J. Phytol. Res. 19(2): 267-269, 2006

ONTOGENETIC STUDIES OF *MELOIDOGYNE INCOGNITA* CHITWOOD INDUCED ROOT GALLS OF *PISUM SATIVUM* L. : REACTION XYLEM

R. K. SHARMA and ANIL MATHUR
Post-Graduate Department of Botany, Govt. M.S.J. College, Bharatpur-321001, India.

Ontogenetic studies of *Meloidogyne incognita* Chitwood induced reaction xylem in the root galls of *Pisum sativum* L. was undertaken. The reaction xylem elements remained concentrated near the distal part of the syncytial complex in young galls or remained defused in the older galls. They are highly irregular in shape and may be blind or perforated with one to many large pores. Their defused, transverse or oblique orientation connected the disjunct normal xylem elements laterally. They help in lateral conduction and impart mechanical strength to the galled tissue.

Keywords: *Meloidogyne incognita;* Nematode gall; *Pisum sativum;* Reaction xylem.

Introduction

The pea *(Pisum sativum* L.) occupies a position of considerable importance in our agricultural economy. Importance of pea as a pulse and vegetable crop in human diet needs no emphasis. It is heavily infected by *Meloidogyne incognita* in the sandy soil of North-East Rajasthan, where it is grown extensively. Root-knots or nematode galls are highly specialized structures containing the nematodes in various stages of development. They possess all the basic characteristics of the root, but showed many anatomical modifications and aberrations within the limits of potentiality of the development of root, in response to the nematode present. Many histopathological changes are responsible for the formation of galls viz. hypertrophy of cortical calls, pericyte and xylem parenchyma; hyperplasia of pericyde and xylem parenchyma; production of giant cells; enlargement of nematode body and production of eggs and formation of reaction xylem inside the host roots[1-4]. The present investigation was undertaken to study the structure and ontogeny of reaction xylem formed in pea infected by *Meloidogyne incognita.*

Materials and Methods

Surface sterilized seeds of cultivar 'Bonneville' were shown in 15 cm earthen pots containing steam sterilized soil (sand and farmyard manure in the ratio of 4:1). The seeds were treated with the specific *Rhizobium* strain before sowing. One week old seedlings were inoculated with 1000 juveniles of *Meloidogyme incognita.* In order to study the structure and development of nematode galls, a few plants were uprooted initially daily till 10 days, at three days interval afterwards till 22 days and finally at one week interval till eight week after inoculation. The roots were carefully washed and fixed in formalin acetic-alcohol (FAA) for 24 hrs and stored in 70% ethanol. After a week, suitable portion of roots were dehydrated, embedded and microtomed at thickness ranging from 10μ to 15μ in transverse and longitudinal planes. The sections were stained in safranine-fastgreen combination and mounted in DPX for observations.

The normal and galled roots were cut into small pieces. They were kept in maceration fluid containing equal parts of 10% aqueous chromic acid and 10% aqueous nitric acid.[5] for about 3-4 days. After proper washing in running water, the material was gently heated in 10% aqueous crystal violet to stain lignified tissues. A piece of root was placed on a slide and macerated with the help of needles and mounted in glycerine jelly.

Results and Discussion

Expanding giant cells in young galls aften crushed or flattened the xylem elements. In serial sections of young galls, it was noted that the central core of xylem was gradually replaced by giant cells. Xylem was generally displaced to one side in a small gall due to excessive hyperplasia and hypertrophy in either pericyde or phloem depending upon the presence of nematode in these regions.

In old galls a group of giant cells was usually found surrounded by an abundance of reaction xylem elements (Fig. 7) however in some galls reaction xylem elements were disposed in a diffused manner. The reaction xylem elements were most concentrated around that part of giant all complex which was most distant from the head of the nematode. Sometimes, the group of giant cells was completely locked inside the reaction xylem elements or

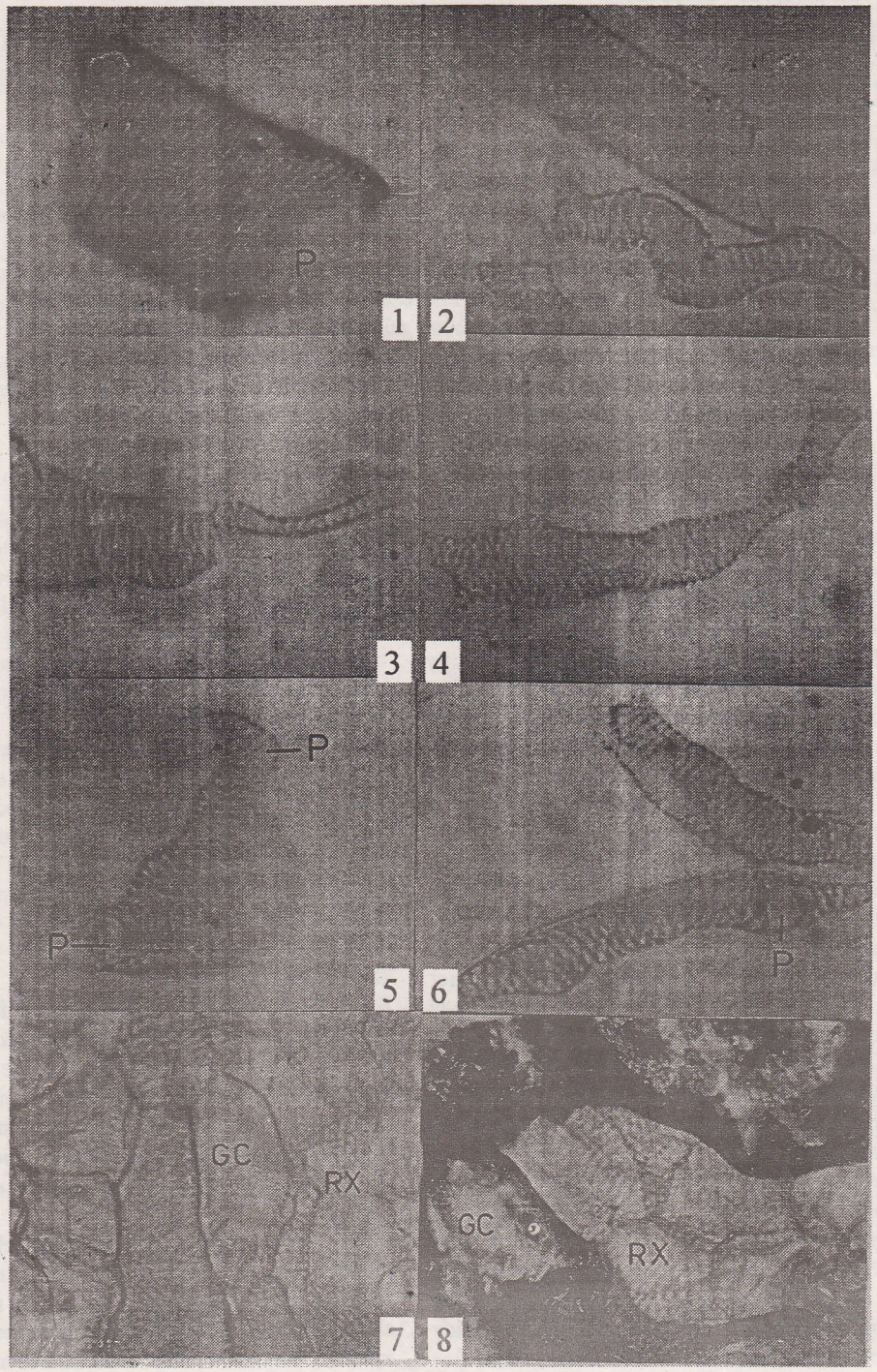

Fig.1-8. *Meloidogyne incognita* on *Pisum sativum* inducing reaction xylem (RX). 1.A normal vessel element. 2. A normal vessel and an abnormal deformed xylem dement. 3-4. Abnormal xylem elements, branched and non-porate. 5-6. Abnormal xylem elements, porate (P). 7. L.S. gall, a portion, compactly arranged reaction xylem elements encircling a syncytium (GC). 8. T. S. gall, a portion, a group of reaction xylem elements within a syncytial complex (All figuresx400).

vice versa (Figs. 7,8). Reaction xylem elements were compactly arranged without intercellular spaces and medullary rays (Fig. 7,8). When the normal xylem cylinder was broken up due to the formation of giant cells and developing nematodes, the reaction xylem joined the broken ends laterally.

The healthy vessel dements were short and tubular with large terminal perforations on thier transverse end walls (Figs. 1,2). Pitting on the lateral walls were simple and thickening were of reticulate type. The reaction xylem elements possessed no definite shape and sige (Figs. 2-6). They were highly irregular and varied in shape, from oval or circular to elongate and branched unbranched. They possessed irregularly placed large perforations in some, while others were blind (Figs. 2-4). The perforations varied from one to many (Figs. 5,6) and may be adjacent to one another or wide apart, subterminal or terminal in position.

As a result of presence and development of the nematode in the stelar tissue, atypical or abnormal xylem was formed. These elements were either concentrated near the distal part of the giant cells in young galls or remained diffused in the old galls. Similar observations were made by earlier workers[6,7]. Their diffuse, transverse or oblique orientation connected the disjunct normal xylem elements laterally in pea galls, helping in lateral conduction and also imparting mechanical strength to the gall. Their position also checked the inward expansion of giant cells. Siddique *et al.*[4] observed that abnormal xylem developed in enormous amount could not function as efficiently as normal one mainly due to their peculiar orientation which facilitate conduction more laterally than vertically. This further strengthened the view that these blind or porate elements were helping in the lateral conduction.

Acknowledgement

The senior author is thankful to the UGC, New Delhi for providing financial assistance.

References

1. Sharma R K and Tiagi B 1989, Giant cell formation in pea roots incited by *meloidogyne incognita* infection. *J. Phytol. Res.* 2(2) 185-191.
2. Bird A F 1962, The inducement of giant cells of *Meloidogyne javanica. Nematologica* 8 1-10.
3. Owens R G and Specht H N 1964, Root-knot histogenesis. *Contr. Boyce Thompson Inst.* 22 471-489.
4. Siddique Z A, Rashid A, Yunus M and Ghouse A K M 1974, Studies on reaction xylem developed due to *Meloidogyne incognita* in the the roots of *Lagenaria leucantha. Indian J. Nematol.* 4 46-52.
5. Johansen D A 1940, *Plant Microtechnique.* McGraw-Hill Book Co. Inc., New York, pp 523.
6. Khan Z 1975, Histopathological studies on some solanaceous and cucurbitaceous plants. Ph.D. Thesis, University of Rajasthan, Jaipur.
7. Roy A K 1976, Pathological effects of *Meloidogyne graminicola* on rice and histopathological studies on rice and maize. *Indian Phytopath.* 29 359-362.