

## MYCORRHIZA OF PLANTATION CROPS

C. R. RAMESH and ROHINI IYER

Central Plantation Crops Research Institute, Kasaragod - 670 124  
Kerala, India.

### ABSTRACT

Studies on endomycorrhizae of coconut and some of the perennial tree spice mixed crops have been recently initiated at the Central Plantation Crops Research Institute, Kasaragod. Soil and roots have been examined and spore types isolated. Crops grown on unfertilised soil yielded more fungal population compared to those on fertilised soil. Younger roots harboured more mycorrhizae than older ones. However, sessile spores were more in the older roots.

### INTRODUCTION

The beneficial effects of mycorrhizae in nutrient mobilisation (Gerdemann, 1970; Gray and Gerdemann, 1967; and Murdoch et al., 1967), maintenance of the soil microbiological equilibrium, elaboration of the growth stimulating substances and antagonism towards the plant pathogens (Zak, 1964; Marx and Davey, 1969; and Marx, 1969) are well known. Studies on mycorrhizae have been under taken to great advantage in perennial systems like forestry. However, similar studies are lacking with respect to coconut and other plantation crops. Only limited attempts have been made and the information available on these crops is scanty. Lilly (1975) reported development of vesicular-arbuscular mycorrhizae in coconut roots by *Endogone fusiculata*. Investigations have been undertaken to survey, isolate, identify and estimate population density of fungal species forming mycorrhizae in coconut and other perennial mixed crops like clove, cacao, cinnamon and pepper. This paper deals with the isolation, identification and intensity of root infection by vesicular arbuscular mycorrhizae in (a) coconut and (b) in cinnamon, mixed-cropped with coconut.

### MATERIALS AND METHODS

Palms growing in the experimental plots at Central Plantation Crops Research Institute, Kasaragod were selected. Trees were selected from the plots where no fertilizers were applied to the plants and also from the plots having coconut mixed cropped with cinnamon. Root and soil samples were collected from both the plots. One year old coconut seedlings were uprooted and root samples were collected. Soil and root samples were also collected from cinnamon plants grown as mixed crops along with coconut.

#### Collection of the Soil sample

An intact block of soil 9" deep by 1 sq. ft. was cut from the ground including some growing roots. Portions weighing 200g were cut from the block and wet-sieved.

#### Isolation of the spores from the soil

Spores were isolated from the soil by using wet sieving and decanting method (Gerdemann & Nicolson, 1963). The soil was mixed with water and stirred well. The heavier particles were allowed to settle. The liquid was decanted through Endecot sieve of mesh size 25 to remove the larger particles suspended in the solution. Later the liquid was passed through a sieve having mesh size 150 which retained the particles of the size of the spores. The washed liquid was filtered through Whatman No. 1 filter paper. The material adhering to the filter paper was examined. The spores were picked up with the help of a needle and identified based on the key given by Mosse and Bowen (1968).

To find out the presence, length and type of infection, the roots were cut into 2-3 cm bits, fixed in acetic alcohol (3:1) for 6 h, washed in running water for 15 minutes and cleared in 10% KOH overnight. They were then washed thoroughly in running water until even traces of KOH were removed and stained with 0.1% cotton blue in lactophenol and mounted in clear lactophenol.

## RESULTS AND DISCUSSION

Soil sieving and decanting yielded the following spore types.

- Spore type 1. Spherical thick walled, radially porate, yellow light brown, the base of the spore having a narrow pore with thin closing membrane, measuring  $120\mu$ . previously described as *Endogone australis*.
- Spore type 2. Globose - subglobose, hyaline, wall two layered, the hyaline spore becomes darker with age, having a suspensor like cell, wall slightly thickened, septate below the swollen apex. Spore type identified as *Gigaspora gilmori* azygospores.
- Spore type 3. Bulbous reticulate spores, greenish yellow, ovoid to round measuring  $210\mu$ .
- Spore type 4. Honey coloured sessile spores. Deep honey orange spherical,  $170\mu$ . More abundant in older root samples.
- Spore type 5. Ovoid spore having number of rounded spores inside, found only in the roots of cinnamon.

Table 1. Relative distribution of vesicular - arbuscular infection in coconut palm grown in fertilised and unfertilised soil.

Sample	No. of root segment examined	Root segments infected (%)	Root length infected (%)	% of infected root segment with		
				No	Few	Many
Arbuscules						
Roots from fertilised soil	101	20	18	70	26	4
Roots from unfertilised soil	105	90	85	7	10	83

**Table 2.** Relative distribution of vesicular-arbuscular mycorrhizal infection in young and old roots of coconut.

Sample	No. of root segment examined	Root segments infected(%)	Root length infected(%)	% of infected root segment with		
				No	Few Arbuscules	Many
Roots young	98	86	76	6	8	86
Roots old	90	42	20	81	16	3

Observations made on the root samples revealed vesicles and arbuscules. The hyphae showed angular bending. Percentage infection of the root samples from the unfertilised soil recorded the maximum of infection (85%) compared to the samples from the fertilised soil (18%).

The number of arbuscules and vesicles were more in the root samples from unfertilised soil as against the ones from the fertilised soil. The younger roots showed more infection (76%) compared to the older roots. In addition, the vesicles and arbuscules were more in number in the younger roots compared to the older root samples. However, the older roots were rich in deep honey coloured sessile spores. Among the spore types isolated from the soil, coconut and cinnamon had in common, spore types 2 and 4. Spore types 1 and 3 were found only in the soil samples of coconut and was absent in the soil samples from cinnamon plants. Spore type 5 was found only in the case of cinnamon root samples.

The fact that, root length infection was very less in the root samples from the fertilised soil sample, shows that, the fertiliser application might affect the growth, perpetuation

and infection cycle of the fungus. This finding also supports the fact that why the tree spices like cinnamon and clove require virgin soil for their initial establishment. Alternately, the native forest soil being rich in compatible flora might be supplying the necessary inoculum for these tree spices to establish. It is also evident from the sampling studies that most of the spore types associated with the coconut palm can also go on to the cinnamon plants. Detailed investigation on this aspect will be helpful for introducing required beneficial strains of the fungus and thus aid successful mixed cropping of cinnamon with coconut. It is well known that in certain mycorrhizal association, the fungal component exhibits antagonism towards plant pathogens (Zak, 1964; Marx and Davey, 1969; and Marx, 1969) thus protecting the host from the pathogens. Finding out the efficiency of such spore types and their property of antagonism and its application to coconut and other mixed crops might be helpful in investigations on Root Wilt of coconut, Yellow disease of arecanut and quick wilt of pepper.

#### ACKNOWLEDGMENTS

We are greatly indebted to Dr. N. M. Nayar, Director, CPCRI., Kasaragod for his invaluable suggestion and encouragement to start this new vista of study in Plantation crops at CPCRI., Kasaragod.

#### REFERENCES

- GERDEMANN, J. W. AND T. H. NICOLSON. 1963. Spores of mycorrhizal Endogone species extracted from soil by wet sieving and decanting. *Trans. Brit. Mycol. Soc.*, 40 233-244.
- GERDEMANN, J. W. 1970. The significance of vesicular-arbuscular mycorrhizae in plant nutrition. From *Root diseases and soil borne plant pathogens*. Ed. T. A., Toussoun, Robert V. Bega, and Paul E. Nelson. Univ. of California Press.
- GRAY, L. E. AND J. W. GERDEMANN. 1967. Influence of vesicular-arbuscular mycorrhizas on the uptake of Phosphorus-32 by

- Lisiodendron tulipifera* and *Liquidambar styraciflua*, *Nature* (Long) **213** : 106-107.
- LILLY, V. G. 1975. Note on the development of vesicular-arbuscular mycorrhiza *Endogone fasciculata* in coconut root. *Curr. Sci.* **44** : 219-220.
- MARX, D. H. 1969. The influence of ectomycorrhizal fungi on the resistance of pinus roots to pathogenic infection II. Production, identification and ecological activity of antibiotics produced by *Leucopaxillus cerealis* var. *piceina*. *Phytopathology*, **54** : 411-417.
- MARX, D. H. AND C. B. DAVEY. 1969. The influence of ectotrophic mycorrhizal fungi on the resistance of pine roots to pathogenic infection III. Resistance of aseptically formed mycorrhizae to infection by *Phytophthora cinnamomi*. *Phytopathology*. **59** : 549-565.
- MOSSE, B. AND G. B. BOWEN. 1968. A key to the recognition of some *Endogone* spore types. *Trans. Brit. Mycol. Soc.*, **46** : 235-244.
- MURDOCH, C. L., J. A. JACKOBS AND J. W. GERDEMANN. 1967. Utilisation of Phosphorus sources of different availability by mycorrhizal and non mycorrhizal maize. *Plant and Soil*. **27** : 329-334.
- ZAK, B. 1964. Role of mycorrhizae in root disease. *Ann. Rev. Phytopath.* **2** : 377-392.