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Effect of moisture and calcium carbonate content on chemical properties of soil and yield of cotton in Nanded District of Maharashtra

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Abstract
Twenty four fields was finalized and forty eight soil samples (0-30 & 30- 60 cm depth) was collected for laboratory analysis at square formation stage. The pH, EC and organic carbon content in soil varied from 7.4 to 8.1, 0.1 to 0.3 dSm^{-1} and 0.32 to 0.89 per cent respectively in 0-30 cm depth, whereas 7.6 to 8.4, 0.2 to 0.4 dSm^{-1} and 0.26 to 0.80 per cent respectively in 30-60 cm depth. The calcium carbonate content varied from 9.4 to 29.4 per cent in 0 - 30 cm soil depth, whereas 6.1 to 32.9 per cent in 30 - 60 cm soil depth which was found increased with depth. Soil fertility status was found low to high and which was found significantly affected by $CaCO_3$ and moisture content in soil at square formation stage. The highest yield of cotton was recorded at Typic Haplusterts and lowest was recorded in Typic Ustorthents. However, significant positive correlation of yield of cotton with available N, followed by Mn, B, K, Mg, Fe and Zn and significant negatively correlated with the $CaCO_3$ and significant positive correlation with soil moisture content at square formation stage, indicating soil moisture and $CaCO_3$ content in soil is the yield reducing factor.

Keywords: Soil moisture, Calcium Carbonate, chemical properties of soil and yield of cotton.

Introduction
Cotton (*Gossypium hirsutum* L.)is one of the most important commercial crops playing a key role in economical, political and social status of the world; popularly known as 'White Gold'. Nanded is one of the district of Maharashtra states which, belongs to semi-arid and tropical (hot and dry) region with an average annual rainfall 1150 mm. The soils of Nanded district are basaltic parent material developed from weathering of basaltic parent material of Deccan trap rock which are rich in Ca, Mg and carbonates but poor in N, P, and K. Soil is a medium for plant growth and development that leads to crop productivity. Crop productivity depends on many factors and soil fertility is major amongst all. 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. Due to continuous cropping system for periods without adequate supply of additional amount of nutrients, there is every possibility of deficiencies of essential nutrients in due course of time. The productivity of soil depends equally on its physical, chemical properties and the nutrients status.

Material Method
Geographically Nanded district of Maharashtra state is located in between 18^0 15'to 19^0 57' N Latitude and 77^0 07'to 78^0 15' E Longitude with the total geographic area about 10528 sq. km, meter. The climate of the Nanded district is hot, dry semi-arid and characterized by mild winter and hot summer season which extends up to first week of June. The mean annual rainfall is 875 mm. Out of which 95 percent (829.37 mm) is received during June to September. The length of growing period 149 days and humid period 106 days soils has Ustic moisture regime and Hyper thermic temperature regime. district was surveyed and representative cotton fields were be selected around adjoining area of already examine seven soil profile (Ghode, 2016) [4]. Twenty four fields were finalized and forty eight soil samples (0-30 & 30- 60 cm depth) were collectedat square formation stage in the month of October-November. Collected soil sample was air dried, ground and sieved using to 2 mm sieve. EC, pH and organic carbon were determined by standard procedure (Jackson, 1958, 1973). Calcium carbonate and available magnesium was determined by method described by Piper (1966) [5, 6, 7]. Available nitrogen was determined by method suggested by Subbiah and Asija (1956), whereas phosphorus and potassium was determined by Standard procedure described

By. Available sulphur and boron was determined by Spectrophotometer (William and Steinberg, 1969 and Berger and Traug, 1939 respectively) [22, 1]. DTPA extractable micronutrient was determined by AAS (Lindsay and Norvell, 1978) [8].

Statistical analysis physical and chemical properties of soil with yield was done as per the procedure described by Panse and Sukhatme (1985) [12].

Result Discussion

The present investigation was carried out to know the dynamics of soil nutrients at square formation stage of Bt cotton crop varied with different soil orders in relation to leaf tissue concentration, and yield of Bt cotton in the fields of Nanded district, of Maharashtra.

Physical properties of soil

Soil moisture

The data pertaining to soil moisture content in root zone 0-30 cm 30-60 cm at the square formation stage of cotton in the month of October was varied from 26 to 45 per cent and 23 to 65 per cent respectively. The minimum water content was noticed under Typic Ustorthents at 0-30 cm (26 to 36 %) and 30-60 cm (25 to 30%) and which was found to be decreased with depth. This may be due to high amount of $CaCO_3$ and less amount and type of clay fraction. The maximum soil moisture was noticed at Typic Haplusterts at 0-30 cm depth (32 to 45%) and 30 to 60 cm (51 to 65 %) which was found to be increased with depth. (Table 1). Moreover significant negative correlation with $CaCO_3$ content in soil (r = -0.84 W.M.), indicating that the $CaCO_3$ content in soil increased led to decreased the moisture content in soil, whereas significant positive correlation with N, K, Mg, Mn, Zn, Cu and B. (r = 0.83, 0.76, 0.75, 0.81, 0.58, 0.48 and 0.51 respectively).

Chemical properties of soil

Soil reaction

The data presented in the table 1 indicated that the cotton growing soils of Nanded district are slightly to moderately alkaline in nature with pH value varied from 7.4 to 8.1 at 0-30 cm depth, whereas 7.6 to 8.4 at 30-60 cm depth. This indicates that pH increased with increasing depth. This might be due high calcium carbonate present in sub surface layer. The maximum pH was noticed at Typic Ustorthents (8.1 to 8.3) and minimum pH was noticed in Typic Haplusterts (7.5 to 7.6). Lindsay (1978) [8] reported that calcareous soil are alkaline because of presence of $CaCO_3$ which dominate their chemistry.

Electrical conductivity

Electrical conductivity of the studied soil varies from 0.1 to 0.3 dSm^{-1} at 0-30 cm depth, whereas 0.2 to 0.4 dSm^{-1}30 to 60 cm depth. Which was found increased with depth and well with in safe limit of electrical conductivity range, designated for normal soil (Richard, 1954) [15] and all soils comes under non-saline class.

Organic carbon

Organic carbon content of the studied soil varies from 0.32 to 0.89 per cent at 0-30 cm depth, whereas 0.26 to 0.80 per cent at 30-60 cm depth. This was indicated that the organic carbon decreases with depth. The maximum organic carbon content was noticed in Typic Haplusterts and minimum was noticed in Typic Ustorthents indicating that soils were low to moderate in organic carbon status.

Similar result regarding organic carbon content in Marathwada region was also reported by Manwar *et al.* (2014) [10], Mane *et al.* (2015) [9], Ghode *et al.* (2016) [4].

Calcium carbonate

Calcium carbonate content under cotton growing soils of Nanded district was varied from 9.4 to 29.4 per cent at 0 - 30 cm soil depth, whereas 6.1 to 32.9 per cent at 30 - 60 cm soil depth which was found increased with depth except in Typic Haplusterts in that it was decreased with depth. The maximum calcium carbonate (21.4 to 29.8%) was noticed in Typic Ustorthents and minimum (8.9 to 11.4%) was noticed in Typic Haplusterts.

The presence of $CaCO_3$ affects both physical and chemical characteristics of soil. High lime concentration may restrict the water movement as well as prevent root penetration. The high $CaCO_3$ concentration particularly in very fine fraction brings risks in lime induced chlorosis in many crops. Howeverit was observed that the significant negative correlation between $CaCO_3$ content in the soil and available nutrients viz. N, Mn, Br, Mg, K, Cu and S. (r = -0.85, -0.85, -0.81, -0.70, -0.66, -0.58 and -0.41 respectively. In general highest significant negative correlation was noticed under 30-60 cm depth. This indicate that the calcium carbonate increases in soil reduce the available nutrient in soil at square formation stage which adversely affected yield of cotton. However, also noted that the low amount of soil moisture at square formation at Typic Ustorthents at 30-60 cm depth (table 1) indicate that the high calcium carbonate in soil affect the available water capacity of soil which has great influence on crop production under rainfed condition. High calcium carbonate affected physical and chemical properties of soil and which may prevent root penetration as well as availability of nutrients in root zone (Sys, 1985) [20], Sehgal (1990) [18] and Marschner (1995) [11].

Macronutrient status in soil

Available Nitrogen

The data pertaining to available nitrogen content in soil at square formation stage of cotton in the month of October under cotton growing soils of Nanded district at different soil type was varied from 128.69 to 185.6 kg ha^{-1} at 0-30 cm soil depth, whereas 88.5 to 165.2 kg ha^{-1} at 30-60 cm depth, it was corresponding to very low to low. The availability of nitrogen was found decreased with depth. This might be due to surface application of fertilizers. The maximum available nitrogen (163.2 to 174.1 kg ha^{-1}) was noticed in Typic Haplusterts and minimum (108.5 to 122.7 kg ha^{-1}) was noticed in Typic Ustorthents.

Moreover, it was observed that the significant negative correlation of available nitrogen with $CaCO_3$ and significant positive correlation between soil moisture at square formation stage of cotton. This indicated that presence of $CaCO_3$ in soil reduced the availability of nitrogen.

Available Phosphorus

Available phosphorus content under cotton growing soils of Nanded district at square formation stage of cotton was varied from 8.3 to 21.7 kg ha^{-1} at 0 – 30 cm soil depth, whereas 4.1 to 17.3 kg ha^{-1} at 30 – 60 cm soil depth. This indicate that phosphorus content in studied soil were low to moderately high and it was decreased with depth. The higher available phosphorus (10.7 to 18.5 kg ha^{-1}) was noticed in Calcic Haplusterts and minimum (6.7 to 10.2 kg ha^{-1}) was noticed in Typic Ustorthents.

Available Potassium

Available potassium content under cotton growing soils of Nanded district at square formation stage of cotton was varied from 251.3 to 537.8 kg ha^{-1} at 0 – 30 cm soil depth, whereas 102.4 to 384.2 kg ha^{-1} at 30 – 60 cm soil depth. This indicate that potassium content in studied soils were low to very high and decreased with soil depth. The higher available potassium (375.4 to 430.5 kg ha^{-1}) was noticed in Calcic Haplusterts (P_{19} to P_{24}) and minimum (180.7 to 203.7 kg ha^{-1}) was noticed in Typic Ustorthents.

However, also noticed that the significant positive correlation of available K content at square formation stage of cotton with soil moisture, whereas significant negative correlation with $CaCO_3$ content.

Available Magnesium

Available magnesium content under cotton growing soils of Nanded district at square formation stage of cotton was varied from 1116 to 2148 mg kg^{-1} at 0 – 30 cm soil depth, whereas 1163 to 2184 mg kg^{-1} at 30 – 60 cm soil depth. This indicate that magnesium content in studied soil was increase with soil depth. This is due to high levels of exchangeable Mg, which are hardly leach in low rainfall region (Brady and Weil, 1999).The maximum available magnesium (1668 to 2166 mg kg^{-1}) was noticed in Calcic Haplusterts and minimum (1158 to 1350 mg kg^{-1}) was noticed in Typic Ustorthents.

Moreover significant negative correlation was found with $CaCO_3$ (r = -0.70) and significant positive correlation with soil moisture at square formation stage.

Available Sulphur

Available sulphur content under cotton growing soils of Nanded district at square formation stage of cotton was varied from 11.7 to 33.7 mg kg^{-1} at 0 – 30 cm soil depth, whereas 11.1 to 24.1 mg kg^{-1} at 30 – 60 cm soil depth. This indicate that sulphur content in studied soil was high in 0-30 cm depth than 30-60 cm depth, this may be due to fertilizer application at surface and it was found medium to high status in soil. The higher available sulphur (22.8 to 26.3 mg kg^{-1}) was noticed in Typic Haplustepts and minimum (15.0 to 16.6 mg kg^{-1}) at Typic Ustorthents (P_{13} to P_{18}). However also observed that significant negative correlation with $CaCO_3$ content and significant positive correlation with soil moisture content at 0-30 cm depth at square formation stage of cotton crop.

Available Micro nutrient status in soil

Available micronutrients (Fe, Mn, Zn, Cu and B)content under cotton growing soils of Nanded district at square formation stage of cotton was varied from 10.0 to 22.8, 7.83 to 19.4, 0.31 to 0.96, 1.46 to 5.81 and 0.26 to 1.33 mg kg^{-1} respectively in 0 – 30 cm soil depth, whereas 9.5 to 21.5, 5.47 to 18.8, 0.23 to 0.81, 1.42 to 5.48 and 0.16 to 1.27 mg kg^{-1} respectively in 30 – 60 cm soil depth. This indicate that available micronutrient content in studied soil found to be decrease with soil depth and found high except zinc low to medium status in soil. However, also noted that DTPA extractable micronutrient Mn, Cu and available B was found significant and negative correlated with $CaCO_3$ content in soil (r = -0.85, -0.58 and -0.81 respectively) and others are non significant.

Moreover, it was also observed available micronutrients viz. Zn, Mn, Cu and B was found significant positive correlated with soil moisture content at square formation stage r = 0.58, 0.81, 0.48, and 0.51 respectively, except Fe which was found non-significant (r = 0.38).

Yield of cotton

The yield of cotton growing soils of Nanded district was varies from 4.1 to 27.5 q ha^{-1}. The maximum yield of cotton (21.88 q ha^{-1}) was recorded at Typic Haplusterts and lowest yield (6.83 q ha^{-1}) was recorded in Typic Ustorthents.

Moreover, there is positive significant correlation of yield of cotton with available N followed by Mn, B, K, Mg, Fe and Zn (r = 0.84, 0.82, 0.69, 0.67, 0.53, 0.51 and 0.43 respectively), whereas P, S and Cu was correlated positively but non significantly.The yield of cotton was positive and significantly correlated with moisture content at square formation stage in the month of October and negatively correlated with $CaCO_3$. This means that decrease in moisture per cent decreased the availability of soil nutrient which cause decreased in yield of cotton.

Conclusion

From the above result, however concluded that the high amount of $CaCO_3$ content in root zone which reduced the moisture content in soil as well as reduced the availability of nutrient which causes reduction in the growth and yield of cotton.

Table 1: Physico -chemical properties and available nutrient status under cotton growing soils of Nanded district. Maha

Pedon	Depth (cm)	Moisture %	pH	EC (dSm^1)	OC (%)	$CaCO_3$ (%)	Available Nutrients (kg ha^{-1})			Mg	S	DTPA extractable (mgkg^{-1})				Available boron
							N	P	K	(mgkg^{-1})		Fe	Mn	Zn	Cu	(mgkg^{-1})
	Adjoining area of Typic Haplustepts: Chenapur															
P1	0-30	42	7.7	0.2	0.41	12.6	164.7	21.7	423.4	1116	27.1	13.7	14.8	0.71	3.81	0.49
	30-60	51	7.9	0.3	0.39	23.1	132.1	14.1	307.1	1488	19.7	11.2	12.4	0.44	3.12	0.38
	W.M.	46.5	7.8	0.2	0.40	17.8	148.4	17.9	365.2	1302	23.4	12.4	13.6	0.57	3.4	0.43
P2	0-30	41	7.8	0.3	0.45	13.9	161.8	21.7	417.9	1248	29.2	13.3	11.2	0.75	3.78	0.47
	30-60	54	7.9	0.3	0.40	26.6	135.2	14.1	318.7	1356	23.4	10.4	7.4	0.53	3.02	0.38
	W.M.	47.5	7.8	0.3	0.42	20.2	148.5	17.9	368.3	1302	26.3	11.8	9.3	0.64	3.4	0.42
P3	0-30	40	8.0	0.2	0.56	9.7	159.2	20.7	391.2	1092	33.7	11.9	19.5	0.31	4.13	0.53
	30-60	52	8.2	0.2	0.51	21.4	142.3	13.1	287.4	1176	18.3	11.1	15.5	0.36	3.45	0.40
	W.M.	46	7.9	0.2	0.53	15.5	150.75	16.9	339.3	1134	26	11.5	17.5	0.33	3.79	0.46
Adjoining area of Typic Haplustepts: Pingali																
P4	0-30	30	8.1	0.3	0.71	14.3	133.4	16.3	323.6	1440	30.2	14.7	10.5	0.33	4.48	0.82
	30-60	46	8.3	0.3	0.61	29	123.3	4.1	253.3	1776	18.6	12.3	7.3	0.25	3.13	0.64
	W.M.	38	8.2	0.3	0.66	21.6	128.9	10.2	288.4	1608	24.4	13.5	8.9	0.29	3.80	0.73
P5	0-30	26	8.1	0.3	0.71	16.7	132.4	15.1	319.3	1344	29.7	14.2	8.1	0.41	4.23	0.79
	30-60	47	8.2	0.4	0.54	24.1	122.1	5.2	254.1	1644	17.1	11.8	7.1	0.35	3.19	0.63

	W.M.	36.5	8.4	0.3	0.62	20.4	128.5	10.15	286.7	1494	23.4	13	7.6	0.38	3.71	0.71
P6	0-30	30	8.3	0.3	0.79	13.6	134.3	18.4	338.8	1320	21.6	13.8	9.0	0.38	4.22	0.72
	30-60	37	8.1	0.4	0.65	27.4	123	11.7	230.2	1776	24.1	12.4	7.8	0.30	3.51	0.51
	W.M.	33.5	8.2	0.3	0.72	20.5	129.6	15.05	284.5	1548	22.8	13.1	8.4	0.34	3.86	0.61
G.M. of T.H.epts		41.3	8.1	0.3	0.6	19.4	138.7	14.7	322.1	1398.0	24.4	12.6	10.9	0.4	3.7	0.6
Adjoining area of Typic Haplustert: Hadsani																
P7	0-30	43	7.5	0.1	0.81	11.7	185.6	13.6	372.8	1776	27.1	14.0	19.4	0.88	5.81	1.17
	30-60	53	7.6	0.3	0.77	11.1	161.3	5.9	319.5	1836	21.9	13.7	16.2	0.51	5.42	0.78
	W.M.	48	7.5	0.3	0.79	11.4	173.4	9.75	346.1	1806	24.5	13.8	17.8	0.69	5.61	0.97
P8	0-30	32	7.6	0.3	0.85	9.4	181.3	13.7	367.2	1776	27.4	14.5	19.2	0.96	5.78	1.21
	30-60	65	7.6	0.3	0.80	10.0	157.0	5.9	307.4	1800	18.6	13.2	17.4	0.44	5.48	1.20
	W.M.	48.5	7.6	0.3	0.82	9.7	169.1	9.78	337.3	1788	23	13.8	18.3	0.7	5.63	1.20
Pedon	Depth (cm)	Moisture %	pH	EC (dSm^1)	OC (%)	$CaCO_3$ (%)	Available Nutrients (kg ha^{-1})			Mg ($mgkg^{-1}$)	S	DTPA extractable ($mgkg^{-1}$)				Available boron ($mgkg^{-1}$)
							N	P	K			Fe	Mn	Zn	Cu	
P9	0-30	45	7.4	0.2	0.69	11.6	176.1	10.3	323.7	1776	30.7	13.8	18.5	0.81	4.38	1.30
	30-60	56	7.8	0.3	0.68	10.1	152.3	6.1	302.2	1836	15.1	11.3	17.1	0.52	3.96	1.16
	W.M.	50.5	7.6	0.2	0.68	10.8	164.2	8.2	312.9	1806	22.9	12.5	17.8	0.66	4.17	1.23
P10	0-30	40	7.6	0.3	0.88	13.6	172.1	12.5	361.9	1776	28.8	14.4	17.9	0.94	3.38	1.19
	30-60	52	7.7	0.3	0.75	8.7	154.3	8.8	329.2	1800	14.3	10.0	14.9	0.68	3.12	0.86
	W.M.	46	7.6	0.3	0.81	11.1	163.2	10.6	345.5	1788	21.5	12.2	16.4	0.81	3.25	1.02
P11	0-30	42	7.6	0.2	0.81	11.7	184.8	13.5	397.3	1776	31.6	14.0	19.3	0.71	3.71	1.33
	30-60	54	7.6	0.3	0.77	6.1	163.5	7.4	311.6	1836	17.1	12.9	17.9	0.38	3.03	1.27
	W.M.	48	7.6	0.2	0.79	8.9	174.1	10.4	354.4	1806	24.3	13.4	18.6	0.54	3.37	1.30
P12	0-30	43	7.7	0.3	0.89	11.5	181.3	12.8	398.7	1776	31.9	13.8	15.4	0.65	3.78	1.26
	30-60	51	7.6	0.3	0.69	9.6	158.0	7.6	339.8	1800	16.9	12.4	18.8	0.36	3.13	1.22
	W.M.	47	7.6	0.3	0.79	10.5	169.6	10.2	369.2	1788	24.4	13.1	17.1	0.50	3.45	1.24
G.M. of T.H.erts		48.0	7.6	0.3	0.8	10.4	169.0	9.8	344.3	1797.0	23.5	13.2	17.7	0.7	4.2	1.2
Adjoining area of Typic Ustorthents : Umri																
P13	0-30	36	8.1	0.3	0.57	27.14	138.2	14.0	274.1	1176	18.1	11.3	9.5	0.74	2.18	0.39
	30-60	30	8.3	0.4	0.51	31.6	98.7	6.1	133.4	1188	15.2	10.0	7.8	0.38	2.14	0.31
	W.M.	33	8.2	0.3	0.54	29.3	118.4	10.0	203.7	1182	16.6	10.6	8.7	0.56	2.16	0.35
P14	0-30	26	8.1	0.3	0.40	25.6	136.4	13.3	269.7	1163	18.5	11.5	8.64	0.70	2.31	0.37
	30-60	23	8.3	0.3	0.39	32.9	100.1	7.2	131.9	1163	14.7	11.1	5.96	0.37	2.19	0.30
	W.M.	24.5	8.2	0.3	0.39	29.2	118.2	10.2	200.8	1166	16.6	11.3	7.3	0.53	2.25	0.33
P15	0-30	33	8.2	0.3	0.42	29.4	136.3	13.6	274.7	1175	17.2	11.2	8.18	0.71	2.24	0.35
	30-60	28	8.3	0.4	0.40	30.3	97.2	6.7	132.2	1178	15.3	10.4	7.02	0.38	2.03	0.23
	W.M.	30.5	8.2	0.3	0.41	29.8	116.7	10.1	203.4	1176	16.2	10.8	7.6	0.54	2.13	0.29
P16	0-30	35	8.1	0.3	0.32	21.7	128.6	10.6	251.3	1200	18.5	10.0	9.22	0.66	1.87	1.19
	30-60	28	8.2	0.4	0.28	22.4	88.5	4.7	110.6	1236	12.1	9.5	7.58	0.24	1.72	0.27
	W.M.	31.5	8.1	0.35	0.30	22.0	108.5	7.65	180.9	1218	15.3	9.75	8.4	0.45	1.79	0.73
P17	0-30	35	8.1	0.3	0.40	23.8	134.2	8.3	259.8	1152	17.1	11.3	8.35	0.58	1.61	1.17
	30-60	25	8.3	0.3	0.36	22.9	111.3	5.1	102.4	1164	14.2	10.0	6.85	0.23	1.42	0.23
	W.M.	30	8.3	0.3	0.38	23.3	122.7	6.7	181.1	1158	15.6	10.6	7.6	0.40	1.51	0.70
Pedon	Depth (cm)	Moisture %	pH	EC (dSm^1)	OC (%)	$CaCO_3$ (%)	Availabl Nutrients (kg ha^{-1})			Mg ($mgkg^{-1}$)	S	DTPA extractable ($mgkg^{-1}$)				Available boron ($mgkg^{-1}$)
							N	P	K			Fe	Mn	Zn	Cu	
P18	0-30	32	8.1	0.3	0.33	21.7	133.8	8.8	257.3	1308	16.7	10.2	9.64	0.84	1.68	0.26
	30-60	28	8.4	0.3	0.26	21.2	107.0	4.9	104.1	1392	13.4	10.7	8.96	0.81	1.44	0.16
	W.M.	30	8.3	0.25	0.29	21.4	120.4	6.8	180.7	1350	15.0	10.4	9.3	0.82	1.56	0.21
G.M. of T.U.ents		29.9	8.2	0.3	0.4	25.9	117.5	8.6	191.8	1207.9	15.9	10.6	8.1	0.6	1.9	0.4
Adjoining area of Calcic Haplusterts : Takali																
P19	0-30	39	7.6	0.2	0.63	16.7	168.8	11.3	476.8	1716	19.6	22.8	9.31	0.71	1.81	0.78
	30-60	53	7.8	0.3	0.58	19.9	153.3	11.2	384.2	1728	13.5	19.6	7.39	0.48	1.72	0.75
	W.M.	46	7.7	0.2	0.60	18.3	161.0	11.2	430.5	1722	16.55	21.2	8.35	0.59	1.76	0.76
P20	0-30	41	7.6	0.2	0.57	17.4	166.4	14.8	469.7	1680	19.4	22.6	7.95	0.72	1.77	0.79
	30-60	48	7.7	0.3	0.52	18.9	156.1	9.1	382.9	1728	14.2	21.5	6.65	0.43	1.68	0.72
	W.M.	44.5	7.6	0.2	0.54	18.1	161.2	11.9	426.3	1704	16.8	22.0	7.3	0.57	1.72	0.75
P21	0-30	38	7.7	0.2	0.71	15.1	178.5	16.3	473.3	1632	18.1	21.2	9.23	0.65	1.46	0.92
	30-60	51	7.8	0.3	0.54	17.1	165.2	14.0	372.1	1704	12.4	21.0	7.97	0.31	1.44	0.87
	W.M.	44.5	7.7	0.2	0.62	16.1	171.8	15.15	422.7	1668	15.25	21.1	8.6	0.48	1.45	0.89
	Adjoining area of Calcic Haplusterts : Koli															
P22	0-30	37	7.8	0.3	0.61	15.8	168.4	19.7	532.6	2076	14.8	13.6	7.83	0.73	4.41	0.71
	30-60	53	8.0	0.4	0.57	13.1	121.5	17.3	294.3	2100	12.8	13.2	6.27	0.54	4.32	0.63
	W.M.	45	7.9	0.3	0.59	14.4	144.9	18.5	413.4	2088	18.45	13.4	7.05	0.63	4.36	0.67
P23	0-30	37	7.9	0.3	0.51	14.9	165.1	17.1	537.8	2148	16.3	13.4	8.07	0.73	4.62	0.68
	30-60	52	7.9	0.4	0.46	14.0	119.8	16.1	304.4	2184	13.5	14.8	6.13	0.48	4.40	0.66
	W.M.	44.5	7.9	0.3	0.48	14.4	142.4	16.6	421.1	2166	16.8	14.1	7.1	0.60	4.51	0.67

P24	0-30	35	7.9	0.3	0.44	18.5	153.2	13.6	486.3	1764	11.7	13.9	7.83	0.91	4.94	0.59
	30-60	58	8.1	0.4	0.42	16.4	128.6	13.1	264.5	1896	11.1	15.3	5.47	0.52	3.73	0.57
	W.M.	46.5	8.0	0.3	0.43	17.4	140.9	13.35	375.4	2166	23.3	14.6	6.65	0.71	4.51	0.58
G.M. of C.erts		45.2	7.8	0.3	0.5	16.5	153.7	14.5	414.9	1863.0	14.8	17.7	7.5	0.6	4.75	0.7

Table 2: Correlation between $CaCO_3$ (%) and available nutrient status under cotton growing soils of Nanded district. **Significant at 5% = 41, *Significant at 1% =51

Nutrient status in soil	$CaCO_3$ (%)		
	0-30	30-60	Weighted mean
N	-0.69*	-0.72*	-0.85*
P	-0.10	-0.14	-0.15
K	-0.49**	-0.59*	-0.66*
Mg	-0.66*	-0.62*	-0.70*
S	-0.67*	-0.14	-0.41**
Fe	-0.30	-0.30	-0.27
Mn	-0.67*	-0.83*	-0.85*
Zn	-0.24	-0.26	-0.37
Cu	-0.66*	-0.49**	-0.58*
B	-0.49**	-0.80*	-0.81*

Table 3: Correlation between Ca CO_3 and soil nutrient status with moisture percent and yield of cotton growing soil. **Significant at 5% =41, * Significant at 1% =5

Nutrient status in soil	Moisture %			Yield (q ha^{-1})		
	0-30	30-60	W.M.	0-30	30-60	W.M.
$CaCO_3$	-0.68*	-0.68*	-0.84*	-0.59*	-0.86*	-0.82*
N	0.79*	0.79*	0.83*	0.85*	0.79*	0.84*
P	0.06	0.49**	0.32	0.12	0.19	0.14
K	0.42**	0.89*	0.76*	0.55*	0.71*	0.67*
Mg	0.57*	0.85*	0.75*	0.60*	0.52*	0.53*
S	0.41**	0.16	0.33	0.18	-0.17	0.06
Fe	0.30	0.42**	0.38	0.52*	0.49**	0.51*
Mn	0.66*	0.85*	0.81*	0.82*	0.82*	0.82*
Zn	0.37	0.25	0.58*	0.53*	0.26	0.43**
Cu	0.29	0.62*	0.48*	0.27	0.39	0.33
B	0.53*	0.70*	0.51*	0.59*	0.69*	0.69*

Table 4: Yield of cotton (q ha^{-1}) in respective pedons.

Pedons	Yield(q ha^{-1})
Adjoining area of Typic Haplustepts: Chenapur	
P_1	9.1
P_2	9.1
P_3	12.5
Adjoining area of Typic Haplustepts: Pingali	
P_4	6.6
P_5	6.6
P_6	3.75
G.M. T.H.epts	7.94
Adjoining area of Typic Haplustert: Hadsani	
P_7	25
P_8	25
P_9	20
P_{10}	27.5
P_{11}	17.8
P_{12}	16
G.M. T.H.erts	21.88
Adjoining area of Typic Ustorthents : Umri	
P_{13}	4.1
P_{14}	4.1
P_{15}	4.1
P_{16}	8.7
P_{17}	10
P_{18}	10
G.M. T.U.ents	6.83
Adjoining area of Calcic Haplusterts : Takali	
P_{19}	21.2
P_{20}	21.2
P_{21}	21
Adjoining area of Calcic Haplusterts : Koli	
P_{22}	19
P_{23}	19
P_{24}	12.5
G.M. C.H.erts	18.98

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