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A STUDY ON AVAILABLE MAGNESIUM STATUS IN TOMATO GROWING SOILS OF KARNATAKA, INDIA

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Abstract

Magnesium plays a vital role in nutrition of tomato hybrids for obtaining desired yield. Thus a survey was conducted in major tomato growing districts of Karnataka to assess the available magnesium status in the soil. A total 129 soil samples were collected and these samples were analyzed for available Mg along with other physio-chemical properties. The results showed that the available Mg ranged from 40.6 ppm to 1721.40 ppm. Bengaluru urban, Bengaluru rural, Kolar, Chikkaballapur and Tumkur districts of Karnataka contained lower levels of available Mg in soil in comparison with other districts. NH_4OAC extracted slightly higher exchangeable Mg over $CaCl_2$. Available magnesium and phosphorus were positively significantly correlated.

Key words : Magnesium status, tomato, hybrid vegetables, magnesium status.

Introduction

Worldwide the cultivated soils are deficient in one or more essential nutrients required for the normal growth for obtaining optimum production. Secondary and micro nutrient deficiency problems in India increased with the application of straight N, P and K fertilizer ignoring secondary and micronutrient (Shukla *et al*., 2009). In recent years, Mg deficiency is reported from many areas, growing hybrid vegetables.

Magnesium availability depends on the soil pH. The acid soils of peninsular India are poor in available magnesium. Generally, Ca and Mg are available in sufficient quantity in neutral and alkaline soils which is having high CEC, on the other hand available Mg is low in acidic, high textured, low pH and less organic matter containing soils. A soil with less than 4-15 per cent Mg saturation of the CES is considered to be deficient in Mg (Biswas *et al.*, 1985). In India, magnesium deficiency can be a problem in acid lateritic soils of Kerala, Malnad area of Karnataka, Nilgiris of Tamilnadu, Goa, parts of Andhra Pradesh, Himachal Pradesh, Bihar and North Eastern region. Magnesium will be leached out of root zone in heavy rainfall areas. The uptake of Mg and Ca are generally low in Alfisols, than in other soils. Red soils of Karnataka contain kaolinite as dominant clay mineral with illite and chlorite as accessory mineral. Mg is present as a part of crystal lattice and illite in the interlayer of chlorite (Grim, 1968). The soil with low pH has a two fold effect on soil nutrient. It enhances the leaching of cations, reducing their availability in the soil. Hence, there is a need to assess the availability of Mg in major tomato growing soils of south Karnataka. Many workers have studied magnesium fertilization in different crops (Aulakh and Pasricha, 1978; Gupta and Singh, 1985; Singh and Singh, 1985) and observed significant yield differences through supplementing nutrition of the crop with magnesium. It is expected that application of Mg to tomato hybrids will enhance both yield and quality of fruits. Hence, this study was undertaken to assess the available Mg status of tomato growing districts of Karnataka, India.

Materials and Methods

Survey of soils of tomato growing areas in Karnataka

In order to assess the soil available magnesium in tomato growing areas, soil samples were collected from major tomato growing districts (Kolar, Chikkaballapura, Bangalore, Tumkur, Belgaum, Hassan etc.) of Karnataka state. Totally 129 soil samples were collected and these samples were analyzed for available magnesium and other physico chemical properties like pH, EC, OC, N, P, K,Ca and Mg.

Table 1 : Analytical methods followed for analysis of soil and plant samples.

S. no.	Parameters	Methodology	Reference
Soil Analysis			
1.	pH (1:2.5)	Potentiometer method	Jackson (1973)
2.	Electrical conductivity (EC)	Conductivity method	Jackson (1973)
3.	Organic carbon	Walkley and Black's Wet oxidation	Jackson (1973)
4.	Available nitrogen	Alkaline potassium permanganate method	Subbiah and Asija (1956)
5.	Available phosphorous	Molybdo phosphate blue colour method	Jackson (1973)
6.	Available potassium	Flame photometer method	Jackson (1973)
7.	Calcium	Atomic absorption spectrophotometer method	Lindsay and Norwell (1978)
8.	NH_4OAc extractable calcium (ppm)	Versanate titration method	Black (1965)
9.	NH_4OAc extractable magnesium (ppm)	Versanate titration method	Black (1965)
Plant Analysis			
1.	Nitrogen	Micro Kjeldahl method	Jackson (1973)
2.	Phosphorous	Vanadomolybdo phosphoric method	Jackson (1973)
3.	Potassium	Flame photometer method	Jackson (1973)
4.	Magnesium	Atomic absorption spectrophotometer method	Lindsay and Norwell (1978)

Soil analysis

Soil samples were collected using standard procedure from 129 tomato growing fields in above mentioned districts from a depth of 0-15 cms. Analytical methods followed for the analysis of soil samples are presented in table 1.

Statistical analysis

The data on available Mg and its relation with other soil properties were tabulated and subjected to statistical analysis. The data collected from the experiment was subjected to the statistical analysis using the "Biostat-IIHR" programme and also by using the "SAS" programme.

Results and Discussion

Available Mg in tomato growing districts of Karnataka

A detailed field survey was conducted in the state of Karnataka covering all the nine tomato growing districts, *viz.*, Belgaum, Bengaluru urban, Bengaluru rural, Chikkaballapura, Hassan, Kolar, Mandya, Mysore and Tumkur. Soil samples were collected from the surface 0-15cm depth during the pre monsoon season of 2010. These samples were analysed for available Mg and other soil physico- chemical properties. (The results are presented in table 2). The available Mg ranged from 40.6 ppm in sample number 97 at Krishi Vigyan Kendra (KVK), Chintamani campus in Chikkaballapur urban district to 172.40 ppm in sample no.112 in Bangalore rural district. Magnesium uptake by plants depends largely on the amount, concentration and activity of Mg in the soil solution and the capacity of the soil to replenish Mg in the soil solution. The availability of Mg depends on the activity or proportion of Mg relative to soluble and exchangeable amounts of K, Ca, Na and Mn (Mayland and Wilkinson, 1989). Raja (2009) surveyed the tomato growing soils in Bangalore urban and Bangalore rural districts and noticed all these soils were deficient in available Mg and the tomato plants showed Mg deficiency and estimated yield loss to the extent of 15-20 per cent. Mg deficiency symptom when soil exchangeable Mg content is less than 10 mg per 100g of soil. This is approximately equal to 200 kg of Mg ha^{-1}. The present result also indicates the same that soil Mg content having around 200 kg of Mg ha^{-1} show Mg deficiency in crops. It has also been reported that for optional tomato growth 0.64 meq per 100g Mg is required (Asiegbu and Uzo, 1983). Hegde and Babu (2009) observed Mg deficiency in high textured soils. They also found acid soils high in native K or applied K usually contains less exchangeable Mg. Thus, there is a need for Mg application to soil for achieving higher tomato yields.

In the present study however, the levels of available Mg recorded higher values. In spite of higher levels of available Mg, tomato grown on these soils respond to applied Mg and plants in the fields show Mg deficiency symptoms. These soils are well supplied with Ca. At higher available Ca levels the availability of Mg to plants decrease and the level of available Mg to be considered as deficient may be higher than that reported for normal soils. This is perhaps the yield potential of modern tomato hybrids are very high compared to earlier varieties and the demand for Mg is also higher for these hybrids. Such

Table 2 : Soil chemical properties and available nutrient status of tomato growing soils in Karnataka State.

S. no.	pH	EC (dsm^{-1})	OC (%)	N (ppm)	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	Name and address of the farmer
1	6.56	0.13	0.69	224.90	40.99	210.00	441.00	**75.2**	Siddagangaiah, H'ghatta
2	7.18	0.16	0.72	261.27	58.18	266.00	355.00	**78.4**	Prakash, Dasanapura
3	7.58	0.12	0.80	290.30	47.92	280.00	368.00	**88.4**	Prakash, Dasanapura
4	7.28	0.21	1.14	413.68	42.98	350.00	414.00	**91.2**	Shivakumar, Agrahara
5	7.92	0.25	1.09	395.54	58.49	280.00	616.00	**79.2**	Ravikumar, gollahally
6	7.66	0.18	1.12	406.43	54.11	490.00	498.00	**96.4**	Narayanappa, Vajraghatta
7	7.61	0.41	1.43	518.90	60.06	462.00	408.00	**84.4**	Muniyappa, Shivakote
8	7.44	0.19	1.32	479.00	66.63	504.00	314.00	**75.6**	Srinivas, kakenahalli
9	7.82	0.15	0.57	206.84	55.61	308.00	285.00	**76.4**	Madhu , Kakolu
10	6.56	0.16	0.69	250.39	89.46	224.00	314.00	**72.8**	VeereGowda, B.halli
11	7.04	0.17	0.51	185.07	65.37	252.00	291.00	**81.6**	Ramanna, Byrapura
12	7.04	0.19	1.06	384.65	39.73	476.00	499.00	**92**	Kambegowda, Haniyur,
13	6.47	0.20	0.92	333.85	70.07	578.00	441.00	**112.4**	Thimmamma, Kasaba
14	6.23	0.16	0.80	290.30	36.60	364.00	314.00	**119.2**	Chandrashekar, Nuggehalli
15	5.61	0.16	0.57	206.84	31.28	364.00	288.00	**92.8**	Honne gowda, Nuggehalli
16	5.15	0.23	0.60	217.73	40.99	182.00	319.00	**96.4**	Nagaraj, Hebbalalu
17	6.87	0.29	0.60	217.73	32.84	294.00	288.00	**112**	Rangegowda, C.R.Patna
18	6.02	0.19	0.46	166.92	51.92	266.00	268.00	**120.4**	Revanahalli
19	7.24	0.45	0.69	250.39	53.18	238.00	251.00	**112.4**	Rajegowda, Hirisave
20	6.31	0.28	0.58	248.15	48.11	266.00	290.00	**119.2**	Manjunath, Chikchettihalli
21	6.49	0.19	1.00	362.88	71.01	308.00	315.00	**79.2**	Govindagowda, Dasarahalli
22	6.36	0.69	0.60	217.73	54.70	364.00	441.00	**83.2**	Malleshamma, Arsikere
23	6.20	0.15	0.60	217.73	70.07	238.00	414.00	**116.4**	Malleshamma, Arsikere
24	5.59	0.15	0.75	271.16	64.12	308.00	355.00	**122.4**	Shivakumar, Arsikere
25	6.90	0.17	0.99	359.25	18.14	252.00	308.00	**117.6**	Thimmarai, Saligame
26	5.91	0.18	0.96	348.36	31.28	742.00	461.00	**125.6**	Kantharaj, Kakenahalli
27	5.44	0.44	0.90	326.59	61.62	434.00	505.00	**128.4**	Nagaraj, Belur
28	5.18	0.79	1.05	381.02	22.52	434.00	394.00	**121.2**	Halappa. Adgur
29	6.24	0.06	1.08	391.91	37.85	406.00	296.00	**123.2**	Mallikarjuna, Adagur
30	7.62	0.11	0.78	283.05	45.67	322.00	361.00	**115.2**	Somanath gowda, Kolar
31	8.07	0.18	1.71	620.52	29.40	462.00	421.00	**119.2**	Ramachandra, Kolar
32	7.51	0.23	0.87	315.71	52.53	532.00	418.00	**110.4**	Narayana Swamy, Kolar
33	7.44	0.15	0.87	315.71	59.74	364.00	491.00	**119.2**	Thimmarayappa, Kolar
34	7.14	0.18	0.81	281.50	42.12	614.00	415.00	**97.2**	Narayanappa, Kolar
35	7.06	0.14	0.87	315.71	46.30	700.00	561.00	**88.4**	Vishwanath, Honganahalli
36	7.06	0.14	0.87	315.71	46.30	700.00	561.00	**88.4**	Vishwanath, Honganahalli
37	7.83	0.17	0.78	283.05	37.85	448.00	614.00	**91.2**	Babu, Kolar
38	7.01	0.19	0.82	265.14	41.61	281.14	501.00	**106**	Krishna Murthy, doddakadalur
39	7.61	0.21	0.38	137.40	52.86	686.00	414.00	**104.4**	Ananda, Malur
40	6.67	0.16	0.78	283.05	24.38	630.00	398.00	**99.6**	Gajendra, Malur
41	7.81	0.19	0.99	359.25	52.55	714.00	614.00	**84.4**	Murugesh, Ramapura,
42	7.81	0.19	0.99	359.25	52.55	714.00	614.00	**84.4**	Murugesh, Ramapura,
43	7.78	0.16	0.87	315.71	47.85	560.00	448.00	**114**	Thippanna, Bangarpet
44	7.48	0.11	0.96	348.36	38.25	294.00	560.00	**119.2**	Srinivas, Vanahalli
45	7.72	0.15	0.78	283.05	46.60	560.00	358.00	**85.6**	Ramachandrappa, Mulbagilu
46	7.15	0.19	0.81	261.40	49.56	601.00	394.00	**120.4**	Seenappa, Mulbagilu
47	7.12	0.18	0.71	242.66	44.16	258.00	215.00	**124**	Somanna, Mulbagilu
48	6.87	0.14	0.66	239.50	60.37	252.00	308.00	**114.4**	Chandrappa, Hunsur
49	5.56	0.02	0.84	304.81	48.80	196.00	319.00	**125.6**	Chikkamada, Hunsur

Table 2 continued...

Table 2 continued...

50	7.94	0.11	0.72	261.27	67.25	224.00	295.00	**123.2**	Kumar. Hunsur
51	7.91	0.07	0.84	304.82	42.90	322.00	221.00	**119.2**	Somanahalli, Hunsur
52	6.48	0.08	0.81	293.93	41.92	308.00	414.00	**104.4**	channaraya, Hunsur
53	6.51	0.32	1.17	424.57	52.24	462.00	386.00	**134**	chikkaradi, KR Nagara
54	7.78	0.07	0.87	315.71	44.73	378.00	298.00	**86**	Govindaraju, Hunsur
55	7.31	0.14	0.78	301.44	51.66	314.00	222.00	**123.2**	Nage Gowda, Kapadi
56	7.21	0.16	0.71	345.14	58.44	325.00	325.00	**125.6**	Sivaraj, Kapadubadi
57	7.34	0.10	1.11	402.79	48.80	476.00	341.00	**123.2**	Bunda Gowda, Arekere
58	6.30	0.45	0.98	337.47	55.05	812.00	424.00	**146.4**	Madevappa, Krishnapura
59	7.44	0.15	1.56	566.09	36.91	742.00	302.00	**127.6**	Ramagowda, Hunsur
60	7.64	0.11	0.90	326.54	51.61	432.00	295.00	**119.6**	Devanahalli
61	7.83	0.08	1.05	381.02	42.85	266.00	408.00	**140.4**	Mudde Gowda, Jayapur
62	7.30	0.18	1.14	413.68	56.62	630.00	361.00	**144.8**	Siddappa, HD Kote
63	6.49	0.30	0.75	272.16	57.87	266.00	278.00	**128.8**	Shivanna, Jayapura
64	7.15	0.21	1.29	468.12	31.38	770.00	396.00	**136.4**	Pommegowda, Jayapura
65	7.74	0.10	0.48	174.18	62.56	252.00	302.00	**140.4**	Nandisha, HD Kote
66	7.80	0.10	0.81	629.13	45.67	224.00	456.00	**122.4**	Prakash, HD Kote
67	7.55	0.16	1.05	381.02	63.49	476.00	515.00	**132.4**	Puttarajegowda, HD Kote
68	7.05	0.62	0.81	293.93	62.56	714.00	414.00	**120.8**	Yamakanmaroli, Hukkeri
69	6.89	0.14	1.01	288.11	54.15	561.00	217.00	**155.2**	Maruthi, Hukkeri
70	6.41	0.18	0.94	301.65	61.56	432.00	288.00	**140.4**	Adiveppa, Hukkeri
71	6.40	0.17	0.75	272.16	63.50	462.00	291.00	**120.8**	Siddappa, Chikkodi
72	8.00	0.18	1.11	402.80	43.48	756.00	514.00	**116.4**	Shiranatha K.Hatti
73	7.44	1.30	0.96	365.03	63.18	700.00	611.00	**142**	Ajith Patil, Belgum
74	7.24	0.54	0.60	217.73	56.92	630.00	506.00	**127.2**	Bhopala, Hukkeri
75	6.65	0.52	0.39	141.52	53.49	462.00	388.00	**142.4**	Basavaraj, Hukkeri
76	7.41	0.42	0.65	306.14	51.45	488.00	445.00	**148.4**	Mallikarjuna, Hukkeri
77	8.03	0.28	1.29	468.12	23.15	588.00	581.00	**116.4**	Ravi babu, Hukkeri
78	7.38	0.75	0.54	195.96	44.10	630.00	521.00	**152.4**	Modaga, Belgum
79	7.50	0.32	0.93	337.48	42.85	490.00	585.00	**145.2**	Marihal, Belgum
80	6.80	0.75	0.78	283.05	38.47	630.00	406.00	**132.8**	Erappa, Belgum
81	6.91	0.68	0.88	281.44	44.15	641.00	417.00	**132.4**	Mallappa, Belgum
82	5.07	0.058	0.87	140.94	2.8	856.2	76	**78.8**	Satish , Gollarahatti
83	5.5	0.06	0.9	145.8	3.32	831.2	94	**46.2**	Krishnaiah, Gollarahatti
84	6.36	0.255	0.84	136.08	5.23	706.2	2055	**61.6**	KVK ,Hirehally
85	6.46	0.201	0.8	129.6	6.86	587.5	1449	**70.6**	KVK ,Hirehally
86	6.36	0.198	0.81	131.22	2.66	837.5	299	**119.6**	Dayananda , Haralur
87	6.22	0.097	0.75	121.5	9.79	775	64	**55.2**	Munegowda , Hadonahally
88	6.07	0.101	0.88	142.56	7.83	781.2	86	**48.4**	Raja ,Hadonahally
89	6.26	0.098	0.81	131.22	7.85	800	224	**116**	Arun , Hadonahally
90	6.08	0.079	0.77	124.74	23.18	794	307	**150.4**	Venkateshappa , Banahally
91	6.86	0.12	0.73	118.26	21.79	812.5	348	**151.2**	Srinivasa , Banahally
92	6.95	0.136	0.84	136.08	20.73	756.2	317	**143.4**	Lakshamanna ,Banahally
93	6.96	0.294	0.93	150.66	6.79	781.2	260	**132.6**	Savithanna ,Banahally
94	7.08	0.215	0.91	147.42	16.36	800	371	**139.4**	Narayanappa ,Banahally
95	5.54	0.301	0.84	136.08	6.76	794	78	**53.8**	UAS , ChintamaniTq.
96	5.63	0.214	0.85	150.66	10.02	806	50	**56.4**	Karupur Village, Chintamani Tq.
97	5.26	0.236	0.88	147.42	14.71	837.5	267	**40.6**	KVK, Chintamani Tq.
98	6.2	0.492	0.93	150.66	12.69	837.5	755	**115**	Krishanappa ,Banahally
99	6.28	0.406	0.91	147.42	12.76	837.5	261	**124.2**	Manjunath ,Banahally
100	6.68	0.396	0.93	150.66	20.66	837.5	296	**94.8**	Jayashankar ,Banahally

Table 2 continued...

Table 2 continued...

101	6.79	0.501	0.95	153.9	4.84	837.5	287	**97.2**	Lakshmi ,Banahally
102	5.24	0.491	0.89	144.18	3.04	844	91	**71.2**	C. Hanumappa, Hadonahally
103	5.21	0.496	0.9	145.8	6.68	844	70	**68.8**	Munegowda,Hadonahlly
104	6.01	0.14	0.81	131.22	9.35	831.2	326	**74.2**	Ramappa ,Kanakanakunte
105	6.42	0.144	0.88	142.56	10.33	825	252	**74.4**	Nagappa ,Kanakanakunte
106	6.03	0.162	0.91	147.42	2.75	837.5	221	**138.2**	Lakshmi ,Thirumagondanahally
107	6.16	0.191	0.84	136.08	20.32	837.5	104	**135.4**	Puramma ,Thirumagondanahally
108	6.35	0.206	0.80	129.6	2.66	825	131	**78.8**	Subbanna ,Hadonahally
109	6.29	0.198	0.88	142.56	3.74	806	79	**73.6**	KVK ,Hadonahally
110	6.44	0.199	0.87	140.94	3.5	719	457	**64**	KVK ,Hadonahally
111	6.55	0.147	0.66	106.92	3.53	806	1018	**161.6**	C.Hanumanthappa , D.B.Pura
112	6.74	0.162	0.65	105.3	4.2	806	477	**172.4**	Muniyappa, D.B.Pura
113	6.8	0.13	0.68	110.16	5.03	816	282	**98**	KVK ,Hadonahally
114	6.57	0.815	1.71	277.02	3.87	650	677	**80.6**	Ramesh , Thammarasanahally
115	6.56	0.89	0.78	126.36	14.94	312.5	719	**73.4**	Nanjundaiah , T.Hally
116	6.17	0.709	0.77	124.74	1.79	237.5	160	**81.4**	Ramesh , Thammarasanahally
117	6.2	0.695	0.78	126.36	1.47	762.5	127	**74.8**	Nanjundaiah , T.Hally
118	6.14	0.809	0.74	119.88	3.51	731.2	158	**61.6**	IIHR Block- No. 3
119	6.14	0.908	0.75	121.5	2.56	775	216	**79.2**	IIHR Block- No. 2
120	6.09	0.816	0.7	113.4	2.66	681.2	961	**91.2**	IIHR Block- No. 4
121	6.18	0.815	0.76	123.12	4.13	719	0.5	**136.8**	Edward Raja plot
122	6.58	0.916	0.78	126.36	3.06	825	101	**68.8**	Mariyappa, Nakkanahally
123	6.51	0.862	0.79	127.98	18.62	812.5	123	**67.2**	Mariyappa, Nakkanahally
124	6.4	0.896	0.84	136.08	19.09	837.5	243	**70.4**	Nagaraj ,Thowdanahally
125	6.34	0.814	0.8	129.6	14.76	844	198	**71.2**	Nagaraj ,Thowdanahally
126	6.08	0.918	0.81	119.6	2.54	774	226	**137.2**	IIHR block No VI
127	6.1	0.941	0.86	122.42	2.66	739	343	**75.6**	IIHR block No VI
128	6.06	0.922	0.89	116.48	2.48	765	229	**74**	IIHR block No. 3
129	6.14	0.908	0.76	121.61	2.61	754	267	**78.4**	IIHR block No. 3

reports are also available from other areas (Scheulte and Kelling, 1993). Hence, there is a need to re-look in to the range of available Mg in soil to be considered as adequate to plant keeping in view the available Ca content of the soils.

Evaluation of different extracts for available Mg in soil

Two methods *viz*., 1N NH_4OAc and 0.01M $CaCl_2$ were used to estimate plant available Mg in soil. Both $CaCl_2$ and NH_4OAc extracted similar quantity of exchangeable Mg (table 3). NH_4OAc extracted slightly higher exchangeable Mg over $CaCl_2$ (1:1.15). Though, Ca is a divalent cation it is because of lower strength of $CaCl_2$ (0.01M) the quantity extracted by it is lower than that extracted by NH_4OAc whose strength is 1N. Mg values extracted by $CaCl_2$ significantly correlated with values of Mg extracted using NH_4OAc (r=0.797). Positive significant correlation was also found between exchangeable Mg and available phosphorus and potassium. The relationship was poor with other soil properties. Mayland and Wilkinson (1989) reported that the availability of Mg depends on the activity or proportion of Mg related to soluble and exchangeable amounts of K, Ca, Na and Mn. However in humid regions and under irrigated conditions, Mg losses are often greatest from agro ecosystems receiving heavy N fertilization from leaching. Hence in this study we did not find significant relationship as observed by Mayland and Wilkinson (1989).

Correlation between available Mg with $CaCl_2$ and NH_4OAC

Amount of Mg extracted with $CaCl_2$ was significantly correlated with the amount of Mg extracted with NH_4OAc (r = 0.797). Non-significant positive correlation of soil pH was observed with Mg content extracted with both $CaCl_2$ and NH_4OAc (table 4). Positive non-significant correlation was also observed between extractable Mg and phosphorus and potassium. The relationship between other soil properties and available Mg was very poor.

Table 3 : Available soil Mg extracted by two extractants in selected samples.

Sample No.	Available Mg (ppm)		Sample No.	Available Mg (ppm)		Sample No.	Available Mg (ppm)	
	$CaCl_2$	NH_4OAc		$CaCl_2$	NH_4OAc		$CaCl_2$	NH_4OAc
1	53	78.8	17	103.4	115	33	67.6	80.6
2	44.8	46.2	18	104.8	124.2	34	64.6	73.4
3	42.6	61.6	19	92.4	94.8	35	69.4	81.4
4	60.6	70.6	20	75.2	97.2	36	56	74.8
5	50.2	95.2	21	99.6	71.2	37	52.2	61.6
6	53.2	55.2	22	68.4	68.8	38	55.6	79.2
7	50	48.4	23	67.4	74.2	39	73	91.2
8	96	116	24	105.2	74.4	40	62.8	136.8
9	101.6	150.4	25	104.4	138.2	41	54.8	68.8
10	78.4	151.2	26	110.4	135.4	42	50.4	67.2
11	105.4	143.4	27	77.2	78.8	43	57.2	70.4
12	106.2	132.6	28	55.6	73.6	44	52.8	71.2
13	135.2	139.4	29	47.6	64	45	55.2	74.4
14	40.8	53.8	30	130	161.6	46	58	75.6
15	56	56.4	31	104.6	172.4	47	61.6	74
16	50.2	40.6	32	93.2	98	48	57.2	78.4

Table 4 : Correlation between extractable Mg and soil properties.

Correlation co-efficient		
Soil properties	NH_4OAc extractable Mg	($CaCl_2$) extractable Mg
pH	0.471	0.393
EC	-0.02	-0.0344
OC	-0.151	-0.007
N	-0.16	0.01
P	0.243	0.312
K	0.118	0.157
Ca	0.073	0.094
Mg1 ($CaCl_2$)	0.797	1.000

Conclusion

The study of available magnesium status in tomato growing of soils revealed that in general, the available magnesium status in tomato growing districts of Karnataka was poor in red alfisols as compared to black vertisols. These soils also contained higher available Ca, as these soils are supplied with Ca containing fertilizers. These soils show Mg deficiency in tomato as modern hybrids of tomatos demad for Mg is very high and applied fertilizers do not contain any Mg. Both $CaCl_2$ and NH_4OAC extracted similar quantity of exchangeable Mg. Mg values extracted by $CaCl_2$ significantly correlated with values of Mg extracted using NH_4OAC (R=0.797).

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