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MELOIDOGYNE ARENARIA AND PLASMODIOPHORA BRASSICAE, CAUSAL AGENTS OF GALL DEVELOPMENT ON CABBAGE ROOTS IN THE REPUBLICA DEMOCRATICA DE SÃO TOMÉ E PRÍNCIPE

by

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Summary. An ultrastructural study of a natural infection of cabbage (*Brassica oleracea*) with the root-knot nematode, *Meloidogyne arenaria*, and the fungus, *Plasmodiophora brassicae*, is reported from the island of São Tomé, República Democrática de São Tomé e Príncipe. Histological examination of galled roots, infected by either pathogens, demonstrated that extensive gall formation was induced. Hyperplasia and hypertrophy were common phenomena in the vascular parenchyma in *Meloidogyne* galled roots, while extensive colonization on cortical and vascular cells with clustering of myxamoebae around the host nuclei were constantly observed on *P. brassicae* infected tissues.

During a plant parasitic nematode survey in the island of São Tomé, República Democrática de São Tomé e Príncipe, severely galled cabbage (*Brassica oleracea* L.) roots (Fig. 1 A) were collected at Macambrarã. Laboratory examination of infected material revealed that two casual agents, the root-knot nematode *Meloidogyne arenaria* (Neal) Chitw. and the obligate intracellular fungal parasite *Plasmodiophora brassicae* (Woronin), were responsible for the gall formation. The present article reports on an ultrastructural investigation of root symptoms and histological changes.

Material and methods

Galled cabbage roots were selected and nematode females excised from individual galls. Females were processed at 10% of lactic acid and identified by head morphology, excretory pore position and perineal patterns of egg-laying specimens. For histological observations galled tissues were fixed in FAA, dehydrated with tertiary butyl alcohol series and embedded in a 58°C melting point paraffin. Embedded material was sectioned (10 µm) transversally and longitudinally and stained with safranin and fast green (Johansen, 1940). Selected sections were observed and photomicrographed.

Observations

Nematode infection (Fig. 1). Galls induced on cabbage roots by *M. arenaria* were variable in size and location (Fig. 1 A). They were usually present on small roots; most of the lateral roots arising from nematode or fungus galled regions were terminally galled by the nematode. Transverse and longitudinal sections of galls induced by *M. arenaria* showed that the giant cells were formed around the anterior portion of the nematode and always in the vascular cylinder (Fig. 1 C, D). The granulated cytoplasm of the giant cells was dense and homogeneous. Each female was surrounded by 3-6 multinucleate cells. Abnormal and interrupted xylem elements were observed in many sections near the giant cells.

Fungus infection (Fig. 2). Gall development was most prominent on secondary roots. Infected tissues were enlarged into club-shaped structures of irregular dimensions, 2-8 times the normal root diameter (Fig. 1 A). Transverse and longitudinal sections of fungus induced swellings revealed extensive infection throughout cortical cells. Many small myxamoeboid "plasmodia" within the cytoplasm of slight enlarged host nuclei were also observed (Fig. 2 A). In many sections resting spores were easily detected (Fig. 2 B, D).

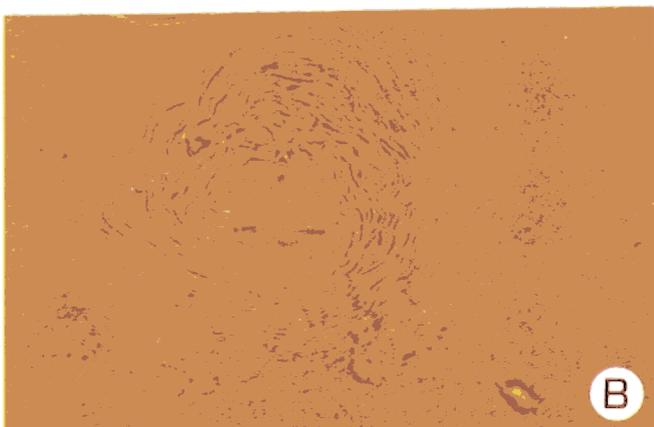
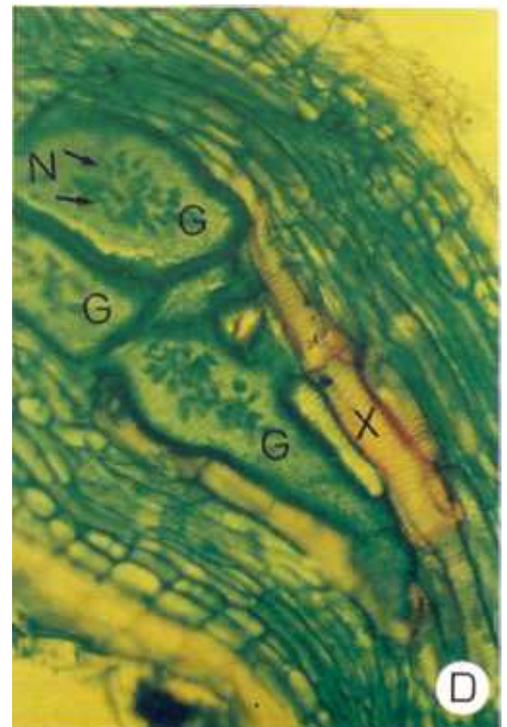
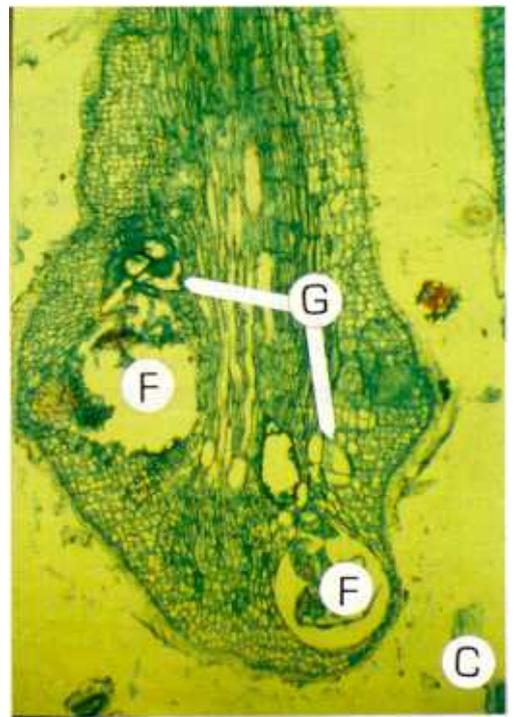
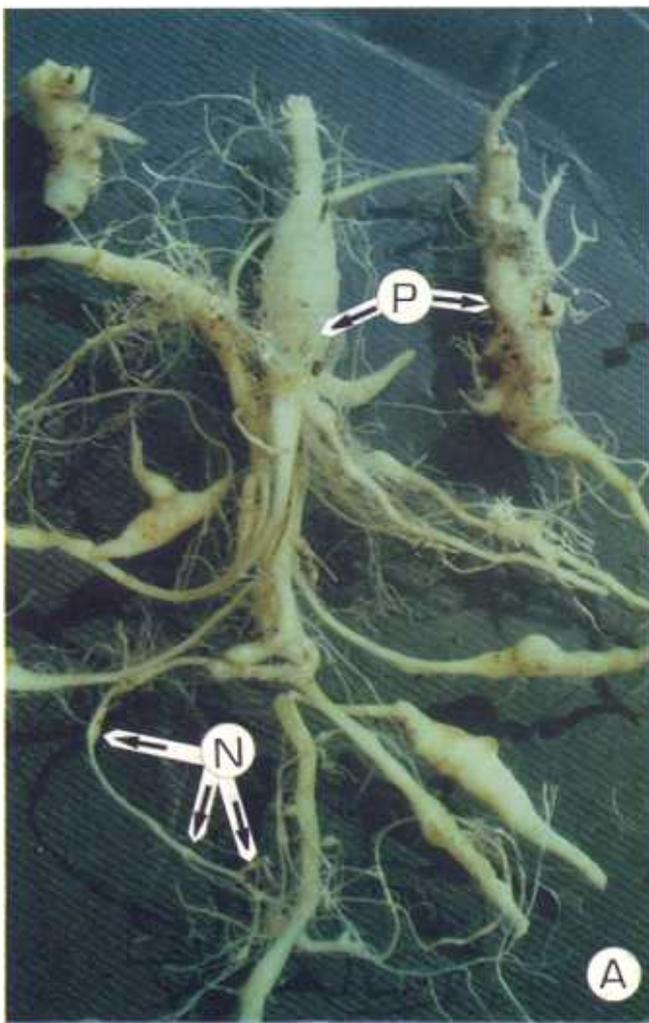


Fig. 1 - Cabbage roots infected with *Meloidogyne arenaria* (N), and *Plasmodiophora brassicae* (P). A, galled roots; B, perineal pattern of *M. arenaria*; C, D, longitudinal sections of nematode galled cabbage roots showing feeding sites of *M. arenaria* (F = female; G = multinucleate giant cells; N = hypertrophied nuclei; X = disorganized xylem elements).

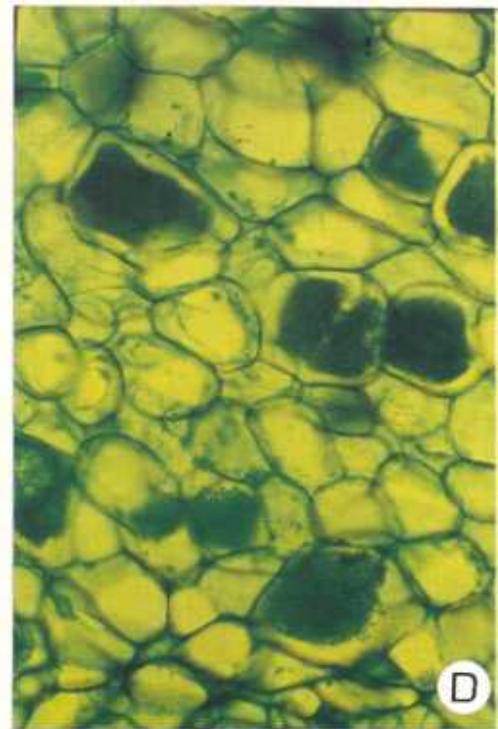
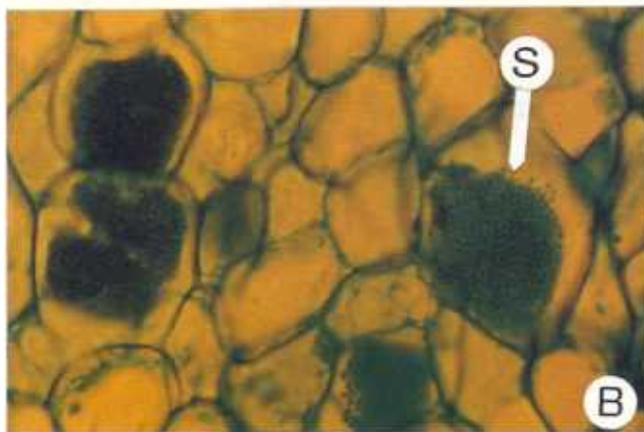
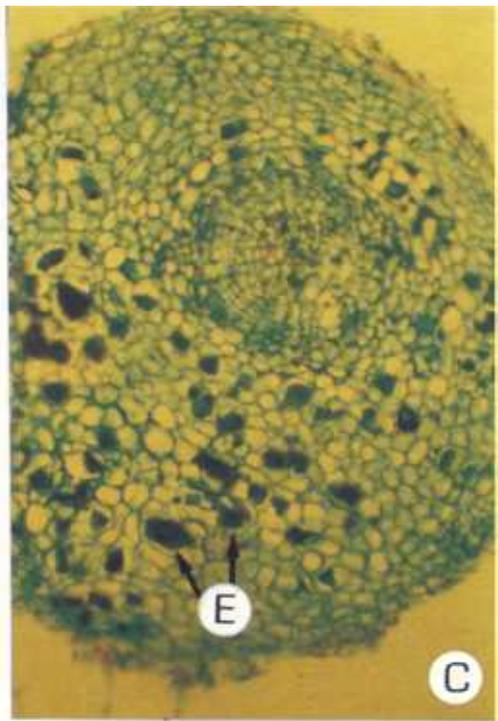
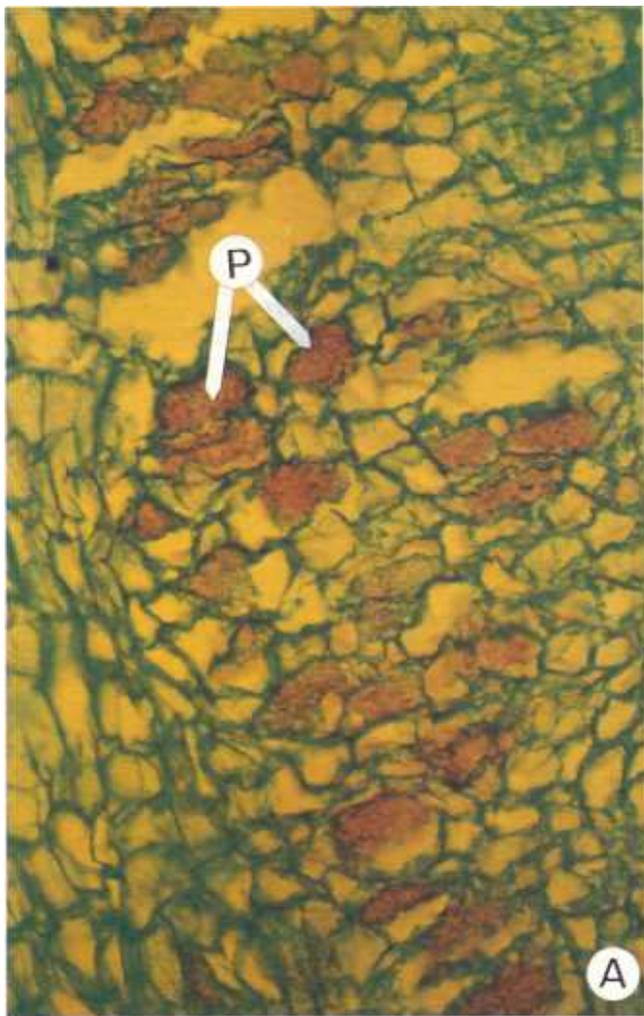


Fig. 2 - Plasmodia (A, C) and resting spores (B, D) of *P. brassicae* in enlarged cabbage cortical cells. (E = enlarged infected cells; P = plasmodia; S = spores).

Discussion

The histological modifications, induced by *Meloidogyne* and observed in cabbage roots are similar to those reported for other root-knot nematodes (Taylor and Sasser, 1978). Disorganization of tissue structure in cabbage infected roots with *P. brassicae* is similar to that observed in root galls induced by the fungus in *Arabidopsis thaliana* (L.) Heynh. (Mithe and Magrath, 1992).

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