www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(10): 1112-1120

www.thepharmajournal.com
Received: 07-08-2021
Accepted: 13-09-2021

E Sathyanarayana
Assistant Professor, Department of Soil Science and Agricultural Chemistry, Agricultural College, Palem, PJTSAU, Hyderabad, Telangana, India

G Padmaja
Senior Professor, Department of Soil Science and Agricultural Chemistry, PJTSAU, Hyderabad, Telangana, India

S Saranya
Department of Agronomy, GD Goenka University, Delhi-NCR, Haryana, India

J Bharghavi
Assistant Professor, Department of Crop Physiology, Agricultural College, Warangal, PJTSAU, Hyderabad, Telangana, India

M Santhosh Kumar
Department of Soil Science, CCS HAU, Hisar, Haryana, India

M Rajashekhar
Scientist, Department of Entomology, KVK, Palem, PJTSAU, Hyderabad, Telangana, India

J Veeranna
Assistant Professor, Department of Agricultural Engineering, Agricultural College, Palem, PJTSAU, Hyderabad, Telangana, India

Kumari Sunita
Assistant Professor, Department of Botany, DDU Gorakhpur University, Gorakhpur, Uttar Pradesh, India

Corresponding Author
E Sathyanarayana
Assistant Professor, Department of Soil Science and Agricultural Chemistry, Agricultural College, Palem, PJTSAU, Hyderabad, Telangana, India

Soil fertility status of soybean growing soils of Adilabad district, Telangana

E Sathyanarayana, G Padmaja, S Saranya, J Bharghavi, M Santhosh Kumar, M Rajashekhar, J Veeranna and Kumari Sunita

Abstract
Soybean is an important oilseed crop predominantly grown in Adilabad district. Investigating the fertility status of soybean growing soils is required to under pin future land use planning. A survey was carried out in major soybean growing soils of Adilabad district of Telangana state. One hundred and ten representative surface soil samples (0-15 cm) were collected and analysed for their salient characteristics *viz.*, pH, EC, OC, available N, P_2O_5, K_2O, S and micronutrients (Zn, Fe, Cu and Mn). Soil fertility maps were prepared for macro and micro nutrients. Results revealed that, soil pH ranged from 6.10 to 8.51. The soils were non-saline to slightly saline (0.14 to 1.26 dSm^{-1}). The organic carbon ranged from 0.18 to 0.80 per cent. With regard to available nutrients, the values varied from 105 to 241 kg/ha for nitrogen, 9.7 to 98 kg/ha for phosphorus, 198 to 395 kg/ha for potassium and 6.12 to 25.32 mg/kg for sulphur. Among the micronutrients 61.81 and 22.72 percent soils were deficient in available zinc and iron, respectively. Further, the soils were not deficient in Cu and Mn.

Keywords: Soil, fertility, soybean, predominantly, Telangana

Introduction
Soybean (*Glycine max* (L.)) is the second largest oilseed crop in India after groundnut. It is the cheapest and richest source of high-quality protein. It is a legume crop belonging to family Leguminosae and sub-family Papillionaceae. Soybean is also called as "Gold of soil" as it builds up the soil fertility by fixing atmospheric nitrogen through nodules. Symbiotically soybean fixes nitrogen and leaves about 25 percent to succeeding crop (Nutan Lal *et al.*, 2019) [5]. In India soybean is grown in 11.33 million hectares with a production of 13.79 million tonnes and productivity of 1217 kg ha^{-1} (Directorate of Economics and Statistics, 2020) [2]. The major soybean growing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Telangana and Gujarat. In Telangana the crop is grown in an area of 0.15 million hectares with 0.23 million tonnes of production and productivity of 1584 kg ha^{-1}. The cultivation of soybean crop is increasing at a faster rate and is extensively grown in Adilabad, Nizamabad, Medak and Karimnagar districts in Telangana state (Sathyanarayana *et al.*, 2021) [10].
Soil fertility is a major constraint to its productivity. Low organic matter content coupled with low and imbalanced application of nutrients limits its full potential yield and is the main yield barrier (Bellakki *et al.*, 1999) [1]. Nutrient level is decreasing continuously in Indian soils due to extensive agriculture while meeting the food demand of escalating population growth. Inventory of the physico-chemical properties, available macro and micronutrients status of the soils helps in demarcating the areas where the application of particular nutrient is needed for profitable crop production (Singh, 2010) [11]. Also, it is already well known that the properties of a soil are the basic attributes that influence directly on the soil response to any specified use (Sood *et al.*, 2009) [12]. Though sporadic information is available on characterization and classification of soils in Adilabad district, detailed and systematic investigation on the properties of soils, specifically in soybean growing soils is meagre. Hence, the present study was taken up in the major soybean growing soils of Adilabad district with an objective to understand and update the knowledge on the potentials and limitations of these soils in enhancing the productivity of soybean. This paper deals with nutrient status (physical, physico-chemical and chemical properties) of soybean growing soils of Adilabad district.

Materials and Methods
Study Area and Sample Collection
The soil survey was carried out representing the major soybean growing soils of the Adilabad district (Fig. 1). A total of one hundred and ten soil samples (0-15 cm depth) were collected.

The soil samples were collected using GPS (Global Positioning System) and the longitude and latitude points of a particular location were recorded. The soil fertility maps were prepared with the help of Arc GIS v 10.2 software using GPS points. The soil samples were packed and labelled properly in polythene bags and brought to the laboratory for further analysis.

Laboratory Analysis

All the soil samples were air dried, grounded and passed through 2 mm sieve for chemical analysis. The soils were analysed for salient characteristics *viz.*, pH, EC, OC, mechanical analysis & available nutrients (N, P_2O_5, K_2O, S, Zn, Fe, Cu and Mn) following standard procedures. After analysis for available nutrient status, the soils were categorised as low, medium and high for N, P_2O_5 and K_2O. The available sulphur and micronutrients (Zn, Fe, Cu and Mn) were rated as deficient and sufficient based on the critical levels as given by Tandon (2005) [15].

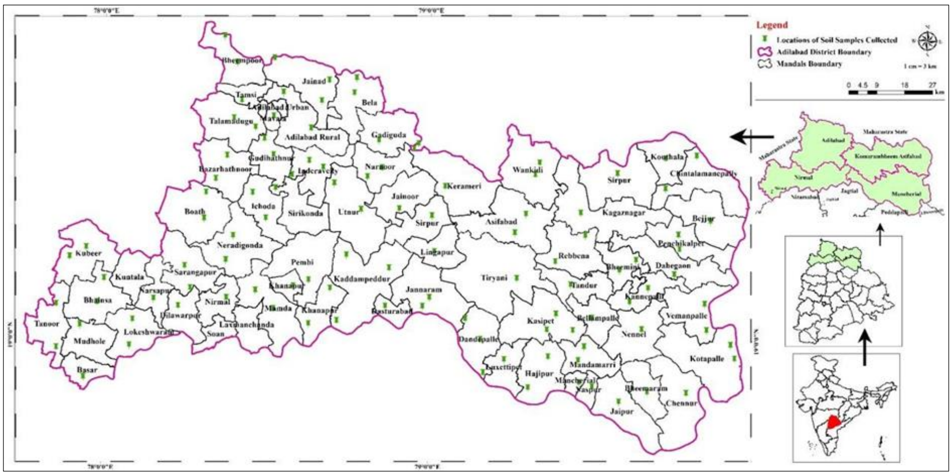

Fig 1: Location of soil samples collected in Adilabad district

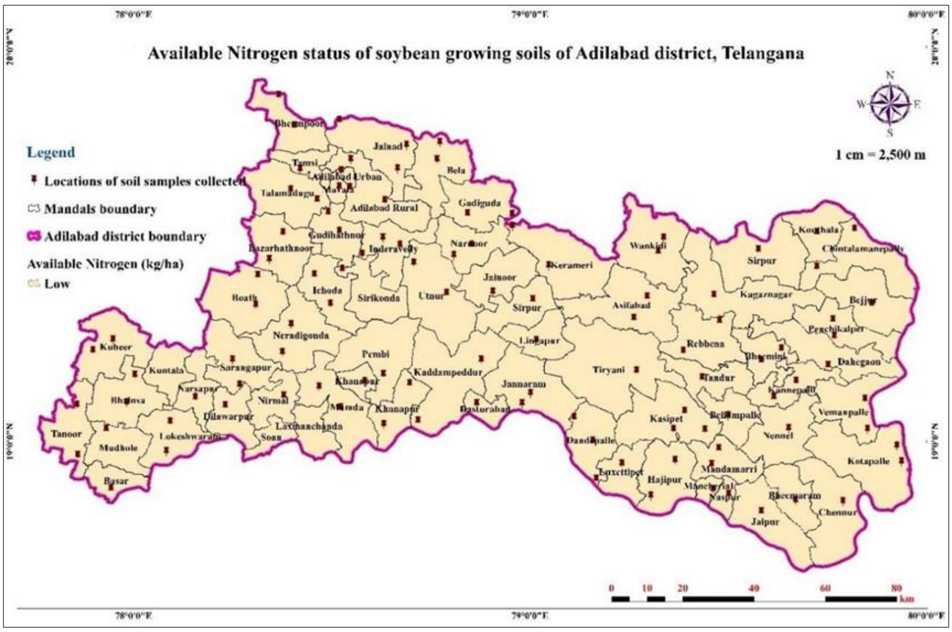

Fig 2: Available Nitrogen status of soybean growing soils of Adilabad district

Results and Discussion

Physical and Physico-chemical Characteristics

The soil texture varied from clay to sandy loam. Out of 110 samples analysed, 43.63 percent soils were clayey, 7.28% were clay loam, 25.45% were sandy clay loam, 21.82% were sandy clay and 1.82% soils were sandy loam in texture.

Soil reaction (pH) of the surface soils ranged from 6.10 to 8.51 indicating that, these soils are slightly acidic to alkaline in reaction. The observations on the soil pH revealed that, 2.72 percent of soils were slightly acidic (<6.5), 66.36% of samples were neutral (6.5-7.5) and 30.92% of samples were alkaline (>7.5) in nature.

Electrical conductivity (EC) of surface soils ranged from 0.14 to 1.26 dSm^{-1} indicating that, these soils were non-saline to slightly saline in nature. The observations on EC revealed that, 97.28% of samples were non-saline, 2.72% of samples were slightly saline in nature.

With regard to the status of organic carbon (%) it did not very much in surface soils. The values found to vary from 0.18 to 0.80%. The observations on organic carbon revealed that, 80.90% of soils were low (<0.5%), 13.65% of soils were medium (0.5-0.75%) and 5.45% of soils were high in organic carbon. The reason for low organic carbon content in most of the soils may be attributed to the prevalence of semi-arid condition, where the degradation of organic matter occurs at a faster rate coupled with little or no addition of organic manures and low vegetation cover on the fields, there by leaving less chances of accumulation of organic carbon in the soils. Intensive cropping is also one of the reasons for low organic carbon content in soils. The similar results were also reported by Nalina *et al.* (2016) [4].

Available Nutrients

The available nitrogen content of the soils ranged from 105 to 241 kg/ha (Table 1 and depicted in Fig. 3). Out of the 100 samples analysed, all the soils found to have low (<280 kg/ha) available nitrogen. From the survey data, previous history of the crops grown was taken which indicated that, cotton is one of the major commercial crops grown in Adilabad. The low available N could be attributed to soil management, varied application of FYM and fertilizers to previous crops. Another possible reason may also be due to low organic matter content in these areas and high temperature which facilitate faster degradation and removal of organic matter leading to N deficiency (Karthikeyan *et al.*, 2014) [3].

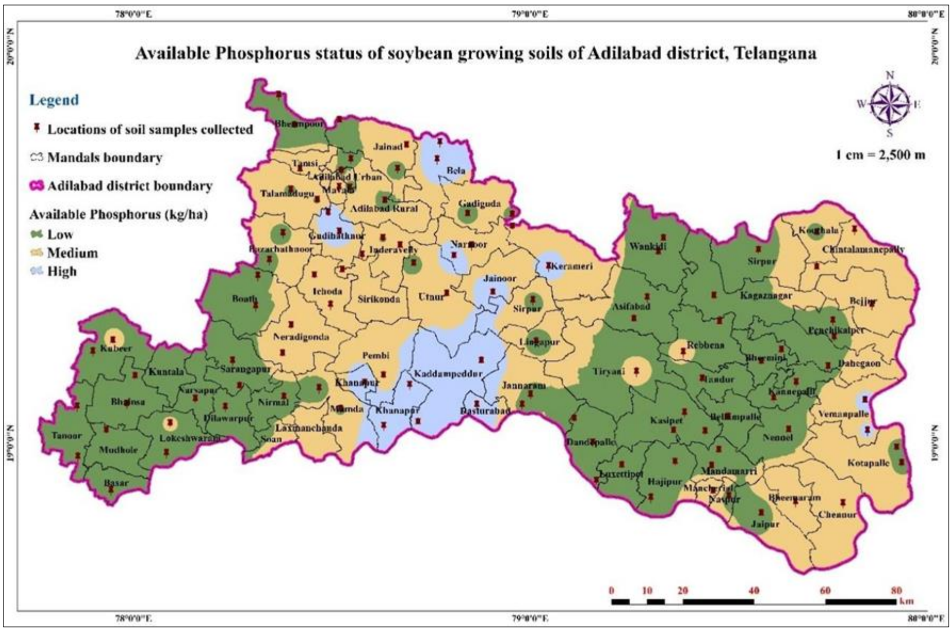

Fig 3: Available Phosphorus status of soybean growing soils of Adilabad district

The available phosphorus content of the soils exhibited extreme variation between 9.7 to 98 kg ha^{-1} (Table 1 and depicted in Fig. 4). The soils found to have low to very high available phosphorus. Among the soils analysed, 64.54, 21.85 and 13.61 per cent of soils registered low (<22 kg ha^{-1}), medium (22-54 kg ha^{-1}) and high available phosphorus (>54 kg ha^{-1}), respectively. Continuous application of DAP to crops without soil testing might have resulted in phosphorus build up and led medium to high available phosphorus status in these soils (Sathish *et al.*, 2018) [9]. Another reason for higher P in surface soils possibly might be due to P confinement to the rhizosphere due to its immobile nature in soils (Rajeshwar and Mani, 2014) [8].

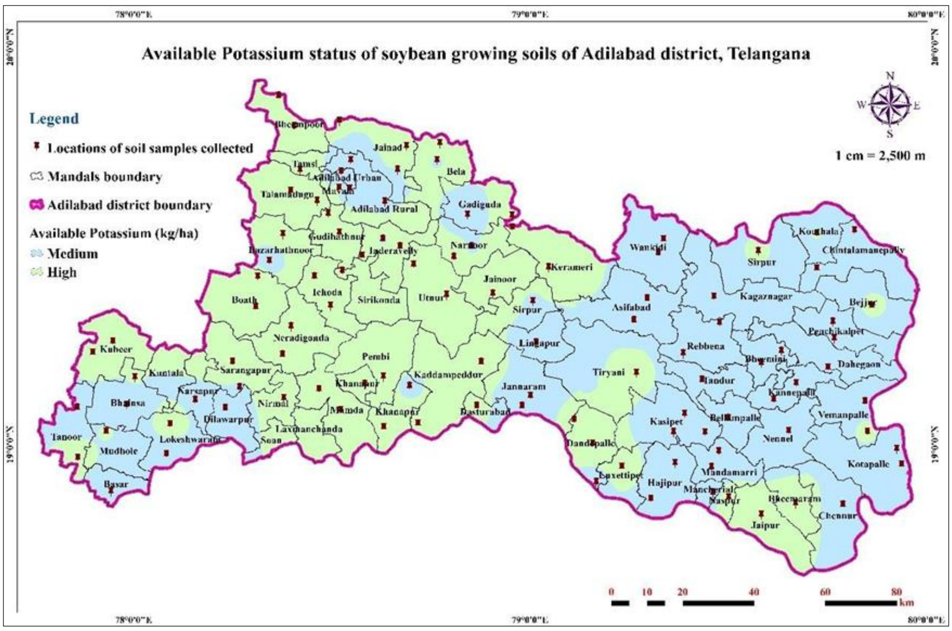

Fig 4: Available Potassium status of soybean growing soils of Adilabad district

The available potassium content of the soils varied from 198 to 395 kg ha^{-1} (Table 1 and depicted in Fig. 5). About 53.63% and 46.37% of soils recorded medium (123-296 kg ha^{-1}) to high (>296 kg ha^{-1}) available potassium, respectively. These soils were able to maintain a sufficient or even high level of exchangeable K and provide a good supply of K to plants f or many years. The medium to higher content of available K_2O in soybean growing soils of Adilabad district may be due to the predominance of K-rich micaceous and feldspar minerals in parent material. Similar results were observed by Srikant *et al.* (2008) [13]. Further, high available K status in surface soils could be attributed to 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. Similar results were reported by Pal and Mukhopadyay (1992) [6].

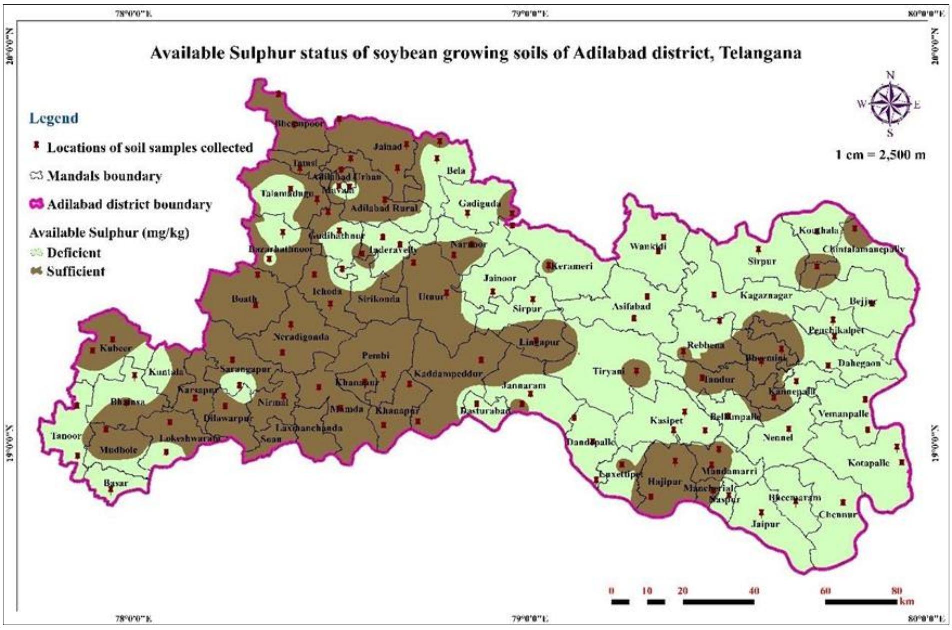

Fig 5: Available Sulphur status of soybean growing soils of Adilabad district

The available sulphur content of the soils ranged from 6.12 to 25.32 mg kg^{-1} (Table 1 and depicted in Fig. 6). Considering 10 ppm as critical limit for available sulphur, 19 and 81 per cent of soils registered deficient (<10 mg kg^{-1}) and sufficient (>10 mg kg^{-1}) available sulphur status, respectively. Intensive cropping without application of sulphur fertilizers may lead to depletion of sulphur in these soils. The low available S is partly due to gypsiferous nature of S which is non-available in black soils, continuous removal of S by crops and use of high analysis complex fertilizers (Venkatesh and Satynarayana, 1999) [16].

Table 1: Available Nutrient Status in Soybean Growing Soils of Adilabad District

S. No	District	Name of the Mandal	Name of the Village	Available Macronutrients				Available Micronutrients			
				N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)	S (mg/kg)	Zn (mg/kg)	Fe (mg/kg)	Cu (mg/kg)	Mn (mg/kg)
1	Adilabad	Adilabad	Wanwat	180	17.6	284	20.00	1.35	14.00	0.58	12.88
2	Adilabad	Adilabad Rural	Chanda	190	20.5	289	22.36	0.31	11.56	5.65	15.20
3	Adilabad	Adilabad Urban	Adilabad	210	18.7	222	11.85	2.11	18.50	2.32	2.56
4	Adilabad	Adilabad Urban	Adilabad	225	21.2	216	25.32	0.98	21.25	1.95	3.31
5	Adilabad	Asifabad	Asifabad	155	15.6	285	10.96	0.49	15.62	0.39	15.21
6	Adilabad	Asifabad	Chirrakunta	191	21.0	286	10.05	0.53	21.25	2.15	14.50
7	Adilabad	Basar	Basar	110	14.5	225	9.65	0.41	3.60	0.66	6.35
8	Adilabad	Bazarhathnoor	Bazarhatnoor	133	20.3	226	14.21	1.98	15.32	4.50	15.36
9	Adilabad	Bazarhathnoor	Morekhandi	198	17.5	333	13.00	0.52	9.23	0.88	35.65
10	Adilabad	Bejjur	Bejjur	188	48.0	310	13.50	0.65	14.12	1.28	19.00
11	Adilabad	Bela	Bela	178	91.3	290	7.10	0.44	10.25	3.33	30.12
12	Adilabad	Bela	Guda	225	95.6	355	16.10	3.12	23.35	1.10	26.30
13	Adilabad	Bellampalle	Bellampalle	156	18.3	198	11.45	0.90	2.61	2.36	24.26
14	Adilabad	Bhainsa	Chintalabori	210	11.0	299	8.00	0.30	2.98	1.00	15.36
15	Adilabad	Bheemaram	Bheemaram	110	51.0	336	8.12	1.12	3.56	1.25	5.64
16	Adilabad	Bheemini	Bhainsa	129	14.4	245	15.32	0.19	20.14	4.10	18.21
17	Adilabad	Bheemini	Bheemini	125	21.3	221	16.91	0.22	14.29	0.65	9.63
18	Adilabad	Bheemini	Thangallapalle	184	14.2	238	22.00	1.25	1.57	3.28	26.36
19	Adilabad	Bheempoor	Antargaon	206	15.6	296	19.56	0.35	3.49	0.98	21.12
20	Adilabad	Bheempoor	Dhanora	195	14.8	315	18.00	0.41	3.10	0.90	19.56
21	Adilabad	Boath	Boath Buzurg	129	19.3	315	20.50	2.58	15.30	4.12	6.36
22	Adilabad	Boath	Sonala	220	17.5	370	19.65	1.56	17.20	1.00	14.25

23	Adilabad	Chennur	Chinnur	172	24.0	270	10.65	0.77	11.58	0.98	10.28
24	Adilabad	Chintalamanepally	Dabba	210	48.0	236	19.21	0.78	19.10	3.04	16.10
25	Adilabad	Chintalamanepally	Ranvalli	226	39.3	251	16.30	0.74	25.00	3.55	13.65
26	Adilabad	Dahegaon	Kunchavelli	109	18.0	205	13.60	0.48	16.00	1.44	16.32
27	Adilabad	Dandepalle	Dandepalle	185	16.3	340	12.38	0.16	10.56	0.75	26.31
28	Adilabad	Dandepalle	Gudem	149	13.3	256	7.14	0.19	2.66	2.69	14.56
29	Adilabad	Dandepalle	Thallapet	221	16.4	325	6.59	0.20	3.98	4.26	19.00
30	Adilabad	Dasturabad	Dasturabad	128	88.0	312	11.23	0.22	10.50	0.88	25.21
31	Adilabad	Dilawarpur	Dilawarpur	240	17.5	226	18.52	0.19	8.50	0.70	8.87
32	Adilabad	Gadiguda	Lokari	234	14.3	235	6.12	0.29	28.65	5.00	10.25
33	Adilabad	Gudihathnur	Gudihathnur	230	88.3	360	11.68	1.65	18.52	0.96	15.00
34	Adilabad	Gudihathnur	Sitagondi	196	85.6	366	21.00	2.20	17.65	1.35	19.65
35	Adilabad	Hajipur	Hazipur	185	21.0	271	16.91	0.52	34.26	4.50	16.36
36	Adilabad	Hajipur	Rallygadpur	184	15.4	228	19.35	0.68	6.38	2.45	24.21
37	Adilabad	Ichoda	Ichoda	116	29.2	369	23.60	0.51	39.32	2.20	20.00
38	Adilabad	Ichoda	Keshapatnam	213	30.1	388	21.00	0.40	35.62	3.00	2.90
39	Adilabad	Inderavelly	Indervelly	189	26.1	375	8.65	0.37	31.02	3.10	6.35
40	Adilabad	Inderavelly	Muthnur	129	21.0	288	11.56	0.29	18.25	3.30	14.87
41	Adilabad	Inderavelly	Tejapur	155	27.1	358	17.14	0.29	25.00	4.20	15.00
42	Adilabad	Jainad	Khapri	220	27.8	344	18.50	0.51	19.56	2.56	3.15
43	Adilabad	Jainad	Korata	188	18.2	305	16.00	0.36	18.50	1.15	3.65
44	Adilabad	Jainad	Laxmipur	175	15.5	295	24.00	0.38	14.65	4.12	8.88
45	Adilabad	Jainoor	Jainoor	196	75.0	364	6.98	0.88	29.12	1.98	17.50
46	Adilabad	Jaipur	Gangipally	158	16.3	325	10.90	2.12	25.36	4.29	20.00
47	Adilabad	Jannaram	Dharmaram	210	19.2	215	16.00	0.78	3.61	2.66	15.33
48	Adilabad	Jannaram	Jannaram	210	15.7	230	11.88	0.89	2.96	2.22	10.36
49	Adilabad	Kaddampeddur	Masaipet	111	95.5	322	22.00	0.21	8.88	1.56	14.25
50	Adilabad	Kaddampeddur	Udampur	120	98.0	390	18.50	0.40	9.65	2.26	13.25
51	Adilabad	Kagaznagar	Sirpur Kaghaznagar	125	15.0	288	12.50	0.44	14.00	3.50	16.32
52	Adilabad	Kannepally	Jajjarvelly	171	22.2	233	21.54	0.23	3.14	5.10	11.15
53	Adilabad	Kannepally	Kannepally	225	13.0	246	10.65	0.20	2.33	1.45	9.66
54	Adilabad	Kasipet	Devapur	192	14.9	245	13.20	0.52	3.10	1.36	14.52
55	Adilabad	Kasipet	Dharmaraopet	176	17.3	239	11.40	1.26	2.22	3.21	16.00
56	Adilabad	Kasipet	Kasipet	148	13.9	271	14.12	0.67	1.99	5.10	25.63
57	Adilabad	Kerameri	Hatkarguda	180	23.2	325	11.56	0.91	22.00	4.44	26.10
58	Adilabad	Kerameri	Kerameri	185	69.0	331	15.20	0.66	15.21	1.55	14.00
59	Adilabad	Khanapur	Ervachintal	120	86.0	285	21.00	0.16	11.56	0.65	9.12
60	Adilabad	Khanapur	Khanapur	132	78.3	305	17.56	0.50	14.69	2.56	31.25
61	Adilabad	Khanapur	Rajura	105	90.0	336	15.58	0.33	11.89	0.93	11.14
62	Adilabad	Kotapalle	Algaon	145	17.5	256	10.36	0.65	15.65	0.88	8.92
63	Adilabad	Kotapalle	Pullagaon	151	20.5	219	10.87	0.99	7.21	1.22	15.66
64	Adilabad	Kouthala	Kouthala	178	19.7	299	7.77	0.81	2.71	0.88	11.98
65	Adilabad	Kubeer	Kubeer	222	24.5	341	19.00	0.44	19.65	3.00	10.00
66	Adilabad	Kubeer	Palsi	168	15.6	341	16.00	0.28	12.00	3.11	14.90
67	Adilabad	Kuntala	Nokewada	189	18.1	325	19.25	0.52	17.36	2.56	15.23
68	Adilabad	Lingapur	Mamidipalli	201	14.7	216	25.00	0.22	31.00	3.10	25.12
69	Adilabad	Lokeshwaram	Dharmara	225	18.6	235	13.26	0.28	9.65	0.75	14.01
70	Adilabad	Lokeshwaram	Kistapoor	195	23.3	334	18.65	0.36	18.25	3.65	16.21
71	Adilabad	Luxettipet	Hanmanthpally	166	12.0	365	15.36	1.00	30.25	3.28	13.28
72	Adilabad	Mamda	Gayadpalle	190	15.0	296	19.63	0.44	13.58	0.68	26.31
73	Adilabad	Mamda	Mamda	241	19.5	296	15.25	0.49	11.20	2.85	16.85
74	Adilabad	Mancherial	Mancherial	128	49.4	238	18.00	1.65	11.58	2.20	16.00
75	Adilabad	Mandamarri	Mandamarri	196	15.2	266	15.20	1.48	3.21	0.98	9.32
76	Adilabad	Mandamarri	Ramakrishnapur	214	17.2	224	18.10	0.71	1.65	2.78	18.36
77	Adilabad	Mavala	Battisawargaon	201	23.5	313	12.55	0.29	11.25	0.60	20.56
78	Adilabad	Mudhole	Mudgal	188	17.5	300	21.56	0.37	14.41	0.81	17.56
79	Adilabad	Narnoor	Gunjala	111	95.2	324	16.50	0.50	14.50	0.90	19.25
80	Adilabad	Narnoor	Narnoor	200	24.0	291	16.52	0.39	17.29	1.50	20.12
81	Adilabad	Narsapur	Narsapur	195	16.6	290	17.50	0.44	25.00	5.10	18.00
82	Adilabad	Naspur	Naspur	201	19.2	352	10.12	1.17	1.90	0.37	7.95
83	Adilabad	Naspur	Srirampur	205	16.5	325	11.00	1.16	1.28	0.39	6.69
84	Adilabad	Nennel	Mailaram	195	16.0	249	9.10	1.10	14.20	1.98	15.28
85	Adilabad	Neradigonda	Neredgonda	215	26.0	325	18.25	0.33	20.00	1.41	23.00
86	Adilabad	Neradigonda	Purushothampur	228	29.2	340	24.15	0.50	18.36	0.66	18.10
87	Adilabad	Nirmal	Medipally	178	19.7	331	23.50	0.35	19.10	0.99	10.36
88	Adilabad	Pembi	Mandapally	205	20.5	302	16.35	0.55	9.37	1.90	15.36
89	Adilabad	Penchikalpet	Lodpalle	193	15.8	254	8.85	1.98	3.87	2.36	24.00
90	Adilabad	Penchikalpet	Yelkapalle	111	16.1	225	7.52	2.88	2.88	6.10	10.00

91	Adilabad	Rebbena	Gollet	124	24.0	236	15.00	0.37	15.00	5.10	25.00
92	Adilabad	Rebbena	Tungeda	212	19.5	210	14.20	0.45	12.50	2.10	15.32
93	Adilabad	Sarangapur	Beeravelli	184	9.7	291	8.56	0.55	7.89	0.93	8.12
94	Adilabad	Sarangapur	Sarangapur	193	20.2	365	16.10	0.39	10.50	1.15	14.58
95	Adilabad	Sirkonda	Ponna	224	28.2	338	6.68	1.15	17.52	0.99	15.60
96	Adilabad	Sirpur (T)	Seetagondi	176	14.6	291	8.10	0.54	15.63	2.00	14.21
97	Adilabad	Sirpur (U)	Sirpur	231	15.3	305	9.10	0.92	18.10	1.14	18.21
98	Adilabad	Talamadugu	Devpur	210	18.7	295	18.50	0.38	10.52	1.88	11.25
99	Adilabad	Talamadugu	Talamadugu	235	20.3	389	9.10	0.41	11.25	4.55	12.85
100	Adilabad	Tamsi	Tamsi	190	28.0	396	18.00	0.46	2.99	6.10	10.00
101	Adilabad	Tandur	Kothapalle	131	17.6	270	16.35	0.48	15.26	4.25	17.12
102	Adilabad	Tanoor	Beltaroda	192	10.8	246	7.12	0.38	11.52	1.12	10.25
103	Adilabad	Tanoor	Kharbala	188	21.0	329	14.26	0.29	20.00	4.12	24.25
104	Adilabad	Tiryani	Tiryani	200	24.0	345	15.90	0.39	3.66	1.55	11.78
105	Adilabad	Utnur	Pulimadgu	225	15.1	355	20.36	0.96	14.60	0.78	16.23
106	Adilabad	Utnur	Utnoor	179	30.0	295	16.55	0.30	20.00	1.18	13.35
107	Adilabad	Vemanpalle	Mulkalpet	115	58.3	310	11.66	2.15	9.56	0.58	8.88
108	Adilabad	Vemanpalle	Vemanpalle	108	61.0	296	14.50	0.69	15.21	2.17	28.10
109	Adilabad	Wankidi	Bambara	169	18.1	292	9.65	0.55	11.68	0.55	11.00
110	Adilabad	Wankidi	Wankidi	224	20.4	290	8.96	0.36	11.00	3.55	6.98

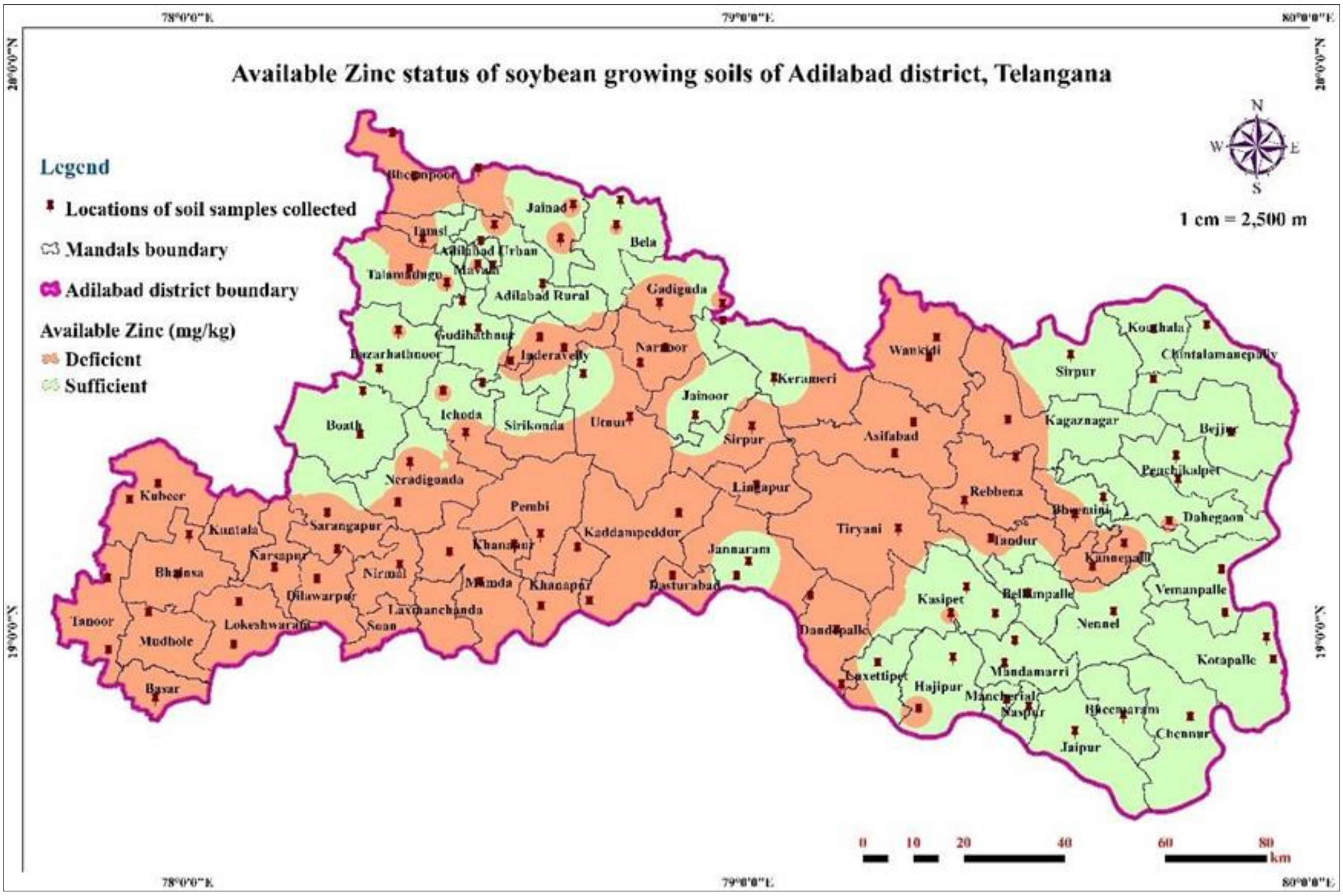

Fig 6: Available Zinc status of soybean growing soils of Adilabad district

Available Micronutrients

The DTPA extractable micronutrients *viz.*, Zn, Fe, Cu and Mn were analysed in the soil samples. The observations on DTPA-extractable Zn (Table 1 and depicted in Fig. 7) stated that, 61.81 and 38.19 per cent of the soils registered deficiency (<0.60 mg/kg) and sufficiency (>0.60 mg/kg) in available zinc, respectively. Since, most of the soils are neutral to alkaline, low in organic carbon, there is a possibility of deficiency of Zn and Fe in these soils. Similar results were observed by Patil *et al.* (2016) [7]. As zinc is an essential nutrient which plays an important role in oilseeds and legume crops for increasing yield, nodule development and nitrogen fixation, it is necessary to apply zinc to soils deficient in zinc.

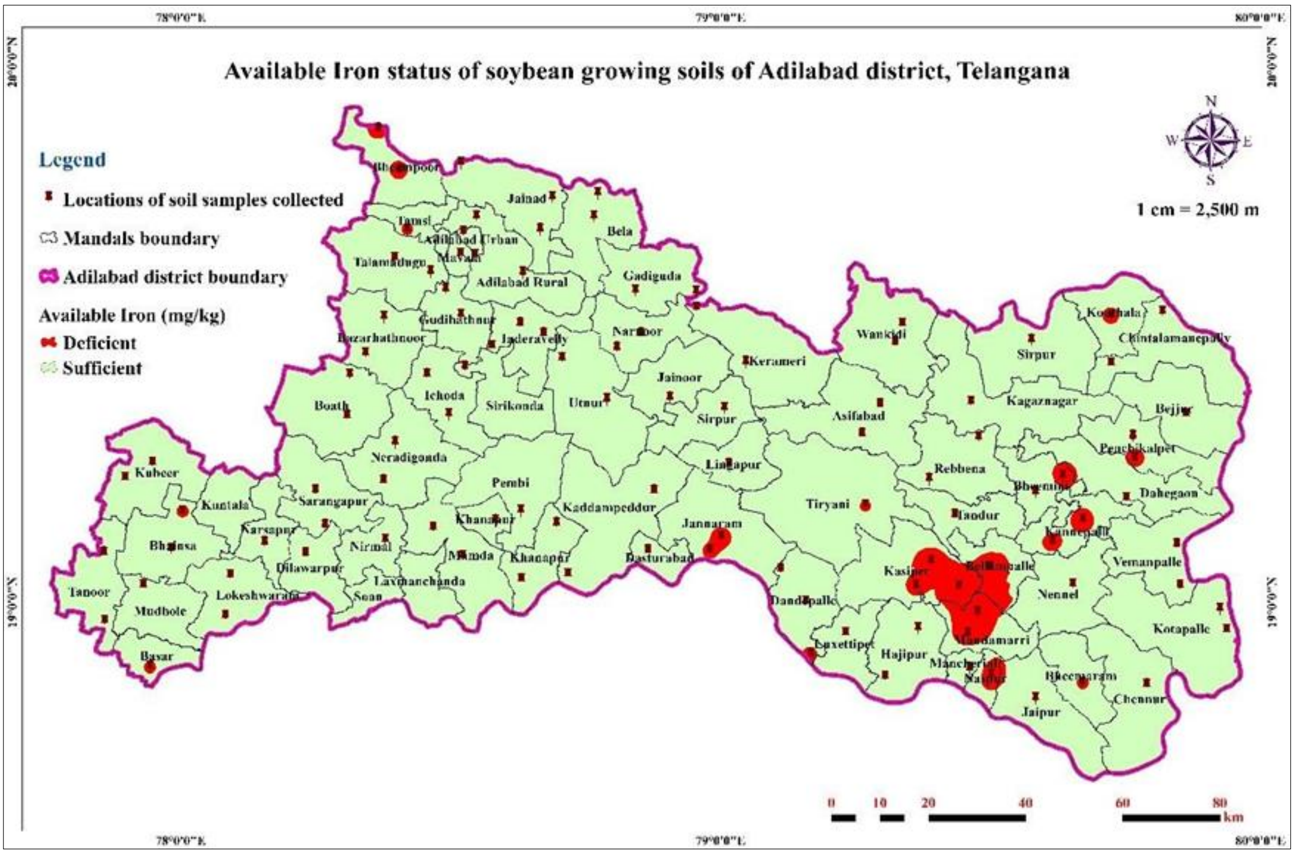

Fig 7: Available Iron status of soybean growing soils of Adilabad district

The available iron (mg/kg) varied from 1.28 to 39.32 mg/kg (Table 1 and depicted in Fig. 8). Out of the total samples (110) analysed, 22.72 per cent of samples were deficient (<4.0 mg/kg) and 77.28 percent of samples have available Fe more than 4.0 mg/kg.

Available copper and manganese deficiency is negligible (Table 1) in all the soils collected from soybean growing areas of Adilabad district. Similar results were also reported by Surendra Babu *et al.* (2019) [14].

Table 2: Ratings of soil available nutrients and percent soils falling under different categories

S. No	Available Nutrients	Values	Percent soils under different categories
1	Nitrogen (kg/ha)		
	Low	<280	100
	Medium	280-560	-
	High	>560	-
2	Phosphorus (P_2O_5 kg/ha)		
	Low	<22	64.54
	Medium	22-54	21.85
	High	>54	13.61
3	Potassium (K_2O kg/ha)		
	Low	< 123	-
	Medium	123-296	53.63
	High	>296	46.37
4	Sulphur (mg/kg)		
	Deficient	<10	19
	Sufficient	>10	81
5	Zinc (mg/kg)		
	Deficient	<0.6	61.81
	Sufficient	>0.6	38.19
6	Iron (mg/kg)		
	Deficient	<4.0	22.72
	Sufficient	>4.0	77.28
7	Copper (mg/kg)		
	Deficient	<0.2	-
	Sufficient	>0.2	100
8	Manganese (mg/kg)		
	Deficient	<2.0	-
	Sufficient	>2.0	100

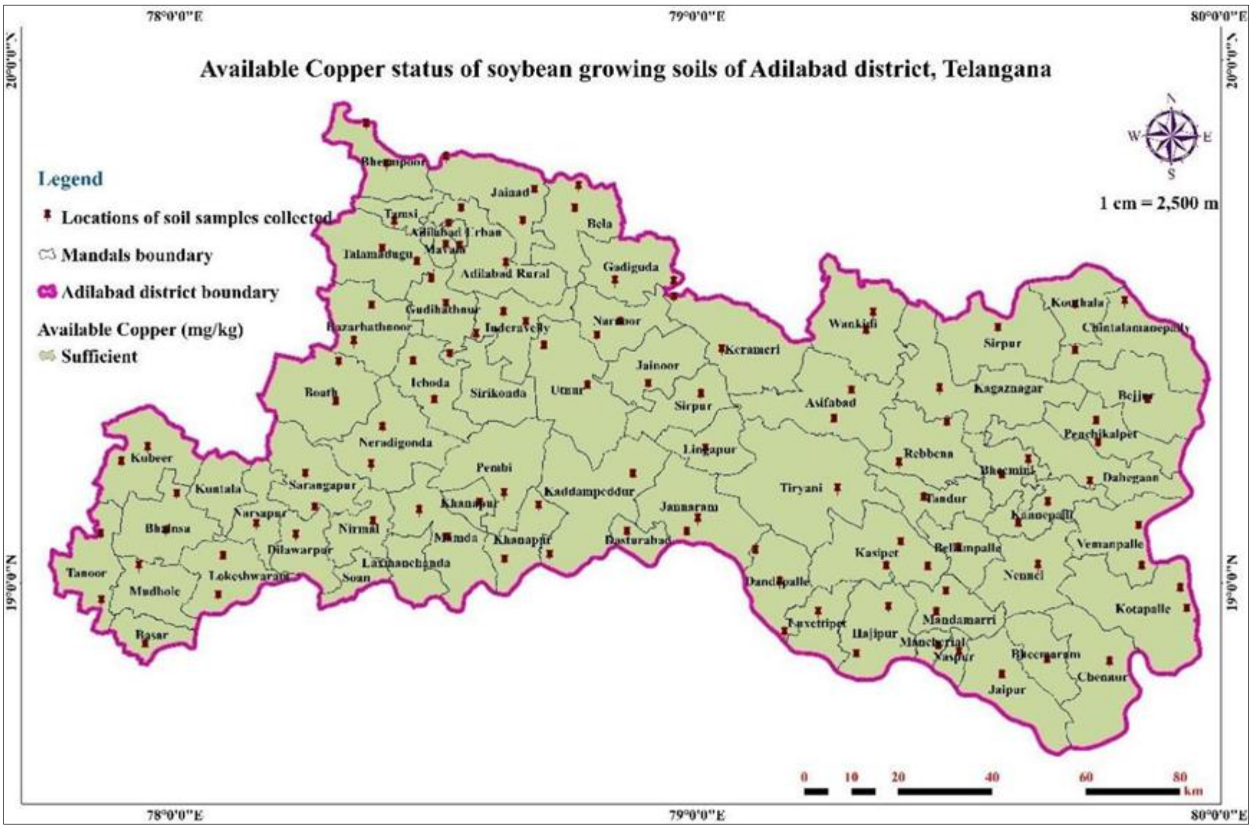

Fig 8: Available Copper status of soybean growing soils of Adilabad district

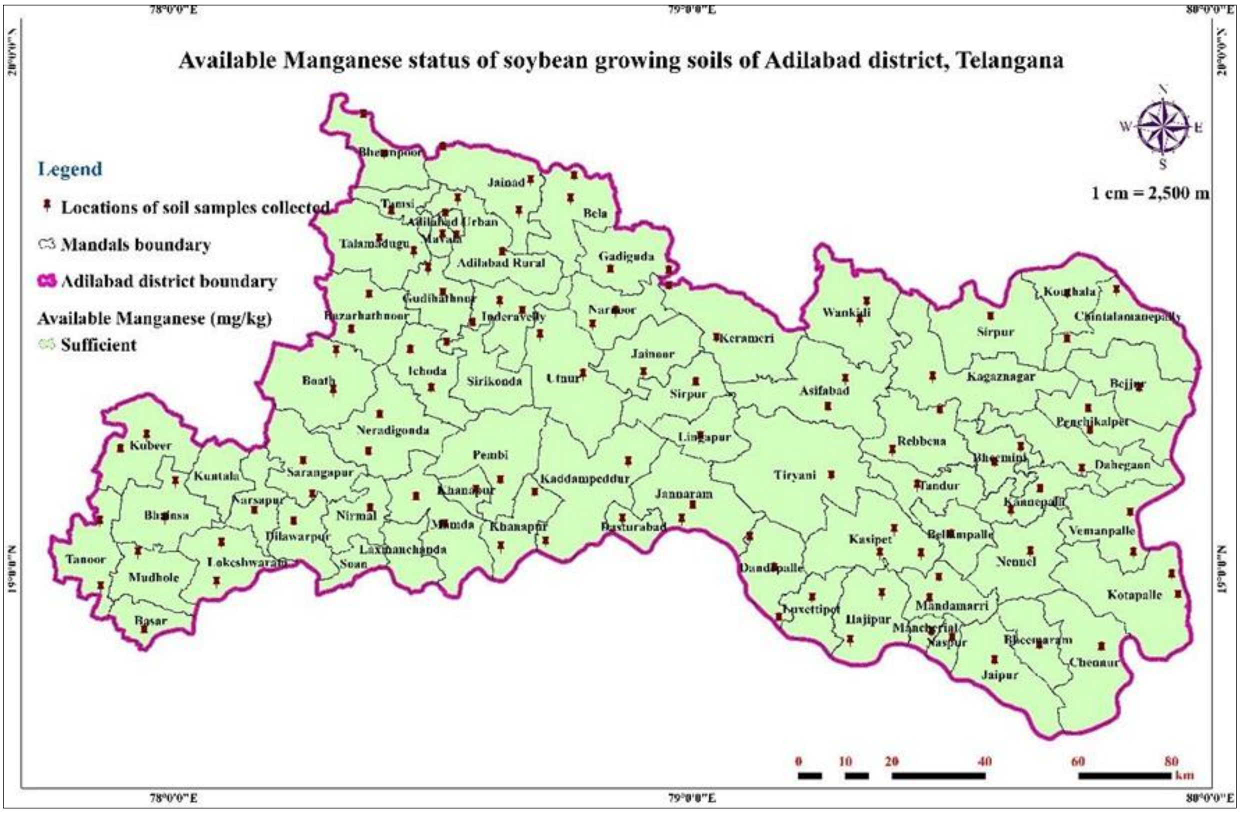

Fig 9: Available Manganese status of soybean growing soils of Adilabad district

Conclusion

- Based on the results obtained, it can be concluded that, application of organic manures needs to be encouraged in soybean growing soils of Adilabad district apart from crop residue incorporation as the soils has low organic carbon (<0.5%).
- As per the survey data, cotton is one of the predominant crops grown in Adilabad and is a heavy feeder of nitrogen, leading to nitrogen deficiency. Introducing legume crops like soybean in crop rotation with crops like cotton is effective as it adds nitrogen to soils.
- In medium to high P soils of Adilabad district, to make

the phosphorus available to crops, integrated use of organic manures along with P solubilizing bacteria can be recommended.

- As zinc and iron are deficient in 65 and 23 percent of soils, application of these micronutrients as $ZnSO_4$ and $FeSO_4$ is essential to minimize the yield losses.
- The soil fertility maps developed for Adilabad district helps in predicts the nutrient deficiencies or sufficiencies, based on which the crop based fertilizer recommendations can be given to sustain the crop productivity and also the excess use of fertilizers can be discouraged.

References

1. Bellaki MA, Badanur VP, Faroda AS, Joshi NL, Kathju S, Kar A. Integrated nutrient management for sustainable crop production (In) Proceeding of Symposium on Recent Advance in Management of Arid Ecosystem held in March 1997 at Jodhpur 1999, 271-276.
2. DES. Statistical Reports of Directorate of Economics and Statistics, India 2020.
3. Karthikeyan K, Pushpanjali Prasad J. Soil fertility status of soybean (*Glycine max* L.) growing soils of Malwa Plateau, Madhya Pradesh. J Indian Soc. Soil Sci 2014;62(2):174-178.
4. Nalina CN, Anilkumar KS, Shilpashree KG, Narendrababu B, Sudhir K, Natarajan A. Inventory and mapping of land resources for land use planning through detail soil survey coupled with remote sensing and GIS techniques: a case study in Nagenahalli watershed, Doddaballapur Taluk, Bangalore rural district, India. International Journal of Current Microbiology and Applied Sciences 2016;6(8):314-331.
5. Nutan Lal Dewangan, Anurag Gupta, Sharma HL. Assessment of Variability of Yellow Sticky Trap Heights in Soybean Whitefly through Standard Meteorological Weeks and Anova Approach. Int J Recent Sci Res 2019;10(09):35662-35665. Doi: http://dx.doi.org/10.24327/ijrsr.2019.1010.4148.
6. Pal SK, Mukhopadyay AK. Distribution of different forms of potassium in profiles of some Entisols. Journal of the Indian Society of Soil Science 1992;40:371-373.
7. Patil PL, Kuligod VB, Gundlur SS, Jahnavi K, Nagaral IN, Shikrashetti P. Soil fertility mapping in Dindur sub-watershed of Karnataka for site specific recommendations. Journal of the Indian Society of Soil Science 2016;64(4):381-390.
8. Rajeshwar M, Mani S. Nutrients status in the surface and subsurface soils of dryland Agricultural Research Station at Chettinad in Sivaganga district of Tamil Nadu. Asian Journal of Soil Sciences 2014;9(2):169-175.
9. Sathish A, Ramachandrappa BK, Devarajappa K, Savitha MS, Gowda MNT, Prashanth KM. Assessment of Spatial variability in fertility status and nutrient recommendation in Alantha cluster villages, Ramanagara district, Karnataka using GIS. Journal of Indian Society of Soil Science 2018;66(2):149-157.
10. Sathyanarayana E, Padmaja G, Sharma SHK, Vidya GC, Sagar S, Bharghavi J *et al.* Effect of different sources and levels of nitrogen, phosphorus and zinc on soil fertility, nutrient content, uptake and yield of soybean. The Pharma Innovation Journal 2021;10(7):1152-1156.
11. Singh. Mahendra Soil management in relation to sustainable food production. J Indian Soc. Soil Sci 2010;58:65-72.
12. Sood Anil, Sharma PK, Tur NS, Nayyar VK. Micronutrient status and spatial variability in soils of Muktsar district of Punjab-A GIS Approach. J Indian Soc. Soil Sci 2009;57(3):300-306.
13. Srikant KS, Patil PL, Dasog GS, Gali SK. Mapping of available major nutrients of a micro-watershed in northern dry zone of Karnataka. Karnataka Journal of Agricultural Sciences 2008;21:391-395.
14. Surendra Babu P, Chandini Patnaik M, Praveen Kumar G, Madhavi A, Srijaya T, Shankaraiah M *et al.* Adilabad District - Soil Fertility Status and Fertilizer Use Guidelines. Publication Number: 117 / SP / PJTSAU / 2019. Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad - 500030 2019, 1-11.
15. Tandon. Methods of Analysis of Soils, Plants, Waters, Fertilizers and Organic manures. Fertilizer Development and Consultation Organisation, 2nd edition 2005.
16. Venkatesh MS, Satynarayana T. Sulphur fractions and C: N: S relationship in oilseed growing Vertisols of North Karnataka. Journal of the Indian Society of Soil Science 1999;47:241-248.