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HISTOPATHOLOGY OF THE NODULATED ROOT OF SOYBEAN INFECTED WITH ROOT KNOT NEMATODE

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Histopathological examination was done on roots of soybean infected with *Meloidogyne incognita* and *Rhizobium* sp. Nematode infection resulted in the formation of giant cells from the parenchymatous cells in the xylem and phloem. Giant cells were observed to be multinucleated and thick-walled, and occasionally formed near tissues infected with bacteroids.

INTRODUCTION

Root knot nematodes are destructive root pathogens. They are also known to influence favorably the incidence of many bacterial and fungal diseases. They have also been reported to reduce root nodulation of leguminous hosts (Hussey and Barker, 1974) although the cause is not known (Taha and Raski, 1969). According to Mansfield (1954) nematode galls on roots may affect nodulation by causing nutritional deficiency on the host plant and by occupying space on the root system. Epps and Chambers (1962) proposed that competition between nematode and root nodule bacteria may be one reason for reduction in nodule formation. They also theorized a possible antagonistic effect of root rot organisms upon root nodule bacteria causing reduced root nodulation.

Nodule invasion by *Meloidogyne* sp. has been observed earlier in cowpea, alfalfa, and soybean nodules (Taha and Raski, 1969). However, the effect of nematodes inside the nodule tissue is not yet clear. Nutman (1949) suggested that nodules attacked by nematodes during the early stages of development become galls, but when attacked at a later stage they become nodules.

This study examined histopathologically the effect of nematode infection on nodulated soybean roots.

MATERIALS AND METHODS

An inoculation experiment was done in the greenhouse to produce infection by the root knot nematode, *Meloidogyne incognita* and root nodules by *Rhizobium* sp. Soybean plants were allowed to grow until they showed well developed egg masses and root nodules. Then samples of roots were taken, fixed in formalin acetic acid: alcohol (FAA) for at least 24 hr and then serially dehydrated in alcohol. The samples were cleared in xylene; they were embedded in paraffin and later sectioned (12 mm) and stained with safranin and fast green. Histochemical tests for starch, pectin, and lignin were also done following the procedures described by Johansen (1940).

Histological changes in the infected tissues were studied and photographs were taken.

RESULTS AND DISCUSSION

Histological examination showed that *M. incognita* caused changes in cell structure and organization in infected tissues. The nematode colonized intercellularly and intracellularly in the xylem and phloem of the roots. Cells just around the head of the nematode enlarged abnormally, thus showing hypertrophy (Figure 1). Eventually, these cells collapsed and disintegrated leaving an empty "island" in the tissues (Figure 2). In some cells exhibiting hypertrophy and hyperplasia, dissolution of cell walls was noted, resulting in the clusters of nuclei from these groups of cells (Figure 3).

Nematode infection also resulted in the formation of giant cells. These cells are multinucleated and thick-walled (Figure 4). Walls of giant cells responded positively to tests for pectin but negatively to lignin and starch, corroborating the results of earlier studies (Dropkin and Nelson, 1960). Disintegration of xylem cells has been noted. Giant cells were also observed in the vascular bundles.

Giant cells were formed near nodulated tissues without disrupting the nodules or bacteroids (Figure 5). Whether or not nematode infection resulting in formation of giant cells has any effect on nodulation, and vice-versa, this study was not in any position to determine. It can only be said that bacteroids existed side by side with tissues showing giant cells. We can speculate, however, that this compatible coexistence of the root-knot nematode and the bacteroids partially explains the belief that nitrogen fixation is little affected by nematode infection. A research to investigate the quantitative effect of nematode injury on nitrogen fixation is, however, wanting.

Fig. 1-5. Response of nodulated soybean root to nematode infection. 1) Hypertrophy due to nematode infection (X350). 2) Disintegration of cells (X350). 3) Nuclei clustering as a result of cell wall dissolution of neighboring cells (X350). 4) Giant cells associated with root-knot nematode infection (X3450). 5) Compatible association between root-knot nematode and root nodule (X350). (HY-hypertrophy; DIS-disintegration; NU-nuclei, GC-giant cells; BA-bacteroids.)

GI ES, L. C. and H. D. FOWLER. 1953. Resistance of a plant disease associated with high glucose content of the leaf. Nature 172: 316.

ES, N. L. . The bacterial blight of cotton. A survey of inoculation technique, grading scale and sources of resistance. Emp. Cott. Gr. Rev. 38: 271-278.

LMAN, A. 1954. The relationship of pathogenicity in *Pseudomonas solanacearum* to colony appearance on a tetrazolium medium. Phytopathology 44: 693-695.

ST, F. T. 1959. Leaf infection by *Xanthomonas malvacearum* (EFSm) Dowson. Ann. Appl. Biol. 47: 647-657.

_____ and M. DRANSFIELD. 1959. Measurement of resistance of cotton to *Xanthomonas malvacearum* (EFSm) Dowson using leaf abrasion technique. Emp. Cott. Grow. Rev. 36: 196-199.

)GAN, C. 1958. Bacterial boll rot of cotton (*Xanthomonas malvacearum* (EFSm) Dowson). I. A comparison of two inoculation techniques for the assessment of host resistance. Ann. Appl. Biol. 46: 230-242.

NCKARD, J. A. and G. N. MONTZ. 1972. Behavior of boll stomata in *Gossypium hirsutum* L. in relation to age, dehiscence and decay. Cott. Grow. Rev. 49: 153-159.

EINKING, O. A. 1918. Philippine economic plant diseases. Phil. J. Sci. 13: 165-170.

_____. 1919. Host index of disease of economic plant. Phil. Agr. 8: 38-54.

ELLES, C. G. 1936. Bacterial plant diseases in the Philippine Islands. Science 56: 18.