

## EFFECT OF FERTILISER LEVELS ON VESICULAR ARBUSCULAR MYCORRHIZA COLONISATION IN CARDAMOM

ROHINI IYER, R. KALPANA SASTRY AND V.S. KORIKANTHIMATH\*

Central Plantation Crops Research Institute, Post Kudlu, Kasaragod - 670 124, Kerala

### ABSTRACT

Roots of cardamom plants growing in experimental plots with three fertiliser levels were examined twice once before and once after the South-west monsoon. Samples revealed the presence of the following three spp. of VAM fungi: *Glomus macrocarpa*, *G. fasciculatum* and *Gigaspora coralloidea*. Percent colonisation in roots varied from 40-100 per cent in pre-monsoon samples and 63-94 per cent in post-monsoon samples. Infection grading varied from 4.5 to 76.0 in pre-monsoon and 30.0 to 77.0 in post monsoon samples. Results showed that increasing doses of fertiliser tended to decrease the intensity and incidence of the VAM population in soil and roots.

### INTRODUCTION

The beneficial effects of vesicular arbuscular mycorrhizae (VAM) on crop growth is now well established (Ross and Harper, 1970; Kleinschmidt and Gerdemann, 1972 and Crush, 1974). Evidence is now accumulating that under certain conditions, mycorrhizal plants grow better than non-mycorrhizal plants. Apart from benefits like better survival in poorly fertilised soils, resistance to plant disease and tolerance to water stress, mycorrhizae act as auxilliary absorption systems for nutrients like phosphorus. Earlier reports indicate that variations in phosphorus levels and many other trace elements in media have shown variation in mycorrhizal infection and intensity (Mosse and Philips, 1971).

Maton), an important export earning plantation crop is cultivated mainly in the high altitude areas of Western Ghats. Mycorrhizal association in cardamom roots was reported for the first time by Bertus in 1942 from Sri Lanka. The presence of these organisms was found to stimulate production and benefit the health of plants whereas the plants gave low yields when grown in soils deficient of these organisms. The existence of VAM in cardamom in India has been reported recently by Manjunath and Bagyaraj (1982) from the soils of Karnataka. However, no report on the influence of fertility levels on incidence of VAM in this crop is available. The present studies are to fill in this lacunae and aim to show the effect of fertility on incidence and intensity of VAM in cardamom.

Cardamom (*Elettaria cardamom*

## MATERIALS AND METHODS

Root samples of cardamom plants of variety Malabar (PV8) type were collected from three plots fertilised with different doses of fertilisers ( $F_1$ :50:25:100,  $F_2$ :100:50:200 and  $F_3$ :150:75:300 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O per hectare) from CPCRI Research Centre, Appangala, Coorg district in Karnataka. Spacing adopted was 2 × 2 m with total of 2,500 plants per hectare. The crop was planted in September, 1983 and samples were collected after 18 months and 24 months of growth.

Sampling was done from these plots twice: (1) during the month of May, 1985 (pre-monsoon) and (2) during the month of November, 1985 (post-monsoon). Samples were taken 25 cm away from the base of the clump and at a depth of 0-25

cm. One composite sample was obtained by pooling three samples around one plant. Three such plants were thus sampled to get three replicates from each treatment.

Processing of the root samples was done by clearing in 10% KoH solution and staining with trypan blue (Philips and Hayman, 1970). Root slide technique (Giovannetti and Mosse, 1980) was used for assessing the mycorrhizal infection and infection grading in the root. Twenty root segments each of one cm. length were examined for each replicate.

## RESULTS AND DISCUSSION

Infection with vesicles and arbuscules characteristic of VAM fungi was observed in all samples. Fungi like *Glomus macrocarpus*, *G. fasciculatus* and



Fig. 1. Vericular arbuscular mycorrhizal infection in cardamom roots.

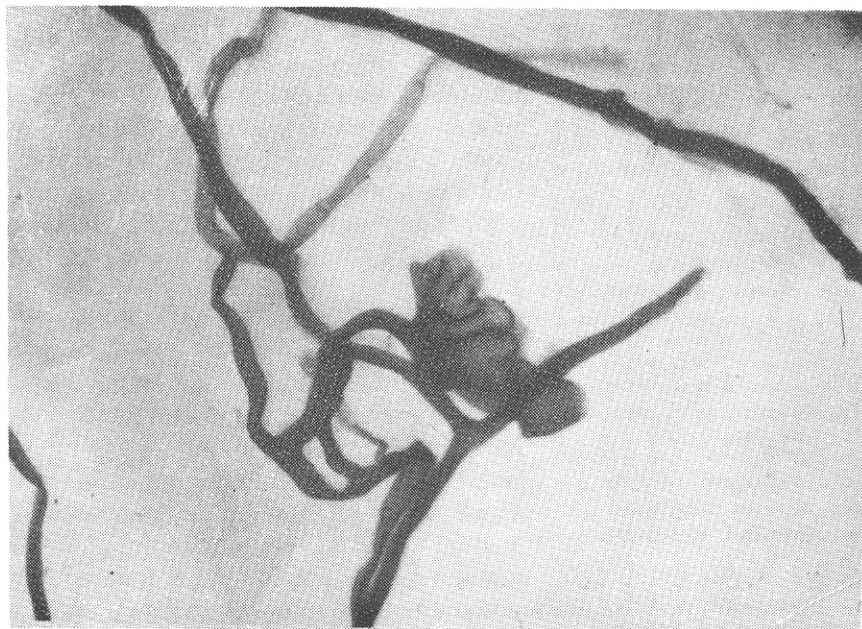


Fig. 2. A young corralloid vesicle.

*Gigaspora coralloidea* were identified (Figs. 1 and 2).

From Table I, a marked difference in the intensity of percent colonisation of VAM fungi was noticed in pre and post-monsoon samples. Increased infection grading after the rains indicate a spurt of activity of the fungus probably stimulated by enhanced root production and by a favourable climate for microbial growth. The results also indicate that colonisation of roots varied from 40-100 per cent in all the samples from the three treatments. A lower incidence and a lower infection grading was observed in samples collected from high fertiliser level. Root samples from plants grown at minimum fertiliser level showed maximum colonisation followed by plants grown at medium fertiliser level. In other field crops like chickpea, high phosphorus

Table I. Effect of VAM association as influenced by fertiliser levels in cardamom.

Dosage of fertilizer given	Pre-monsoon sampling		Post-monsoon sampling	
	Percent colonisation in roots	Infection grading	Percent colonisation in roots	Infection grading
F <sub>1</sub>	100	76.25	94	76.67
F <sub>2</sub>	70	17.25	82	57.67
F <sub>3</sub>	40	4.50	63	30.00

status showed only 10 to 20 per cent colonisation of roots by VAM endophytes and 60 to 80 per cent in roots from soils of low P in Haryana State (Jalali and Thareja, 1985). Similarly Khan (1972) reported that VAM infection in roots of maize decreased with increase of P in soil. *In vitro* studies on the growth of

*Endogone* in *Trifolium parvifolium* indicated that a low dose (100 mg P/litre medium) gave optimum growth of fungus. However, intensity and not incidence diminished till P levels were increased by addition of 30 mg P/litre. Added doses (260 mg/litre) reduced both incidence and intensity of infection (Mosse and Philips, 1971).

Results obtained in this experiment also indicate that with high levels of fertilisation, incidence and intensity of VAM infection in cardamom was lowered. Status of nutrient levels are, therefore, important to get optimum incidence of VAM fungi in field. Baylis (1967) and Mosse (1971) have, in fact, shown that high P levels decreased and finally eliminate mycorrhizal infection from soils. However, our results show that even at the highest dose of fertilizers administered, VAM colonisation is still found. I would therefore, be worthwhile to exploit such fungi to increase production because cardamom is usually grown on a commercial scale where fertilizer application is quite common.

#### ACKNOWLEDGEMENTS

We place here on record our indebtedness to Dr. K.V. Ahmed Bavappa, Director, CPCRI for encouraging the project and for affording the necessary facilities. We are thankful to Dr. S.K. Ghai, Head, Microbiology for his efforts at various stages of planning and execution of this work. Our thanks are due to Dr. K.K.N. Nambiar, Head, Pathology for his keen interest in the work. We thank Shri H. Moosa for technical help rendered during the study.

#### REFERENCES.

- BAYLIS, G.T.S. 1967. Experiments on the ecological significance of phycomycetous mycorrhizas. *New Phytol* **66**: 231-245.
- BERTUS, L.S. 1942. Adm. Rep. Dir. Agric. Ceylon. 1941. p. DS 1942. (RAM **22**: 197.
- CRUSH, J.R. 1974. Plant growth responses to vesicular arbuscular mycorrhiza VII. Growth and nodulation of some herbage legumes. *New Phytol.* **73**: 743-749.
- GIOVANNETTI, M. and MOSSE, B. 1980. An evaluation of techniques for measuring vesicular arbuscular mycorrhizal infection in roots. *New Phytol.* **84**: 489-500.
- JALALI, B.L. and THAREJA, M.L. (1985). Plant growth responses to V-A mycorrhizal inoculation in soils incorporated with rock phosphate. *Indian Phytopath.* **38**: 306-310.
- KLEINSCHMIDT, G.D. and GERDEMAN, J.W. (1972). Stunting of citrus seedlings in fumigated nursery soils related to the absence of endomycorrhizae. *Phytopathology* **62**: 1447-1453.
- KHAN, A.G. (1972). The effect of vesicular arbuscular mycorrhizal association on growth of cereals. I. Effects on maize growth. *New Phytol.* **71**: 613-619.
- MANJUNATH, A. and BAGYARAJ, D.J. (1982). VAM in three plantation crops and cultivars of field bean *Curr. Sci.* **51**: 707-708.
- MOSSE, B. (1971). Annual Report - Rothamstead Experimental Station for 1970 p. 89.
- MOSSE, B. and PHILIPS, J.M. (1971). The influence of phosphate and other nutrients on the development of vesicular arbuscular mycorrhiza in culture. *J. Gen. Microbiol.* **69**: 157-166.
- PHILIPS, J.M. and HAYMAN, D.S. (1970). Improved procedures for clearing and staining parasitic and vesicular arbuscular mycorrhizal fungi for rapid assessment of infections. *Trans. Brit. Mycol. Soc.* **55**: 158-161.
- ROSS, J.P. and HARPER, J.A. (1970). Effect of *Endogone* mycorrhiza on Soybean yields. *Phytopathology.* **60**: 1552-1556.