

MICROBIOLOGY OF ROOT REGION OF ARECA PALM

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ARECANUT is an important plantation crop grown mainly in high rainfall regions of Kerala, Karnataka, Tamil Nadu, Maharashtra, West Bengal and Assam. It is a perennial crop and the palm continues to yield for 35 to 50 years. The root region is a reservoir for various kinds of micro-organisms, majority of which are saprophytic and few are parasitic. Micro-organisms are beneficial in increasing the soil fertility and plant growth as they are involved in several important biochemical transformations in soil.

The microbiological activity depends on root activity particularly the exudations from the roots and root respiration. Other soil characteristics like soil moisture, pH, temperature and also the age and condition of the palms are known to influence the root region microflora and microbiological activities.

The microflora population in the root region of arecanut palms was counted by obtaining soil samples at four lateral distances namely 0-30 cm, 30-60 cm, 60-90 cm and 90-120 cm and four vertical depth of 0-15 cm, 15-30 cm, 30-45 cm and 45-60 cm. The population of major microbial groups was pronounced between 0-60 cm lateral distance and at a depth of 0-30 cm. Therefore this is considered as the active zone for the microbiological activities (Table 1).

The bacterial, fungal and actinomycetes flora were estimated both

quantitatively and qualitatively. As compared to the other soil types, bacteria were less numerous possibly due to the acidic nature of the soil (pH 5.2 to 5.8). The population of some bacteria (*Arthrobacter* sp. and *Nocardia* sp.) is always uniform and constant in soil, since their nutrition is derived from the native organic matter. The fermentative bacteria like *Pseudomonas* sp., *Bacillus* sp., and *Micrococcus* sp., require external source of energy. When specific substrate (organic matter) is

added to the soil its number increases and gradually decreases when the substrate is exhausted. To this category belongs the cellulose decomposers, nitrogen utilizing bacteria and those splitting ammonia to nitrate.

Among the fungi, the *Trichoderma* sp. (18-35 per cent) and *Aspergillus* sp., (21-31 per cent) are found dominating in the rhizosphere of arecanut palms. The other genera of fungi inhabiting the root region are *Penicillium* sp., *Curvularia* sp., *Rhizoc-*

TABLE 1. RHIZOSPHERE MICROFLORA OF ARECANUT PALM

Lateral distance from the base of arecanut palm (cm)	Organism	Microbial population in the rhizosphere				Mean
		Depth (cm)				
		15	30	45	60	
30	F	33.00	25.10	13.60	5.75	19.40
	B	63.90	56.40	47.00	12.25	44.90
	A	13.50	9.50	5.75	0.00	7.17
60	F	34.00	22.60	16.40	5.90	19.70
	B	63.40	45.40	30.10	13.90	38.28
	A	13.00	10.75	5.50	0.00	7.31
90	F	33.20	19.10	8.90	2.00	15.80
	B	59.10	30.40	21.50	4.50	28.88
	A	8.75	5.00	2.00	0.00	3.94
120	F	11.75	9.40	3.00	0.60	6.20
	B	34.40	18.50	8.30	—	15.28
	A	6.75	2.25	1.00	0.00	2.50
Mean	F	28.00	19.06	10.50	3.50	
	B	25.20	37.80	26.70	7.60	
	A	10.50	6.90	3.30	0.00	

F = Fungi (10⁸)
B = Bacteria (10⁴)
A = Actinomycetes (10⁴)

tonia sp., *Rhizopus* sp., *Mucor* sp., *Fusarium* sp., *Cylindrocarpon* sp., *Cladosporium* sp., *Alternaria* sp., *Gangrenella* sp. and *Trichosporiella* sp. The quantity and quality of organic matter present in soil have a direct bearing on fungal flora in soil, as most of the fungi are heterotrophic in nutrition. Fungi are dominant in acid soils. The primary function of filamentous fungi in soil is to degrade organic matter thus releasing plant nutrients and help in soil aggregation.

The actinomycetes found in the root region are *Streptomyces* sp., *Nocardia* sp., *Micromonospora* sp., and *Actinomyces* sp., The population of actinomycetes increases in the presence of decomposing organic matter.

Alteration of rhizosphere microflora of areca palm is possible with soil amendments and artificial inoculation of seed or soil. The microbial seed inoculants, such as *Azotobacter*, *Beijerinckia* or phosphate solubilizing micro-organisms may help in the establishment of these beneficial micro-organisms in the immediate vicinity of growing roots. The application of farm yard manure (12 kg/palm) and green leaf (12 kg/palm) is a common cultivation practice adopted by the areca growers which is supplied during September-October as the post-monsoon application of fertilizers. The base of arecanut palm is opened about 75 cm radius for the addition of FYM and green leaf and then it is covered with a layer of soil. The application of green leaf and farm yard manure increases the soil organic matter content though temporarily and maintains the soil pH and enhances the soil microbiological activities. The growers sometimes apply only farm yard manure, green leaf and wood ash without going in for the chemical fertilizers. The trials conducted at this institute on the continuous application of organic manures and chemical fertilizers alone or in combination did

not indicate any difference in the plant growth and yield.

Some of the soil amendments practised in arecanut plantation are lime and fresh soil application. The lime application is done to improve the soil pH and nutrient availability. Whereas soil application is practised by the growers once in 5 or 6 years to improve the general fertility status of the soil. Root degeneration in arecanut palms is a common phenomenon. Many bacterial and fungi are found responsible for the degeneration of roots. As the old roots degenerate, the new roots arise from the base of the palm.

Application of Husk

A common practice adopted by the growers is the application of arecanut husk to palms. The husk is rich in cellulose (37-49 per cent), Pentosans (15-19 per cent), lignin (17.6-25 per cent) and pectin (0.9-3.3 per cent), which is slowly degraded by several soil micro-organisms. The husk will serve as a mulch to conserve soil moisture in summer and helps prevent soil erosion during monsoon. Addition of this organic matter influences the microbiological activities beneficially. The complete degradation and recycling of this waste will take about two years or more in field depending on the nature of soil and the microbiological activities. There is a possibility of enhancing the degradation of husk by inoculating some fungi, found efficient in degrading the husk. Husk is also burnt after drying and the ash (4-6 per cent) is applied to palms, which is a good source of potash. The slow degradation of husk makes the nutrients available to the palm.

The associative and antagonistic activity are very much prevalent in the rhizosphere of areca palm as is in any other plant. The dependence of one micro-organism upon another for extracellular products such as amino-acids and growth promoting factors can be regarded as

associative effect. Auxins, indole, gibberellin and gibberellin-like substances are known to be produced by certain bacteria and fungi. The biosynthesis of antibiotics by micro-organisms in soil and the resultant biological inhibition of growth of other susceptible micro-organisms is considered as antagonistic phenomenon. A number of actinomycete colonies antagonistic to bacteria are observed in the rhizosphere of areca palm.

The asymbiotic N_2 -fixers inhabiting the rhizosphere are *Azotobacter* sp., *Beijerinckia* sp., and *Derrxia* sp. Among these *Beijerinckia* and *Derrxia* occurs in large numbers. The phosphate solubilizers observed in the root region are *Aspergillus* sp., *Penicillium* sp. and *Pseudomonas* sp. The occurrence of endogone V-A mycorrhizal spores as well as the extent of infection of roots by the mycorrhizae are also less in the arecanut palms.

Inter-cropping

Inter or mixed cropping is a common practice in arecanut gardens. This is encouraged to increase the productivity per unit area and to get more income to the growers. Several green manure legumes, cover legumes and forage legumes are recommended as intercrop. The green manure crop is turned into soil, while it is tender to enrich the soil with organic matter and nutrients. When the green matter is decomposed, the nitrogen bound in the organic matter is released first as ammonia and further it is converted to nitrate. Apart from the enrichment of soil nitrogen, green manuring enriches the soil with several other plant nutrients. The legume intercrops increase the soil nitrogen by fixing the atmospheric nitrogen through symbiotic and asymbiotic nitrogen fixation. Further they stimulate soil microbiological activities and prevent soil erosion.

The mixed cropping in arecanut
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a high strength as exhibited by a material like plywood may not be required but in the absence of a suitable material, plywood may have been so far employed. Further studies on these aspects are in progress at CPCRI, Kasaragod. Use of these plyboards in such applications shall save a considerable quantity of softwood timber which can be channelled for other sophisticated uses.

The flexibility of the plyboards can enable their application in suitcase manufacture also. The satisfactory bursting strength, and the ability to bend them to short curvature are desirable properties for making file boards, brief cases and tubular packages. The file boards made of areca leaf sheath plyboards have been put to use in CPCRI, Vittal for the past five years.

Throw-away Plates and Cups

The flexibility and mouldability of the sheath when wet makes it a good material for heat moulding. The CFTRI, Mysore has developed a machine for making cups and throw-away plates which may substitute the paper plates and cups now being used. The machine is manually operated by leg and is

capable of producing 100 cups per hour with one skilled operator and helper. The leaf sheath is subjected to 158°C for 10 seconds in the machine for moulding. Such plates and cups are already being produced in small scale units in south Karnataka.

Decorative Veneer Panels and Picture Mounts

Aesthetically attractive and imaginative novelties can be made from areca leaf sheaths taking advantage of the natural colour and grain variation in the surface. For this, the sheath surface, given a finish in varnish or French polish, makes a beautiful picture mount or a decorative panel. The dark and white faces of the outer and inner surfaces of the sheath have been exploited to prepare decorative panels of wooden almirahs and teapots.

House Chappals

The easy yielding of the sheath for stitching and its resemblance to animal hide, suggest its usefulness as a cheap substitute for leather sole-tops in house chappals and cheap summer wear chappals in the drier regions of India.

Other Applications

Briefcases, brief bags, spectacle

cases, tea or coffee trays are the other products that can be prepared out of areca leaf sheaths. Possibilities for using the sheaths in manufacture of low grade paper boards for packing purposes look promising.

The exploitation of areca husk and areca leaf sheaths for these applications will fetch an additional income to the arecanut growers and also generate additional employment in the rural sector of our country.

The comfortable status of arecanut industry at present depends on the traditional demand for chewing. The marketing system is fairly sound and stable. It can take care of the minor shocks due to the tilts in the balance of demand and supply. But one has to be watchful as to how far the generations to come show tendencies to break-off from traditions. A drastic break-off means a bigger shock to the industry leading to the inevitable glut. It is here the diversification has got to come into full play. We are now fairly clear about the potentialities of the raw product in manufacturing industry.

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plantation with cowpea, NB-21 (hybrid napier) and Guinea grass increased the nitrogen fixing *Beijerinckia*, *Azotobacter* and phosphate solubilizing micro-organisms. The areca and cocoa mixed cropping has shown synergetic effects as it increased the yield of arecanut crop. This could be mainly due to the constant addition of organic matter by way of cocoa leaf fall. The leaf litter serves as natural mulch in summer and help in moisture conservation by preventing the evaporation loss and also increases the microbiological activities of the soil. Leaf litter decomposition releases nutrients slowly and continuously and makes it available to the palm.

Several micro-organisms are found inhabiting in the root region of arecanut palm. The *Trichoderma* sp., and *Aspergillus* sp. are the fungi covering nearly 30 to 50 per cent of the fungal flora. The actinomycetes observed are *Streptomyces* sp., *Nocardia* sp., *Micromonospora* sp. and *Actinomyces* sp. The potential antagonistic micro-organisms such as *Trichoderma* and actinomycetes group can be used in the biological control of root inhabiting pathogens. The exploitation of asymbiotic nitrogen fixers, phosphate solubilizers and endogon V-A mycorrhizae are possible for increasing the plant growth. The inter or mixed cropping practice in arecanut plantation increases the microflora and microbiological activity of the soil.

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