STUDIES ON THE EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON LEAF NUTRIENT STATUS AND ENZYMES ACTIVITIES IN TEA (*CAMELLIA* SP.)

Abstracts

An experiment was conducted in two varieties of tea *viz.*, Assam jat and ATK clone at Parry Agro Industries Ltd., Valparai, Coimbatore district. The experiment consisted of 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. The treatments T_5 (100% estate practice along with 6 t/ha of DCC and biofertilizers) closely followed by T_3 (100% estate practice along with 3 t/ha of DCC alone) and T_4 (100% estate practice along with 6 t/ha of DCC alone) recorded maximum leaf phosphorus content when compared to estate practice in both the varieties. The treatments received higher amount of DCC with and without biofertilizers recorded relatively higher amount of nitrate reductase activity, polyphenol oxidase activity and peroxidase activity than estate practice at all levels in both the varieties.

Key words: INM, DCC, Biofertilizers Leaf nutrient, Assam jat and ATK clone

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Introduction

The existing practice in tea plantations involves mostly application of inorganic sources of fertilizers alone for the last one century to supply the required nutrients to get high productivity. However, this has not taken care of the health of the tea soil in South India (Rajagopal and Ramarethinam, 1997). Swaminathan (1992) emphasized the importance of integrated nutrient management in tea plantations to increase the soil health and thus the productivity. 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 has been taken up during one complete pruning cycle to assess their impart on leaf nutrient content and certain enzymes activities.

Materials and Method

The field trial was conducted during 1997-2002 in Parry Agro Industries Ltd., Valparai, Coimbatore district to study the effect of digested coirpith compost (DCC) and biofertilizers on two varieties of tea *viz*., Assam jat and ATK clone. A total of eighteen treatments (Table 1) 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. 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. The entire experiment was laid out in RBD with three replications. There were 100 tea bushes in each treatmental unit. Leaf nutrients content were analysed in third leaf from tip of 100 young shoots. The leaf samples were collected during the lean season of December 2000 and 2001. The leaf samples were dried in shade and then in oven at 60°C for three hours.

The dried leaves were chopped into bits with stainless steel scissors and powdered using a Wiley mill having stainless steel sieves and then used for analysis. The nitrogen content in leaf samples was estimated by Microkjeldahl method of Piper (1966). The phosphorus and potassium content of leaf samples were estimated by Vanadomolybdate and Flame photometer method respectively (Piper, 1966). Enzyme activities viz., nitrate reductase activity, polyphenol oxidase activity and peroxidase activity were analysed during the month of May 2001 and 2002. Nitrate reductase activity was estimated at 540 nm using Naphthaline Ethylene Diamine Dihydrochloride by following the procedure described by Nicholas *et al*. (1976). Polyphenol oxidase and peroxidase activity were estimated as per the method described by Gunasekar *et al*. (1994).

Results and Discussion

Significant differences existed for nitrogen, phosphorus and potassium content during December 2000 and 2001 in both ATK clone and Assam jat (Table 2). Among the various treatments, T_5 had the maximum leaf nitrogen content as compared to other treatments in both the varieties. Biofertilizers alone also did increase the leaf nitrogen contents when compared with estate practice. Inoculation of *Azospirillum* might have induced proliferation of root growth, providing maximum surface area for the absorption of nutrients and water (Govindan and Vikraman Nair, 1983). VAM has also been reported to increase the leaf N content in tea (Cooper, 1984). The increased level of N could also be attributed to the increase in the level of nitrogen availability in the soil (Ranganathan and Natesan, 1985). Dhanasekaran and Govindaswamy (1992) mentioned that application of organic manures, which increased the humic acid content of the soil, consequently facilitated the uptake of nitrogen by the tea plants, there by the shoots becoming richer in nitrogen content. In respect of leaf P content, treatment T_5 had higher leaf phosphorus content than rest of the treatments. Inoculation of biofertilizers alone also had higher leaf phosphorus than estate practices. Generally DCC applied plots either with or without biofertilizers had higher leaf phosphorus content than the estate practice. The increase in organic matter content due to the application of DCC formed more humus, which would have reacted with aluminium and prevented the fixation of P and hence increasing its availability to the plants (Barbora, 1995). Similar studies by Thomas and Shantaram (1984) have revealed that incorporation of green manure increased considerably the population of specific groups of micro-organisms and also the dehydrogenase activity, phosphatase and urease activities which in turn increased the phosphorus uptake of the plant. The increased leaf P content might also be related to the role of VAM in the present study, as hyphae of VAM are known to absorb P and translocate it to the host plant. The increased concentration of phosphorus in the VAM infected roots might probably be explained by Sander and Tinkers (1971) theory that the higher influx of phosphorus from soil to root is governed by the action of electrical potential gradients leading to bulk flow of H_2PO_4 into the protoplasmic stream of the roots.

Application of DCC either with or without biofertilizers recorded maximum leaf potassium contents when compared to estate practice. More leaf potassium was recorded in the treatment T_5 as compared to rest of the treatments. Inoculation of biofertilizers also had higher leaf potassium content than the estate practice. The increased leaf K content could be attributed to the decomposition or solubilization and liberation of K in the organic matter into the soil and thereby adding to the K content of the leaf (Bear, 1965).

In the present study, application of DCC along with biofertilizers increased the enzyme activities *viz*., nitrate reductase activity, polyphenol oxidase and peroxidase activity. Biofertilizers alone did not increase the enzyme activities (Table 2). Increase in enzyme activities could be attributed to the addition of organic matter through DCC, which in turn enhanced the humic acid formation. This humic acid when absorbed by the plant system and mediates in respiration, acts as hydrogen acceptor (Schnitzer, 1991) affecting oxidation and reduction reaction through enhanced enzyme activities *viz*., nitrate reductase activity (Dutta and Sharma, 2000). In the present study, inoculation of biofertilizers did not affect enzyme activities. However, synergistic effect of biofertilizers and DCC on the enzyme activity might probably be correlated with the increased uptake of nitrogen (Thomas *et al*., 1991). Increased activity of enzyme could also be related to the increased uptake of water and nitrogen by the plants (Dhanasekaran and Govindaswamy, 1992) as the nitrate reductase activity was significantly inhibited under stress.

Thus addition of organic matter in any form helps in maintaining soil fertilizer level, thereby improving the efficiency of applied fertilizer which in turn exhibited higher leaf nitrogen, phosphorus and potassium contents (Dutta and Sharma, 2000) and enzyme activities.

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Table 1. Treatment details.

Treatments	Details
T_1	Recommended dose of inorganic fertilizers (Estate practice or control)
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 leaf nutrients and enzymes activity in tea varieties

Treatments	**Leaf N (%)**		**Leaf P (%)**		**Leaf K (%)**		**Nitrate Reductase activity ($\mu mNO_2\,g^{-1}\,hr^{-1}$)**		**Polyphenol oxidase activity ($\mu mole/O_2/min/g$)**		**Peroxidase activity ($\mu mole/O_2/min/g$)**	
	ATK	**Assam**	**ATK**	**Assam**	**ATK**	**Assam**	**ATK**	**Assam**	**ATK**	**Assam**	**ATK**	**Assam**
T_1	3.07	3.00	0.16	0.15	1.39	1.31	192.8	166.3	8.42	8.13	17.56	16.88
T_2	3.29	3.23	0.18	0.16	1.42	1.36	197.0	169.5	8.95	9.05	18.51	17.44
T_3	3.30	3.25	0.18	0.17	1.44	1.39	198.2	173.5	9.18	9.20	18.69	17.72
T_4	3.42	3.37	0.19	0.17	1.48	1.42	200.0	172.8	9.42	9.22	19.06	18.12
T_5	3.50	3.48	0.20	0.18	1.58	1.48	200.7	174.7	9.57	9.38	19.27	18.23
T_6	3.09	3.00	0.15	0.15	1.40	1.31	191.7	167.5	8.40	8.10	17.52	16.74
T_7	3.41	3.36	0.17	0.14	1.45	1.38	194.5	170.7	9.38	9.22	19.03	17.87
T_8	3.50	3.44	0.18	0.16	1.50	1.40	198.0	173.8	9.55	9.37	19.23	18.18
T_9	3.29	3.24	0.16	0.15	1.44	1.38	196.3	172.5	9.27	9.19	18.93	17.81
T_{10}	3.05	2.95	0.15	0.14	1.35	1.28	189.8	164.7	8.36	8.09	17.55	16.75
T_{11}	3.38	3.30	0.16	0.15	1.42	1.35	195.2	167.7	9.31	9.18	18.85	17.72
T_{12}	3.46	3.35	0.17	0.15	1.45	1.37	196.5	172.0	9.52	9.24	18.98	18.09
T_{13}	3.27	3.21	0.15	0.13	1.41	1.35	193.2	171.0	9.15	9.15	18.71	17.76
T_{14}	2.99	2.97	0.14	0.13	1.34	1.30	189.0	164.2	8.33	8.10	17.56	16.83
T_{15}	3.32	3.30	0.16	0.14	1.44	1.36	192.8	169.2	9.27	9.16	18.82	17.68
T_{16}	3.39	3.33	0.16	0.15	1.45	1.38	195.0	168.5	9.52	9.23	18.88	18.05
T_{17}	3.21	3.20	0.15	0.14	1.41	1.36	194.2	167.3	9.12	9.12	18.65	17.72
T_{18}	3.33	3.26	0.16	0.15	1.44	1.38	195.2	170.0	9.27	9.21	18.95	17.84
S.Ed	0.1355	0.1285	0.0555	0.013	0.053	0.058	1.831	2.025	0.311	0.319	0.574	0.555
CD (P=0.05)	0.276	0.1285	0.0215	0.026	0.106	0.117	3.732	4.114	0.632	0.647	1.166	1.129