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Effect of integrated nutrient management on growth and green leaf yield of tea (*Camellia* sp.)

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The existing practice in tea plantations involves mostly application of inorganic sources of fertilizers for the last one century to supply the required nutrients to get high productivity. However, this has not helped to take care of the health of the tea soil in South India (Rajagopal and Ramarethinam, 1997). Not only the physical and chemical conditions of the soil have become poor but also its microbial and biochemical activities have reduced substantially (Rehman, 1990). It is also possible for the toxins to get accumulated in old tea soil. This may result in lesser productivity and the scope for increase in vacancy due to death of tea bushes is more. Isolated studies on the use of biofertilizers viz., VAM (Morita and Konishi, 1989), *Azospirillum brasilense* and phosphobacteria (Merina Premkumari, 1991) and combined inoculation of digested organic supplements and biofertilizers (Rajagopal and Ramarethinam, 1997) had been taken up in tea only in the nursery stage without extending it to the field. Swaminathan (1992) stressed the importance of integrated nutrient management in tea to increase the soil health and thus the productivity. With this background, the present study of nutrient management through the use of organic manures in the form of Digested Coirpith Compost (DCC) and biofertilizers like *Azospirillum brasilense*, Vesicular Arbuscular Mycorrhizae (VAM) and phosphobacteria was taken up during one complete pruning cycle to assess their influence on the vegetative growth parameters and leaf yield

MATERIALS AND METHOD

The field trial was conducted during 1997-2002 at Parry Agro Industries Ltd., Valparai, Coimbatore district in two varieties of tea viz., Assam jat and ATK clone. Totally eighteen treatments with different combinations of 100, 75, 62.5 and 50 per cent of the recommended doses of fertilizers along with DCC and biofertilizers constituted the study (Table 1). The DCC at the rate of three and six tonnes ha⁻¹ and biofertilizers viz.,

VAM, *Azospirillum* and Phosphobacteria each @ 50 kg ha⁻¹ were given annually. Each treatmental unit comprised of 100 tea bushes and the treatments were replicated thrice. Girth of the orthotropic shoots was measured at 10 cm from the base from randomly selected five bushes in each treatment during April, 1999, 2000 and 2001 and expressed in cm. Tea shoots (leaves) were grouped into two, based on the status of apical bud i.e. flush shoot with actively growing bud and banji dormant terminal bud. All the plucked tea shoots (leaves) from individual treatments were thoroughly mixed and hundred grams of leaves were taken and from this banji shoot percentage was calculated. This banji shoot percentage was taken during the peak and lean seasons of 1998, 2000 and 2002. The green leaf yield was recorded from December 1997 to June 2002 for individual treatments and expressed in kilograms for one complete pruning cycle.

RESULTS AND DISCUSSION

The girth of orthotropic shoots and per cent banji shoots were recorded in the experiment (Table 2 and 3) were not significantly different among the treatments. However in ATK and Assam jat, the treatment T₁₁ i.e. 62.5 per cent of estate practice along with 3 tonnes of DCC and biofertilizers had relatively better girth increment during third and fourth year. Ranganathan and Natesan (1985) in a study with varying levels of ratios of N and K did not find any significant effect on the growth parameters like collar diameter. Though the green leaf yield varied with treatments and varieties, it failed to attain the significance (Table 4). Analysis of green leaf yield over one pruning cycle (Table 4) revealed that T₁₃ (62.5 % of estate practice along with biofertilizers alone), T₃ (100 % of estate practice along with 6 tonnes of biofertilizers) and T₁₆ (50 % of estate practice along with 6 tonnes of DCC and biofertilizers) were found to be superior as far as the green leaf in ATK clone. In case of the Assam jat, T₉ i.e. 75 per cent estate practice along with application of biofertilizers was found to be superior than the rest of the treatments. The differential response between ATK and Assam jat could be attributed due to the genetic make up (homogeneous population in ATK being a clone and heterogeneous population in Assam jat being seedling origin) and also due to the wider age disparities (ATK around 25 years old while Assam jat was nearly 100 years old plantations). In the present study, though the treatments consisting of application

of 100%, 75%, 62.5% and 50% of recommended dose of fertilizers alone were not statistically significant implying that reduced doses of fertilizer application assumed greater importance. Inherent soil fertility and available nutrient status might be responsible for such a negligible difference in green yield despite higher NPK application. Application of DCC with and without biofertilizers was found to enhance green leaf yield even at reduced level of the recommended dosage. This might be due to the enhanced soil properties *viz.*, water holding capacity, organic matter, CEC, micronutrients and population dynamics of beneficial microbes culminating in better nutrient mobilization and thus the increased yield.

Mycorrhizal colonization would have increased the effective absorption surface of the root which ultimately would have enhanced the plant growth and yield by efficient absorption of water and nutrient (Jakobsen *et al.*, 1992). Though DCC alone could not enhance the yield immediately, its beneficial effect in combination with biofertilizers should be given proper weightage as it may help in sustaining soil health and productivity of tea in the long run. Verma and Chandramouli (1995) have also reported the same in tea, i.e. any influence of nutrients on green yield could be test verified only after a period of almost two pruning cycle. Hence if the present is continued probably for another one more pruning cycle may probably produce significant influences on the green yield. The cost benefit ratio worked out for all treatments based on the particulars provided from the estate administration revealed that in ATK clones, cost benefit ratio was maximum in T₄, T₇, T₁₂, T₁₆, T₁₇ and T₁₃ in order elucidating that additional costs involved in the application of DCC and biofertilizers were effective enough to bring out economic returns (Table 6), while in case of Assam jat, T₁₈, T₇ and T₉ recorded the maximum cost benefit ratio (Table 5). In case of ATK clone, application of DCC was not economically viable, however, its remarkable effect on the improvement of physical, chemical and biological properties of soil could not be ignored. Probably the future productivity might reflect the beneficial effect of DCC on soil health.

SUMMARY

A field trial was conducted in a private estate at Parry Agro Industries Ltd., Valparai, during 1997-2002 Coimbatore district in two varieties of tea *viz.*, Assam jat and ATK

clone. Totally eighteen treatments with different combinations of 100, 75, 62.5 and 50 per cent of the recommended doses of fertilizers along with DCC and biofertilizers. The DCC at the rate of three and six tonnes ha⁻¹ and biofertilizers viz., VAM, *Azospirillum* and Phosphobacteria each @ 50 kg ha⁻¹ were given annually. During one complete pruning cycle, the treatment T₁₃, i.e. 62.5 per cent estate practice along with biofertilizers alone and T₉, i.e. 75 per cent of estate practice along with biofertilizers recorded the maximum green leaf yield in ATK clone and Assam jat respectively. The treatments did not show any significant effect / impact on vegetative growth parameters viz., girth of orthotropic shoot and banji shoot percentage. The treatments T₄ (100% of estate practice along with 3 tonnes of DCC and biofertilizers) in ATK and T₁₆ (100% of estate practice along with biofertilizers) in Assam jat registered the highest net additional revenue of.

LITERATURE CITED

1. Jakobsen, I., L.K. Abbott and A.D. Robsen (1992). External hyphae of VAM fungi associated with *Trifolium subterraneum* L. I. Spread of hyphae and phosphorus in flow roots. *New Phytol.*, 120: 371-380
2. Merina Premkumari, S. (1991). Response of certain horticultural crops to inoculation of VAM fungi, *Azospirillum* and phosphobacteria. M.Sc. (Ag.) Thesis. Tamil Nadu Agricultural University, Coimbatore-3.
3. Morita, A. and S. Konishi (1989). Relationship between VAM infection and soil P concentration in tea fields. *Soil Sci. Plant Nutr.*, 35 : 139-143.
4. Rajagopal, B. and P. Ramarethinam (1997). Influence of combined inoculation of biofertilizers and digested organic supplements on the growth and nutrient uptake in organic tea cultivation. *Planter's chron.*, 92 : 7-14.
5. Rehman, F. (1990). Rehabilitation and mulching crops. *Tea Encyclopedia*, SI. No. 178, p-3.
6. Swaminathan, P. (1992) Integrated nutrient management in tea. UPASI scientific conference, Coonoor, India, 14 Sep. *Bulletin No.45*, 13-28.
7. Verma, D.P. and B. Chandramouli (1995). Scope for biofertilizers in tea cultivation in South India. *Planter's chron.*, 90(10) : 495-499.

Table 1. Treatment details.

Treatments	Details
T ₁	Recommended dose of inorganic fertilizers (Estate practice or c ontrol)
T ₂	T ₁ + Digested Coirpith Compost (DCC) alone @ 3 t/ha
T ₃	T ₁ + Digested Coirpith Compost (DCC) alone @ 6 t/ha
T ₄	T ₂ + Biofertilizers
T ₅	T ₃ + Biofertilizers
T ₆	75% of T ₁
T ₇	75% of T ₁ + DCC @ 3 t/ha + Biofertilizers
T ₈	75% of T ₁ + DCC @ 6 t/ha + Biofertilizers
T ₉	75% of T ₁ + Biofertilizers alone
T ₁₀	62.5% of T ₁
T ₁₁	62.5% of T ₁ + Biofertilizers
T ₁₂	62.5% of T ₁ + DCC @ 6 t/ha + Biofertilizers
T ₁₃	62.5% of T ₁ + Biofertilizers alone
T ₁₄	50% of T ₁
T ₁₅	50% of T ₁ + DCC @ 3 t/ha + Biofertilizers
T ₁₆	50% of T ₁ + DCC @ 6 t/ha + Biofertilizers
T ₁₇	50% of T ₁ + Biofertilizers alone
T ₁₈	T ₁ + Biofertilizers alone

Biofertilizers - VAM, *Azospirillum* and Phosphobacteria each @ 40 kg/ha

Table 2. Effect of digested coirpith compost and biofertilizers on orthotropic shoot girth in tea varieties.

Treatments	ATK clone				Assam jat				
	April 1999	April 2000	April 2001	April 1999	April 2000	April 2001	April 1999	April 2000	April 2001
T ₁	2.26	3.02 (33.63)	3.79 (25.4)	2.03	2.70 (33.00)	3.38 (25.1)	2.03	2.70 (33.00)	3.38 (25.1)
T ₂	2.39	3.40 (42.26)	4.39 (29.2)	1.83	2.25 (22.95)	2.58 (14.5)	1.83	2.25 (22.95)	2.58 (14.5)
T ₃	2.40	2.93 (22.08)	3.45 (17.7)	1.86	2.29 (23.12)	2.69 (17.6)	1.86	2.29 (23.12)	2.69 (17.6)
T ₄	2.28	2.34 (24.56)	2.77 (18.4)	1.80	2.51 (39.44)	3.27 (30.2)	1.80	2.51 (39.44)	3.27 (30.2)
T ₅	2.22	3.12 (40.54)	4.06 (30.2)	1.92	2.36 (22.92)	2.99 (26.8)	1.92	2.36 (22.92)	2.99 (26.8)
T ₆	2.22	2.80 (26.13)	3.34 (19.4)	2.01	2.55 (22.86)	3.05 (19.7)	2.01	2.55 (22.86)	3.05 (19.7)
T ₇	2.32	2.87 (23.71)	3.40 (18.6)	2.00	2.81 (40.50)	3.64 (29.5)	2.00	2.81 (40.50)	3.64 (29.5)
T ₈	2.61	3.78 (44.83)	4.43 (17.3)	1.70	2.42 (42.35)	3.16 (30.5)	1.70	2.42 (42.35)	3.16 (30.5)
T ₉	2.34	3.22 (37.61)	4.14 (28.6)	1.90	2.79 (46.84)	3.72 (33.4)	1.90	2.79 (46.84)	3.72 (33.4)
T ₁₀	2.34	3.27 (39.74)	4.26 (30.4)	1.80	2.61 (45.00)	3.42 (31.0)	1.80	2.61 (45.00)	3.42 (31.0)
T ₁₁	2.19	3.21 (46.57)	4.36 (35.8)	1.88	2.89 (53.37)	3.85 (33.2)	1.88	2.89 (53.37)	3.85 (33.2)
T ₁₂	2.22	2.86 (28.83)	3.44 (20.4)	1.88	2.58 (37.23)	3.36 (30.4)	1.88	2.58 (37.23)	3.36 (30.4)
T ₁₃	2.30	3.07 (33.48)	3.87 (26.1)	1.78	2.50 (40.45)	3.30 (31.9)	1.78	2.50 (40.45)	3.30 (31.9)
T ₁₄	2.28	3.12 (22.01)	3.73 (24.3)	2.04	2.54 (24.50)	3.00 (18.1)	2.04	2.54 (24.50)	3.00 (18.1)
T ₁₅	2.07	3.29 (58.93)	4.31 (31.0)	2.13	2.73 (28.17)	3.29 (20.5)	2.13	2.73 (28.17)	3.29 (20.5)
T ₁₆	2.22	3.32 (49.55)	4.42 (33.1)	1.88	2.49 (32.44)	3.09 (23.9)	1.88	2.49 (32.44)	3.09 (23.9)
T ₁₇	2.49	2.95 (18.47)	3.37 (14.1)	1.71	2.51 (46.78)	3.30 (31.5)	1.71	2.51 (46.78)	3.30 (31.5)
T ₁₈	2.53	3.08 (21.74)	3.62 (17.4)	1.96	2.59 (32.14)	3.21 (23.8)	1.96	2.59 (32.14)	3.21 (23.8)
S.Ed	0.28	0.49	3.840	0.22	0.33	3.240	0.22	0.33	3.240
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

(Values in parenthesis are per cent increase over previous year)

Table 5. Cost benefit ratio for ATK.

Treatments	Yield (Kg ha ⁻¹)	Made tea (Kg ha ⁻¹)	Income (ha ⁻¹)	Cost of cultivation (ha ⁻¹)	Additional cost involved (ha ⁻¹)	Additional made tea (ha ⁻¹)	Net Profit	Cost benefit ratio
T ₁	18525	4113	246753	134759	0	0	111994	1.83
T ₂	18338	4071	244256	134275	-485	-42	109981	1.82
T ₃	18525	4113	246753	134759	0	0	111994	1.83
T ₄	19888	4415	264902	138283	3524	302	126618	1.92
T ₅	19013	4221	253247	136020	1261	108	117226	1.86
T ₆	18375	4079	244755	134372	-388	-33	110383	1.82
T ₇	19575	4346	260739	137475	2716	233	123264	1.90
T ₈	18975	4212	252747	135923	1164	100	116824	1.86
T ₉	18638	4138	248252	135050	291	25	113201	1.84
T ₁₀	18075	4013	240759	133596	-1164	-100	107163	1.80
T ₁₁	18950	4207	252414	135859	1099	94	116555	1.86
T ₁₂	19388	4304	258242	136990	2231	191	121251	1.89
T ₁₃	19375	4301	258075	136958	2198	189	121117	1.88
T ₁₄	17913	3977	238595	133175	-1584	-136	105419	1.79
T ₁₅	18550	4118	247086	134824	65	6	112262	1.83
T ₁₆	19413	4310	258575	137055	2295	197	121520	1.89
T ₁₇	19438	4315	258908	137119	2360	203	121788	1.89
T ₁₈	18775	4168	250083	135406	647	56	114677	1.85

Table 6. Cost benefit ratio for Assam jat.

Treatments	Yield (Kg ha ⁻¹)	Made tea (Kg h ⁻¹)	Income (ha ⁻¹)	Cost of cultivation (ha ⁻¹)	Additional cost involved (ha ⁻¹)	Additional made tea (ha ⁻¹)	Net Profit	Cost benefit ratio
T ₁	9570.5	2124.642	127478.5	100711.2	0.0	0.0	26767.3	1.27
T ₂	10771.3	2391.233	143474.0	108316.9	7605.7	266.6	35157.1	1.32
T ₃	10111.6	2244.774	134686.4	111110.7	10399.5	120.1	23575.8	1.21
T ₄	10165.2	2256.664	135399.8	112674.2	11963.0	132.0	22725.7	1.20
T ₅	10003.4	2220.752	133245.1	116755.8	16044.6	96.1	16489.3	1.14
T ₆	10982.7	2433.729	146023.8	103386.9	2675.7	309.1	42636.8	1.41
T ₇	12503.5	2775.787	166547.2	117796.8	17085.6	651.1	48750.5	1.41
T ₈	9216.9	2046.151	122769.1	113796.8	13085.6	-78.5	8972.3	1.08
T ₉	11513.8	2556.066	153363.9	110737.1	10025.9	431.4	42626.8	1.38
T ₁₀	9915.7	2201.295	132077.7	100219.2	-492.0	76.7	31858.5	1.32
T ₁₁	8916.4	1979.446	118766.8	10559.7	7348.5	-145.2	10707.0	1.10
T ₁₂	11922.4	2646.775	158806.5	120333.8	19622.6	522.1	38472.7	1.32
T ₁₃	10433.2	2316.164	138969.9	107482.3	6771.1	191.5	31487.5	1.29
T ₁₄	9069.3	2013.389	120803.3	97565.14	-3146.1	-111.3	23238.2	1.24
T ₁₅	10621.9	2358.056	141483.4	112005.4	11294.2	233.4	29478.0	1.26
T ₁₆	11456.5	2543.333	152600.0	118663.8	17952.6	418.7	33936.2	1.29
T ₁₇	10099.8	2242.161	134529.7	106155.2	5444.0	117.5	28374.4	1.27
T ₁₈	12109.1	2688.212	161292.7	113201.5	12490.3	563.6	48091.2	1.42