitradurga district under zero budget natural farming of Karnataka

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Abstract
The study was conducted to evaluate the nutrient status of selected villages under six taluks of Chitradurga District. For this purpose, 854 surface soil samples were collected from six taluks of Chitradurga district in Karnataka. The results showed that soil pH varied from 6.00-8.00 slightly acidic to slightly alkaline and EC is non-saline nature. Soils were found to be low too high in available nitrogen (46-400 kg kg N ha) and samples fall under medium to high available phosphorus (>22.50 kg P ha) category. The available potassium status in surface soils of different talukas ranged from 94.08 to 685.44 kg ha. Available sulphur content in soil varied from 2.85 to 24.60 kg ha^{-1}. Among the 854 samples of the six taluks, Maximum soil samples area showing sufficient in zinc status, only <10% samples were deficient in Cu. Manganese deficiency in the study area was only <2%, when compared to other micronutrients and soils were deficient on hot water soluble boron in Chitradurga district.

Keywords: Nutrient, OC, Chitradurga

Introduction
Soil is the most vital and precious natural resource that sustains life on the earth. The sustainability of a productive soil mainly depends upon its ability to supply essential nutrients to the growing plants. Soil fertility is one of the important factors controlling the crop yields. Intensively cultivated soils are being depleted with available nutrients especially secondary and micronutrients. Soil fertility deterioration is a major constraint for higher crop production in Karnataka. Intensive agriculture without adequate and balanced use of chemical fertilizers, non-ecofriendly tillage practices, and with little or no use of organic manure caused severe fertility deterioration of agricultural soils resulting in stagnating or even declining of crop productivity and soil health (Baruah *et al*., 2013) [3] only. The deficiency of these nutrients in crops leads to various types of disorders in many commercially important crops (Duarah *et al*., 2011) [9]. Soil testing provides the information about the nutrient availability of the soil upon which the fertilizer recommendation for maximizing crop yield is made
Nutrient availability plays an important role in crop production and it depends on soil, climate, cropping system, management practices etc (Raysschaert *et al*., 2004) [15]. Evaluation of soil fertility thus, serves as one of the most important tool to achieve higher crop yields. Soil tests provide information about nutrient availability upon which the fertilizer recommendations could be made for maximizing crop yields. Nitrogen, phosphorus, potassium and sulphur are important soil elements that control the fertility and yield of crops. Soil related limitations affecting the crop productivity including nutritional disorders can be determined by evaluating the fertility status of the soils. Maintenance of optimum concentration of plant nutrient in soil has resulted in obtaining sustainable growth and yield.

Materials and Methods
Chitragurga area falls under Southern Plateau and Hills Region (10) Altitude 14º13'18.40" N Latitude 76º24'02.31 "E. Longitude it comprises of six taluks. To study the fertility status of soils six taluk was selected, 854 villages have been identified. Out of 854 soil samples were collected from Chitradurga district.

From each taluka, 148 soils samples from Molakalmaru (MLK), 130 from Chitradurga (CTA), 175 from Holalkere (HLK) 151 from Hosdurga (HSD), 116 from Hiriyur (HYR) and 134 from Chalkere (CLK) talukas.

Surface soil samples from 0-15 cm depth were collected from 6 Chitradurga district. Soil samples collected were air dried, processed to pass through 2 mm sieve and analyzed for pH (1:2.5 soil:water ratio) by pH meter (Model Systronics 361); soil organic matter by wet oxidation method (Walkley and Black, 1934) [18]; and free CaCO3 content by acid titration (Richards, 1954). Among major soil nutrients, alkaline potassium permanganate method for available-N (Subbiah and Asija, 1956) [17]; ammonium molybdate complex colorometric method for available P (Jackson, 1973) [11] and ammonium acetate extractant - flame photometric method for available K (Jackson, 1973) [11] were adopted. The secondary nutrients namely, available-S was determined by versenate titration and turbidometric method respectively (Black, 1965) [4]. DTPA extractable Zn, Fe, Cu and Mn was determined by atomic absorption spectrophotometer (Lindsay and Norvell, 1978) [12] and hot water soluble Boron by method outlined by Wolf, 1974. Based on the soil test values for different nutrients, soil samples were generally classified into three categories viz., low, medium and high.

Soil pH and EC

Data presented in Table 1, showed that all soil samples of the selected tehsils chitradurga district soil pH varied from 6.00-8.00 with an average of 7.16. According to classification of soil reaction suggested by Brady (1985) [5], soils are of slightly acidic to slightly alkaline in soil reaction. The minimum value of pH (6) was noticed in MLK, CTA and HLK taluks. The slightly acidic pH in the soils may be attributed to rainfall associated with 3+ loss of bases due to leaching and presence of Al on exchange complex. Due to precipitation and less evaporation demand, the salt accumulation is not prevalent in this region, which is suitable for crop growth. The electrical conductivity of soils varied from 0.07-0.99 dSm^{-1} with an average of 0.23 dSm^{-1}. On the basis of limits for salt problems of soils, all the samples were found to be normal.

Table 1: Status of major nutrient in surface soils of Chitradurga district

Taluks	Total number of samples	pH	EC dSm^{-1}	OC (%)	Available major nutrients (kg/ha)				Available micro nutrients (ppm)				
					Avail. N	Avail. P	Avail. K	Avail. S	Zn	Avl B	Fe	Mn	Cu
MLK	148.00	6.00-8.00	0.13-0.80	0.19-1.00	46.00-238.00	22.37-64.42	134.40-685.44	7.63-20.25	0.31-1.18	0.07-1.64	2.23-5.28	0.75-2.65	0.09-0.39
		7.16	0.30	0.50	120.16	42.87	288.78	13.95	0.67	0.33	3.96	1.79	0.21
CTA	130.00	6.00-7.80	0.13-0.99	0.30-1.19	72.50-283.50	26.54-90.97	134.40-389.76	4.10-12.53	0.17-1.96	0.25-0.96	1.32-4.00	0.06-2.39	0.04-0.97
		6.74	0.28	0.67	160.58	54.26	247.71	7.88	0.84	0.49	2.32	1.32	0.44
HLK	175.00	6.00-7.90	0.11-0.67	0.21-0.66	51.00-157.00	22.37-73.97	134.40-537.60	2.85-16.15	0.16-1.69	0.25-1.04	0.74-4.56	0.01-4.94	0.01-1.19
		6.95	0.32	0.38	90.58	45.86	275.79	9.11	0.64	0.50	2.39	1.64	0.36
HSD	151.00	6.70-7.60	0.11-0.43	0.19-1.02	46.00-242.00	13.12-137.49	201.60-537.60	5.65-17.00	0.02-2.26	0.10-0.69	0.41-2.22	0.34-2.51	0.01-1.16
		7.00	0.23	0.65	154.55	50.82	325.32	9.57	0.67	0.36	2.42	1.22	0.43
HYR	116.00	6.10-7.80	0.10-0.48	0.23-1.68	54.50-400.00	12.82-214.74	120.96-456.96	6.20-17.85	0.08-1.82	0.11-0.78	1.61-4.93	0.29-2.51	0.02-0.81
		7.15	0.23	0.57	136.67	43.93	261.15	12.86	0.68	0.38	2.95	1.28	0.28
CLK	134.00	6.10-7.90	0.07-0.56	0.24-1.44	57.50-342.00	22.37-94.84	94.08-510.72	7.90-24.60	0.31-1.18	0.15-0.85	2.23-5.28	0.75-2.65	0.09-0.39
		7.27	0.22	0.72	170.95	52.88	275.12	14.24	0.65	0.46	3.90	1.79	0.21

Soil Organic Carbon

The soil organic carbon content in the survey area ranged from 0.19-1.68% with an average of 0.58%. The majority of soil samples organic carbon content was low (than the rate of decomposition, SOM will decline and, conversely if the rate of organic matter addition is greater than the rate of decomposition, SOM will increase (David, 2004) [7]. This might be the reason for variation in organic carbon in different taluks of Chitradurga district. The minimum value of soil organic carbon (0.19%) was noticed in MLK, HSD taluks. Whereas higher soil organic carbon was found in CTA, HYR and CLK taluks. Organic Carbon Soil organic matter (SOM) generally increases where biomass production is higher and where organic material additions are common. As the district is dry having high temperature with low in rainfall resulted in faster decomposition and lesser status of organic carbon. Intensive cultivation affects the soil aggregates increasing the rate of SOM decomposition. Stable soil aggregates increase active organic matter and protect stable organic matter from rapid microbial decomposition (Preston Sullivan, 2000) [14]. Measures that increase soil moisture, soil temperature and optimal aeration accelerate SOM decomposition.

Available nitrogen

Available nitrogen status in surface soils varied from 46-400 kg ha with an average value of 138.92 kg ha^{-1}. In general available nitrogen ranges from low to high and higher available nitrogen was recorded in HYR and CLK taluks. The available nitrogen was low in MLK, HLK and HSD taluks amd higher available nitrogen was recorded in HYR (400 kg ha^{-1}) and CLK (342 kg ha^{-1}) and CTA (283.50 kg ha^{-1}) taluks. The variation in N content may be related to available organic carbon status, management practices, application of FYM and fertilizer to previous crops (Ashok Kumar, 2000). The low organic matter content, low rainfall and vegetation in these soils facilitates faster degradation and removal of organic matter, lost through leaching and volatilization leads to low nitrogen status. The medium N status in soils may be due to continuous application of N fertilizer recommended dose for the crop which maintains the nitrogen status in these soils. (Anon., 1998) [1] reported that 35.8% of the soils in Karnataka state were moderate in available nitrogen particularly in the

areas under irrigation and hilly region of the plateau, while rest of the area was low in available nitrogen content.

Available phosphorus

Available phosphoru status in surface soils varied from 12.82-214.74 kg ha^{-1} with an average value of 48.43 kg ha^{-1}. In general available phosphorus ranges from medium to high and lower value of available phosphorus was recorded in HYR and HSD taluks. The mean value of available phosphorus is high in all taluks as it ranges from (42.87-52.88). Though the phosphorus is the second most limiting element in soil, Available Phosphorus Phosphorus is the second most limiting nutrient often affecting plant growth, which exists in soil in both organic and inorganic forms. Higher P content in soils of the study area might have increased due to addition of phosphatic fertilizers specially the DAP for the crops grown in that area.

Available Potassium

The available potassium status in surface soils of different talukas of chitradurga district ranges from 94.08 to 685.44 kg ha. Considering the mean values, the highest K content of 685.44 kg ha^{-1} K was recorded in MLK taluk and the lowest value of 94.08 kg ha^{-1} in CLK with overall mean value of 278.92 K kg ha^{-1}. All the Taluks of Chitradurga Districts recorded medium to high. In available potassium status, which indicates that K fertilizers were scantily applied in the last 2 decades as the low category has virtually remained the same and the high area has fallen (Datta, 2011) [6]. Response of crops to applied potassium depends on the threshold levels of potassium. Based on available K, buffering capacity, rate constant of release and fixation and threshold levels which predicts potential K supply of a soil. It showed that response of crops to applied fertilizer depends on the position of threshold levels of K release in relation to its present level of available K.

Available sulphur

Available sulphur content in soil varied from 2.85 to 24.60 kg $ha^{-1}$with mean value of 11.26 kg ha^{-1}. The mean available sulphur status was found to be low to high. Lower available sulphur was recorded in HLK taluk (2.85 kg ha^{-1}) and high in CLK (24.60 kg ha^{-1}) considering. About 75% soil samples were found to be deficient. Low level of sulphur is due to lack of sulphur in soils and continuous removal by crops (Balanagoudar, 1989) [2]. According to Scherer *et al*. (2012) [16], organic sulphur was more in surface horizons which could be attributed to the higher organic carbon content in surface layers. Fine textured soils resulted in higher available sulphur (Deveraj, 1994) [8].

DTPA Extractable Micronutrients.

The DTPA-Zn in soils of Chitradurga district ranged from 0.02 to 1.96 ppm. Lower value (0.02) and higher value (2.26 ppm) of Zn content was recorded HSD taluk. Maximum soil samples area showing sufficient in zinc status. In general, the deficiency of Zn was pronounced in most of the villages of the six taluks of Chitradurga district. The DTPA-Fe content varied from 0.41 to 5.26 ppm with mean value of 2.99 ppm. The soils of HLK and CTA show the deficient and remaining all the taluks are sufficient in Fe availability (Nagaraju *et al*., 2015) [13]. Among the 854 villages of the taluks, only <10% samples were deficient in Cu. The variation in the DTPA-Cu availability in district may be attributed to the difference in the topography, texture and organic matter status of soils. Mn is essential to all the organisms and is responsible for the production of molecular oxygen in plants during photosynthesis. Manganese deficiency in the study area was only <2%, when compared to other micronutrients. Hot water soluble boron content in

surface soils ranged from 0.07-1.64 ppm. Maximum soil samples of HYR, HSD and MLK taluks were deficient on hot water soluble boron in Chitradurga district. Soil derived from igneous rocks and those in tropical and temperate region of the world have much lower B concentration than the soils derived from sedimentary rocks and those in arid and semi arid regions (Ho, 2000) [10]. Decrease in hot water soluble boron might also be associated with the surface adsorption of borate by freshly precipitated Al (OH).

Conclusion

The study clearly indicated that soils of Chitradurga district were slightly acidic to slightly alkaline in reaction with non-saline in nature. Available nitrogen ranges from low to high and higher available nitrogen was recorded in HYR and CLK taluks. Available phosphorus ranges from medium to high and lower value of available phosphorus was recorded in HYR and HSD taluks. All the Taluks of Chitradurga Districts recorded medium to high in potassium And available sulphur status was found to be low to high in status. Most of the surveyed areas are sufficient in Zinc, Iron and only <10% samples were deficient in Cu, <2% in Mn and maximum in boron status.

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