# A COMPARATIVE STUDY OF THE RHIZOSPHERE MICROFLORA OF COCONUT PALMS FROM DISEASED AND HEALTH AREAS WITH REFERENCE TO ROOT (WILT)

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## INTRODUCTION

The Root (wilt) disease of coconut palm is the most serious of all coconut diseases in Kerala, causing an annual loss of over 300 million rupees. Deterioration of root system is one of the important symptoms of this disease.

It is a widely accepted fact that the plant roots and soil microorganisms form an inseparable relationship. Interaction may occur between the exudates of the plant roots and the products liberated by the activity of the microorganisms. It is therefore possible that the microflora of the root system and also the soil microflora may have some bearing on the disease.

Radha and Menon (1954); Nagaraj and Menon (1955; 1956); Radha and Rawther (1959); Rawther and Radha (1963); Lily (1964) and Srivastava *et al.* (1969) have studied the microorganisms associated with the root and related aspects of the root (wilt) affected coconut palms.

A better understanding of the rhizosphere microflora of the root (wilt) affected and healthy palms under different environmental conditions may be very useful in understanding the etiology of the disease. An attempt was therefore made in the present investigation to assess the fluctuation in the population of rhizosphere microflora of root (wilt) affected and healthy coconut palms during different seasons.

## MATERIALS AND METHODS

Root and soil samples were collected from diseased and healthy palms from diseased area at Kayamkulam and from healthy palms from disease free area at Vellayani during rainy and dry seasons of the year. Samples from the tip and basal regions of both young and old roots were collected and the microbial populations assessed from each sample.

Samples of coconut roots and control soil were collected separately in flasks containing 100 ml of sterile distilled water and they were shaken for half an hour on a mechanical shaker. Serial dilutions of the suspensions were then prepared, the final dilution being one in a million. One ml each of the diluted suspension was pippetted into sterile petri dishes and incorporated with 15 ml of the respective medium for the isolation of different microorganisms. Soil extract agar, kenknight agar, and peptone dextrose agar with rose bengal and streptomycin were used for bacteria, actinomycetes and fungi respectively. The population counts of different microorganisms were recorded and expressed in million per gram of soil on dry weight basis.

## RESULTS AND DISCUSSION

The results are presented in Tables 1, 2 and 3. The data revealed that the root (wilt) affected palms harbour a higher fungal and bacterial rhizosphere population as compared to healthy palms from both diseased and healthy areas. This increase was chiefly noticed in the case of bacteria. However, a reverse trend was observed with regard to actinomycetes population.

It is well known that plants affected by root infecting pathogens support a higher rhizosphere microbial population than healthy ones. As the disease advances, its effect is reflected on the rhizosphere microflora also, on account of the physiological changes brought about by the infecting pathogens on the host.

The increase in the fungal and bacterial population in the rhizosphere of root (wilt) affected palms may be due to the suppression of the competitors with the result that these organisms might have gained prominence. However, the higher incidence of actinomycetes in healthy palms both in healthy and diseased areas is believed to be due to the favourable environmental conditions provided by the host.

A higher fungal and bacterial population were also observed in the rhizosphere of healthy palms of diseased areas than those of healthy palms of disease free areas. This increase may probably be due to the fact that the healthy palms in diseased areas may be in the initial stages of attack of the root (wilt) disease.

In the present studies it was noticed that the total microbial population in the rhizosphere was much higher than that of the corresponding control soil. This result is to be naturally expected and the increased population is attributed to the presence of root exudates and sloughed-off tissues in the rhizosphere which stimulates the growth and multiplication of the microorganism.

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*Seasonal variations.*—The data showed that the fungal population was higher during dry seasons than the wet seasons (Table 1). The reverse was found to be true with regard to bacteria and actinomycetes (Table 2 and 3). This may be due to the ability of fungi to survive under periods of drought by the formation of formant structures. It is likely that soil environment itself will be having some influence on the rhizosphere population during different seasons of the year (Rouatt *et al.*, 1963).

*Effect of sample.*—There were variations in the microbial populations even in the different regions of the same root and also in roots of different maturity (Tables 1, 2 & 3). Young and growing regions of the roots were found to harbour more microorganisms than the matured and basal portions. It is interesting to note that this was more evident in the disease affected areas. However, the basal regions of the young and old roots support a higher bacterial population in the healthy palms in disease free area at Vellayani.

The increased activity of microorganisms at the growing young root tips than dead or non-growing roots is believed to be due to various root secretions such as amino acids, vitamins and sugars. Miller (1938) found that growing roots liberate more root exudates as compared to the non-growing or old roots. It is also possible that the basal region of the roots in the diseased area usually showed a certain amount of decay, which may account for reduced microbial population.

The presence of higher bacterial population at the basal region in the healthy palms may be due to the fact that the root exudates in the basal region may be more favourable for the multiplication of bacteria than that of other organisms.

## SUMMARY

Plants affected by root infecting pathogens support a higher rhizosphere microbial pathogens than healthy ones. It was noticed that the total microbial population in the rizosphere was much higher than that of the correspondilig control soil. This increased population is attributed to the presence of root exudates and sloughed-off tissues in the rhizosphere. The data also revealed that soil environment itself will be having some influence on the rhizosphere population during different seasons of the year. There were variations in the microbial populations in different regions of the root. Young and growing regions of the roots were found to harbour more microorganisms, which is believed to be due to various root secretions.

It is therefore suspected from the present investigation that higher population of fungi and bacteria associated with the root system of coconut palms may have some bearing on the incidence of the root (wilt) disease.

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TABLE 1

*Fungal population in the Rhizosphere of diseased and healthy coconut palms at Kayamkulam and healthy coconut palms at Vellayani (Population $10^4$ per gram of dry soil)*

| Sl. No. | Conditions of the palms and locality from which roots collected | Portions of the root sample used | Wet season | | | Average (wet season) | Dry season | | | Average (Dry season) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | June | July | Aug. | | Dec. | Jan. | Feb. | |
| I. | Diseased palms (root-wilt affected at Kayamkulam) | Young root tip | 7.84 | 10.64 | 17.97 | 12.15 | 17.73 | 21.91 | 22.22 | 20.29 |
| | | Young root base | 5.52 | 4.46 | 15.45 | 8.46 | 12.12 | 17.47 | 22.04 | 17.21 |
| | | Old root tip | 7.01 | 2.67 | 20.55 | 10.09 | 10.44 | 28.07 | 0.62 | 13.04 |
| | | Old root base | 3.16 | 2.63 | 5.20 | 3.66 | 3.59 | 32.31 | 2.02 | 12.64 |
| | | Soil sample | 3.07 | 1.04 | 3.21 | 2.44 | 0.73 | 23.24 | 0.55 | 8.17 |
| II. | Healthy palms from diseased area (at Kayamkulam) | Young root tip | 0.90 | 3.64 | 11.85 | 5.49 | 3.08 | 8.70 | 7.87 | 6.55 |
| | | Young root base | 3.06 | 1.42 | 8.98 | 4.49 | 3.03 | 50.37 | 1.01 | 18.14 |
| | | Old root tip | 4.55 | 6.56 | 9.81 | 6.97 | 5.86 | 51.02 | 6.38 | 21.09 |
| | | Old root base | 5.58 | 0.57 | 2.11 | 2.75 | 4.31 | 34.49 | 5.79 | 14.86 |
| | | Soil sample | 1.31 | 0.52 | 5.70 | 2.51 | 1.17 | 9.11 | 1.61 | 8.96 |
| III. | Healthy palms from healthy area (at Vellayani) | Young root tip | 4.48 | 0.86 | 0.80 | 2.05 | 20.34 | 20.88 | 11.65 | 17.62 |
| | | Young root base | 3.12 | 1.74 | 3.95 | 2.94 | 7.39 | 15.60 | 3.70 | 8.90 |
| | | Old root tip | 1.49 | 1.20 | 10.77 | 4.49 | 1.45 | 12.51 | 6.25 | 6.74 |
| | | Old root base | 4.12 | 1.08 | 3.95 | 3.05 | 0.32 | 14.58 | 2.61 | 5.84 |
| | | Soil sample | 0.60 | 4.51 | 0.20 | 1.77 | 1.40 | 12.92 | 5.35 | 6.89 |

TABLE 2

*Bacterial population in the Rhizosphere of diseased and healthy coconut palms at Kayamkulam and healthy coconut palms at Vellayani (Population $10^6$ per gram of dry soil)*

| Sl. No. | Conditions of the palms and locality from which roots collected | Portions of the root sample used | Wet season | | | Average (wet season) | Dry season | | | Average (Dry season) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | June | July | Aug. | | Dec. | Jan. | Feb. | |
| I. | Diseased palms (root-wilt affected) at Kayamkulam. | Young root tip | 50.73 | 91.51 | 72.59 | 71.98 | 92.03 | 33.15 | 43.42 | 56.20 |
| | | Young root base | 40.82 | 43.42 | 33.33 | 39.19 | 6.06 | 21.08 | 1.69 | 9.63 |
| | | Old root tip | 9.81 | 98.14 | 4.59 | 37.51 | 5.86 | 65.50 | 6.62 | 25.99 |
| | | Old root base | 33.05 | 11.28 | 8.23 | 17.52 | 12.35 | 23.08 | 2.11 | 12.51 |
| | | Soil sample | 1.31 | 4.43 | 5.16 | 3.63 | 3.86 | 22.54 | 9.68 | 12.03 |
| II. | Healthy palms from diseased area (at Kayamkulam). | Young root tip | 82.03 | 64.54 | 7.83 | 51.47 | 26.67 | 25.27 | 5.62 | 19.19 |
| | | Young root base | 33.33 | 15.04 | 6.58 | 18.98 | 14.18 | 36.88 | 5.53 | 18.81 |
| | | Old root tip | 2.60 | 77.10 | 12.33 | 30.88 | 10.41 | 12.50 | 3.60 | 8.85 |
| | | Old root base | 4.34 | 45.73 | 6.94 | 19.00 | 37.84 | 52.22 | 4.69 | 31.84 |
| | | Soil sample | 4.20 | 6.94 | 4.28 | 5.14 | 1.71 | 3.35 | 3.63 | 2.89 |
| III. | Healthy palms from healthy area (at Vellayani) | Young root tip | 6.55 | 20.29 | 7.77 | 11.54 | 6.72 | 26.36 | 4.26 | 12.45 |
| | | Young root base | 40.00 | 26.30 | 16.05 | 28.12 | 9.38 | 25.05 | 22.38 | 18.94 |
| | | Old root tip | 14.27 | 44.89 | 3.13 | 20.76 | 19.80 | 22.98 | 16.15 | 19.64 |
| | | Old root base | 20.53 | 37.61 | 13.04 | 23.73 | 25.77 | 37.25 | 11.86 | 24.96 |
| | | Soil sample | 1.02 | 7.59 | 2.60 | 3.74 | 4.19 | 59.90 | 3.37 | 22.49 |

TABLE 3

*Actinomycetes population in the Rhizosphere of diseased and healthy Coconut palms at Kayamkulam and healthy coconut palms at Vellayani (Population $10^6$ per gram of dry soil)*

| Sl. No. | Conditions of the palms and locality from which roots collected | Portions of the root samples used | Wet season | | | Average (wet season) | Dry season | | | Average (Dry season) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | June | July | Aug. | | Dec. | Jan. | Feb. | |
| I. | Diseased palms (root-wilt affected at Kayamkulam). | Young root tip | 2.96 | 2.62 | 11.85 | 5.81 | 5.08 | 2.20 | 1.12 | 2.80 |
| | | Young root base | 2.04 | 0.65 | 2.14 | 1.61 | 1.00 | 7.09 | 0.33 | 2.81 |
| | | Old root tip | 0.75 | 0.62 | 0.44 | 0.60 | 2.35 | 4.17 | 0.20 | 2.24 |
| | | Old root base | 9.30 | 0.68 | 0.21 | 3.39 | .. | 0.33 | .. | 0.11 |
| | | Soil sample | 1.60 | 1.22 | 0.16 | 0.99 | 2.34 | 0.14 | 0.40 | 0.96 |
| II. | Healthy palms from diseased area (at Kayamkulam). | Young root tip | 22.06 | 3.07 | 0.92 | 8.68 | 22.27 | 3.93 | 2.47 | 9.56 |
| | | Young root base | 6.60 | 1.86 | 0.86 | 3.10 | 4.06 | 1.81 | 0.56 | 2.14 |
| | | Old root tip | 4.15 | 4.20 | 2.74 | 3.69 | 2.06 | 3.51 | 0.31 | 1.96 |
| | | Old root base | 3.55 | 3.68 | 0.74 | 2.66 | 0.89 | 6.15 | 2.11 | 3.05 |
| | | Soil sample | 1.85 | 1.16 | 2.14 | 1.02 | .. | 1.41 | 0.28 | 0.56 |
| III. | Healthy palms from healthy area (at Vellayani) | Young root tip | 4.48 | 2.42 | 1.60 | 2.83 | 6.78 | 1.43 | 1.91 | 3.38 |
| | | Young root base | 15.63 | 26.12 | 12.59 | 18.11 | 3.72 | 5.93 | 1.23 | 3.63 |
| | | Old root tip | 8.42 | 2.70 | 1.03 | 4.05 | 2.88 | 8.16 | 1.56 | 4.20 |
| | | Old root base | 14.43 | 6.48 | .. | 6.97 | 0.81 | 5.41 | 0.87 | 2.36 |
| | | Soil sample | 0.70 | 11.59 | 1.39 | 4.56 | 2.36 | 1.31 | 1.59 | 1.76 |