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CELLULAR RESPONSE OF GRAPE SEEDLINGS TO *ROTYLENCHULUS RENIFORMIS* AND *TYLENCHULUS SEMIPENETRANS* INFECTIONS

by

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The population dynamics of the reniform nematode, *Rotylenchulus reniformis* Linford *et* Oliveira, and the citrus nematode, *Tylenchulus semipenetrans* Cobb, on grapevine seedlings, *Vitis vinifera* L., have been studied previously (Taha and Sultan, 1977). In this paper the cellular response of grapevine to each of the nematode species is described.

MATERIALS AND METHODS

V. vinifera cv. Al-Zeiny seedlings were grown out of doors in 10 cm clay pots containing steam-sterilized sandy soil (Taha and Sultan, 1977). Some of the pots were separately inoculated with *R. reniformis* or *T. semipenetrans*. Root samples were taken 70 days after inoculation, fixed in FAA, dehydrated in ethyl alcohol series, cleared in xylene, and embedded in paraffin. Sections, 11 μm thick, were stained on slides with safranin-fast green (Jensen, 1962).

RESULTS AND DISCUSSION

Our histological studies of *R. reniformis* infections confirm the observations of others (Rebois *et al.*, 1970, 1975; Oteifa and Salem, 1972; Cohn, 1973; Heald, 1975; Jones and Dropkin, 1975; Razak and

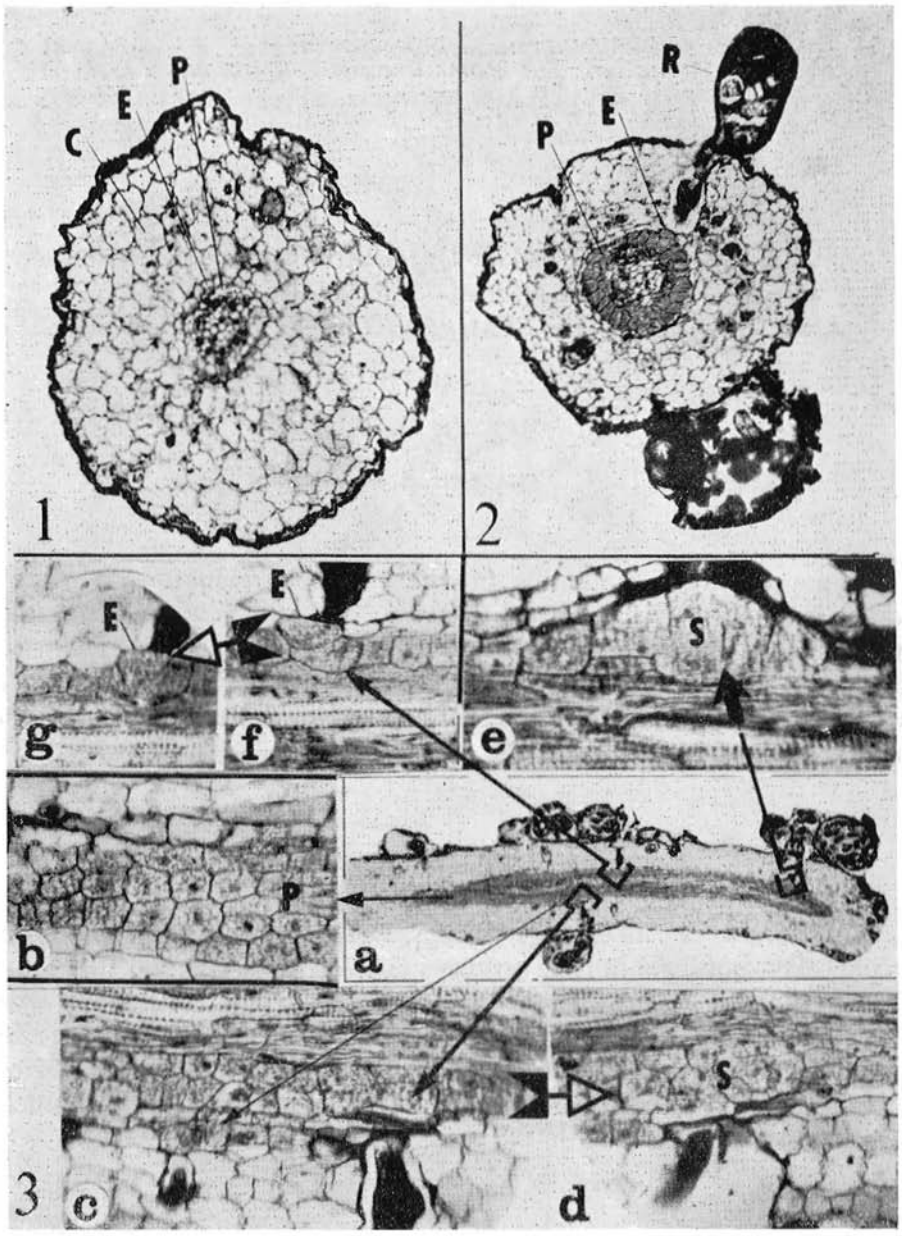


Fig. 1 - Cross section of healthy grape root: C = cortex; E = endodermis; P = pericycle.

Fig. 2 - Cross section of grape root infected with *R. reniformis* mature female (R) showing a ring of hypertrophied pericycle cells (P) and an endodermal feeding cell (E).

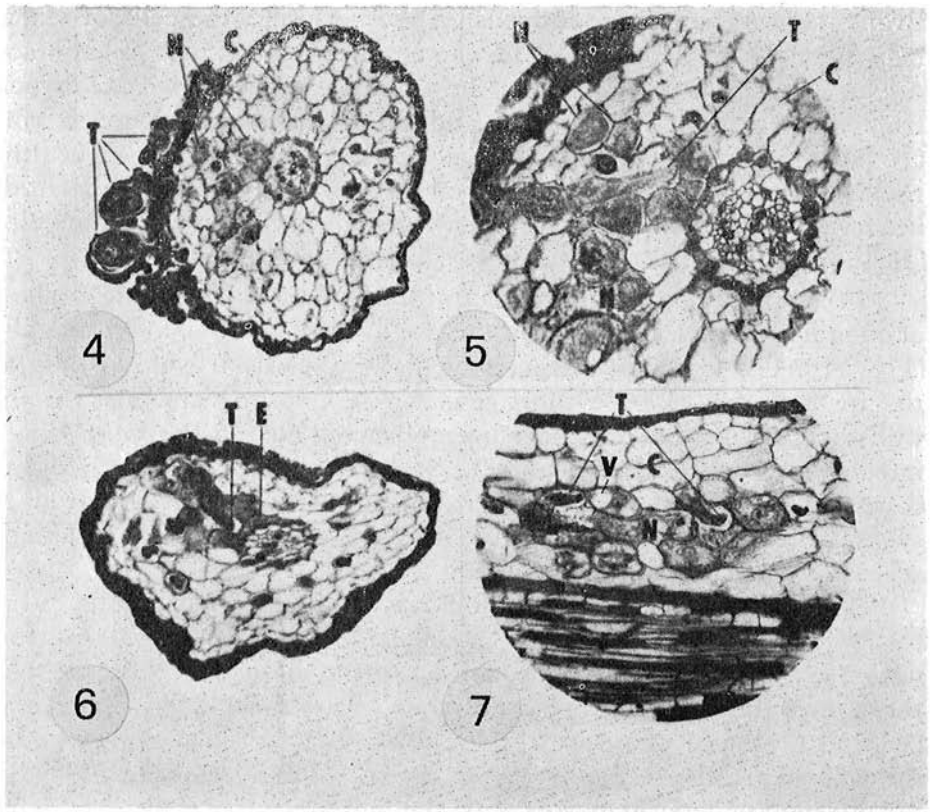
Fig. 3 - a: Longitudinal section of grape root heavily infected with *R. reniformis* from which different locations were magnified to show; b: a sheet of hypertrophied uninucleate pericycle cells (P); c: an initial phase of syncytium formation (bold arrow) and affected cortical cell (thin arrow); d: a successive section of syncytium formation (S) of endodermal and pericycle cells; e: well-developed syncytium; f and g: involvement of an endodermal cell (E) in syncytium formation.

Evans, 1976). The nematode feeds on the pericycle, the cells of which may be affected even when the nematode head is not in contact. At an early stage of infection, the uninucleate cells became hypertrophied, with dense cytoplasm and thin walls, and formed a ring around the conducting tissues (Fig. 2); this was not seen in healthy roots (Fig. 1). The endodermal cell in contact with the nematode head was also modified; it has been referred to as the « feeding cell » (Head, 1975) or the « prosyncyte » (Rebois *et al.*, 1975).

In roots with multiple *R. reniformis* infections (Fig. 3 a), a sheet of modified pericycle cells was observed when viewed longitudinally (Fig. 3 b). The walls of the pericycle cells were destroyed, leading to the formation of a syncytium (Fig. 3 c-e). Gaps or openings in the walls of the pericycle cells have been observed also in *R. reniformis* — infected soybean (Rebois *et al.*, 1975; Jones and Dropkin, 1975) and cowpea (Razak and Evans, 1976). Each pericycle cell involved in syncytial formation had a nucleus but continuity of cytoplasm among several cells occurred.

An endodermal cell was also observed to be involved in the initial formation of the syncytium (Fig. 3 f, g). The cell enlarged, became wedge-shaped and interconnected with the adjacent pericycle cell through openings in its distended walls (Fig. 3 f). Successive sections (Fig. 3 g) showed that walls then ruptured, and the cytoplasm of the affected cells merged. Rebois *et al.* (1975) indicated that the prosyncyte (endodermal cell) was the initial cell of the developing syncytium in susceptible « Lee » soybeans. However, they did not exclude the possibility of a pericycle or other cell being the prosyncyte. On the other hand, Razak and Evans (1976) found that endodermal cells in cowpea remained visibly intact, with only slightly thickened walls, and therefore did not take part in syncytial formation. In cotton roots, the endodermal cells were destroyed and pericycle cells developed to giant cells (Oteifa and Salem, 1972). In addition to endodermal and pericycle cells, cortical cells were subjected to alteration as a result of parasitism by *R. reniformis* (Fig. 3 c, thin arrow).

In contrast to *R. reniformis* infection, the feeding site of *T. semipenetrans* was exclusively localized in the cortex and its effect was limited to a few cells around the anterior of the nematode (Figs 4, 5); this observation concurs with those of Van Gundy and Kirkpatrick (1964), Schneider and Baines (1964), and Cohn (1965) on citrus. Nevertheless, the effect of the nematode was found to extend to the



Figs. 4-6 - Cross sections of grape root infected with *T. semipenetrans* (T) showing nurse cells (N) in the cortex (C) and hypertrophied endodermal cell (E).
Fig. 7 - Longitudinal section of grape root infected with *T. semipenetrans* (T) showing nurse cells (N) in the cortex (C) and cells with vacuoles (V).

endodermis (Fig. 6). The affected cells were normal in size, except the endodermal cell which was slightly hypertrophied, with large nuclei and nucleoli and dense cytoplasm (Fig. 6). Few cells had vacuoles (Fig. 7). The cells retained their individual identity without the formation of a syncytium. Cohn (1964) stated that the depth of penetration within the cortex differed according to the diameter of the root; and in fine roots, the female invariably reached the endodermis. No females were found to have penetrated to the vascular bundle as reported by Van Gundy (1958) and Seddik (1974).

SUMMARY

The cellular responses of « Al-Zeiny » grape seedlings to two sedentary semi-endoparasitic nematodes, *Rotylenchulus reniformis* and *Tylenchulus semipenetrans*, were studied. Pericycle cells represented the feeding zone and, eventually, the substrate for syncytial formation for *R. reniformis*. Involvement of an endodermal cell in syncytial formation and breakdown of endodermis and pericycle cell walls was also noticed. Conversely, the cellular alterations induced by *T. semipenetrans* were confined to the cortical cells. However an endodermal cell was also altered. Neither cortical nor endodermal cells showed signs of wall breakdown and syncytial formation.

RIASSUNTO

Modificazioni anatomiche indotte da Rotylenchulus reniformis *e* Tylenchulus semipenetrans *in radici di Vite.*

Vengono descritte le alterazioni istologiche causate da *Rotylenchulus reniformis* Linford *et* Oliveira e da *Tylenchulus semipenetrans* Cobb in radici di barbatelle di Vite della cv « Al-Zeiny ». La formazione di sincizi costituiti da cellule mononucleate del periciclo e a volte anche dell'endodermide è stata osservata nel caso di attacco di *R. reniformis*, mentre nel caso di *T. semipenetrans* l'attività trofica del parassita è apparsa circoscritta al parenchima, nel quale sono state notate cellule specializzate con nuclei ipertrofici e citoplasma granuloso. Ipertrofia delle cellule dell'endodermide è stata constatata solo occasionalmente.

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