

## CHARACTERISATION OF CALCAREOUS SOILS IN MAHBOOBNAGAR AND NALGONDA DISTRICT OF TELANGANA STATE

### ABSTRACT:

A survey was conducted in the year 2019-20 in old Mahboobnagar and Nalgonda district of Telangana state to study the characters of calcareous soils, based on effervescence with dilute.HCL the samples were collected and were analysed for its characters. Majority of soils collected were medium to high in  $\text{CaCO}_3$  status. All the soils collected were alkaline to highly alkaline in reaction. Soils were low to medium in available nitrogen and phosphorus content. The average pH, N,  $\text{P}_2\text{O}_5$ ,  $\text{K}_2\text{O}$  value recorded in these soils were 8.49, 77.19  $\text{kg ha}^{-1}$ , 6.215  $\text{kg ha}^{-1}$ , 72.88  $\text{kg ha}^{-1}$  respectively. The main objective of the study is to know the properties of Calcareous soil and also to study the effect of calcium carbonate on the different properties of soil and therefore a correlation study was conducted which reported that there is significant positive relationship is seen between  $\text{CaCO}_3$  content and pH and significant negative relationship is seen between  $\text{CaCO}_3$  content and available N and  $\text{P}_2\text{O}_5$  in soil. No significant relationship is seen between  $\text{CaCO}_3$  content and EC and OC values.

KEY WORDS: *Calcareous Soil, characterization,  $\text{CaCO}_3$  Content, Correlation.*

### INTRODUCTION

Calcareous soils are soils rich of calcium carbonate which occur mainly in the arid and semi-arid subtropics of both hemispheres. The diagnostic horizon in the calcareous soil is the calcic horizon which contains more than 15%  $\text{CaCO}_3$  and has a depth of more than 15cm thick. Potential productivity of calcareous soils is relatively high where adequate water and nutrients can be supplied. Crusting of the surface may affect not only infiltration and soil aeration but also the emergence of seedlings. Cemented conditions of the subsoil layers may hamper root development and water movement characteristics.

Many scientists discussed the definition of Calcareous soils as soils which contains high levels of calcium carbonate ( $\text{CaCO}_3$ ) that affects soil properties related to plant growth, such as soil water relations and the availability of plant nutrients. Calcareous soils are common in the arid areas of the earth (FAO, 2016) occupying >30% of the earth's surface, and their  $\text{CaCO}_3$  content varies from just detectable up to 95% (Marschner, 1995). Calcareous soils are the soils in which a high amount of calcium carbonate dominates the problems related to agricultural land use. They are characterized by the presence of calcium carbonate in the parent material and by a calcic horizon, a layer of secondary accumulation of carbonates (usually Ca or Mg) in excess of 15% calcium carbonate equivalent and at least 5% more carbonate than an underlying layer. In the World Reference Base (WRB) soil classification system calcareous soils may mainly occur in the Reference Soil Group of *Calcisols*.

Calcareous soils are common in arid and semi-arid climates affecting over 1.5 billion acres of land worldwide. These soils are identified on the basis of presence of the mineral calcium carbonate in the parent material and an accumulation of lime. Calcite and aragonite ( $\text{CaCO}_3$ ), dolomite [ $\text{CaMg}(\text{CO}_3)_2$ ] and Magnesite ( $\text{MgCO}_3$ ) are the calcium and magnesium carbonate minerals found in calcareous soils. They are mainly present as calcite, and to a lesser extent as dolomite. It is most easily recognized by the effervescence or fizz that occurs when these soils are treated with dilute acid (Agriculture Canada, 1976 and Soil Science Society of America, 1997). The pH of these soils is usually above 7.0 and may be as high as 8.5 (Yaalon, 1957). When such soils contain sodium carbonate, the pH may exceed 9.0. Calcareous soils are classified in to four classes based on the presence of calcium carbonate percent in them and they are slight (0-5%), moderate (5-10%), high (10-20%) and very high calcareous soils (20- 25%). Calcareous soils are productive for agricultural use when they are managed properly.

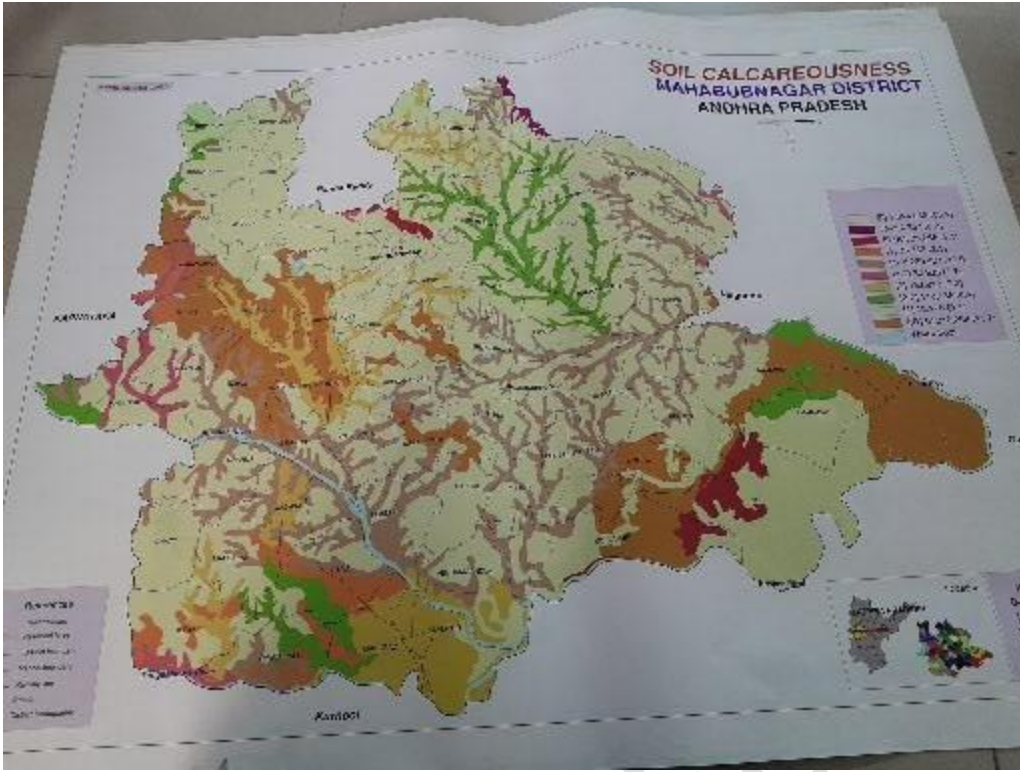
## Materials and Methods

The survey work was conducted during 2019-2020 to collect representative surface soil samples of different calcareous soils in old Mahaboobnagar and Nalgonda district of Telangana state. On the field dilute .HCl was applied with the help of dropper, the soils which has effervescence were subjected to chemical analysis and categorized into slightly, moderately and strongly calcareous soils with respect to per cent calcium carbonate status.



NBSSLUP, 2004

Fig. 1: Map of study location (Nalgonda district)



NBSSLUP, 2004

Fig.2 : Map of study location (Mahabubnagar district)

### **Soil sample collection and chemical analysis**

The collected samples were air-dried, ground and passed through a 2 mm sieve and stored in polythene bags for further analytical work. The pH and EC of soils was measured in 1:2.5 soil water suspension using a glass electrode and Conductivity Bridge, respectively (Jackson, 1973). The organic carbon content of the soil was estimated by Walkley and Black's wet oxidation method as described by Jackson, 1973. Calcium carbonate in soil was determined by rapid acid titration method. The available nitrogen was determined by alkaline potassium permanganate method and Available phosphorus in soil was extracted by Olsen's extractant and Available potassium were extracted with neutral normal ammonium acetate solution and using flame photometer.

### **RESULTS AND DISCUSSION**

Characters of different samples calcareous soils of Mahaboobnagar and Nalgonda is given in Table 1 and Table 2 respectively.

The percent of calcium carbonate in the soil samples collected from Mahaboobnagar and Nalgonda district ranged from 4.90 (lowest) to 14.58 (highest) and 4.93 (lowest) to 14.00 (highest) respectively. The  $\text{CaCO}_3$  content variation in these soils may be due to parent material, native  $\text{CaCO}_3$  content in soil profile and faulty agricultural practices. Similar reports regarding the presence of calcium carbonate content in vertisols were reported by Halajinia *et al.* (2009). According to categorisation 30 soil samples collected are slight calcareous, 45 are moderately calcareous and remaining 50 were highly calcareous, mean value for  $\text{CaCO}_3$  content is 9.63 in Nalgonda district whereas in Mahaboobnagar district 13 were slightly Calcareous, 54 were moderately Calcareous and 58 were highly Calcareous soils with mean value of 8.65.

All calcareous soils were alkaline in nature with pH value ranging from 7.91 to 9.07 with the average value of 8.44 and 7.84 to 9.16 with average of 8.65 in Nalgonda and Mahaboobnagar respectively. Being predominated by calcium carbonate, it was logical that pH of these soils were alkaline. Similar analytical result for soil pH in calcareous soils was reported by Afif *et al.* (1993). Organic carbon percent for these soils remained low to medium 0.04 to 1.62 % in Mahaboobnagar and 0.22 to 1.53 % in Nalgonda district due to insufficient availability of organic manures. The average OC value is 0.63 % in Nalgonda and 0.68 % in Mahaboobnagar district.

The highest available nitrogen content in soils was 42.70 kg ha<sup>-1</sup> to 616 kg ha<sup>-1</sup> in Nalgonda and 131 kg ha<sup>-1</sup> to 450 kg ha<sup>-1</sup> in Mahaboobnagar with the average values of 206 kg ha<sup>-1</sup> and 204 kg ha<sup>-1</sup> respectively in Mahaboobnagar and Nalgonda respectively, majority of the soils were belongs to category of low to medium in available nitrogen. The poor status of soil organic carbon resulted in low status of available nitrogen. The available phosphorus ranged from 13.40 to 37.20 kg ha<sup>-1</sup> in Nalgonda and 12.30 to 38.90 in Mahaboobnagar with average value of 19.75 kg ha<sup>-1</sup> from Mahaboobnagar and 22.30 from Nalgonda implies that majority of the soils were low to medium in available phosphorus. It may due to phosphorus fixation as Ca-P in soil resulted in low status of phosphorus. Similar result of low availability of phosphorus in calcareous soils was reported by Mostashari *et al.*, 2008. Maximum available potassium recorded was 422.49 kg ha<sup>-1</sup>; minimum available potassium recorded was 89.2 kg ha<sup>-1</sup> average of 221.9 kg ha<sup>-1</sup> in Mahaboobnagar and Maximum available potassium recorded was 396.49 kg ha<sup>-1</sup>; minimum available potassium recorded was 150 kg ha<sup>-1</sup> average of 245.38 kg ha<sup>-1</sup> in Nalgomda.

To study the effect of calcium carbonate on the different properties of soil and therefore a correlation study was conducted. The correlation analysis indicated significant positive relationship between CaCO<sub>3</sub> content and pH values. The correlation values (r) for a Mahaboobnagar and Nalgonda are presented in the table 3 and 4 respectively. As the CaCO<sub>3</sub> value increases there is increase in pH value is observed. This is because of the dissolution of excess CaCO<sub>3</sub> present in these soils, results in a high solution HCO<sub>3</sub><sup>-</sup> concentration, that buffers the soil in the pH range of 7.5 to 8.5 (Imas, 2000): as  $\text{CaCO}_3 + \text{H}_2\text{O} \leftrightarrow \text{Ca}^{2+} + \text{HCO}_3^- + \text{OH}^-$ .

There is significant negative relationship is seen between  $\text{CaCO}_3$  content and available nitrogen and available P, because as the  $\text{CaCO}_3$  content increases, the pH value will also increase (Table 3 & 4). The alkaline pH values affects the rates of N transformations, which in turn can influence the efficiency of N use by plants (Wahba *et al.*, 2019) and at higher pH values, phosphate anions react with Ca and Mg to form phosphate compounds of limited solubility reported by Mortedt (1999). Maximum availability to plants of both native and applied P is in the pH range of 6.0 to 7.5. There is no significant relationship is seen between EC, OC and available K. in Mahaboobnagar whereas in Nalgonda, a positive and significant correlation was found between  $\text{CaCO}_3$  and PH, EC, OC; negative and significant between relationship  $\text{CaCO}_3$  and N,P,K.. As mentioned above high pH values affects the nutrient availability.

## CONCLUSION:

Majority of the soil samples collected were medium to high in calcium content. All of the samples collected (Slightly, moderately and strongly calcareous soils) were alkaline in reaction. These soils were slightly saline to saline and organic carbon status of these calcareous soils remained low to medium. Different type of calcareous soils belongs to low to medium in available nutrients *i.e.*, N, P, K content. Slightly calcareous soils had relatively more available nutrients (N, P, K,) compare to moderately and strongly calcareous soils. OC and EC values remained unaffected by  $\text{CaCO}_3$  content.

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**Table 1: Properties of calcareous soil samples collected from Mahaboobnagar district**

S.No	Village name	Mandal name	CaCO <sub>3</sub>	pH	EC	OC	N (kg ha <sup>-1</sup> )	P <sub>2</sub> O <sub>5</sub> (kg ha <sup>-1</sup> )	K <sub>2</sub> O (kg ha <sup>-1</sup> )	Sand %	Silt%	Clay %
1	Achampet	Achampet	7.74	8.35	0.38	0.50	207.90	21.20	187.00	42.34	36.66	21.00
2	Ainole	Achampet	6.85	8.22	0.25	0.45	236.90	24.70	172.00	57.20	23.42	19.38
3	Akkavaram	Achampet	5.04	7.95	0.09	0.13	402.00	35.60	105.00	56.34	26.66	17.00
4	Bolghatpalle	Achampet	12.36	8.89	1.01	0.93	151.70	14.60	288.60	54.34	20.66	25.00
5	Bommenapalle	Achampet	13.97	9.00	1.66	1.24	139.10	13.40	311.49	40.60	33.42	25.98
6	Brahmanapalle	Achampet	10.82	8.70	0.62	0.70	175.60	16.70	238.00	55.20	21.42	23.38
7	Chandapur	Achampet	8.76	8.49	0.44	0.57	196.90	19.50	197.20	55.74	22.66	21.60
8	Chennaram (Sabak)	Achampet	9.47	8.60	0.52	0.64	189.30	18.60	225.60	48.78	28.66	22.56
9	Choutapalle	Achampet	4.90	7.84	0.04	0.04	450.00	38.90	89.20	64.94	18.66	16.40
10	Ghanapur	Achampet	6.10	8.12	0.16	0.37	323.20	27.70	138.00	59.14	22.42	18.44
11	Gumpampalle	Achampet	7.43	8.30	0.32	0.47	214.10	22.70	179.00	58.94	20.66	20.40
12	Amrabad	Amrabad	9.15	8.54	0.49	0.58	194.00	18.90	200.49	54.60	23.42	21.98
13	Gangupenta	Amrabad	11.18	8.77	0.77	0.76	166.70	15.90	246.49	47.74	28.42	23.84
14	Gudur	Amrabad	12.68	8.95	1.29	1.03	147.90	14.30	293.49	44.18	30.66	25.16

15	Ippalapalle	Amrabad	14.58	9.13	4.58	1.62	131.60	12.30	422.49	38.34	34.66	27.00
16	Lakshmapur	Amrabad	10.04	8.63	0.55	0.65	184.90	18.20	228.60	45.80	31.42	22.78
17	Macharam	Amrabad	5.62	8.01	0.12	0.23	365.00	31.50	123.00	55.20	27.42	17.38
18	Maddimadugu	Amrabad	6.71	8.20	0.24	0.44	261.90	24.80	149.60	62.54	18.42	19.04
19	Mannanur	Amrabad	10.60	8.69	0.60	0.69	178.10	16.90	235.00	56.54	20.42	23.04
20	Maredugu	Amrabad	11.54	8.81	0.84	0.80	160.40	15.50	262.20	57.14	18.42	24.44
21	Padra	Amrabad	13.82	9.00	1.56	1.18	141.60	13.50	299.00	39.74	34.42	25.84
22	Thirumalapur	Amrabad	14.43	9.09	2.01	1.40	135.40	12.80	328.49	50.78	22.66	26.56
23	Turkapalle	Amrabad	10.17	8.64	0.56	0.66	182.70	17.50	230.00	54.34	22.66	23.00
24	Bekkara	Kalvakurthy	8.33	8.43	0.40	0.56	201.60	20.50	188.60	59.20	19.42	21.38
25	Gundur	Kalvakurthy	7.70	8.34	0.36	0.49	209.20	21.50	186.49	50.34	28.66	21.00
26	Jeedipalle	Kalvakurthy	8.59	8.48	0.43	0.56	198.20	19.80	193.00	57.20	21.42	21.38
27	Jillella	Kalvakurthy	10.93	8.74	0.71	0.76	173.00	16.60	244.20	53.74	22.66	23.60
28	Kalwakurthy	Kalvakurthy	11.72	8.85	0.92	0.87	157.70	14.90	280.60	37.80	37.42	24.78
29	Kurmidda	Kalvakurthy	14.03	9.01	1.70	1.28	139.10	13.10	313.49	51.14	22.42	26.44
30	Lingasanipalle	Kalvakurthy	7.15	8.25	0.29	0.46	214.90	23.40	175.60	50.60	29.42	19.98
31	Marchal	Kalvakurthy	5.08	7.99	0.12	0.22	381.00	33.80	113.20	48.34	34.66	17.00
32	Mukural	Kalvakurthy	6.26	8.15	0.16	0.37	314.40	27.00	139.20	57.14	24.42	18.44
33	Panjugul	Kalvakurthy	6.82	8.22	0.25	0.45	239.60	24.80	171.49	59.20	21.42	19.38
34	Raghupathipeta	Kalvakurthy	8.81	8.51	0.45	0.58	195.70	19.50	198.49	58.60	19.42	21.98
35	Suddakal	Kalvakurthy	9.28	8.58	0.51	0.60	189.50	18.80	220.49	59.14	18.42	22.44
36	Bhairampalle	Midjil	11.43	8.80	0.80	0.78	162.70	15.60	249.20	52.60	23.42	23.98

37	Boinpalle	Midjil	12.47	8.90	1.14	0.95	149.20	14.50	290.60	54.54	20.42	25.04
38	Bommarasipalle	Midjil	13.14	9.00	1.33	1.15	143.00	13.70	298.49	41.74	32.66	25.60
39	Chedughattu	Midjil	6.54	8.20	0.23	0.42	288.70	25.70	149.00	60.34	20.66	19.00
40	Chiluveru	Midjil	5.97	8.10	0.15	0.36	339.00	28.70	129.00	65.74	16.42	17.84
41	Donur	Midjil	12.25	8.88	0.98	0.89	153.00	14.70	286.49	54.34	20.66	25.00
42	Gudiganpalle	Midjil	11.58	8.81	0.85	0.85	160.40	15.20	263.49	56.78	18.66	24.56
43	Ippaipahad	Midjil	7.57	8.32	0.33	0.47	211.70	22.20	182.49	59.14	20.42	20.44
44	Jagboinpalle	Midjil	10.29	8.65	0.58	0.68	181.60	17.10	232.20	50.34	26.66	23.00
45	Jakanalapalle	Midjil	10.87	8.72	0.68	0.74	175.30	16.70	239.00	49.20	27.42	23.38
46	Kanchanpalle	Midjil	13.08	8.99	1.32	1.09	144.20	14.00	298.00	49.20	25.42	25.38
47	Kothapalle	Midjil	14.43	9.10	2.30	1.50	133.10	12.50	409.60	44.34	28.66	27.00
48	Aloor	Jedcherla	9.51	8.60	0.52	0.64	187.70	18.50	227.60	40.78	36.66	22.56
49	Alwanpalle	Jedcherla	8.09	8.40	0.38	0.53	204.00	20.80	188.49	58.34	20.66	21.00
50	Ambatapur	Jedcherla	4.99	7.91	0.07	0.12	410.00	36.80	103.00	58.34	24.66	17.00
51	Ammapalle	Jedcherla	6.30	8.15	0.20	0.38	314.20	26.80	143.00	57.14	24.42	18.44
52	Badepalle	Jedcherla	6.86	8.22	0.26	0.45	232.60	24.40	173.20	57.74	22.66	19.60
53	Bureddipalle	Jedcherla	14.00	9.01	1.69	1.25	139.10	13.40	313.00	40.94	32.66	26.40
54	Burgupalle	Jedcherla	11.87	8.85	0.95	0.89	156.40	14.90	283.00	37.80	37.42	24.78
55	Chinna Adiryal	Jedcherla	12.63	8.93	1.18	0.95	149.20	14.40	292.20	38.54	36.42	25.04
56	Chintaboinpalle	Jedcherla	10.36	8.66	0.59	0.69	179.80	16.90	233.60	60.54	16.42	23.04
57	Earlapalle	Jedcherla	9.47	8.60	0.52	0.64	189.30	18.70	223.20	48.78	28.66	22.56

58	Gangapur	Jedcherla	8.33	8.44	0.38	0.56	200.60	20.50	188.60	52.54	26.42	21.04
59	Gollapalle	Jedcherla	7.79	8.35	0.38	0.51	207.90	21.00	187.60	60.34	18.66	21.00
60	Goplapur	Jedcherla	7.12	8.24	0.28	0.46	215.80	23.60	174.20	56.60	23.42	19.98
61	Antharam	Talakondalapalle	6.52	8.20	0.22	0.40	289.50	25.90	147.60	64.34	16.66	19.00
62	Badnapur	Talakondalapalle	5.90	8.10	0.14	0.36	347.70	29.60	127.00	61.74	20.66	17.60
63	Chandradana	Talakondalapalle	7.54	8.30	0.33	0.47	212.90	22.60	180.00	65.14	14.42	20.44
64	Cheepunuthala	Talakondalapalle	9.20	8.54	0.50	0.58	193.10	18.90	200.60	46.94	30.66	22.40
65	Chellampalle	Talakondalapalle	10.29	8.65	0.58	0.68	180.60	17.00	230.60	56.34	20.66	23.00
66	Chennaram	Talakondalapalle	10.87	8.71	0.68	0.75	175.50	16.70	240.49	51.74	24.66	23.60
67	Chukkapur	Talakondalapalle	11.29	8.77	0.79	0.76	166.50	15.90	248.60	36.60	39.42	23.98
68	Garvipalle	Talakondalapalle	11.71	8.85	0.91	0.85	157.70	14.90	280.00	50.78	24.66	24.56
69	Gattu Ippalapalle	Talakondalapalle	12.08	8.88	0.97	0.89	153.20	14.70	285.60	37.80	37.42	24.78
70	Julapalle	Talakondalapalle	13.11	9.00	1.32	1.10	143.90	13.80	298.00	53.74	20.66	25.60
71	Khanapur	Talakondalapalle	11.43	8.78	0.81	0.79	165.60	15.70	260.00	38.94	36.66	24.40
72	Lingarapalle	Talakondalapalle	10.82	8.70	0.63	0.71	176.50	16.70	238.49	49.20	27.42	23.38
73	Aithole	Tandoor	8.87	8.51	0.45	0.58	195.00	19.40	199.60	54.60	23.42	21.98
74	Akunellikuduru	Tandoor	8.62	8.48	0.44	0.57	197.80	19.60	193.49	55.74	22.66	21.60
75	Allapur	Tandoor	8.38	8.45	0.41	0.56	200.40	20.50	190.00	57.20	21.42	21.38
76	Antharam	Tandoor	7.41	8.28	0.32	0.47	214.40	22.80	178.60	50.60	29.42	19.98
77	Bhallanpalle	Tandoor	7.68	8.34	0.34	0.47	209.40	21.70	183.49	52.34	26.66	21.00
78	Cherlaitikyala	Tandoor	9.44	8.59	0.52	0.60	189.40	18.70	222.49	50.78	26.66	22.56

79	Govindayapalle	Tandoor	11.18	8.75	0.78	0.76	167.70	15.90	248.00	52.60	23.42	23.98
80	Gunthakoduru	Tandoor	11.58	8.83	0.85	0.84	160.10	15.20	263.49	51.14	24.42	24.44
81	Indrakal	Tandoor	12.47	8.89	1.05	0.95	150.40	14.60	289.00	50.34	24.66	25.00
82	Kummera	Tandoor	12.97	8.97	1.32	1.04	145.40	14.30	295.00	49.20	25.42	25.38
83	Medipur	Tandoor	10.83	8.70	0.68	0.72	175.50	16.70	238.60	55.20	21.42	23.38
84	Nagadevupalle	Tandoor	9.22	8.54	0.50	0.59	191.90	18.90	201.49	61.14	16.42	22.44
85	Allampalle	Timmajipet	8.58	8.48	0.42	0.56	199.00	19.80	192.60	59.20	19.42	21.38
86	Appajipalle	Timmajipet	7.69	8.34	0.35	0.48	209.20	21.50	185.60	50.34	28.66	21.00
87	Avancha	Timmajipet	6.51	8.17	0.20	0.39	312.90	26.60	143.60	49.14	32.42	18.44
88	Bajipuram	Timmajipet	9.15	8.54	0.48	0.58	193.90	18.90	200.49	58.60	19.42	21.98
89	Bhavajipalle	Timmajipet	12.66	8.95	1.21	0.98	148.00	14.40	292.49	50.18	24.66	25.16
90	Budhasamudra m	Timmajipet	8.62	8.49	0.44	0.57	197.80	19.60	194.20	59.74	18.66	21.60
90	Chegunta	Timmajipet	10.93	8.74	0.69	0.75	174.20	16.60	243.20	45.74	30.66	23.60
91	Gorita	Timmajipet	8.09	8.42	0.38	0.55	202.80	20.60	188.60	58.54	20.42	21.04
92	Gummakonda	Timmajipet	6.55	8.20	0.23	0.43	273.00	25.40	149.00	58.34	22.66	19.00
93	Ippalapalle	Timmajipet	5.30	7.99	0.12	0.22	377.60	33.80	120.60	57.20	25.42	17.38
94	Koduparth	Timmajipet	5.82	8.10	0.14	0.33	350.00	29.90	125.60	47.20	35.42	17.38
95	Marepalle	Timmajipet	6.99	8.24	0.28	0.46	228.30	23.90	173.60	51.74	28.66	19.60
96	Marikal	Timmajipet	11.61	8.83	0.91	0.85	159.30	15.10	264.20	52.78	22.66	24.56
97	Ammapur	Nawabpet	14.43	9.12	1.82	1.32	131.60	12.40	315.60	52.78	20.66	26.56
98	Chowdoor	Nawabpet	14.43	9.10	3.32	1.53	134.10	12.50	421.49	52.34	20.66	27.00

99	Darpalle	Nawabpet	13.57	9.00	1.44	1.15	141.70	13.60	298.60	39.74	34.42	25.84
100	Depalle	Nawabpet	11.87	8.85	0.93	0.87	156.40	14.90	283.00	37.80	37.42	24.78
101	Gurukunta	Nawabpet	11.43	8.78	0.81	0.78	162.70	15.70	250.60	36.60	39.42	23.98
102	Hajilapur	Nawabpet	10.09	8.63	0.56	0.66	184.00	17.80	229.20	58.34	18.66	23.00
103	Hanmasanipalle	Nawabpet	8.43	8.45	0.42	0.56	200.30	20.40	191.49	59.20	19.42	21.38
104	Ippatur	Nawabpet	7.54	8.31	0.33	0.47	211.70	22.40	180.60	61.14	18.42	20.44
105	Kakarjala	Nawabpet	9.27	8.56	0.50	0.59	189.90	18.80	201.49	61.14	16.42	22.44
106	Kakarlaphad	Nawabpet	10.76	8.70	0.62	0.70	177.70	16.80	237.20	54.18	22.66	23.16
107	Kamaram	Nawabpet	11.01	8.75	0.73	0.76	171.50	16.20	245.00	37.74	38.66	23.60
108	Karkonda	Nawabpet	13.93	9.00	1.62	1.20	140.40	13.50	309.60	40.60	33.42	25.98
109	Angadi Raichur	Kodangal	14.28	9.07	1.79	1.29	135.70	12.80	315.49	52.78	20.66	26.56
110	Annaram	Kodangal	12.43	8.89	1.04	0.94	151.50	14.60	288.60	52.34	22.66	25.00
112	Appaipalle	Kodangal	9.71	8.61	0.54	0.65	186.90	18.50	228.00	45.80	31.42	22.78
113	Chinna Nandigam	Kodangal	8.79	8.50	0.45	0.57	196.50	19.50	198.00	57.38	20.66	21.96
114	Chitlapalle	Kodangal	7.87	8.35	0.38	0.52	207.60	20.90	187.60	60.34	18.66	21.00
115	Gandlepalle	Kodangal	7.29	8.28	0.31	0.47	214.40	22.90	176.49	56.60	23.42	19.98
116	Hasnabad	Kodangal	5.97	8.12	0.16	0.36	332.00	27.90	133.49	60.60	21.42	17.98
117	Indanoor	Kodangal	5.06	7.95	0.10	0.21	388.00	35.40	107.20	56.34	26.66	17.00
118	Kastoorpalle	Kodangal	14.43	9.10	2.20	1.44	135.40	12.70	328.60	50.34	22.66	27.00
119	Kodangal	Kodangal	13.11	8.99	1.33	1.12	144.10	14.00	298.00	49.74	24.66	25.60

120	Nagaram	Kodangal	11.54	8.80	0.83	0.79	160.50	15.50	261.49	38.94	36.66	24.40
121	Parsapur	Kodangal	10.19	8.65	0.57	0.67	181.90	17.40	230.00	52.34	24.66	23.00
122	Lingampet	Jedcherla	8.33	8.43	0.41	0.56	201.80	20.60	189.00	59.20	19.42	21.38
123	Boinpally	Mehboob Nagar	6.79	8.20	0.25	0.44	240.80	24.80	170.60	63.20	17.42	19.38
124	Fatehpur	Nawabpet	4.93	7.91	0.07	0.08	426.00	37.20	100.00	63.80	19.42	16.78
125	Fatehpur	Nawabpet	5.73	8.05	0.13	0.32	352.00	30.90	123.60	55.20	27.42	17.38
	Mean		9.65	8.57	0.71	0.69	206.58	19.74	221.98	52.55	25.17	22.28
	Standard deviation		2.71	0.32	0.64	0.32	71.49	6.0	66.55	7.32	6.14	2.79

Note: CaCO<sub>3</sub> - Calcium carbonate (%), pH - Acidity or Alkalinity of soil, EC - Electrical conductivity, OC - Organic Carbon (%), N (kg ha<sup>-1</sup>) - Available Nitrogen, P<sub>2</sub>O<sub>5</sub>(kg ha<sup>-1</sup>) - Available phosphorus, K<sub>2</sub>O (kg ha<sup>-1</sup>) - Available potassium

**Table 2: Properties of calcareous soil samples collected from Nalgonda district**

S.No.	Village name	Mandal name	CaCO <sub>3</sub>	pH	EC	OC	N (kg ha <sup>-1</sup> )	P <sub>2</sub> O <sub>5</sub> (kg ha <sup>-1</sup> )	K <sub>2</sub> O (kg ha <sup>-1</sup> )	Sand	Silt	Clay
1	Annaram	Thungathurthi	6.26	8.15	0.39	0.46	198.20	27.00	187.60	39.54	37.66	22.80
2	Bandaramaram	Thungathurthi	5.90	8.10	0.30	0.40	261.90	29.60	179.00	54.40	24.42	21.18
3	Ganugubanda	Thungathurthi	5.06	7.95	0.09	0.26	484.90	35.40	167.00	53.54	27.66	18.80
4	Kunta Pale	Thungathurthi	11.65	8.85	1.26	1.09	144.20	14.90	290.60	51.54	21.66	26.80
5	Laxmapur	Thungathurthi	12.47	8.90	1.71	1.29	112.90	14.50	349.20	37.80	34.42	27.78
6	Manapur	Thungathurthi	10.09	8.63	0.68	0.68	159.00	17.80	260.00	52.40	22.42	25.18
7	Pasnur	Thungathurthi	6.59	8.20	0.50	0.56	181.90	25.10	233.60	52.94	23.66	23.40
8	Pasthala	Thungathurthi	8.33	8.43	0.58	0.59	166.50	20.50	243.20	45.98	29.66	24.36
9	Ramachandrapuram	Thungathurthi	4.93	7.91	0.04	0.22	616.00	37.20	150.00	62.14	19.66	18.20
10	Vempati	Thungathurthi	5.62	8.01	0.20	0.36	365.00	31.50	173.60	56.34	23.42	20.24
11	Anantharam	Tirumala	6.05	8.12	0.34	0.44	209.20	27.90	183.49	56.14	21.66	22.20

12	Bandla Palle	Tirumala	6.79	8.20	0.52	0.56	171.50	24.80	237.20	51.80	24.42	23.78
13	Chenna Puram	Tirumala	11.05	8.75	0.78	0.74	156.40	16.20	268.49	44.94	29.42	25.64
14	Etoor	Tirumala	11.87	8.85	1.33	1.18	134.10	14.90	316.49	41.38	31.66	26.96
15	Gudepuri	Tirumala	14.00	9.01	3.32	1.53	42.70	13.40	396.49	35.54	35.66	28.80
16	Jalal Puram	Tirumala	8.62	8.48	0.59	0.64	162.70	19.60	246.49	43.00	32.42	24.58
17	Mali Puram	Tirumala	5.30	7.99	0.15	0.32	426.00	33.80	171.49	52.40	28.42	19.18
18	Mamidi Palle	Tirumala	5.82	8.09	0.29	0.38	314.40	29.90	176.49	59.74	19.42	20.84
19	Mamidiyala	Tirumala	9.44	8.59	0.66	0.67	159.30	18.70	256.00	53.74	21.42	24.84
20	Nanda Puram	Tirumala	11.43	8.78	0.91	0.77	149.50	15.70	280.60	54.34	19.42	26.24
21	Phanigiri	Tirumala	12.47	8.90	1.70	1.24	116.70	14.50	344.20	36.94	35.42	27.64
22	Sidda Samudram	Tirumala	12.93	8.96	2.20	1.33	77.80	14.30	369.49	47.98	23.66	28.36
23	Brundavanapuram	Nadigudem	8.79	8.50	0.62	0.64	160.50	19.50	248.60	51.54	23.66	24.80
24	Chakirala	Nadigudem	6.52	8.20	0.44	0.48	193.10	25.90	208.00	56.40	20.42	23.18
25	Chan Palle	Nadigudem	6.26	8.15	0.38	0.46	199.00	27.00	187.00	47.54	29.66	22.80
26	Eklashkhanpet	Nadigudem	6.54	8.20	0.45	0.55	185.70	25.40	230.60	54.40	22.42	23.18
27	KagithaRama- Chandrapuram	Nadigudem	10.93	8.74	0.77	0.71	156.70	16.60	268.00	50.94	23.66	25.40
28	Karivirala	Nadigudem	11.58	8.83	0.97	0.87	149.00	15.20	286.49	35.00	38.42	26.58
29	Nadigudem	Nadigudem	12.63	8.93	2.01	1.30	105.40	14.40	353.60	48.34	23.42	28.24
30	Palaram	Nadigudem	5.97	8.10	0.32	0.44	218.90	28.70	180.60	47.80	30.42	21.78
31	Rama Puram	Nadigudem	5.08	7.99	0.13	0.28	458.20	33.80	170.60	45.54	35.66	18.80

32	Ratnavaram	Nadigudem	5.62	8.01	0.20	0.36	352.00	31.50	173.60	54.34	25.42	20.24
33	Singavaram	Nadigudem	5.88	8.10	0.30	0.39	261.90	29.80	178.60	56.40	22.42	21.18
34	Agamothkur	Vemulapalle	6.71	8.20	0.52	0.56	175.50	24.80	235.00	55.80	20.42	23.78
35	Amangal	Vemulapalle	7.70	8.34	0.54	0.58	168.90	21.50	238.60	56.34	19.42	24.24
36	Annapareddiguda	Vemulapalle	11.11	8.75	0.81	0.76	153.30	15.90	273.20	49.80	24.42	25.78
37	Bheeman Palle	Vemulapalle	11.77	8.85	1.33	1.12	139.10	14.90	293.49	51.74	21.42	26.84
38	Bommakal	Vemulapalle	12.32	8.89	1.49	1.23	121.70	14.60	340.20	38.94	33.66	27.40
39	Buggabavi Guda	Vemulapalle	5.73	8.05	0.25	0.37	323.20	30.90	175.60	57.54	21.66	20.80
40	ChaliChimala Palem	Vemulapalle	5.48	8.00	0.17	0.35	377.60	31.80	173.20	62.94	17.42	19.64
41	Chirumarthy	Vemulapalle	11.65	8.84	1.19	1.01	145.40	14.90	289.00	51.54	21.66	26.80
42	Gandravaniguda	Vemulapalle	11.47	8.80	0.95	0.84	149.20	15.60	283.00	53.98	19.66	26.36
43	Itikyala	Vemulapalle	6.10	8.12	0.38	0.45	201.80	27.70	186.49	56.34	21.42	22.24
44	Kalvalapalem	Vemulapalle	9.22	8.54	0.63	0.66	159.90	18.90	251.49	47.54	27.66	24.80
45	Kamepalle	Vemulapalle	10.29	8.65	0.73	0.69	157.70	17.00	263.49	46.40	28.42	25.18
46	Ailapuram	Miryalaguda	11.98	8.87	1.44	1.20	133.00	14.80	320.00	46.40	26.42	27.18
47	Alagadapa	Miryalaguda	13.11	8.99	2.72	1.40	62.70	14.00	390.49	41.54	29.66	28.80
48	Annaram	Miryalaguda	8.43	8.45	0.58	0.60	166.40	20.40	244.20	37.98	37.66	24.36
49	Chillapuram	Miryalaguda	6.51	8.17	0.42	0.47	196.50	26.60	187.60	55.54	21.66	22.80
50	Chintha Palle	Miryalaguda	5.04	7.95	0.07	0.23	518.60	35.40	162.49	55.54	25.66	18.80
51	Goguvanigudem	Miryalaguda	5.70	8.04	0.22	0.36	347.70	31.50	174.20	54.34	25.42	20.24
52	Gudur	Miryalaguda	5.90	8.10	0.31	0.42	240.80	29.60	179.00	54.94	23.66	21.40

53	Hydla Puram	Miryalaguda	12.51	8.93	1.79	1.30	110.40	14.50	353.49	38.14	33.66	28.20
54	Kalva Palle	Miryalaguda	11.61	8.83	1.18	0.95	147.00	15.10	288.60	35.00	38.42	26.58
55	Kista Puram	Miryalaguda	11.82	8.85	1.33	1.12	138.00	14.90	295.00	35.74	37.42	26.84
56	Kothaguda	Miryalaguda	9.28	8.58	0.63	0.67	159.30	18.80	253.00	57.74	17.42	24.84
57	Miryalaguda	Miryalaguda	8.33	8.43	0.58	0.59	166.70	20.60	240.49	45.98	29.66	24.36
58	Mulkalkalva	Miryalaguda	6.52	8.19	0.44	0.48	195.00	26.10	205.49	49.74	27.42	22.84
59	Anajipuram	Penpahad	6.30	8.15	0.41	0.47	197.80	26.80	187.60	57.54	19.66	22.80
60	Anatharam	Penpahad	5.93	8.10	0.32	0.43	228.30	28.70	180.00	53.80	24.42	21.78
61	Bhakthalapuram	Penpahad	5.73	8.05	0.25	0.37	339.00	30.90	175.60	61.54	17.66	20.80
62	Cheedella	Penpahad	5.47	8.00	0.17	0.34	377.60	32.90	172.00	58.94	21.66	19.40
63	Dharmapuram	Penpahad	6.10	8.12	0.34	0.45	208.20	27.80	185.60	62.34	15.42	22.24
64	Dosapahad	Penpahad	6.99	8.24	0.52	0.58	170.60	23.90	238.00	44.14	31.66	24.20
65	Dupahad	Penpahad	9.20	8.54	0.63	0.65	160.10	18.90	250.60	53.54	21.66	24.80
66	Gajulamalkapuram	Penpahad	10.83	8.70	0.73	0.70	157.60	16.70	263.49	48.94	25.66	25.40
67	Lingala	Penpahad	11.09	8.75	0.81	0.76	154.80	16.10	270.00	33.80	40.42	25.78
68	Macharam	Penpahad	11.54	8.81	0.97	0.86	149.20	15.50	285.60	47.98	25.66	26.36
69	Mohammadapuram	Penpahad	11.62	8.83	1.19	0.98	146.80	15.00	288.86	35.00	38.42	26.58
70	N.Annaram	Penpahad	12.08	8.87	1.46	1.21	131.70	14.70	322.49	50.94	21.66	27.40
71	Alangapuram	Neredcherla	11.29	8.77	0.81	0.76	151.90	15.90	278.49	36.14	37.66	26.20
72	Bodaladinna	Neredcherla	10.17	8.64	0.69	0.68	159.00	17.50	261.49	46.40	28.42	25.18
73	Bothalapalem	Neredcherla	6.71	8.20	0.52	0.56	174.20	24.80	235.00	51.80	24.42	23.78

74	Chillepalle	Neredcherla	6.55	8.20	0.46	0.55	184.00	25.40	232.20	52.94	23.66	23.40
75	Dacharam	Neredcherla	6.52	8.20	0.45	0.51	189.50	25.70	230.00	54.40	22.42	23.18
76	Dirsencherla	Neredcherla	5.97	8.12	0.33	0.44	211.70	27.90	182.49	47.80	30.42	21.78
77	Fathepuram	Neredcherla	6.19	8.12	0.38	0.45	201.60	27.50	186.49	49.54	27.66	22.80
78	Guduguntla Palem	Neredcherla	7.79	8.35	0.58	0.58	168.00	21.00	239.00	47.98	27.66	24.36
79	Gundeboina Gudem	Neredcherla	11.08	8.75	0.79	0.75	155.20	16.10	268.60	49.80	24.42	25.78
80	Gundlapahad	Neredcherla	11.43	8.80	0.94	0.78	149.20	15.60	282.00	48.34	25.42	26.24
81	Janala Dinne	Neredcherla	11.76	8.85	1.32	1.10	143.90	14.90	292.49	47.54	25.66	26.80
82	Janapahad	Neredcherla	11.94	8.85	1.44	1.19	133.10	14.80	318.60	46.40	26.42	27.18
83	Kallur	Neredcherla	10.19	8.65	0.71	0.69	158.10	17.40	262.20	52.40	22.42	25.18
84	Kalvaladinna	Neredcherla	7.29	8.28	0.52	0.58	169.30	22.90	238.00	58.34	17.42	24.24
85	AdaviDevula Palle	Dameracharla	6.54	8.20	0.45	0.53	189.30	25.70	230.60	56.40	20.42	23.18
86	Baleenpalle	Dameracharla	6.25	8.15	0.38	0.46	200.30	27.00	187.00	47.54	29.66	22.80
87	Chityala	Dameracharla	5.70	8.05	0.23	0.36	341.30	31.50	174.20	46.34	33.42	20.24
88	Dameracherla	Dameracharla	6.79	8.20	0.52	0.56	173.00	24.80	237.20	55.80	20.42	23.78
89	Dilawarpur	Dameracharla	11.87	8.85	1.33	1.15	135.40	14.90	309.20	47.38	25.66	26.96
90	Irkigudem	Dameracharla	6.55	8.20	0.48	0.55	182.70	25.10	232.20	56.94	19.66	23.40
90	Kalle Palle	Dameracharla	10.93	8.74	0.73	0.70	156.80	16.60	264.20	42.94	31.66	25.40
91	Kesawapur	Dameracharla	6.52	8.18	0.44	0.48	195.70	26.30	201.49	55.74	21.42	22.84
92	Kondrapolu	Dameracharla	5.79	8.07	0.28	0.37	314.50	30.70	176.49	55.54	23.66	20.80
93	Kotha Palle	Dameracharla	5.30	7.99	0.13	0.30	450.00	33.80	170.60	54.40	26.42	19.18

94	Mudimanikam	Dameracharla	5.41	8.00	0.16	0.33	381.00	33.30	172.00	44.40	36.42	19.18
95	Mulkacharla	Dameracharla	5.90	8.10	0.31	0.43	239.60	29.30	180.00	48.94	29.66	21.40
96	Alwala	Anumula	11.47	8.80	0.97	0.85	149.20	15.60	283.00	49.98	23.66	26.36
97	Ambatpalle	Anumula	12.93	8.95	2.20	1.32	77.80	14.30	365.60	49.98	21.66	28.36
98	Annaram	Anumula	13.11	9.00	3.32	1.44	59.80	13.80	393.49	49.54	21.66	28.80
99	Anumula	Anumula	12.32	8.89	1.69	1.24	117.90	14.60	341.49	36.94	35.42	27.64
100	Ibrahim Peta	Anumula	11.58	8.83	1.00	0.87	147.90	15.20	288.60	35.00	38.42	26.58
101	Kompalle	Anumula	11.18	8.77	0.81	0.76	152.90	15.90	273.60	33.80	40.42	25.78
102	Konerpuram	Anumula	8.62	8.49	0.62	0.64	160.90	19.60	248.00	55.54	19.66	24.80
103	Kosalamarri	Anumula	6.52	8.20	0.45	0.52	189.40	25.70	230.00	56.40	20.42	23.18
104	Kothapalle	Anumula	6.10	8.12	0.35	0.45	207.90	27.70	185.60	58.34	19.42	22.24
105	Kummarikunta Kalva	Anumula	7.54	8.31	0.54	0.58	169.00	22.40	238.49	58.34	17.42	24.24
106	Kupasalle	Anumula	9.47	8.60	0.66	0.67	159.00	18.60	259.60	51.38	23.66	24.96
107	Bankapur	Nidamanur	11.01	8.75	0.78	0.73	156.40	16.20	268.00	34.94	39.66	25.40
108	Bokkamanthula Pahad	Nidamanur	12.47	8.90	1.71	1.24	114.20	14.50	347.20	37.80	34.42	27.78
109	Gopalpur	Nidamanur	12.68	8.95	2.09	1.32	104.10	14.30	358.49	49.98	21.66	28.36
110	Gunti Palle	Nidamanur	11.71	8.85	1.32	1.10	144.10	14.90	292.20	49.54	23.66	26.80
112	Kannekal	Nidamanur	8.58	8.48	0.58	0.60	162.70	19.80	245.00	43.00	32.42	24.58
113	Kesavapuram	Nidamanur	6.68	8.20	0.50	0.56	180.60	24.80	233.60	54.58	21.66	23.76
114	Marpaka	Nidamanur	6.40	8.16	0.41	0.47	197.80	26.80	187.60	57.54	19.66	22.80

115	Mupparam	Nidamanur	5.97	8.10	0.33	0.44	214.40	28.70	180.60	53.80	24.42	21.78
116	Nehatapur	Nidamanur	5.49	8.01	0.20	0.36	375.40	31.60	173.20	57.80	22.42	19.78
117	Nidamanur	Nidamanur	5.08	7.99	0.13	0.27	467.00	33.80	168.00	53.54	27.66	18.80
118	Vattemurthy	Narketpally	13.08	8.99	2.72	1.39	77.80	14.00	389.49	47.54	23.66	28.80
119	Gundrampally	Chityal	12.25	8.89	1.49	1.21	125.40	14.60	338.00	46.94	25.66	27.40
120	Marikal	Ammajipet	11.43	8.77	0.81	0.77	151.80	15.80	280.00	36.14	37.66	26.20
121	Chenapalli	Rajapur	8.81	8.51	0.62	0.65	160.40	19.50	249.20	49.54	25.66	24.80
122	Gundrampally	Gundrampally	6.52	8.20	0.44	0.49	191.90	25.90	219.20	56.40	20.42	23.18
123	Gandiguda	Chityal	5.82	8.10	0.29	0.39	314.40	29.90	178.60	60.40	18.42	21.18
124	Panthangi	Choutuppal	5.04	7.95	0.04	0.22	536.90	35.60	160.00	61.00	20.42	18.58
	Mean		8.65	8.44	0.77	0.69	204.04	22.30	245.38	49.75	26.17	24.08
	Standard Deviation		2.80	0.35	0.72	0.35	105.48	6.93	63.17	7.35	6.13	2.81

Note: CaCO<sub>3</sub> - Calcium carbonte (%), pH – Acidity or Alkalinity of soil, EC – Electrical conductivity, OC – Organic Carbon (%), N (kg ha<sup>-1</sup>) – Available Nitrogen, P<sub>2</sub>O<sub>5</sub>(kg ha<sup>-1</sup>) - Available phosphorus, K<sub>2</sub>O (kg ha<sup>-1</sup>)– Available potassium

**Table 3: Correlation among the different properties of Calcareous soils of Mahaboobnagar**

	CaCO <sub>3</sub>	pH	EC	OC	Avail N	Avail P	Avail K
CaCO <sub>3</sub>	1.000						
pH	0.994 <sup>**</sup>	1.000					
EC	-0.072 <sup>NS</sup>	-0.058 <sup>NS</sup>	1.000				
OC	-0.083 <sup>NS</sup>	-0.085 <sup>NS</sup>	-0.215 <sup>*</sup>	1.000			
N	-0.865 <sup>**</sup>	-0.900 <sup>**</sup>	0.003 <sup>NS</sup>	0.026 <sup>NS</sup>	1.000		
P	-0.927 <sup>**</sup>	-0.955 <sup>**</sup>	0.012 <sup>NS</sup>	0.055 <sup>NS</sup>	0.981 <sup>**</sup>	1.000	
K	0.092 <sup>NS</sup>	0.107 <sup>NS</sup>	0.011 <sup>NS</sup>	0.007 <sup>NS</sup>	-0.087 <sup>NS</sup>	-0.100 <sup>NS</sup>	1.000

significant correlations (\*\*).

Note: CaCO<sub>3</sub> - Calcium carbonte (%), pH – Acidity or Alkalinity of soil, EC – Electrical conductivity, OC – Organic Carbon (%), Avail N – Available Nitrogen, Avail P- Available phosphorus, Available K – Available potassium

**Table 4: Correlation among the different properties of Calcareous soils of Nalgonda**

	CaCO <sub>3</sub>	pH	EC	OC	Avail N	Avail P	Avail K
CaCO <sub>3</sub>	1.00						
pH	0.998 <sup>**</sup>	1.00					
EC	0.856 <sup>**</sup>	0.840 <sup>**</sup>	1.00				
OC	0.934 <sup>**</sup>	0.927 <sup>**</sup>	-0.673 <sup>**</sup>	1.00			
Avail N	-0.740 <sup>**</sup>	-0.764 <sup>**</sup>	-0.671 <sup>**</sup>	-0.741 <sup>**</sup>	1.00		
Avail P	-0.961 <sup>**</sup>	-0.974 <sup>**</sup>	-0.774 <sup>**</sup>	-0.880 <sup>**</sup>	0.866 <sup>**</sup>	1.00	
Avail K	0.950 <sup>**</sup>	0.946 <sup>**</sup>	0.936 <sup>**</sup>	-0.563 <sup>NS</sup>	-0.150 <sup>NS</sup>	-0.978 <sup>**</sup>	1.00

significant correlations (\*\*).

Note: CaCO<sub>3</sub> - Calcium carbonate (%), pH - Acidity or Alkalinity of soil, EC - Electrical conductivity, OC - Organic Carbon (%), Avail N - Available Nitrogen, Avail P - Available phosphorus, Avail K - Available potassium