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RESEARCH ARTICLE

NUTRIENT STATUS OF MULBERRY SOILS OF SERICULTURISTS UNDER VARIED BIVOLTINE SERICULTURAL CLUSTERS OF KARNATAKA

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ABSTRACT

The fertility of soil plays key role for the development of any farming crops and mulberry is no exception for it. Demand for essential nutrient supply to the soils ever growing due to intensive cropping systems. Therefore, additional supplementation of required organic and inorganic nutrients to retain the desired levels of soil nutrient status in mulberry is imperative for sustainable leaf production. In the present study a total of 1118 composite soil samples were collected from the traditional sericultural areas of 14 clusters under Cluster Promotion Programme (CPP) to assess the prevailing nutrient status spread over in 13 districts of Karnataka. The soils were subjected for the categorization of their soil types and chemical analysis to determine their soil reaction, salinity and nutrient status *viz.* pH, EC, OC, available macro (N, P & K) and micro (S, B, Zn, Fe, Mn & Cu) nutrients respectively. The perusal of the results indicated that out of the soils received, loamy soils recorded high (52%) followed by red (28%), black (12%) where as lateritic type in low (8%) among the soils categorised, indicating maximum soils are mulberry friendly. In regard to the soil reaction (pH) 59% soils recorded in desired level (6.5-75), 20% with low (<6.5) where as 21% soils in high pH (>7.5). Most of the cluster soils (97%) showed ideal range of soluble salts (<1.0 dS/m). Organic carbon (OC) was low in 80% soils (<0.65%) whereas 19% medium (0.65-1.0%) and only 1% soils recorded higher OC content (>1.0%). In case of macronutrients, available Nitrogen (N) recorded low in 70% soils (<250kg/ha) whereas Phosphorous (P) and Potassium (K) recorded high (>25kg/ha & >224kg/ha) in 44% and 62% soils, respectively. Micronutrients such as available S, B, Zn, Fe, Mn and Cu, sulphur (S: >15ppm) prevailed high in 71% soils, Boron (B) medium level (0.5-1.0 ppm) in 48%; 49% soils recorded low (<0.6ppm) in Zinc (Zn); Ferrous (Fe) was recorded high in (<4.5ppm) 67% soils; Manganese (Mn) high (>4.0) in 79% soils where as 86% soils recorded with high Copper content (Cu: >0.4%), respectively.

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INTRODUCTION

Mulberry (*Morus alba* L.) being perennial in nature cultivated as seasonal crop plant for its foliage to feed silkworm demands high doses of manure and inorganic fertilizers. Therefore, mulberry gardens supplemented NPK @350:140:140kg/ha/yr and 20MT FYM/ha/yr, respectively, for irrigated mulberry to harvest a leaf yield of >70MT/ha/yr in tropical areas of South India (Dandin *et al*., 2003). Mulberry cherish under desirable levels of pH (6.5-7.5), electrical conductivity (EC-<1.00dS/m), organic carbon (OC: 0.65-1.0%), available macro nutrients i.e. N (250-500kg/ha), P (15-25kg/ha), K (120-240kg/ha) and micronutrients such as available S (10-15ppm), B (0.5-1.0), Zn (0.6-1.2), Fe (4.5-9.0), Mn (2.0-4.0) and Cu (0.2-0.4ppm), respectively. Even though use of recommended doses of manures and fertilizers plays a pivotal role in mulberry leaf yield and quality, the adoption of the same is not found at the farmers level resulting in low mulberry yield and low soil fertility (Sarkar, 2000). Further, hectic crop schedules and frequent harvesting (5 crops/yr) of leaf shoot biomass @ 80-100mt/ha/yr it is imperative that depletion of soil fertility status of mulberry gardens is a regular phenomenon. Therefore, frequent supplementation of essential nutrients along with manuring for conditioning soils and balancing the soil nutrient status for enhanced quality mulberry leaf production is essential. Earlier workers emphasized on the need of balanced fertilization and their impact on quality mulberry and cocoon production (Fang Chen *et al,* 2009). Though since decades the mulberry garden soils of Karnataka are utilized for the production and harvesting of leaf, but efforts to detect the soil fertility status and recommending suitable analysis based soil amelioration prescriptions for enhanced mulberry leaf and cocoon production are limited (Kar *et al.,* 2008; Subbaswamy *et al*., 2001; Sudhakar *et al.*, 1999). Therefore, emphasis to study the cluster soils fertility status for their soil reaction, salinity, organic carbon and other available macro and micronutrient levels for targeted yields and need to find out the soil test based amelioration recommendations become the priority of the farming in the recent past (Bose *et al.,* 2008; Lal, 2004; Sudhakar *et al.,* 2018). Moreover, the soil fertility status assessment of the mulberry soils in totality in an integrated approach for bivoltine sericulture development in Karnataka is still remained an un-attempted field of research. Therefore, in the present study an effort was made to assess the current soil nutrient status of prominent bivoltine sericultural areas under Cluster Promotion Programme (CPP) in 13 Districts of Karnataka and extending soil analysis based amelioration recommendation in the form of 'Soil Health Cards' for improving their mulberry soils for enhanced quality mulberry and cocoon production.

MATERIALS AND METHODS

Central Sericultural Research and Training Institute (CSRTI), Central Silk Board (CSB), Mysore, Govt. of India, Karnataka and its sister units *viz.* Regional Sericultural Research Stations (RSRSs) located at Bangalore (Karnataka), Salem (Tamil Nadu) and Ananthapur (Andhra Pradesh) have initiated a research programme ***"Soil health cards (SHCs) for sericulture farmers in Southern States"*** during 2016-19. Under the programme efforts made to collect the soil samples from the sericultural farming community to issue SHCs for suitable amelioration of their mulberry garden soils for enhanced quality leaf production. Under the above research programme 1118 soil samples were received from 14 Clusters earmarked for the bivoltine sericultural development programme scattered in 4 corners of the Karnataka. Distributed in eco-geographically varied 13 districts *viz.*

Bangalore Rural (12º58'N-77º38'E), Bellari (15º09'N-76º55'E), Bidar (16º50'N-75º47'E), Bijapur (16º50'N-75º47'E), Chikkaballapur (13º26'N-77º46'E), Chitradurga (14º14'N-76º42'E), Gadag (15º30'N-76º36'E), Haveri (14º33'N-75º41'E), Kolar (13º16'N-78º39'E), Koppala (15º20'N-76º13'E), Ramanagaram (12º54'N-78º02'E), Tumkur (13º20'N-77º08'E) and Yadagiri (15º5'N-74º34'E). Soil samples with varied heterogeneity were received from the above clusters during 2016-17 and analysed for their soil reaction (pH), electrical conductivity (EC) and other macro (N, P & K) and micronutrients (S, B, Zn, Fe, Mn & Cu) at Soil Testing Laboratory, RSRS, CSB, Kodathi, Bangalore. Based on the soil analysis results, analysis based suitable soil amelioration recommendations were prepared in the form of "Soil Health Cards" and served to the sericulturists for enhanced quality mulberry leaf and bivoltine cocoon production. Though, all the clusters are falling in the same tropical geo-climatic zones but are typically varied soil characters and textures. Soils received from the cluster areas includes loamy, red, lateritic and black soils with varied soil reaction (pH), salinity (EC) and nutrient parameters. Soil samples received from the sericulture farmers at 0-30cm depths were air-dried in shade, powdered, passed through a 10µ mesh sieved and stored in a fresh polythene covers with proper labeling following the standard procedures (Dandin *et al.,* 2003). Soil characters like pH, EC, organic carbon (OC%), available macronutrients *viz.* nitrogen (N), phosphorous (P), potassium (K/ha) and micronutrients like sulphur (S), boron (B), zinc (Zn), ferrous (Fe), manganese (Mn) and copper (Cu in ppm), respectively were determined by using the standard methods (Subbaiah and Asija, 1956; Jackson, 1973).

RESULTS AND DISCUSSION

The perusal of the results were mean values of 1118 number soils collected from sericultural farmers situated in 14 cluster under varied Districts of Karnataka (Fig. 1). The analysis results on soil types, reaction, salinity and nutrient status of the sericultural farming community are revealed the following:

Soil types, pH, EC and OC status: Out of the soils analysed (1118) large number of soils 52% soils recorded as clay loamy (582) indicating that most of the soils of clusters are favourable for mulberry cultivation because of their richness in plant nutrients, humus and will retain more water. This may be the reason that sericulture has become main and major cultivation and flourishing in Karnataka giving the credit of highest raw silk producing state in India. Whereas, 28% of the soils (313) are red soils followed by 12% are black (134) and only 8% were recorded (89) as lateritic soils. Soil reaction (pH) of 59% soils recorded in the range of desired level (6.5 to 7.5%) confirming their better suitability for mulberry cultivation where as 21% soils with high (>1.0%) and 18% in low pH (<0.65%) recorded. Soil pH is an excellent indicator of general health of soil and its conditions (Tisdale *et al.,* 1985). All most all the soils (99%) recorded with ideal electrical conductivity (EC <1.0 dS/m) confirming further most of the soils are favourable for mulberry with ideal pH and salinity. However, rest of the soils reaction can be corrected by incorporating integrated nutrient management (INM) components such as farmyard manure (FYM), green manuring and trenching mulching practices instead chemical correction (Jaishankar and Dandin, 2005). Organic carbon (OC %) is considered as the best soil fertility indicator of any farming gardens. But the same was recorded low (<0.65%) in 80% soils indicating that ¾th of the soils received were poor in OC content and needs improvement in organic matter, whereas 19% soils with desired level of OC% (0.65-1.0%). It is surprising to know that neglected level (1%) of mulberry gardens showed higher OC (>1.0%) indicating that Karnataka soils are deficient in OC content needs improvement of the same (Fig. 1).

Soil macro nutrient status: At least 17 elements are known to be essential nutrients for plants. In relatively large amounts, the soil supplies nitrogen (N), phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg) and sulphur (S) are often called the macronutrients. The analysis results presented in Table 1 & Fig. 1 showed that 70% soils are low in available N (<250kg/ha), 28% in desired level of N (250-500kg/ha) where as 2% showed higher side of available N indicating that mulberry garden soils of Karnataka where bivoltine is reared intensively are deficient in available N. Available phosphorous (P) was high (>20kg/ha) in 44% soils followed by 28% soils in low (<15kg/ha) and desired level (10-20kg/ha), respectively. Potassium (K) content was high in 62% soils (>240kg/ha) followed by medium level (120-240kg/ha) in 31% and least in 7% soils (<110kg/ha). Sulphur (S) was recorded high (>15ppm) in 71% soils followed by 21% in medium range (10-15ppm) whereas only 8% soils are recorded with low level of sulphur (<10ppm). Nitrogen, phosphorous and sulphur are the limiting nutrients, which are commonly applied to mulberry gardens for effective crop production. Optimum quantity of nitrogen from an appropriate source increases the crop yield (Pradhan *et al.,* 1992). Prasad *et al.* (1992) opined that efficiency of nitrogen is affected by the availability of other plant nutrients, and the maximum benefits from N application can only be obtained when adequate supply of other essential

Table 1. Distribution of soil reaction, macro and micro nutrient status of 14 clusters sericultural farmers under Karnataka

Nutrients	Ranges	% off soil nutrient distribution among the mulberry garden soils of cluster farmers.													
		Andara lahalli	Bija pur	Ch. Patta-na	Aro halli (Hkt)	Hiri yuru	Jama khandi	Kuda lagi	Rani benn-ur	Ravgo dulu`	Sha Pur (Klr)	Shaha pur (Ygr)	Shira hatti	Tuba gere	Tum kuru
No. of soils	**1118**	**36**	**103**	**164**	**136**	**35**	**53**	**134**	**79**	**100**	**83**	**52**	**35**	**31**	**77**
pH	<6.5	6	1	29	23	0	91	10	1	31	36	2	74	6	9
	6.5-7.5	61	75	54	61	71	9	114	61	69	53	37	26	68	70
	>7.5	33	24	17	16	29	70	10	38	0	11	62	0	26	21
EC (dS/m)	<1.00	100	100	99	100	100	30	134	92	100	100	98	100	100	100
	>1.00	0	0	1	0	0	0	0	8	0	0	2	0	0	0
OC (%)	<0.65	92	82	79	88	69	92	109	86	52	98	67	83	100	60
	0.65-1.00	8	18	20	12	29	8	25	14	48	2	29	17	0	40
	>1.00	0	0	1	1	3	0	0	0	0	0	4	0	0	0
Avl. N (Kg/ha)	<250	56	83	76	71	51	45	89	100	61	75	75	97	61	52
	250-500	44	16	23	29	49	30	45	0	39	25	23	3	39	48
	>500	0	2	1	0	0	25	0	0	0	0	0	0	0	0
Avl. P (kg/ha)	<10	92	31	43	34	43	0	16	24	37	8	15	0	23	19
	10-20	8	17	27	24	49	8	42	28	32	27	38	23	35	38
	>20	0	52	29	43	9	92	76	48	31	65	46	77	42	43
Avl. K (kg/ha)	<110	0	0	2	4	0	30	25	0	0	4	0	26	0	0
	110-240	6	15	31	37	34	17	87	38	22	33	8	51	35	22
	>240	94	85	66	60	66	53	22	62	78	64	92	23	65	78
Avl. S (ppm)	<10	14	19	13	6	6	23	0	9	0	6	15	0	0	0
	10-15	36	26	31	32	46	32	25	9	27	27	25	3	3	3
	>15	50	54	55	62	49	45	109	82	73	67	60	97	97	97
Avl. B (ppm)	<0.5	33	55	37	24	63	51	27	29	8	19	12	17	23	18
	0.5-1.0	56	34	51	50	26	32	49	23	21	22	88	74	39	17
	>1.0	11	11	12	26	11	26	58	48	71	59	0	9	39	65
Avl. Zn (ppm)	<0.6	11	66	20	15	51	98	48	51	56	47	62	94	52	8
	0.6-1.2	42	27	26	26	37	2	72	28	38	42	15	6	16	91
	>1.2	47	7	54	58	11	0	14	22	6	11	23	0	32	1
Avl. Fe (ppm)	<4.5	6	99	35	40	89	21	131	96	65	61	88	97	29	74
	4.5-9.0	19	0	29	43	11	13	2	4	27	14	12	0	10	19
	>9.0	75	1	36	17	0	66	0	0	8	24	0	3	61	6
Avl. Mn (ppm)	<2.0	0	29	4	1	11	0	5	0	2	8	27	9	10	4
	2.0-4.0	0	34	12	10	26	0	9	16	4	12	31	17	3	8
	>4.0	100	37	84	89	63	100	120	84	94	80	42	74	87	92
Avl. Cu (ppm)	<0.2	0	2	2	0	0	91	2	0	2	4	4	3	0	3
	0.2-0.4	0	1	2	1	17	9	16	1	3	4	10	6	6	4
	>0.4	100	97	96	99	83	70	116	99	95	93	87	91	94	94

Table 2. Clusters wise trends of soil reaction (pH & EC), organic carbon, macro and micro nutrients status of Karnataka sericulturists

Soil nutrients	**Sta-tus**	**Cluster wise soil samples received under Karnataka**													
		Aro halli (Hkt)	**Andara lahalli**	**Bija-pur**	**Ch.R. Patt-ana**	**Hiri yuru**	**Jama kha-ndi**	**Kud lagi**	**Rani ben-nur**	**Rav-godlu**	**Sha Pur (Klr)**	**Shaha pur (Ygr)**	**Shira hatti**	**Tuba gere**	**Tum kuru**
Soils (no)	**1118**	**136**	**36**	**103**	**164**	**35**	**53**	**134**	**79**	**100**	**83**	**52**	**35**	**31**	**77**
pH	Min	5.54	6.37	6.42	5.57	6.88	5.92	6.19	6.16	6.16	5.89	6.46	6.08	6.37	6.56
	Max	7.96	8.00	7.97	8.11	8.30	8.73	7.94	8.29	6.25	7.91	8.22	7.10	7.91	7.93
	Avg	**6.90**	**7.28**	**7.21**	**6.91**	**7.30**	**7.36**	**7.12**	**7.41**	**6.71**	**6.76**	**7.51**	**6.42**	**7.23**	**7.20**
EC (dS/m)	Min	0.214	0.116	0.11	0.07	0.10	0.06	0.10	0.09	0.06	0.11	0.11	0.21	0.21	0.21
	Max	0.710	0.41	0.40	0.69	0.76	1.86	0.90	1.45	0.65	0.86	1.29	0.51	0.43	0.49
	Avg	**0.370**	**0.260**	**0.18**	**3.63**	**0.37**	**0.41**	**0.41**	**0.48**	**0.32**	**0.36**	**0.31**	**0.38**	**0.36**	**0.31**
OC (%)	Min	0.062	0.058	0.06	0.06	0.05	0.11	0.06	0.112	0.06	0.11	0.12	0.16	0.117	0.31
	Max	1.038	0.932	1.05	1.50	3.45	0.99	0.87	0.92	0.98	0.88	0.14	0.98	1.10	0.98
	Avg	**0.400**	**0.350**	**0.38**	**0.43**	**0.57**	**0.49**	**0.45**	**0.44**	**0.51**	**0.36**	**0.54**	**0.49**	**0.46**	**0.68**
Avl. N (Kg/ha)	Min	150.5	175.6	100.4	62.7	25.0	150.5	175.6	138.0	175.6	100.3	50.20	175.6	175.6	200.7
	Max	301.1	288.5	539.3	602.1	275.9	288.5	276.0	225.8	388.9	276.0	376.3	250.9	376.3	326.1
	Avg	**223.9**	**240.4**	**214.4**	**219.0**	**229.3**	**203.5**	**231.7**	**180.8**	**236.7**	**214.3**	**217.4**	**203.9**	**242.7**	**247.4**
Avl. P (kg/ha)	Min	0.45	0.45	0.67	0.45	2.73	1.34	**4.26**	1.57	2.69	5.15	2.69	12.99	2.46	3.58
	Max	96.1	18.5	123.2	109.9	22.18	135.5	79.7	126.5	69.44	96.54	147.6	68.54	58.02	103.0
	Avg	**25.3**	**4.21**	**271.0**	**17.9**	**10.90**	**16.20**	27.0	**25.38**	**17.99**	**29.4**	**25.76**	**35.63**	**20.92**	**16.52**
Avl. K (kg/ha)	Min	26.0	224	134.0	90.0	134.0	142.0	89.06	134.0	134.0	89.6	179.0	44.8	179.0	179.0
	Max	627.0	940	161.3	1030	537.0	1344	314.4	1254	627.0	627.0	1075.0	498.2	492.0	627.0
	Avg	**286.1**	**518.4**	**574.0**	**379.6**	**296.7**	**513.8**	**177.4**	**365.1**	**291.7**	**268.1**	**583.2**	**183.0**	**297.3**	**295.0**
Avl. S (ppm)	Min	3.44	8.49	7.20	6.85	9.27	0.57	10.33	7.20	10.43	8.80	8.40	12.8	14.41	13.61
	Max	30.7	82.1	88.9	231.0	35.11	84.9	124.2	265.3	40.29	213.0	61.80	82.09	41.48	59.39
	Avg	**17.62**	**21.2**	**26.0**	**20.9**	**16.9**	**20.3**	**26.09**	**45.50**	18.00	**24.88**	**20.81**	**30.3**	**23.15**	**29.39**
Avl. B (ppm)	Min	0.02	0.09	0.05	0.02	0.04	0.09	0.13	0.15	0.32	0.08	0.02	0.17	0.13	0.12
	Max	1.93	1.22	6.85	2.91	1.71	19.9	3.30	2.44	3.60	3.80	0.96	1.75	12.31	3.4
	Avg	**0.78**	**0.63**	**0.58**	**0.57**	**0.49**	**3.13**	**1.04**	**0.88**	**1.99**	**1.44**	**0.30**	**0.68**	**2.44**	**1.32**
Avl. Zn (ppm)	Min	0.054	0.284	0.04	0.04	0.09	0.24	0.09	0.12	0.05	0.09	0.12	0.19	0.10	0.04
	Max	3.30	3.30	3.30	3.90	3.30	3.30	1.52	3.30	1.91	2.49	3.30	0.83	3.30	0.55
	Avg	**1.71**	**1.52**	**0.59**	**1.63**	**0.78**	**1.02**	**0.72**	**0.89**	**0.60**	**0.67**	**0.79**	**0.41**	**1.15**	**0.25**
Avl. Fe (ppm)	Min	0.203	2.37	0.69	0.38	0.22	0.44	1.20	1.03	0.26	0.32	1.07	1.30	0.37	0.47
	Max	17.59	17.59	17.6	17.59	6.81	10.30	13.14	5.47	17.59	23.0	9.13	17.08	17.59	17.59
	Avg	**6.13**	**12.53**	**1.80**	**7.97**	**1.50**	**1.81**	**2.24**	**2.13**	**4.01**	**6.28**	**2.52**	**2.54**	**11.63**	**3.04**
Avl. Mn (ppm)	Min	0.92	4.29	0.19	0.622	0.92	0.64	0.88	2.15	1.90	1.09	0.73	0.336	1.35	0.95
	Max	14.3	14.29	14.3	14.20	14.29	14.3	14.29	1429	15.8	14.3	10.9	14.22	14.29	16.0
	Avg	**10.31**	**13.41**	4.17	**9.81**	**6.80**	**6.87**	**9.81**	**8.29**	**10.39**	**8.85**	**3.77**	**6.91**	**10.84**	**8.50**
Avl. Cu (ppm)	Min	0.24	0.92	0.01	0.098	0.20	0.61	0.12	0.32	0.11	0.10	0.14	0.128	0.27	0.17
	Max	1.10	7.44	4.27	3.42	3.70	4.86	2.63	2.78	7.99	2.83	2.04	1.49	3.48	2.66
	Avg	**1.52**	**1.98**	**1.73**	**1.37**	**0.87**	**32.56**	**0.93**	**1.45**	**1.56**	**0.44**	**0.89**	**0.90**	**1.25**	**1.05**

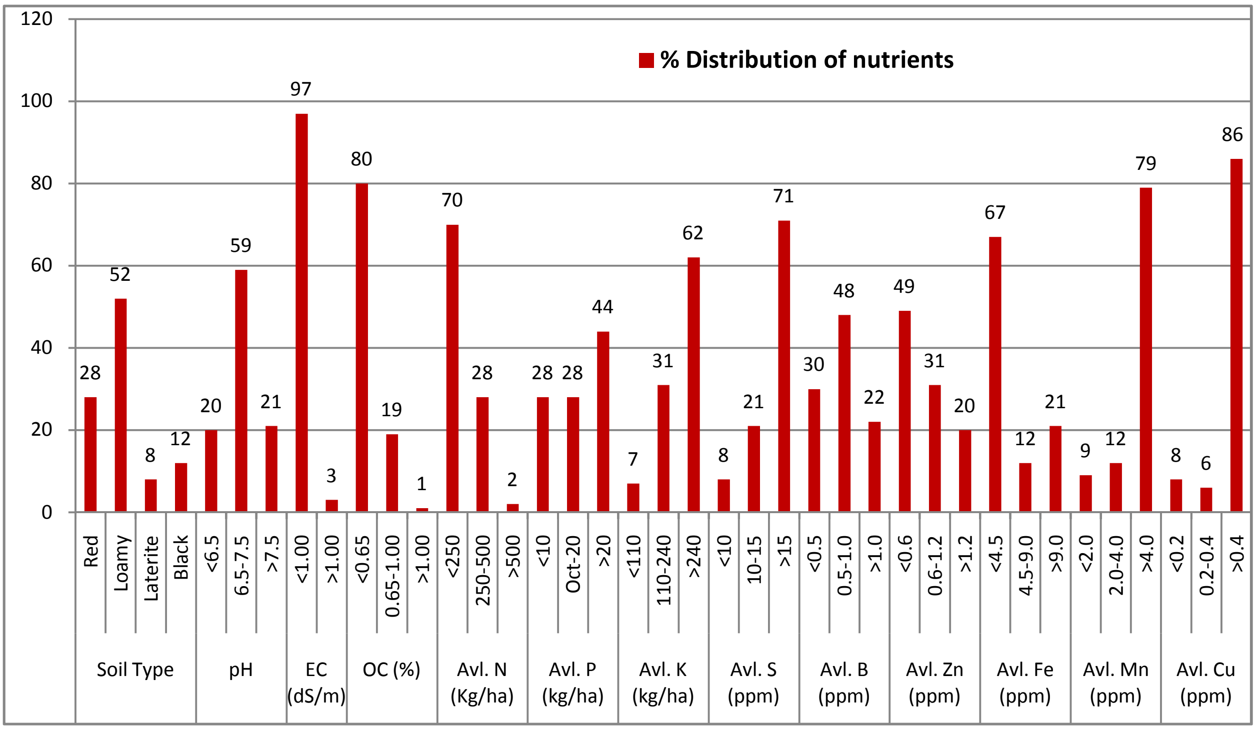

Fig. 1. Distribution of soil types & nutrient parameters of mulberry gardens among the cluster farmers.

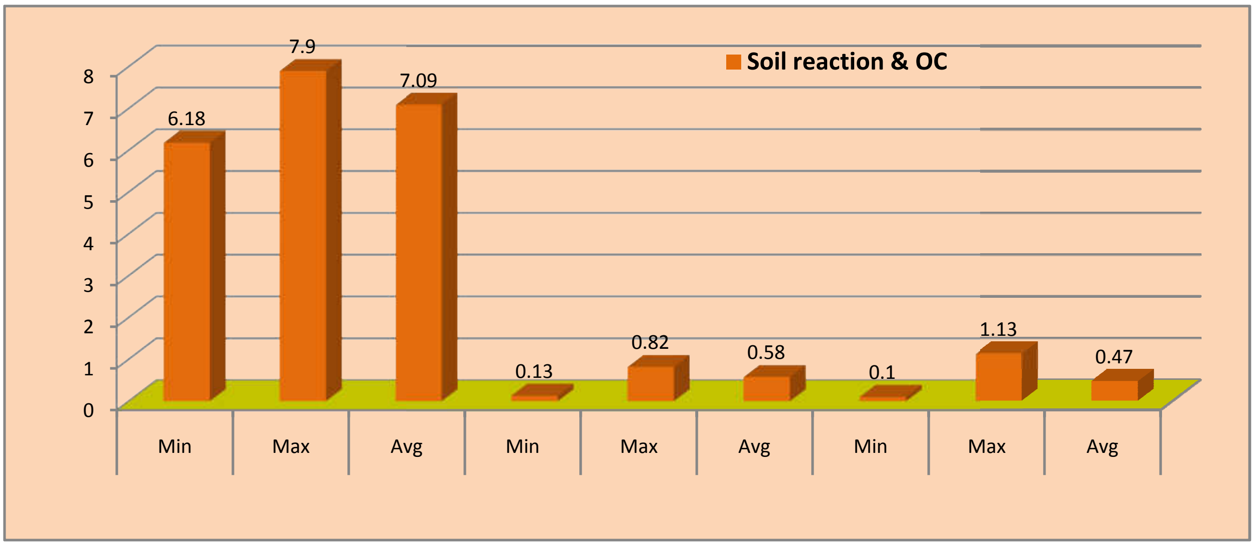

Fig. 2. Range of soil reaction (pH & EC) and organic carbon content of CPP farmers soils under Karnataka

plant nutrients assured. Similarly, Bennet (1993) gave a detailed account on the sulphur deficiency and its impact on the chlorophyll development thereby affecting the yield, nutrient status on the chlorosis occurrence which further encounters in a number of nutrient disorders. Whereas, phosphorous is a major constituent of important organic compounds, which are, in addition to inorganic phosphorous, involved in energy utilization and storage reactions (Maschner, 1983) and ultimately biomass production. Absorption of phosphorous in plants depends on the source of nitrogen (Scott V. Eaton, 1922). Under P-deficient conditions, even if sufficient nitrogen is applied, argentine is accumulated in plants, which lead to reduced protein synthesis (Subbaswamy *et al.,* 2001). Kurose (1966) opined that silkworms fed on P-deficient mulberry leaves exhibited inhibitory growth. These observations are of special significance since mulberry leaves are the sole food of silk producing caterpillar (*Bombyx mori* L.) and the stability of silkworm crop greatly depends on the quality of mulberry leaves (Aruga, 1994).

Soil micro nutrient status: Proportionate to primary and secondary nutrients, plants need a much smaller quantity of micronutrients such as copper (Cu), ferrous (Fe), boron (B), manganese (Mn) and zinc (Zn). It is evident that all these micronutrients are actively involved in enzyme activation, aides in protein synthesis, enzyme activation and formation of chlorophylls thereby contribution of leaf quality. Boron (B) was recorded high in 48% soils in ideal range (0.5-1.0ppm), 30% soils exhibited low level of boron content (<0.5ppm) however, 22% soils analysed with high boron content (>1.0ppm). Zinc (Zn) was assessed and found 49% soils are deficient with Zn (<0.6ppm), 31% were in ideal range (0.6-1.2ppm) only 20% soils resulted rich in Zn nutrient (>1.2%). Where as in case of Ferrous (Fe) 67% soils are deficient in

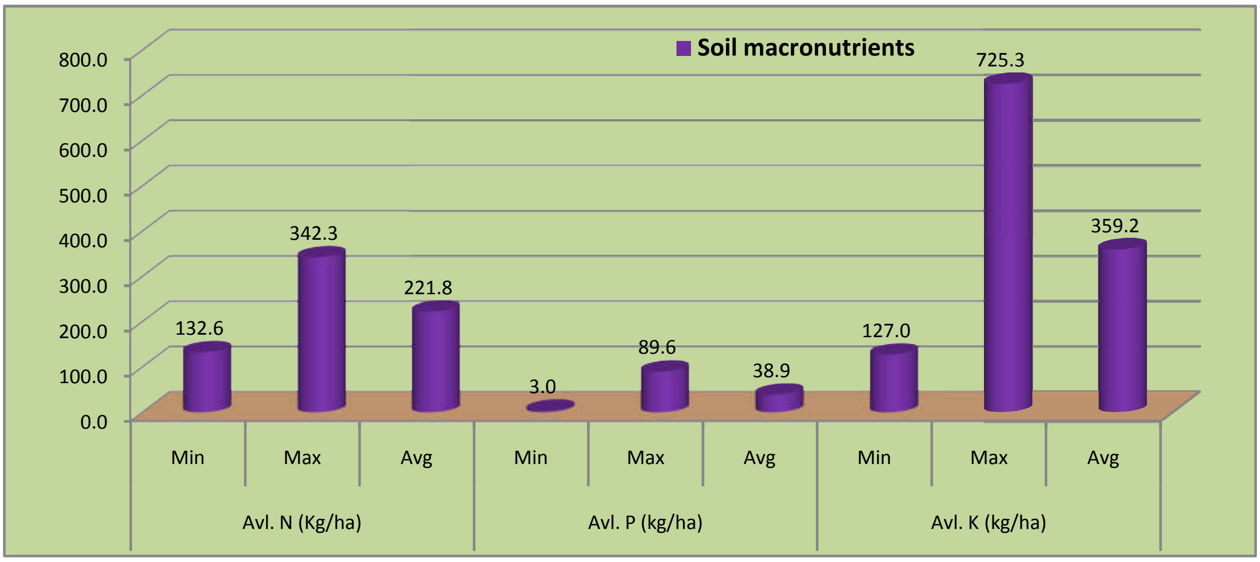

Fig. 3. Range of macronutrients (available N, P & K) status of cluster farmers soils under Karnataka.

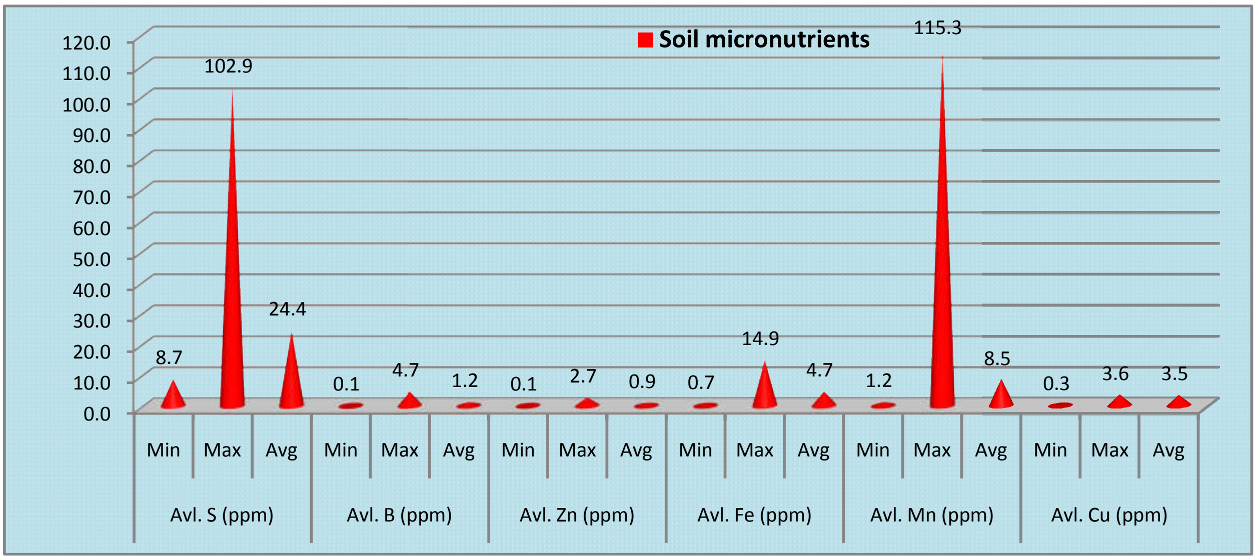

Fig. 4. Range of micronutrients (available S, B, Zn, Fe, Mn & Cu) status of cluster farmers soils under Karnataka.

Fe (<4.5ppm), 21% are high (>9.0ppm) and only 12% soils recorded ideal range of ferrous (4.5-9.0) content. Manganese (Mn) was high in 79% soils, 12% soils shown ideal range (2-4ppm) where as 9% soils recorded poor levels of Mn (<2.0ppm). Copper (Cu) was analysed and noticed rich in 86% (>0.4ppm) soils where as 8% low (<0.2ppm) and 6% medium (0.2-0.4ppm) range soils was recorded, respectively (Table 1 & Fig. 1). Clusters wise soil fertility distribution status, nutritional ranges and mean values of the same recorded from the soils of the sericulturists mulberry gardens in Karnataka and presented in Table 2 and Fig. 2, 3 & 4 also resulted similar trend as depicted earlier. Most of the cluster soils under the districts exhibited ideal pH (7.09), EC (0.58dS/m), low level of OC (0.47%), low level of available N (221.8kg/ha) whereas moderately higher levels of P (38.9kg/ha), K (359.2kg/ha) and S (24.36kg/ha). Similarly in case of S, B, Mn and Cu also recorded higher concentrations of the same in soils i.e. 1.16, 0.91, 8.48 and 3.46ppm respectively. However, Zn ((0.91ppm) and Fe (4.72ppm) were recorded ideal ranges for cherishing mulberry growth. Importance of micronutrients on various crop plants and their influence on the crop yield and production was investigated by several workers (Fageria *et al.,* 2002; Govindaraj *et al*., 2011; Singh, 2008). Over the last few decades efforts have been made to increase crop production by changing the soil to fit the plants. This approach, including the heavy use of chemical fertilizers, was successful in improving soil properties and increasing crop productivity (Yu and Rengel, 1999). Fageria *et al* (2002) pronounced that micronutrient deficiencies occurs due to numerous factors such as use of fertilizers with low levels of soil organic matter, increased cultivation in areas with low soil fertility and reduced application of organic residues in cultivated areas. In mulberry micronutrients deficiency is a regular phenomenon as because, mulberry too is cultivated for its foliage and harvested leaf five times in a year @ 60MT/ha/yr leaf. Dandin *et al*. (2003) has detailed the importance of macro and micronutrient deficiencies in mulberry and their impact on silkworm rearing and quality cocoon production.

Conclusion

A detailed account on the influence of nutrients (macro, secondary & micronutrients) and consequences on their excess and deficiencies was discussed by several workers (Anonymous, 2011). Blanket recommendation of fertilisers leads to over or under use of fertilisers ultimately deterioration of soil health (Anonymous, 2015). Soil test based fertilizer prescription necessitates avoiding over use or under use of fertilizers for crop requirement. Therefore, soil analysis based prescriptions are necessary to improve crop productivity and to increase nutrient use efficiency. Hence, the sericultural farming community is advised to take up time to time soil chemical testing of their garden soils at least once in a year or once in two years and impart soil analysis based (Soil Health Cards) soil amelioration recommendations for correcting the soil health and maintaining desired levels of soil nutrient status for cherishing mulberry with enhanced quality mulberry leaf production leading to flourishing with enhanced quality cocoon production.

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