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Nutrient Status of Vegetable Growing Soils of Guntur District, Andhra Pradesh

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ABSTRACT

Horizon wise soil samples of six profiles representing red and back soils in the vegetable growing area of Guntur district were studied for their fertility status. All the soils were low to medium in available nitrogen. The P content was medium at the surface and low in subsurface horizons. The K content was medium to high and the sulphur content was sufficient at the surface of the black soils but deficient in red soils and lower horizon of black soils. Total N and P followed a decreasing trend, whereas total K values varied widely. All the samples were sufficiently rich in Mn and Cu , but deficient in Fe.Surface black soils recorded relatively high Zn but red soils and other horizons in black soils recorded Zn values less than the critical limit

Keywords: Black soils, Fertility status, Macro and micronutrients, Red soils.

Vegetables are the relatively cheaper source of vitamins and minerals and can provide good health standards to the people. Economic production of the vegetables largely depends upon the nutrient supplying capacity of the soils. Guntur district has a potenital belt of around 2600 acres of land under different vegetables like coccinia, brinjal, tomato bittergourd etc., in Narakoduru area. The present study was conducted with an obejctive of finding out the petential and available nutrient contents of the soils, as such informatation for this area was lacking.

MATERIAL AND METHODS

Four profiles in black soils (I, II, V and VI) and two profiles in red soils (III and IV) representing the vegetables growing belt of Narakoduru area of Guntur district were opened up to the parent material / hard substratum and horizon wise soil samples were collected.The samples were subjected to total and available nutrient analyses. The available nitrogen was determined by modified alkaline permanganate method (Subbiah and Asija, 1956). Total nitrogen was determined as per the procedure given by Hesse (1971). The available P was estimated by the procedure outlined by Watanable and Olsen (1965). Total P, K and available K contents were determined by the procedures given by Jackson (1973). Avilable sulphur content was determined by turbidimetric method using spectrophotometer (Cottenie *et al.*, 1979).

Available and total micronutrients were estimated by using DTPA extract as given by Lindsay and Norvell, (1978) and Hesse (1971), respectively.

RESULTS AND DISCUSSION

The results pertaining to available and total macronutrients are presented in Table 1 and correlation coefficients showing the relation between soil properties and nutrient contents are given in Table 3. The available nitrogen status of the soils was low to medium with values ranging from 63 to 214 ppm in balck soils and 49 to 142 ppm in red soil profiles. The low nitrogen content could be due to low organic carbon as confirmed by the positive corrrelation (r= 0.830) between organic matter and available nitrogen contents of the soils. Relatively higher values were noticed in surface horizons, which might be due to application of nitrogenous fertilizers and organic manures by the farmers at the surface. Total nitrogen content varied from 392 to 784 ppm in black soils and 336 to 644 ppm in red soil profiles.

The available phosphorus contents varied from 10 to 25 and 7 to 20 ppm in black and red soil profiles, respectively. The P content of surface soils was medium in all the profiles and low in subsurface horizons. More or less a decreasing trend, similar to organic carbon was noticed in all the profiles. A significant positive correlation with organic carbon (r = 0.770) confirmed this relation. Total P varied from 262.5 to 662.5 ppm and 275 to 330.0 ppm in black and red soil profiles, respectively. This might be due to variations in native phosphorus content of soils.

The avialable potassium contents were found to be varying from 75 to 184 ppm. The highest value (184 ppm) was observed in Ap horizon of profile 1 while Bt 3 horizon of profile 4 had the lowest

Table 1. Total and available macronutrient status of the study area

Profile No	Horizon	Depth (m)	Total Macronutrients (ppm)				Available Macronutrients (ppm)			
			N	P	K	S	N	P	K	S
I	Ap	0.00-0.21	784	512	3925	198	214	23	184	14.4
	A2	0.21-0.45	672	660	4025	186	172	19	175	12.8
	A3	0.45-0.71	628	450	3850	175	158	17	168	9.3
	Ass1	0.71-0.98	560	375	3725	153	138	15	144	8.5
	Ass2	0.98-1.27	532	380	3800	150	119	13	128	6.4
	Ass3	1.27-1.54	476	337	3875	143	103	10	115	6.0
II	Ap	0.00-0.28	756	537	3625	210	198	25	176	15.3
	A2	0.28-0.54	644	487	3700	185	144	21	154	12.2
	Ass1	0.54-0.72	588	475	3625	162	126	19	145	9.7
	Ass2	0.72-0.99	532	400	3700	157	99	21	137	7.6
	Ass3	0.99-1.34	504	325	3825	148	91	17	119	7.2
	Ass4	1.34-1.65	448	287	3900	148	70	12	96	5.1
III	Ap	0.00-0.21	644	330	2225	156	138	19	144	8.6
	B	0.21-0.49	588	312	2135	149	113	20	129	7.7
	Bt1	0.49-0.72	532	300	2450	137	110	17	115	5.2
	Bt2	0.72-1.04	448	300	2675	118	110	13	97	4.5
	Bt3	1.04-1.33	364	287	2850	100	79	9	84	4.3
	Bt4	1.33-1.5	336	275	3000	95	63	7	76	3.9
	C	1.5+	Weathered parent material with pockets of soil							
IV	Ap	0.00-0.19	588	325	2300	145	142	14	124	8.3
	Bt1	0.19-0.39	560	300	2275	134	79	11	112	6.2
	Bt2	0.39-0.69	532	312	2450	110	63	10	84	4.6
	Bt3	0.69-0.92	564	287	2575	94	49	7	75	4.7
	C	0.92+	Weathered parent material with pockets of soil							
V	Ap	0.00-0.19	700	450	3250	187	166	21	147	14.4
	A2	0.19-0.39	560	412	3300	174	114	19	129	13.2
	Ass1	0.39-0.60	532	387	3150	165	100	15	135	10.6
	Ass2	0.60-0.99	560	375	2975	160	89	12	115	8.8
	Ass3	0.99-1.32	476	362	3225	158	74	12	108	7.2
	AC	1.32-1.70	448	325	3325	146	63	10	94	6.8
VI.	Ap	0.00-0.21	728	387	3425	194	184	19	158	11.2
	A2	0.21-0.50	616	350	3525	187	145	21	146	10.6
	Ass1	0.50-0.79	537	362	3450	165	130	16	137	8.2
	Ass2	0.79-1.09	537	362	3525	156	114	13	118	7.0
	Ass3	1.09-1.39	476	337	3600	144	92	10	97	7.3
	Ac	0.39-1.68	392	262	3675	146	78	8	78	6.4

Table 2. Total and available micronutrient status of the study area

Profile No	Horizon	Depth (m)	Total Micronutrients (ppm)				Available Micronutrients (ppm)			
			Zn	Cu	Mn	Fe(%)	Zn	Cu	Mn	Fe
I	Ap	0.00-0.21	67	137	693	3.25	1.32	1.24	8.3	3.8
	A2	0.21-0.45	63	123	643	3.33	0.98	1.39	9.5	3.6
	A3	0.45-0.71	43	111	621	3.33	0.76	1.26	6.6	3.4
	Ass1	0.71-0.98	49	118	597	3.69	0.72	1.45	5.8	3.8
	Ass2	0.98-1.27	48	85	443	3.76	0.46	1.58	4.3	3.0
	Ass3	1.27-1.54	43	80	434	4.88	0.46	1.60	4.5	2.6
II	Ap	0.00-0.28	71	142	761	2.42	0.92	1.40	9.2	3.6
	A2	0.28-0.54	56	155	698	2.35	0.74	1.47	8.6	3.4
	Ass1	0.54-0.72	46	141	723	2.96	0.78	1.53	7.9	3.1
	Ass2	0.72-0.99	42	139	632	3.14	0.66	1.49	8.8	3.3
	Ass3	0.99-1.34	40	117	594	3.68	0.46	1.39	6.2	3.4
	Ass4	1.34-1.65	40	78	427	3.85	0.43	1.40	4.3	2.8
III	Ap	0.00-0.21	55	138	621	3.98	0.74	1.82	16.1	3.2
	B_1	0.21-0.49	53	121	604	3.61	0.88	1.63	15.3	3.0
	Bt1	0.49-0.72	46	89	523	3.73	0.64	1.73	13.1	3.1
	Bt2	0.72-1.04	42	89	429	4.92	0.62	1.51	11.3	2.7
	Bt3	1.04-1.33	39	75	334	4.92	0.44	1.21	9.3	2.6
	Bt4	1.33-1.5	38	72	291	4.73	0.38	1.49	8.2	2.3
	C	1.5+	Weathered parent material with pockets of soil							
IV	Ap	0.00-0.19	55	134	589	4.37	0.68	1.80	14.3	2.9
	Bt1	0.19-0.39	49	117	501	4.32	0.70	1.73	13.1	2.6
	Bt2	0.39-0.69	43	92	503	4.13	0.65	1.66	11.5	2.8
	Bt3	0.69-0.92	39	87	421	4.13	0.54	1.62	9.2	2.3
	C	0.92+	Weathered parent material with pockets of soil							
V	Ap	0.00-0.19	64	130	778	2.32	0.96	1.30	8.5	3.8
	A2	0.19-0.39	48	101	687	2.32	0.62	1.44	9.2	3.4
	Ass1	0.39-0.60	47	113	623	2.08	0.56	1.44	9.7	2.9
	Ass2	0.60-0.99	46	96	594	2.49	0.62	1.54	7.2	2.5
	Ass3	0.99-1.32	44	75	531	3.93	0.46	1.38	4.5	2.1
	AC	1.32-1.70	43	68	428	4.02	0.38	1.32	4.3	2.1
VI.	Ap	0.00-0.21	69	128	804	2.85	1.12	1.36	8.6	3.6
	A2	0.21-0.50	53	112	652	2.69	0.70	1.46	6.4	3.2
	Ass1	0.50-0.79	54	117	667	3.76	0.56	1.32	8.2	2.8
	Ass2	0.79-1.09	49	108	538	3.95	0.62	1.30	4.6	2.9
	Ass3	1.09-1.39	43	84	492	3.74	0.64	1.30	4.8	2.3
	AC	1.39-1.68	41	80	412	3.89	0.48	1.28	4.8	2.0

Table 3 Relation among soil properties and available nutrients

Nutrient	Organic carbon	$CaCO_3$	pH	Clay
Nitrogen	0.830*	0.211	-	0.040
Phosphorus	0.770*	0.270	-	0.031
Potassium	0.899*	0.406*	-	0.158
Sulphur	0.868	0.295	-	0.158
Zinc	0.647*	-0.004	-0.070*	-0.020
Copper	-	-0.343*	-0.630*	-0.640*
Manganese	-	-0.655*	-0.800*	-0.856*
Iron	0.738*	-	-	-0.020

* Significant at 1% ** Significant at 5%

available potassium content of 75 ppm. The available K status of the soils was high in the surface horizons and medium to high in lower horizons, whcih could be due to enhanced release of potassium from weatherable minerals under frequent wetting and drying cycles and may also be due to application of potassium fertilizers by the farmers. The total K values varied between 2135 and 4025 ppm. The variations among different profiles could be due to variations in potassium bearing minerals of the soils.

The available S content in surface horizons of black soils was found to be sufficient, where as the red soil porfiles and sub surface horizons of black soils were deficient in S, considering a critical limit of 10 ppm (Ghai *et al*, 1984). The total sulphur content decreased with depth in all the profiles and these values ranged between 94 and 210 ppm. The highest value of 210 ppm was observed in Ap horizon of profile II and the lowest value of 94 ppm was noticed in Bt3 horizon of profile 4. The values ranged from 143 to 210 and 94 to 156 ppm in black and red soil profiles, respectively.

Total and available micronutrient contents are given in Table 2. The available zinc contents varied from 0.38 to 1.32 ppm. Relatively higher available zinc contents were observed in black soils than in red soils. The available zinc content in red soil profiles and lower layers of black soils was below the critical limit of 0.8ppm as laid by Lindsay and Norvell (1978). More or less decreasing tend with depth was observed in the proifiles, which might be due to management for zinc at surface horizons and low organic matter in deeper layers. A significant positive correlation with organic carbon (r = 0.647) was in conformity with above relation. The total zinc content of the soils varied from 38 to 71 ppm. These variations might be due to variation in clay content, parent material and organic carbon in soils.

Available copper contents varied from 1.24 to 1.60 ppm in black soil profiles and 1.21 to 1.82 ppm in red soil profiles and were above the critical level of 0.2 ppm as given by Lindsay and Norvell (1978). The results were in accordance with those of Sharma and Gupta (2001) in soils of Madhya Pradesh. Total copper contents ranged from 68 to 155 and 72 to 138 ppm in black and red soil profiles, respectively. The variations in total copper contents of red and black soils could be due to variations in copper bearing minerals.

A-B-C profiles exhibited relatively higher values of available manganese contents than A-C profiles. These values varied from 4.3 to 16.1 ppm. Available manganese contents were above the critical level of 1.0 ppm (Lindsay and Norvell, 1978) in all the soils. Relatively higher values were observed in red soils compared to black soils. These variations in available manganese contents could be due to the variations in soil pH, $CaCO_3$ and clay content. Low manganese content in soils having high pH could be due to the formation of insoluble hydroxides (Parmar *et al*., 1999). Available manganese showed a negative correlation with pH (r = -0.800), $CaCO_3$ (r = -0.655) and clay (r = -0.856) contents.Total manganese contents varied from 291 to 804 ppm. In black soil profiles these values varied from 412 to 804 ppm and for red soil profiles the range was in between 291 and 621 ppm.

The available iron contents varied from 2.0 to 3.8 ppm. In black soil profiles these values varied from 2.0 to 3.8 ppm and in red soil profiles values were found in the range of 2.3 to 3.2 ppm. All the soils were below the critical limit of 4.5ppm as laid by Lindsay and Norvell (1978). The low status could be due to lower organic matter content as confirmed by a significant positive correlation (r = 0.738) between organic carbon and available iron. The total iron contents varied between 2.32 and 4.92 per cent. Relatively higher total iron values were observed in red soils than in black soils. This could be due to the differences in parent material.

The present study revealed that the soils of vegetable growing area of Guntur district covering both black and red soils were low to medium in nitrogen, medium in P, Medium to high in K, S is sufficient in black soils but deficient in red soils. All the soils are deficient in Fe, sufficient in Cu and Mn but red soils are deficient in Zn.

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