

Plant Parasitic Nematodes associated with Cocoa

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Cocoa (*Theobroma cacao* L.) a native of the Amazon region in South America, is one of the major cash crops in the tropics, about 60 per cent being grown in West Africa. In India, cocoa has been grown for 200 years, but until recently, was confined to a very small area. There has been in recent years, an increasing interest in the cultivation of cocoa in this country, particularly as a mixed crop in coconut and arecanut gardens. Today the area under cocoa is about 10,000 ha of which Kerala State grows 5,500 ha.

Ritzema Bos (11) was the first to record the root-knot nematode on cocoa. This paper presents the results of a preliminary survey on plant parasitic nematodes associated with cocoa in Kerala and Karnataka and supplements the review of nematological investigations by Whitehead (17) and Thorold (15).

Evidence of nematode attack

Though many species of plant parasitic nematodes have been recorded from the rhizosphere of cocoa, precise information on the pathogenicity of any one of them except *Meloidogyne incognita*, is lacking. Ghesquiere (6) showed that *Meloidogyne* sp. caused rapid drying of the aerial parts and quick death of the tree as a consequence of intensive attack on rootlets. Similar symptoms on the aerial parts of the tree are typical of the disease "morte subite" or "sudden death", a puzzling disease noted occasionally in most of the cocoa growing areas in Brazil.

Jimenez (7) suggested that destruction of feeding roots by both root-knot and root lesion eelworms might be the cause of "morte subite". Sharma *et al.* (12) studied the pathogenicity of *M. incognita* on cocoa var. 'Catongo' in Brazil using three inoculum levels under glasshouse conditions. Significant differences in plant growth appeared 17 weeks after inoculation. The inoculated plants were stunted and unthrifty, with galled root systems. Comparing the plants inoculated at three levels with controls 37 weeks after inoculation it was found that dry plant weight, stem diameter and plant height had decreased by 31.2% to 47.9%, 10.6% to 17.4% and 20.6% to 28.4% respectively. Histopathological observations of inoculated plants revealed giant cell formation and hyperplasia of the vascular parenchymatous cells. The stelar region was completely disorganised with partial to total destruction of xylem, phloem, pericycle and endodermis. Adult females were found embedded in the cortex with giant cells around their heads and egg masses deposited on the root surface through ruptures in the cortex. Thus the pathogenicity of *M. incognita* was established on cocoa and also suggested its probable primary role in the etiology of "sudden death" disease under field conditions in Brazil.

Preliminary observations in Ghana and Nigeria revealed the decreasing incidence of eelworms with increasing distance from bananas and plantains planted amongst cocoa. Concern was expressed that these hosts might maintain a large population of parasitic nematodes injurious to cocoa trees (4, 5).

In Ghana *Terminalia ivorensis* was found free of nematodes (5) and was considered as a suitable tree for shading cocoa (2).

In Papua New Guinea *M. javanica* was found to infest roots of the shade tree *Leucaena glauca* but appeared not to affect cocoa (16). Corbett (3) put forth the need for an alternative nurse crop to cocoa in place of banana to reduce the nematode infestation in Malawi.

Nematodes in India

Kumar *et al.* (9) reported multiplication of *M. incognita*, *Pratylenchus coffeae* and *Rotylenchulus reniformis* on cocoa in the coffee tracts of South India.

Results of the preliminary survey (Table 1) comprising 88 samples of both soil and roots collected in Kerala and Karnataka showed that the most common root parasite is *Meloidogyne incognita* and the dominant nematodes in the rhizosphere are *Hoplolaimus* sp and *Helicotylenchus* sp. Inoculation studies showed that cocoa seedlings developed severe root galling with females of *M. incognita* with egg masses exposed on the root surface. On the other hand the 'banana race' of *Radopholus similis* collected from coconut was found to penetrate cocoa roots in small numbers but failed to multiply.

Control

Entwistle and Caveness (4) reported in Ghana that nematodes were controlled by Nemagon @ 4 gal. per acre. Increase in number of pods through application of different nematicides such as Dasanit, Nema-cur and Nemagon were reported by Martin (10). Nemagon @ 70 lb/acre was reported to be phytotoxic because of decreased yields. Jimenez *et al.* (8) studied the effect of Nemagon on germination and growth of seedlings and mature plants of cocoa. Seedlings were damaged by high concentrations but young plants and trees withstood soil applications of 40 or 60 ml of 75% Nemagon emulsion applied at a depth of 15 cm. Tarjan *et al.* (13, 14) reported increased yields subsequent to application of nematicides such as Nema-cur, Terra-cur and Moca-p which also indicated that cocoa trees infested with nematodes are benefitted by application of nematicides.

Nematodes in the nursery can retard the growth of seedlings or kill them. The transplantation of nematode infested seedlings carries nematodes to the plantations, where the transplants may die. In the nursery protection may be easily obtained by raising the seedlings in pots/polythene bags using soil fumigated with methyl bromide @ 500 g/100 cu. ft. under polythene cover for 24-48 hrs. This is a standard practice in all government pepper nurseries in Kerala (1).

Table 1 — Occurrence and population density of nematodes in association with cocoa in India.

Genera	Number of occurrence in 88 samples	Population range in 250 g soil
<i>Aphelenchus</i> sp.	2	3-5
<i>Criconemoides</i> sp.	4	3-114
<i>Diphtherophora</i> sp.	1	14
<i>Helicotylenchus</i> sp.	22	2-321
<i>Hemicriconemoides</i> sp.	2	5-15
<i>Hoplolaimus</i> sp.	22	2-166
<i>Longidorus</i> sp.	7	1-3
<i>Meloidogyne</i> sp.	27	7-2341
<i>Mononchus</i> sp.	9	1-41
<i>Pratylenchus</i> sp.	1	3
<i>Radopholus similis</i>	9	1-8
<i>Rotylenchulus</i> sp.	11	32-1213
<i>Trichodorus</i> sp.	3	1-3
<i>Tylenchorhynchus</i> sp.	17	7-440
<i>Xiphinema</i> sp.	11	1-76

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