Optimizing combinations of different nutrient sources for organic banana farming with respect to conventional farming

K J Jeyabaskaran, R Pitchaimuthu, K N Shiva, M Loganathan and S Uma*

**email : jeyabaskarankj@gmail.com*

ICAR-National Research Centre for Banana,
Thogamalai Road, Thayanur Post,
Tiruchirapalli, Tamil Nadu,
INDIA

S21 - Session O2
16th Aug. 12.00-12.15PM

Introduction

- ✓ *India ranks first among the banana producing countries with total annual production of 30 million tons from 0.8 million hectares of land.*
- ✓ *Though India strides for developing systematic organic farming in horticulture sector, it does not find place in the list of organic banana producing countries while the Dominican Republic (12 000 ha), Ecuador (11 500 ha), the Philippines (6 500 ha), Peru (5 500 ha) and Costa Rica (4 500 ha) occupied major share in the global organic banana production.*
- ✓ *In India, organic banana farming has gained importance over recent years because of its quality produce, environmental safety, and profitable livelihood.*
- ✓ *So far, nine states in India have promoted policies and programs on organic farming.*
- ✓ *Integration of available organic sources, particularly FYM and poultry mature along with the full recommended dose of mineral fertilisers is found to be essential for improving productivity system.*
- ✓ *In addition to produce quality, organic banana farming improves the soil organic matter content, soil biological activity and soil structure and fertility compared with conventional farming.*
- ✓ *As of now, systematic information on organically produced banana with respect to physico-chemical-biological quality of the soil is limited.*
- ✓ *Hence, an attempt was made to compare the banana yield, postharvest keeping quality, nutritional value, soil organic carbon content and soil microbial dynamics with that of conventional banana farming.*

Material and Methods

Experimental location: Research farm of ICAR-National Research Centre for Banana with soil (silty clay loam soil, Typic Ustropept, mixed, hyperthermic), climatic condition (tropical dry/humid with mean annual precipitation of 850 mm) ($10^{o}47'22"N$ and $78^{o}34'20"E$)

Soil status: pH – 8.9, EC – 0.21 dSm^{-1}, Organic Carbon –1.1 g kg^{-1}, $CaCO_3$-3.7%, CEC – 9.4 cmol(p+)kg^{-1}, N – 104 kg ha^{-1}, P_2O_5 – 4.5 kg ha^{-1}, K_2O – 224 kg ha^{-1}, Cu – 5.2 mg kg^{-1}, Mn – 63.2 mg kg^{-1}, Fe – 61.1 mg kg^{-1}, Zn – 39.5 mg kg^{-1}.

Experimental details:

Banana variety : Grand Naine

Population : 3000 plants per hectare (spacing : 1.8m x 1.8m)

Experimental design : Completely Randomized Block Design

Treatments

T1 – application of 10kg Farm Yard Manure (FYM) + 1.25kg Neem Cake (NC) + 5kg Vermicompost (VC) + 3.75kg of Wood Ash (WA) per plant.

T2 – application of 5kg Poultry Manure (PM) + 1kg Groundnut Cake (GC) + 3kg Rural Compost (RC) + 3.5kg WA per plant.

T3 – 10kg Sugarcane Pressmud (SP) + 1kg Castor Cake (CC) + 5kg RC + 4kg WA per plant.

T4 – 435g urea + 500g single super phosphate (SSP) + 500g muriate of potash (MOP) per plant.

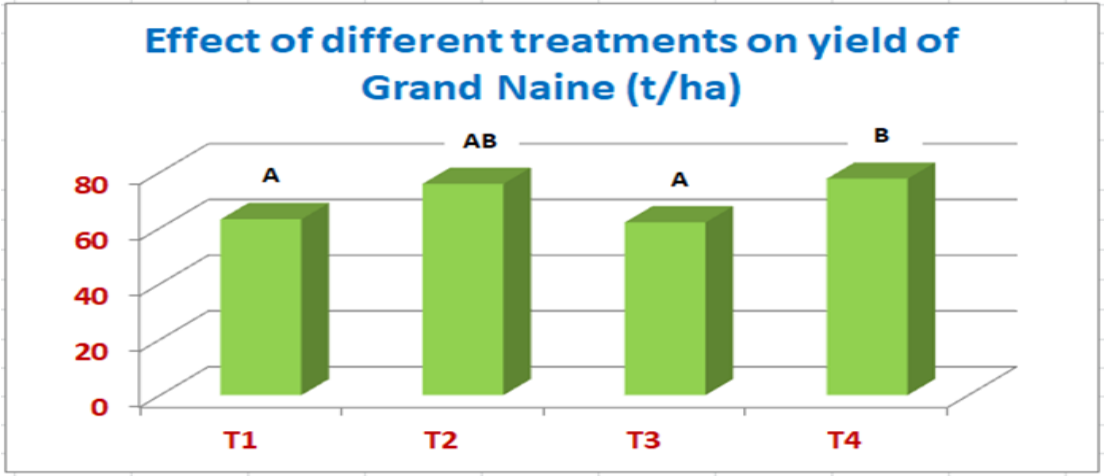
Nutrients supplied through the treatments: 200g N + 100g P_2O_5 + 300g K_2O per plant

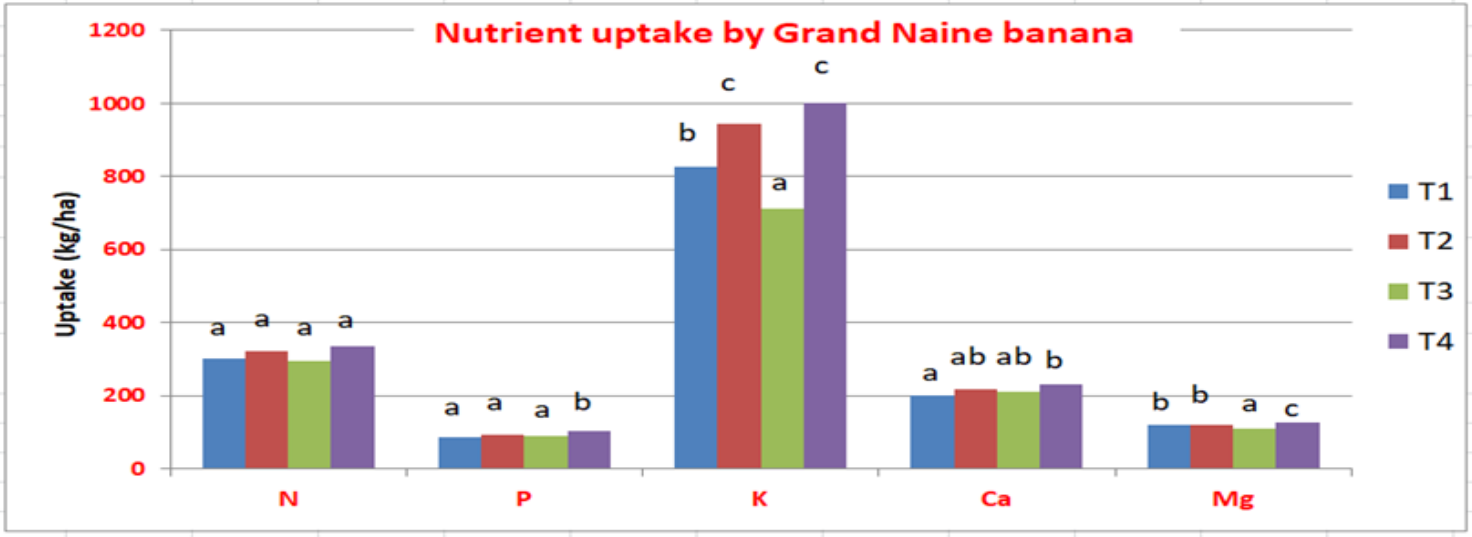
Except T4, all the main treatments were imposed in 3 equal splits at 45^{th} day after planting (DAP), 90^{th} DAP and 135^{th} DAP and T4 was imposed in 3 equal splits at 90^{th}, 150^{th} and 210^{th} DAP. The sub treatment.

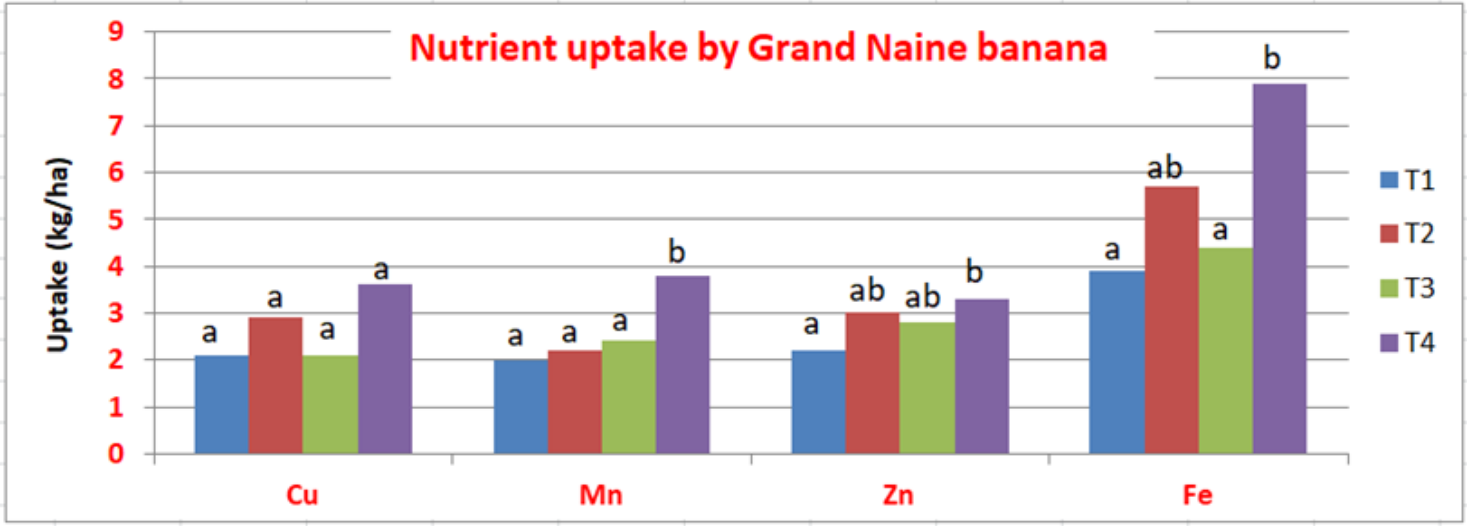
Effect of different treatments on growth and yield of Grand Naine banana

Treat-ment	Plant growth parameters					Yield parameters				
	Plant height (cm)	Pseudo-stem girth (cm)	Total number of leaves	Total leaf area (m^2)	Phyllo-chron Leaves per week	Number of hands per bunch	Number of fingers per bunch	Bunch weight (kg)	Yield t/ha	B:C ratio
T1	187a	62.1a	28.3a	3.9ab	0.97a	7.0a	142.4ab	21.05a	63.15a	1.7a
T2	188a	68.6b	30.1ab	4.2b	0.98a	9.1b	150.5bc	**25.30ab**	**75.90ab**	2.2a
T3	186a	61.8a	29.5ab	3.5a	0.92a	7.5ab	138.9a	20.67a	62.01a	1.9a
T4	190a	69.5b	31.7b	4.1b	0.98a	8.9b	152.1c	**25.90b**	**77.70b**	3.1b

Note: The mean values in a column followed by same letter are not significantly different at (p<0.05)




Nutrient uptake by Grand Naine banana
Uptake (kg/ha)
1200
1000
800
600
400
200
0
a a a a
a a a b
b c a c
a ab ab b
b b a c
N
P
K
Ca
Mg
T1
T2
T3
T4


Nutrient uptake by Grand Naine banana
Uptake (kg/ha)
9
8
7
6
5
4
3
2
1
0
a a a a
a a a b
a ab ab b
a ab a b
Cu
Mn
Zn
Fe
T1
T2
T3
T4

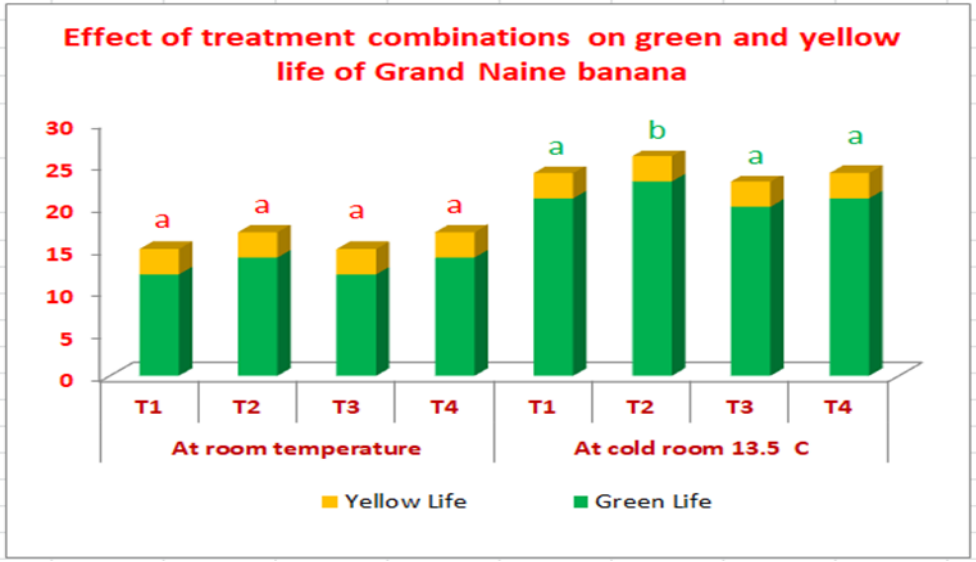
Correlation Coefficients between the soil nutrient contents and nutrient uptakes by Grand Naine plants at different stages of growth

Soil Nutrient Contents	<----------Nutrient Uptake---------->					
	5 leaf stage	10 leaf stage	15 leaf stage	20 leaf stage	Shooting stage	Harvesting stage
	Nutrient Uptake at T1					
5 leaf stage	-0.249	0.229	-0.395*	0.544*	0.308	0.292
10 leaf stage		0.318	-0.094	0.447*	0.244	0.558*
15 leaf stage			0.315	-0.321	0.453*	0.580*
20 leaf stage				0.517*	0.358*	-0.276
Shooting stage					0.618**	-0.279
Harvesting stage						0.243
	Nutrient Uptake at T2					
5 leaf stage	-0.168	0.552*	0.329	0.373*	-0.292	0.256
10 leaf stage		-0.072	0.670**	0.665**	0.239	-0.111
15 leaf stage			0.522*	0.721**	-0.374*	0.144
20 leaf stage				-0.251	0.758**	0.405*
Shooting stage					0.142	0.692**
Harvesting stage						0.672**
	Nutrient Uptake at T3					
5 leaf stage	0.529*	0.328	0.395*	-0.421	-0.218	0.321
10 leaf stage		0.259	-0.271	-0.120	0.101	0.541*
15 leaf stage			0.186	0.613**	0.244	-0.419*
20 leaf stage				0.517*	0.358*	-0.276
Shooting stage					-0.288	0.479*
Harvesting stage						-0.399*
	Nutrient Uptake at T4					
5 leaf stage	0.327	0.511*	0.507*	-0.380*	0.277	-0.494*
10 leaf stage		0.173	0.623**	0.423*	-0.219	-0.448*
15 leaf stage			0.672**	0.643**	-0.113	0.509*
20 leaf stage				0.517*	0.525*	0.125
Shooting stage					-0.372*	0.757**
Harvesting stage						0.334

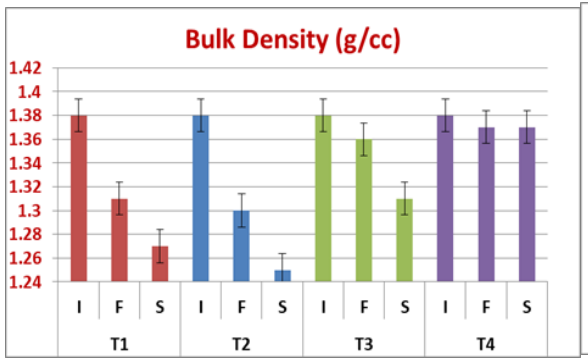
Effect of different treatments on fruit qualities of Grand Naine banana

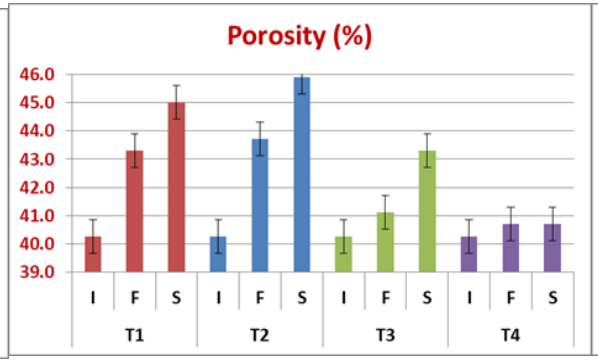
S.No.	Parameter	Treatments			
		T1	T2	T3	T4
1.	Pulp : Peel	2.23ab	2.72bc	2.03a	2.82c
2.	TSS (° Brix)	20.61a	21.20b	20.35a	20.78ab
3.	Acidity	0.31	0.33	0.33	0.37
4.	TSS/Acidity	66.5b	64.2b	61.7b	56.2a

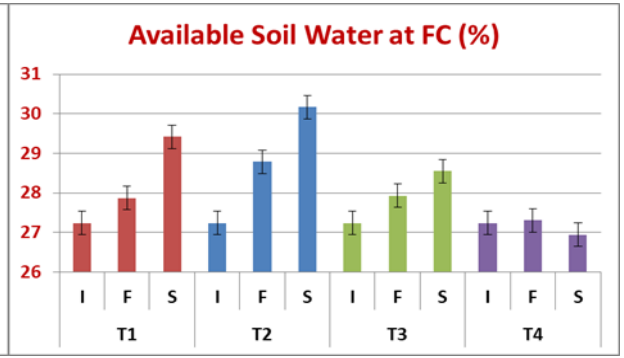
The mean values in a column followed by same letter are not significantly different at (p<0.05)

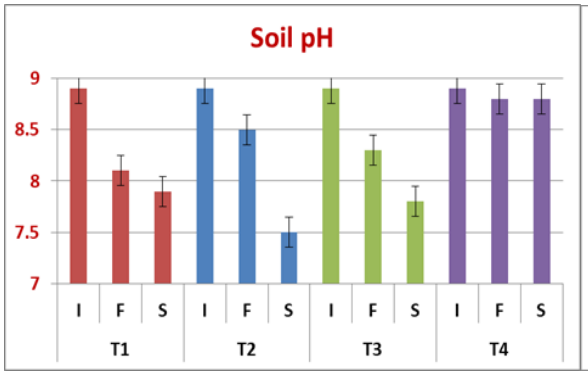


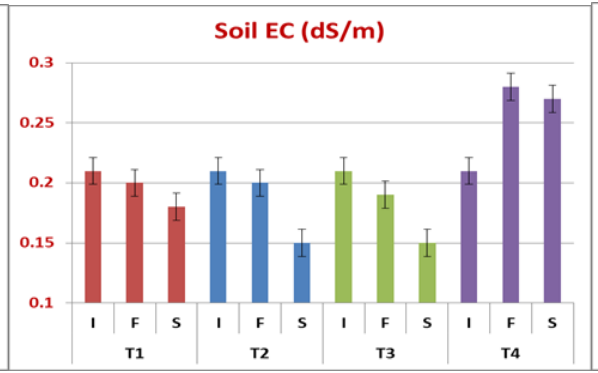
Effect of different treatments on physico-chemical properties of post harvest soils in two seasons

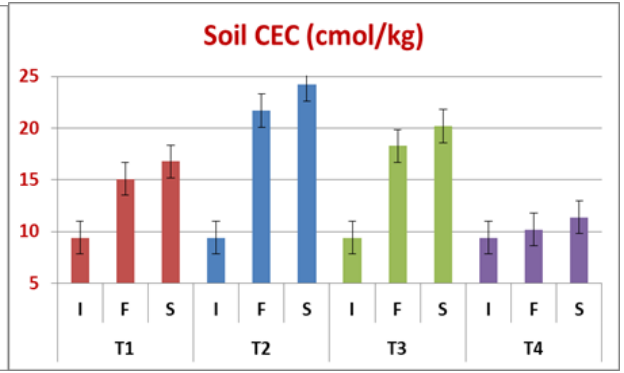


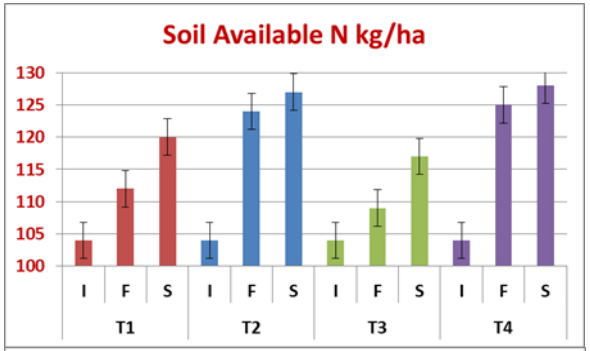


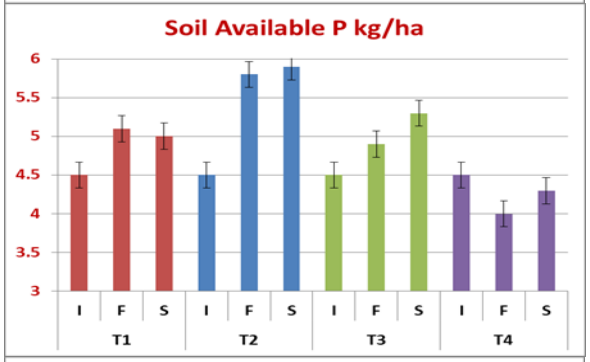


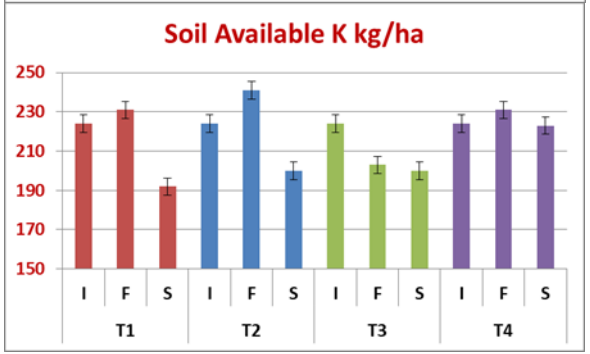


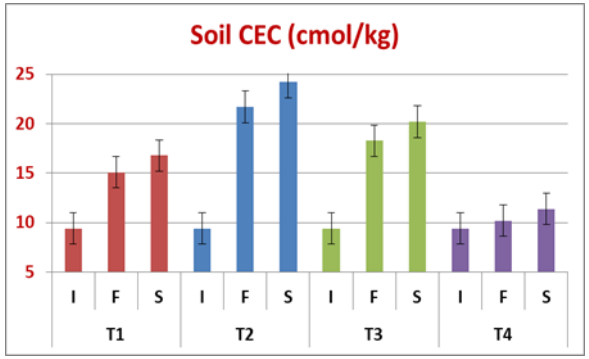




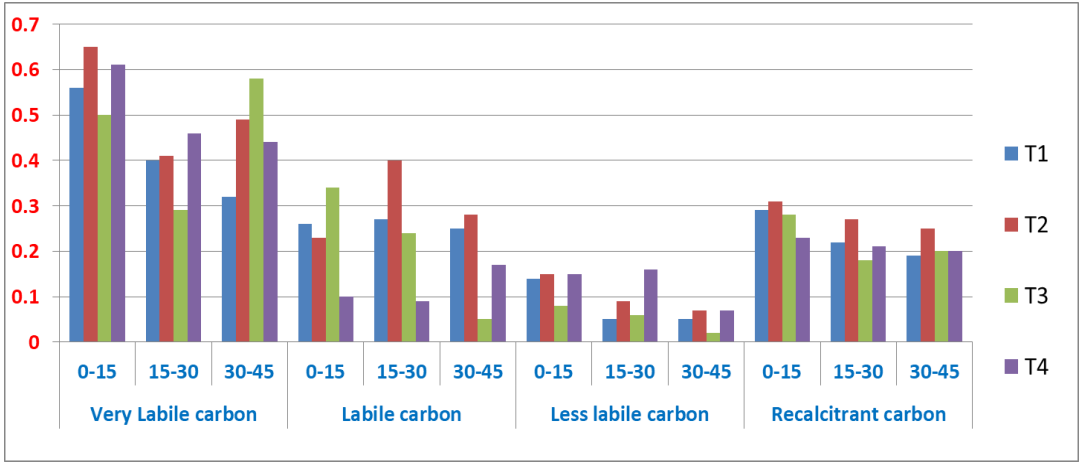




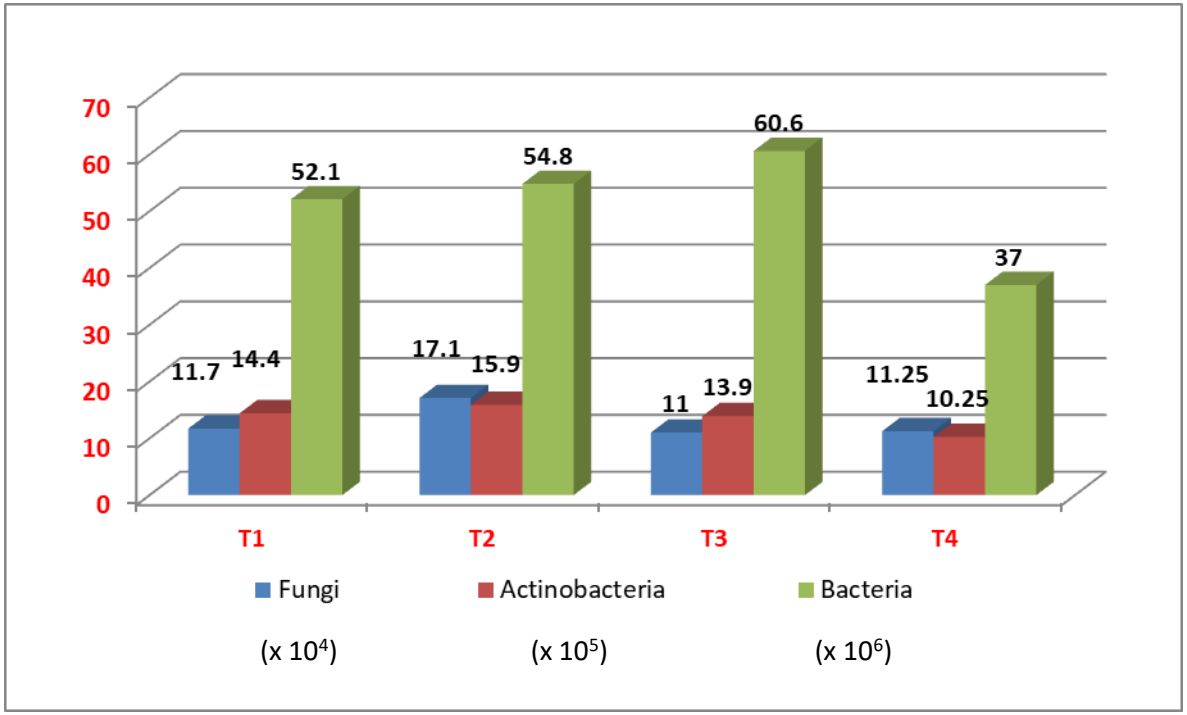




Different fractions of oxidizable organic carbon (%) at three different depths



Effect of different treatments on microbial populations (cfu/g) of post-harvest soil



Conclusion

- *Application of 5kg Poultry Manure + 1kg Groundnut Cake + 3kg Rural Compost + 3.5kg Wood Ash per plant produced an yield of 75.90 tons of Grand Naine banana per hectare and it was at par with the yield (77.70 t/ha) of conventional Grand Naine banana cultivation with 100% inorganic fertilisers.*

- *Though other two organic combinations contained Farm Yard Manure, Vermicompost, Rural Compost, Sugarcane Pressmud, Neem Cake, Castor Cake and Wood Ash as major organic components at proportionate quantities to supply the same amount of nitrogen, phosphorus and potassium as that of inorganic fertiliser applied conventional banana farming, they failed to perform at par with conventional farming.*

- *All the organic treatment combinations improved the fruit qualities and shelf life to desired level when compared to the conventional farming.*

- *The physic-chemico-biological properties of the post-harvest organic farming soil were also found better than that of conventional farming.*

- *In the present study, it was inferred that though the soil health – friendly organic banana farming is more efficient than conventional inorganic farming in improving qualities and increasing shelf life of fruits, it fails to surpass the productivity of conventional banana farming because, of its mismatching of nutrient releasing pattern of soil with that of nutrient uptake of banana crop.*

- *Hence, it is concluded that whatever be the best organic manure we select for organic banana farming, the level of composting or decomposition of these organic manures should be such that the nutrient releasing pattern of them coincides exactly with the nutrient requirement pattern of the banana crop.*