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Evaluation of Different Organic 'Packages of Practice' in Young Tea Plantation: A case study under FAO-CFC-TBI Project at Maud Tea Estate, Assam, India

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Abstract

Maintenance of young tea under organic package of practice is a challenging task and needs a proper intervention. The present study under FAO-CFC-TBI project was done at Maud Tea Estate, Assam, India to find out an effective pathway for growing healthy and productive young tea plants. Seven different organic packages of practice were chosen to evaluate their potential in terms of crop efficiency as well as soil quality rejuvenation. Crop yield was recorded of highest value under Inhana Rational Farming (IRF-2: made tea 807 kgha^{-1}) package of practice. Yield under the treatment was 55.2 percent higher than control and about 25.6 percent higher than the next best performing package of practice i.e. VMI (653 kgha^{-1}). The third highest yield was obtained under IRF-1 and VCO, which recorded almost similar crop (made tea: 619 & 618 kgha^{-1} resp.) followed by BD (593 kgha^{-1}), Co (567 kgha^{-1}) and MI (556 kgha^{-1}) packages. Value cost ratio (VCR), which is excess revenue generated per unit rupee invested; followed similar trend as observed in case of New Plantation experiment indicating highest economic sustainability under IRF-2 (4.37) followed by IRF-1 (2.33) package. Value cost ratio in case of other organic packages varied between 0.25 and 1.02, indicating economic vulnerability considering that VCR < 2.00 has been indicated by Agricultural economists as the critical mark below which there is no necessary risk coverage against investment towards input cost.

Keywords: *Organic package of practice, tea, agronomic efficiency, value cost ratio*

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INTRODUCTION

Young tea area often plays a contributory role towards sustenance/ increment of crop productivity of any garden, since its bringing up greatly influences the future productivity [1]. Hence, to ensure high yielding garden, effective management of young tea plants is crucial in order to enable conditions suitable for the plants to attain optimum yield potential. At the same time when limitations of chemical practices are widely apparent, switching over to organic management system from the early stage shall not only serve to curtail the associated negativities but also enlist the plants to a favorable environment where their growth as well as longevity is encouraged.

However, effective rearing of young tea under organic management still forms a major challenge due to chemical fertilizer sensitive clone plants, the present improper soil dynamics as well as recurring pest/disease problems [2]. These pose a wide array of limitations that are much difficult to address under organic system. The following study at Maud tea estate (Assam), India under FAO-CFC-TBI Project (2008–2011); was taken up to evaluate the effectiveness of different organic methods/ 'Packages of Practice'

towards yield performance of young tea as well as soil quality rejuvenation.

MATERIALS AND METHODS

In Young tea experiment (plantation age 3 to 6 years) field trial was laid out selecting the same organic methods/ 'Packages of Practice' as treatments (treatment details in Table 1) (Figure 1); that were evaluated for effectiveness under new plantation experiment. Experiment was laid out as per randomized block design (RBD) with eight treatments and three replications (Figure 2). Effectiveness of the different packages was evaluated in terms of yield achieved over control, year wise yield progression towards meeting the target and finally economic viability.

Fig. 1: *Organic Young Tea Management at Maud Tea Estate, Assam, India.*

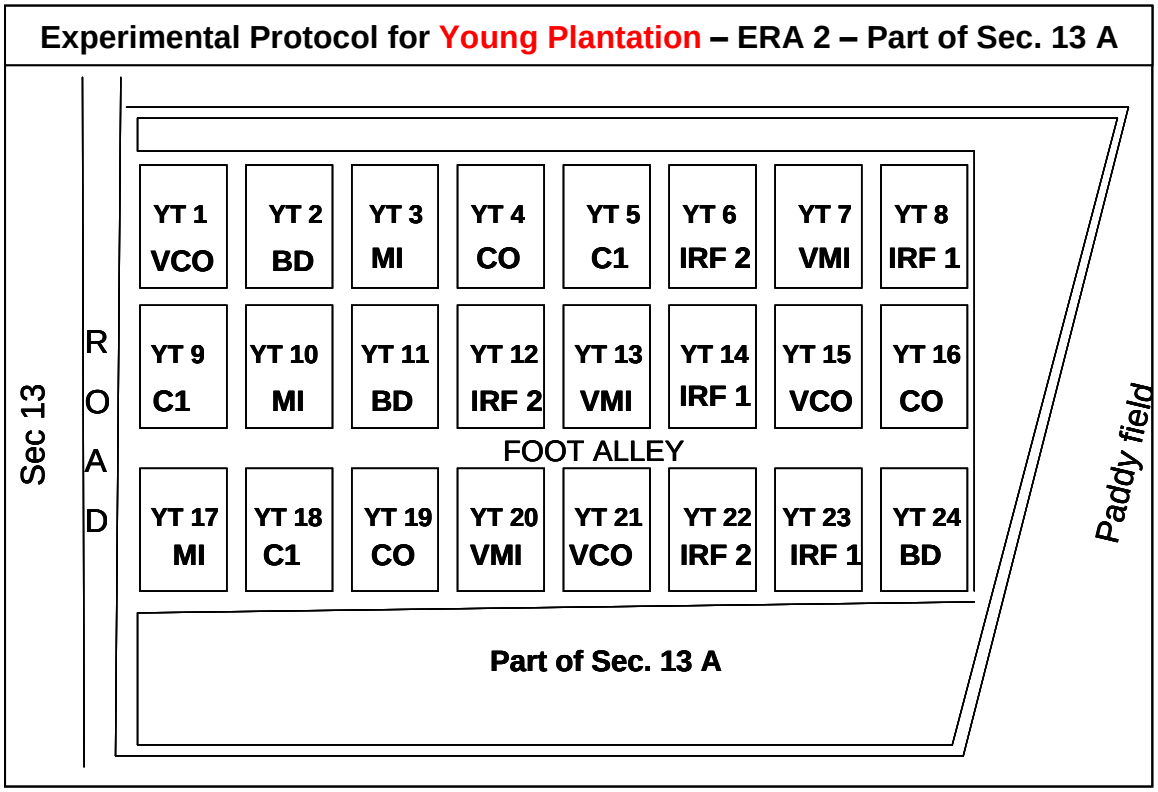

Fig. 2: *Lay-out of Experimental Research Area– 2 (ERA-2) for Evaluation of Different Organic Packages of Practice in Young Tea.*

Table 1: *Treatment Details of Different Organic Package of Practice for Young Tea Management.*

T_1	:	Control (**C**)
T_2	:	Vermi compost @ 9.4 ton/ ha + Herbal concoctions for pest and disease management (**VCO**).
T_3	:	Vermi compost @ 9.4 ton/ ha + Bio-fertilizer (1.125 ton City compost + 37.5 kg Bio-NPK) + Bio-growth promoter + Bio-pesticides (**VMI**).
T_4	:	Novcom compost @ 2.6 ton/ha + Elemental-S + Rock Phosphate + IRF* plant management package + Neem & Karanj oil concoction for pest management (**IRF 1**).
T_5	:	Novcom compost@ 8.0 ton/ha+ Elemental-S + Rock Phosphate + IRF plant management package+ Neem & Karanj oil concoction for pest management (**IRF 2**).
T_6	:	Bio-fertilizer (1.125 ton City compost + 37.5 kg Bio-NPK) + Bio-growth promoter + Bio-pesticides (**MI**).
T_7	:	Biodynamic compost @ 10 ton/ ha + Cow Pat Pit + Cow horn manure + Biodynamic package for plant management (**BD**).
T_8	:	Indigenous compost/ Farm Yard Manure (FYM) @ 13.5 ton/ ha + Herbal concoctions for pest and disease management (**CO**).

Note: **Inhana Rational Farming (IRF) Technology is an organic farming practice developed by an Indian Scientist Dr. P. Das Biswas; which advocates energization of both soil and plant system. This is perhaps the only organic farming technology which provides a complete scientific solution from seed sowing to crop harvest [3–8].*

Table 2: *Impact of Different Packages of Practice on Crop Performance of Young tea (3^+ to 6^+ Years Aged) under Different Pruning.*

Treatment	Unpruned (2009)			First Frame Formation (2010)			Unpruned (2011)		
	Yield ($kgha^{-1}$)	% over control	RAE[1]	Yield ($kgha^{-1}$)	% over control	RAE	Yield ($kgha^{-1}$)	% over control	RAE
T_1 : C	1062	0.00	0.00	1619	0.00	0.00	4013	0.00	0.00
T_2 : VCO	1568	47.62	73.15	2121	47.28	50.29	4260	6.15	12.36
T_3 : VMI	1608	51.32	78.84	1880	24.57	26.13	4918	22.54	45.29
T_4 : IRF-1	1493	40.53	62.26	1948	30.99	32.96	4521	12.65	25.41
T_5 : IRF-2	1754	65.13	100.00	2618	94.02	100.00	6011	49.78	100.00
T_6 : MI	1186	11.68	17.94	1838	20.65	21.96	4127	2.82	5.67
T_7 : BD	1387	30.58	46.98	1914	27.80	29.57	4334	7.99	16.04
T_8 : CO	1310	23.29	35.78	1681	5.78	6.15	4301	7.18	14.42
CD $_{(P = 0.5)}$	***450.48***	-	-	***NS***	-	-	***520.83***	-	-

[1]*RAE: Relative Agronomic Effectiveness*

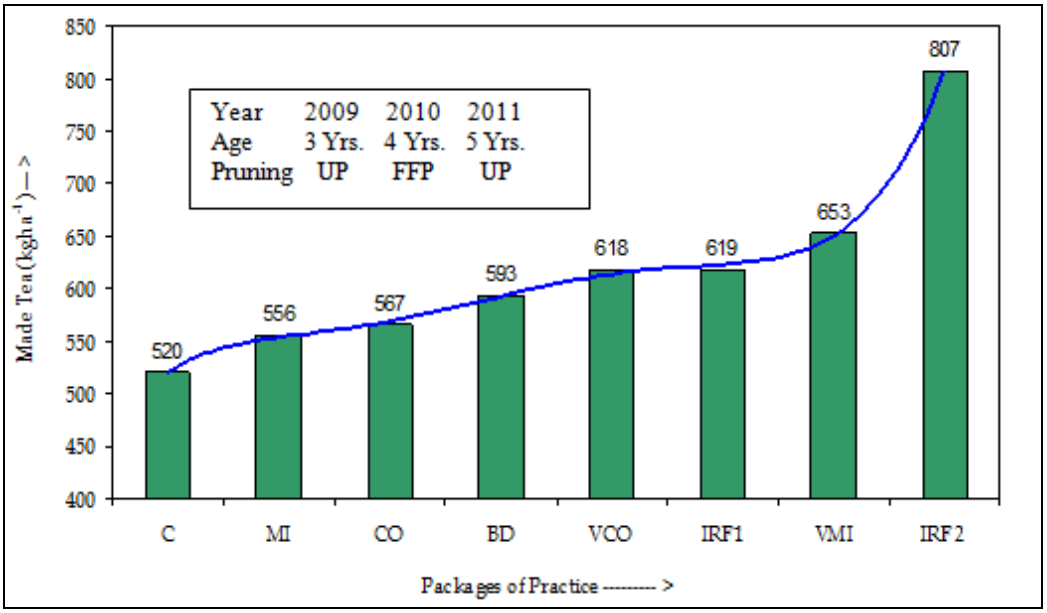

Fig. 3: *Average Crop Performance (2009 - 2011) under Different Organic Packages of Practice in Young Tea under FAO-CFC-TBI Project at Maud T.E, Assam.*

RESULTS AND DISCUSSIONS

Evaluation of the Effectiveness of Different Organic 'Packages of Practice' (POP) in Terms of Yield Performance

Green leaf yield of young tea under different packages of practice was documented from 2009 to 2011 (3 years) under different pruning operations (Table 2) (Figure 4). Crop load was found to increase under different packages with progress of time. In the 1st year highest yield was obtained in case of IRF-2 (1754 $kgha^{-1}$) followed by VMI (1608 $kgha^{-1}$) and VCO (1568 $kgha^{-1}$) packages. In the second and third year also IRF-2 showed highest crop performance, however; while VCO scored over VMI in 2010, the trend was once again reversed in 2011. Overall evaluation of the effectiveness of different packages of practice in terms of crop yield i.e. made tea (Figure 3) revealed most promising results under IRF-2 (made tea: 807 $kgha^{-1}$), which was 55.2 percent higher than control and about 25.6 percent higher than the next best performing package i.e. VMI (made tea: 653 $kgha^{-1}$).

At the same time, three years assessment of yield under different packages and under different pruning operations revealed most consistence performance under IRF-2 followed by VMI package.

Table 3: *Ranking of Different Packages of Practice in Terms of Crop Efficiency and Cost Per Hectare in Young Tea.*

Rank	Packages of Practice	Crop Efficiency			Cost ha^{-1} (Rs.)	VCR[2]
		Yield ($kgha^{-1}$)	% over control	RAE[1]		
1.	T5 : IRF-2	807	55.2	100.00	13,129/-	4.37
2.	T3 : VMI	653	25.6	46.34	66,257/-	0.40
3.	T5 : IRF-1	619	19.0	34.49	8,485/-	2.33
4.	T2 : VCO	618	18.8	34.15	40,023/-	0.49
5.	T7 : BD	593	14.1	25.44	14,377/-	1.02
6.	T8 : CO	567	9.0	16.38	12,792/-	0.73
7.	T6 : MI	556	6.9	12.54	28,657/-	0.25

[1]RAE: Relative agronomic effectiveness, [2]VCR: value cost ratio

Note: *Quantity of soil inputs under different POP were calculated on plant– N requirement basis i.e. for giving 60kg N, except for the soil inputs which had fixed recommended dosage like BF, BD and FYM-2. Actual dosage was calculated based on N and moisture percent in the soil input. Novcom compost was applied in combination with 40 kg Elemental-S and 80 kg Rock phosphate per hectare. In case of soil mgt. using Biodynamic compost, CPP @ 12.5 kg/ ha and Cow horn manure (15 ltr. soln/ ha) was also used. Pruning: UP - FFP - UP; Bush Population: 7065/ha; Age: 3 - 5 years; VCR was calculated considering Made tea @ Rs. 200/ kg.*

Fig. 4: *View of Young Tea Plantation Selected for Experiment under FAO-CFC-TBI Project at Maud T.E., Assam.*

Relative Agronomic Effectiveness (RAE) under Different Organic Packages of Practice

Relative agronomic effectiveness (RAE), which measures the comparative effect of management practice [9] was also calculated for different POP with respect to IRF-2 (since highest yield was obtained under this package, hence; RAE under IRF-2 is considered as 100). As compared to IRF-2, wide variation in RAE was noted for different POP with progress of time (Table 2). While in the 1st year only three packages *viz.* VMI, VCO and IRF-1 scored above 50, in the 2nd year only VCO barely scored the 50 mark, while in the 3rd year none of these three packages performed even closely.

MI and CO packages performed poorly during all the three years whereas BD although scoring close to the 50 mark in 2009; failed to perform similarly during the next two years. The results once again substantiated the consistent and best crop performance under IRF-2.

Agronomic Efficiency (AE) under Different Organic Packages of Practice

Agronomic efficiency of plants [10] under different packages of practice (AE_{POP}) is a useful measure of management effect as it provides an index that quantifies total economic output relative to the utilization of system resources [11]. It was calculated as the excess green leaf divided by the cost of package, and expressed in $gmRs.^{-1}$. In 2009, highest AE_{POP} was observed under IRF-2 (53.28 $gmRs.^{-1}$) closely followed by IRF-1 (51.60 $gmRs.^{-1}$). Evaluation of the AE_{POP} value obtained for the different packages of practice in 2010 and 2011 also indicated higher and consistent performance of IRF packages as compared to others (Table 4).

Agronomic efficiency can be increased by increasing plant physiological efficiency along with activation of soil-plant-nutrient dynamics [4]. Hence, the results obtained in IRF-2 plots might be the result of improvement in soil dynamics due to enhanced microbial proliferation and activity post application of Novcom compost containing huge population of self- generated microbes (Figure 5).

Effectiveness of Different Organic Packages of Practice (POP) in terms of Economics

Value cost ratio is (VCR) used as an important tool to assess economic sustainability of any management system [12]. Value cost ratio was distinctly higher in case of IRF packages during all the three years irrespective of the type of pruning operation (Tables 3 and 4). Other packages of practice *viz.* VCO and VMI which registered 2nd best crop performance, scored very low (less than 1.00) VCR, which depicted economic vulnerability [13, 14] if at all adopted mainly due to high cost of vermicompost. Economically sustainable organic farming will be possible only through adoption of a package of practice, which can influence significant crop response but at a relatively lower cost (Figure 6).

Table 4: *Agronomic Efficiency and Related Cost for Young Tea Development under Different Pruning Operations with Different Packages of Practice.*

Treatment	Unpruned (2009)			First Frame Formation (2010)			Unpruned (2011)		
	AE_{POP}[1] ($gmRs.^{-1}$)	Cost ($Rs.ha^{-1}$)	VCR[2]	AE_{POP} ($gmRs.^{-1}$)	Cost ($Rs.ha^{-1}$)	VCR	AE_{POP} ($gmRs.^{-1}$)	Cost ($Rs.ha^{-1}$)	VCR
T_1 : C	-	-	-	-	-	-	-	-	-
T_2 : VCO	12.61	40154	0.58	12.64	39760	0.59	6.16	40154	0.28
T_3 : VMI	8.29	65838	0.38	3.89	67094	0.18	13.75	65838	0.64
T_4 : IRF-1	51.60	8352	2.37	37.64	8752	1.76	60.82	8352	2.83
T_5 : IRF-2	53.28	12996	2.46	74.58	13396	3.49	153.76	12996	7.17
T_6 : MI	4.41	28238	0.21	7.44	29494	0.35	4.02	28238	0.18
T_7 : BD	22.80	14270	1.05	20.25	14592	0.95	22.49	14270	1.05
T_8 : CO	13.69	18108	0.63	6.20	9937	0.30	27.92	10331	1.30

[1]AE_{POP}: Agronomic Efficiency under Different Packages of Practice is Expressed in gram $Rs.^{-1}$; [2]VCR: Value Cost Ratio

Fig. 5: *Visit of FAO-CFC-TBI team, Scientists and Advisory Board Members of Inhana Organic Research Foundation along with Tea Research Association scientists at study area in Maud Tea Estate.*

Fig. 6: *Dr. P. Das Biswas, Developer of Inhana Rational Farming Technology Discussing Some points Regarding Organic Cultivation during the Visit of FAO-CFC-TBI team, at Maud Tea Estate, Assam.*

CONCLUSION

Upbringing the young tea for desired productive level under organic management is difficult due to their fertilizer sensitivity as well as dearth of effective pest/ disease control measures, which are necessary for optimum physiological development. The finding conclusively established better crop and economic efficiency with application of organic package of practice under Inhana Rational Farming Technology. Most significantly, the package of practice gave a consistence performance under different pruning, which was lacking in case of other organic package of practice.

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