

# Beneficial Micro-organisms in the Root Region of Arecanut Palm

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## Abstract

*The micro-organisms inhabiting in the root region of arecanut palms are enumerated. The occurrence of asymbiotic nitrogen fixers, phosphate solubilizers and cellulolytic micro-organisms were recorded. The antagonistic Streptomyces sp. and Actinomyces sp. were found to be associated in the root regions. The influence of intercropping on the population of asymbiotic nitrogen fixers was studied. Among the asymbiotic nitrogen fixers Beijerinckia sp., Derxia sp. and Azotobacter sp. were present. Aspergillus sp., Penicillium sp. and Pseudomonas sp. being the phosphate solubilizers were also detected in the root region. Indole producing bacteria were isolated from the rhizosphere of arecanut palms. The micro-organisms capable of utilizing cellulose, hemicellulose, starch and pectin are discussed.*

## Introduction

Arecanut cultivation is restricted mainly to the high rainfall belts. Being a perennial crop, the palm continues to yield for 35-50 years. Root region is the active zone for the proliferation of several micro-organisms. The rhizosphere activities depend on root spread, exudation and respiration of the roots. In arecanut 60-80 per cent of the roots are confined to 50 cm radius from base to a depth of 50 cm. The other soil characteristics like soil moisture, pH, temperature, the age and also the conditions of the palms are known to influence the microflora and microbiological activities in the root region. The micro-organisms are beneficial in increasing the soil fertility and plant growth as they are involved in several important biochemical transformations and mineralisation activities in soil.

In the present investigation, the enumeration and occurrence of beneficial micro-organisms in the root region of arecanut palms are discussed. The influence of intercropping on the population of asymbiotic N<sub>2</sub> fixers are also studied.

## Materials and Methods

The arecanut rhizosphere samples were collected from the experimental plot of the institute. The samples were collected from the base of arecanut palms between 30-60 cm lateral distance and at 0-30 cm depth. The sampling was done from three palms. The non-rhizosphere samples were collected to enumerate the micro-organisms with a view to find out the rhizosphere and non-rhizosphere ratio (R:S ratio). The bacterial, fungal and actinomycetes flora were enumerated quantitatively using soil extract agar, Martin's rose bengal agar and Kustar's agar medium, respectively (Dilution plating

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method, Jensons, et al., 1959). The representative colonies of bacteria, fungi and actinomycetes were isolated, purified and maintained on Nutrient Agar (NA), Potato Dextrose Agar (PDA) and Kustar's agar (KA) respectively for identification and for the studies on the utilization of different components of organic matter.

The enumeration of *Azotobacter*, *Beijerinckia* and *Derxia* (asymbiotic nitrogen fixers) were carried out using specific medium viz., Jensen's medium (Jensen, 1942), Beeking medium (Beeking, 1959) and medium of Campelo and Dobereiner (1969) respectively for each of them. Both dilution plating technique and spread plate technique (0.1 g soil) were employed to enumerate the different asymbiotic nitrogen fixers. The phosphate solubilizing organisms were counted using Katznelson and Bose (1959) and Pikovskaya's medium and the plates were incubated at room temperature for 7 days. A clear zone develops around the colonies of those capable of solubilizing phosphate.

The micro-organisms capable of utilizing the different components were studied by inoculating the different isolates of bacteria, fungi and actinomycetes. Cellulose, hemicellulose, pectin and starch were used as source of carbon in the medium and the growth of micro-organisms were recorded. The cellulose decomposing ability was found out in Omeliansky's medium using filter paper strips in the test tube and cellulose decomposers were recorded after 15 days of incubation.

#### Enumeration of asymbiotic nitrogen-fixers in arecanut intercrops:

The rhizosphere samples were collected from the intercrops of cowpea, arrow root, elephant foot yam, sweet potato, ginger,

ragi, *Dioscorea*, banana and Napier grass (NB-21) for the enumeration of *Azotobacter* (Waksman medium No. 77) and *Beijerinckia* (Beeking medium) population. The control soil, where there was no intercrop was used for comparison.

The bacterial isolates were grown for 48 hr in test tube broth containing Tryptophane and Voges-Proskauer test (V-P test) was conducted for the production of indole.

### Results and Discussion

The occurrence of bacteria, fungi and actinomycetes flora in the rhizosphere region of arecanut and non-rhizosphere soils were studied and indicated that large number of bacteria, fungi and actinomycetes were observed in the rhizosphere soils ( $153.3 \times 10^4$ ,  $37.3 \times 10^3$  and  $10.7 \times 10^4$ ) as compared to non-rhizosphere ( $47.0 \times 10^4$ ,  $4.3 \times 10^3$  and  $7.3 \times 10^4$ ) respectively. The rhizosphere effect indicates the overall influence of plant roots on soil micro-organisms. The R:S ratio for bacteria (3.6) and actinomycetes (1.5) is narrow because the population difference between root region and non-rhizosphere is not much, mainly due to the acidic nature of the soil (pH 5.2-5.8).

The enumeration of asymbiotic nitrogen fixers indicated the occurrence of *Azotobacter* sp., *Beijerinckia* sp. and *Derxia* sp. on different medium. The colonies of asymbiotic nitrogen fixers were small and not well developed in the dilution plating method, whereas sprinkling of soil (0.1 g) and spread plate method on the medium produced slow growing as well as fast growing well developed colonies. This indicates that these organisms require some growth promoting compounds in the

medium. In general, *Beijerinckia* sp. and *Derxia* sp. were more compared to *Azotobacter* sp.

The intercropping in areca garden in general has increased the population of asymbiotic nitrogen fixers, in addition to the increase in the total microflora i.e., bacteria, fungi and actinomycetes (Muralidharan-personal communication). Similarly the mixed cropping trials with cowpea, Guinea grass and Napier grass (NB-21) in arecanut has increased the asymbiotic N<sub>2</sub> fixers (*Azotobacter* and *Beijerinckia*) and phosphate solubilizing micro-organisms (Rawther, et al., 1979). This indicates that several intercrops could be grown in areca gardens so as to increase the productivity per unit area through nitrogen fixers and P solubilization mechanisms.

The population of phosphate solubilizing micro-organisms was in the range of 5-10 × 10<sup>4</sup>/g of soil. *Aspergillus* sp., *Penicillium* sp. and *Pseudomonas* sp. were the phosphate solubilizers observed in the root region.

The genera of micro-organisms isolated from the rhizosphere of arecanut palms capable of utilizing different components of organic matter are given in Table 1. The studies on the micro-organisms capable of decomposing cellulose and hemicellulose indicated that they were in abundant number in the root region of areca palms. The starch hydrolysing and pectin degrading micro-organisms were also recorded. The green leaf and farm yard manure (FYM) application is the common practice by growers every year in the month of September - October. Therefore, the cellulose, hemicellulose, lignin and pectin degrading micro-organisms are important in the decomposition of organic matter (green

leaf and FYM), The degradation of organic matter by the activities of root-region microflora releases the nutrients and makes it available to the plant for the uptake slowly. Variety of organic substances available at the root region by way of exudates from roots directly or indirectly influence the quantity and quality of micro-organisms in the root region.

The crowded plate technique using Potato Dextrose Agar (PDA) and Nutrient Agar (NA) has yielded several actinomycetes antagonistic to bacteria. The antagonistic actinomycetes belong to the genera of *Streptomyces* sp. and *Actinomyces* sp. Root region may also provide a food base for the growth of the pathogenic micro-organisms in soil. The indole producing bacteria isolated from the rhizosphere of arecanut belong to *Pseudomonas* sp.

Table 1. Genera of micro-organisms isolated from the root region of areca palms capable of utilizing different components of organic matter

Cellulose	F: <i>Aspergillus, Chaetomium, Fusarium, Penicillium, Rhizoctonia, Rhizopus, Trichoderma, Alternaria.</i> B: <i>Bacillus, Pseudomonas.</i> A: <i>Micromonospora, Nocardia, Streptomyces.</i>
Hemicellulose	F: <i>Aspergillus, Rhizopus, Fusarium, Chaetomium, Penicillium, Alternaria.</i> B: <i>Bacillus, Pseudomonas.</i> A: <i>Streptomyces.</i>
Starch	F: <i>Aspergillus, Fusarium, Rhizopus.</i> B: <i>Bacillus.</i> A: <i>Micromonospora, Nocardia, Streptomyces.</i>
Pectins	F: <i>Fusarium.</i> B: <i>Bacillus, Pseudomonas.</i>

F = Fungi B = Bacteria A = Actinomycetes

Several micro-organisms were found inhabiting in the root region of areca palms. The micro-organisms are responsible for ammonification, nitrification, denitrification, carbohydrate utilization, cellulose decomposition and nitrogen fixation. In general, the greater rhizosphere effect is seen with bacteria (R:S ratio ranging from 10 to 20 or more) but it is not so with the rhizosphere of arecanut palm, may be due to the acidic nature of the soil and soil

type (laterite soils). From the agronomic point of view, the abundance of nitrogen fixing and phosphate solubilizing micro-organisms in the rhizosphere assumes a natural significance.

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