



Quantification of rhizosphere microflora of coconut in sandy and lateritic soils

B.B. Thombre and M.S. Joshi

Abstract

There was considerable variation in the microbial population in the sandy and lateritic soils of coconut rhizosphere. Maximum mean microbial population ($96.57 \times 10^3 \text{ g}^{-1}$) was recorded in lateritic soil in comparison with that of sandy soil ($64.61 \times 10^3 \text{ g}^{-1}$). Bacterial population was maximum in both the soil types and was $27.57 \times 10^3 \text{ g}^{-1}$ and $75.88 \times 10^3 \text{ g}^{-1}$ in sandy and lateritic soils respectively. It was followed by fungi. However, the actinomycetes population was comparatively very low. When fungal population was compared with the total microbial population, it was revealed that sandy soils recorded comparatively more fungi load of $47.34 \times 10^3 \text{ g}^{-1}$ as compared to lateritic soils is $8.39 \times 10^3 \text{ g}^{-1}$. Most predominantly occurring bacteria were species of *Bacillus* and *Pseudomonas* while two species of *Aspergillus* viz. *A. niger* and *A. terreus* and *Penicillium chrysogenum* were most commonly occurring fungi in both the soil types.

Introduction

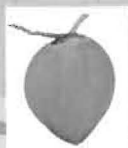
Coconut is a major horticultural crop of Konkan region of Maharashtra. Area under coconut

cultivation in Konkan region is 33426 ha. (Anonymous 2006-2007). The crop is cultivated mainly in sandy soils at sea coast and in lateritic soils in the interior parts where irrigation facilities exist. The concept of rhizosphere is expressed as the zone of increased microbial activity. It is well understood that rhizosphere microflora play vital role in plant growth. Qualitative as well as quantitative distribution of fungi in rhizosphere and non-rhizosphere soil has been discussed in detail. (Harley and Waid 1955). Microbial population in the soil vary depending on many factors such as type of soil, vegetation, temperature, organic matter etc. In order to know the effect of soil types on the rhizosphere microflora of coconut in general and fungal population in particular present investigation was carried out.

Material and Methods

In all, fifty soil samples from rhizosphere of coconut (*Cocos nucifera* L.) at the depth of 15cm were collected from five locations of Ratnagiri district (M.S.) by following the standard sampling technique. Out of that, 20 samples were obtained from Regional

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Coconut Research Station, Bhatye, Ratnagiri and farmers field at Murud (Dapoli) Dist. Ratnagiri where the crop was cultivated on sandy soils. Thirty soil samples from lateritic soils were obtained from three University plantations located at Dapoli and Wakawali. All these samples were collected from the gardens which were applied with uniform and recommended doses of manures and fertilizers 8 months prior to sampling. Soil samples so collected were brought in the laboratory, dried properly and then used for enumeration of microbial load. Dilution plate method was followed for enumeration of microbes present. For bacterial enumeration, nutrient agar medium was used. For estimation of fungal population, potato dextrose agar medium was used while for actinomycetes, Kenknight's medium was used. Three replications were maintained for each sample and for each medium. The inoculated plates with respective media were observed after 24, 72 and 144 hrs to record the bacterial, fungi and actinomycetes population respectively.

Results and Discussion

It was observed that there was considerable variation in the average microbial population and its number in sandy and lateritic soils (Table 1 & 2). The maximum mean microbial population ($96.57 \times 10^3 \text{ g}^{-1}$) was recorded in lateritic soils in comparison with that of sandy soils ($54.61 \times 10^3 \text{ g}^{-1}$). The bacterial population was maximum in both the soil types and was $27.57 \times 10^3 \text{ g}^{-1}$ and $75.88 \times 10^3 \text{ g}^{-1}$ in sandy and lateritic soils respectively. It was

followed by the fungal population which was $24.96 \times 10^3 \text{ g}^{-1}$ and $16.77 \times 10^3 \text{ g}^{-1}$ in sandy and lateritic soils respectively. The actinomycetes population was very low in both the soil types and was $2.06 \times 10^3 \text{ g}^{-1}$ and $4.87 \times 10^3 \text{ g}^{-1}$ respectively. Nair and Subba Rao (1997) reported the microflora in the rhizosphere of coconut under mixed cropping with cacao and recorded the population range of fungi, bacteria and actinomycetes was $15-90 \times 10^4$, $92-200 \times 10^6$ and $2-5 \times 10^6$ respectively.

When fungal population was compared with the total microbial population, it was revealed that lateritic soils recorded comparatively more fungal load of $24.96 \times 10^3 \text{ g}^{-1}$ (47.34%) as compared to sandy soils $16.77 \times 10^3 \text{ g}^{-1}$ (18.39). These findings expressed similar trend as earlier findings of Thomas *et al.*

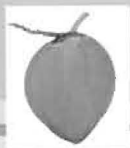
(1985) who studied the effect of soil types on variation in microbial population in the rhizosphere of coconut. The soil types studied were sandy, alluvial, clay and lateritic where maximum fungal population (23.69×10^3) was recorded from a lateritic soils.

The data presented in Table 1 revealed that in the lateritic soils fungal population was high in sample number ten collected from the coconut plantation, CES, Wakawali ($38.6 \times 10^3 \text{ g}^{-1}$) and low population was observed in sample no. five and eighteen collected from coconut plantation, Department of Horticulture and College of Agriculture, Dapoli, ($15 \times 10^3 \text{ g}^{-1}$). This indicated that there was even variation in the fungal population of soils having same type but different location.

Table 1. Total microbial count in the rhizosphere of count grown in lateritic soil (cfu/g of soil) $\times 10^3$

Sample No.	Total Count			Total No. of microbes	% fungal load
	Fungi*	Bacteria*	Actinomycetes*		
Location: Coconut plantation, Department of Horticulture, Dapoli					
1	27.6	14	3.3	44.9	61.5
2	19.3	14.6	3.6	37.5	51.5
3	25.6	14.3	1.6	41.5	61.7
4	19	26.6	2.3	47.9	39.7
5	15	11	1	27	55.5
6	25.6	29	2.6	57.2	44.7
7	27	34	3	64	42.2
Location: Central Experimentation Station, Wakawali					
8	30.6	17.3	-	47.9	63.9
9	31.6	17	-	48.6	65.02
10	38.6	18	-	56.6	68.2
11	26.6	39.6	3.3	69.8	38.1
12	25.6	33	2.3	60.9	42.03
13	23.3	44.6	2.3	70.2	33.2
14	24.6	28	2	54.6	45.05
Location: College of Agriculture, Dapoli					
15	38	33.3	1	72.3	52.5
16	15.6	46.6	5.3	67.5	23.1
17	25	42	1	68	36.7
18	15	24.6	1	40.6	36.9
19	22	47	3.6	72.6	30.0
20	23.6	17	2	42.6	55.4
Mean	24.96	27.57	2.06	54.61	47.34

*means of three replications

Table 2. Total microbial count in the rhizosphere of coconut grown in sandy soil (cfu/gm of soil) x 10³

Sample No.	Fungi*	Total Count		Total No. of microbes	% fungal load
		Bacteria*	Actinomycetes*		
Location: Farmers field, Murud					
21	23.3	58	4.3	85.6	27.2
22	18.3	72.3	2	92.6	19.7
23	16.3	77.6	1.3	95.2	17.1
24	17.6	50.6	2.3	70.5	24.9
25	15.6	52.6	1	69.2	22.5
26	13	81.3	5.6	99.9	13.01
27	21.3	64.3	6.6	92.2	23.1
28	13.3	63.3	-	76.6	17.3
29	25	92.3	-	117.3	21.3
30	14.6	35.6	12.6	62.8	23.2
31	22	49	3.6	74.6	294
Location: Regional Coconut Res. Station, Bhatye (Ratnagiri)					
32	8	38.3	4	50.3	15.9
33	21	62	6.6	89.6	23.4
34	21.3	74	2	97.3	21.3
35	20.3	75	6.3	101.6	20
36	14	44.3	9	67.3	20.8
37	18.3	59	2	79.3	23.07
38	15.6	57	-	72.6	21.5
39	14.6	79.3	3.3	97.2	15.02
40	12	58.3	2	72.3	16.6
41	17.6	83.6	4.6	105.8	16.6
42	20.3	66.3	9	95.6	21.2
43	19.3	59	4	82.3	23.4
44	15.3	152.3	-	167.6	9.1
45	10	116	-	125	7.9
46	9.6	111.3	2	122.9	7.8
47	12.6	84	11.3	107.9	11.7
48	14	106.6	8.3	128.3	10.9
49	17	93	5.33	115.3	14.7
50	22	160.3	-	182.3	12.1
Mean	16.77	75.88	4.87	96.57	18.39

* means of three replications

The percentage of fungal load in lateritic and sandy soil ranged from 23.1-68.2 and 7.8-29.4 per cent respectively.

Maximum bacterial count ($47 \times 10^3 \text{ g}^{-1}$) was recorded from sample number nineteen and minimum count ($11 \times 10^3 \text{ g}^{-1}$) from sample number five which were collected from College of Agriculture, Dapoli and Department of Horticulture, Dapoli respectively. The highest count of actinomycetes ($5.3 \times 10^3 \text{ g}^{-1}$) was recorded in sample number sixteen. The lowest population ($1 \times 10^3 \text{ g}^{-1}$) was recorded from most of the samples, however, some of the

samples showed no actinomycetes population. Out of twenty lateritic soil samples, fungal load ranged from 23.1 - 68.2 per cent. Maximum per cent of fungal population was detected in sample number ten (68.1%). However, lowest per cent of fungal population (23.1%) was observed in sample number sixteen which was collected from College of Agriculture, Dapoli.

The commonly occurring bacteria were species of *Arthobacter*, *Bacillus*, *Achromobacter*, *Pseudomonas*, *Serratia* and some un identified bacterial genera. *Rhizopus*,

Aspergillus, *Fusarium*, *Trichoderma*, *Penicillium*, *Pythium*, *Sclerotium* and *Chaetomium* were the commonly encountered genera of fungi during the study. Out of these, most predominantly and repeatedly occurring bacteria were species of *Bacillus* and *Pseudomonas* while two species of *Aspergillus viz. A. niger* and *A. terreus* and *Penicillium chrysogenum* were most commonly occurring fungi in both the soil types. Bopaiah (1990) also stated that among fungi, *Trichoderma* spp., *Aspergillus* spp. and *Penicillium* spp. dominated in root zone of coconut palm.

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