Journal of Nematology 17(3):371–373. 1985.

Single Modified Food Cell Induced by *Helicotylenchus pseudorobustus* in Corn Roots

N. VOVLAS[1] AND R. N. INSERRA[2]

Key words: spiral nematode, *Zea mays*, feeding behavior, histopathology, host response.

Helicotylenchus pseudorobustus (Steiner) Golden is a common parasite of corn (*Zea mays* L.) in the midwestern United States (9). A 1983 survey of northern Italy indicated that *H. pseudorobustus* was the most common plant-parasitic nematode associated with corn. *H. pseudorobustus* is generally semiendoparasitic, feeding in the cortical parenchyma of corn roots and causing necrosis and disruption of cortical cells (7,9). Formation of "food cells" with dense cytoplasm and increased number of organelles without nuclear enlargement has been reported in barley (*Hordeum sativum* L.), oat (*Avena sativa* L.), and wheat (*Triticum* sp.) roots infected with *H. digonicus* Perry, *H. pseudorobustus*, and *H. varicaudatus* Yuen (5). Membranous networks around the stylet and loss of nucleolus without evidence of nuclear enlargement occurred in cortical cells of potato (*Solanum tuberosum* L.) roots infected by *Scutellonema brachyurum* (Steiner) Andrassy (8), another hoplolaimid nematode. This research note describes alterations in corn roots induced by feeding of *H. pseudorobustus*.

Pregerminated Dekalb-XL-41 corn seeds were sown in bins containing sandy clay loam soil (23% clay, 11% silt, 62% sand, 4% gravel) infested with one nematode/cm^3 soil of a population of *H. pseudorobustus* collected at Rauscedo, in northern Italy. Plants were grown in a greenhouse at 22 ± 4 C. Seedlings were harvested and root systems gently washed free of soil 20 days after sowing. Corn roots infected with nematodes were examined with a stereomicroscope, cut in segments 4–5 mm long, fixed in FAA (formalin, acetic acid, ethanol), dehydrated in a tertiary butyl alcohol series, and embedded in paraffin. Sections of fixed root samples were cut 10–15 μm thick, stained with safranin and fast green, mounted in Dammar xylene, and examined under a compound microscope (3).

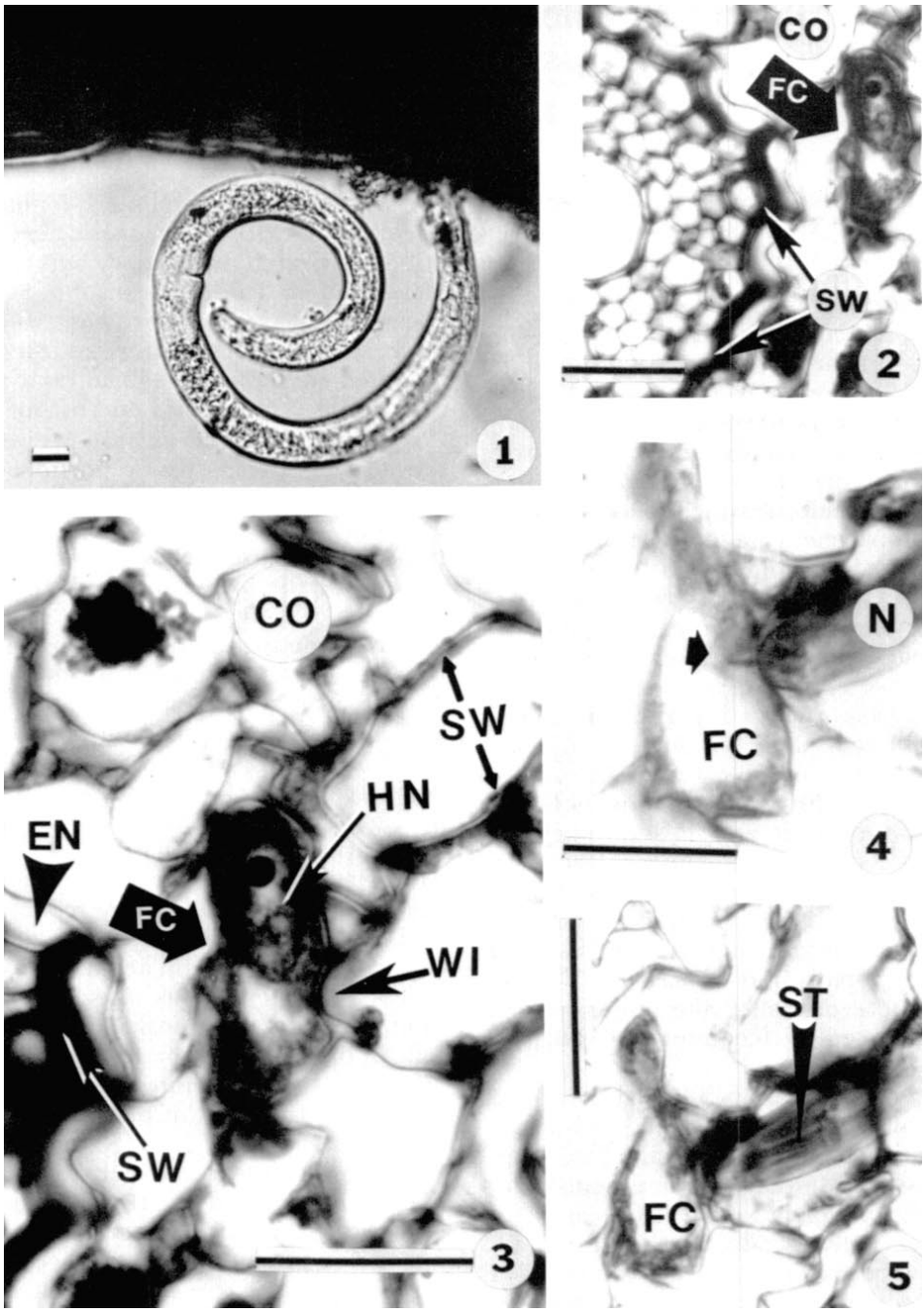
Specimens of *H. pseudorobustus* were observed with the posterior portion of the body protruding from the root surface (Fig. 1). Examination of infected root cross sections indicated that the nematode partially penetrated the cortex and fed from a modified cortical cell (Fig. 2). This "food cell" was the same size as adjacent cortical cells, but had denser cytoplasm and an enlarged nucleus with a prominent nucleolus (Figs. 2, 3). The hypertrophied nucleus was oval and 21 μm long by 10 μm wide, whereas normal cortical cell nuclei were 3.5 μm long by 2.5 μm wide.The cell wall had a slight indentation at the nematode feeding site which may have been caused by compression by the nematode during feeding (Fig. 3). Dense material was deposited along the cell wall (Figs. 4, 5) and around the nematode stylet when it was inserted into the food cell (Fig. 2). Cortical and endodermal cells in proximity to the food cell had lignified walls stained more densely with safranin than the walls of more distant cells (Figs. 2, 3, 6).

Dense cytoplasm and a hypertrophied nucleus in the food cell (Fig. 3) may indicate high metabolic activity and suggest a specialized function. This food cell is similar to cortical nurse cells with hypertrophied nuclei induced by *Tylenchulus semipenetrans* Cobb and the mononucleate giant cells induced by *Rotylenchulus macrodoratus* Dasgupta, Raski, and Sher and some Heteroderidae species (1,2,6). Previous studies gave evidence that some *Helicotylenchus* species feed as sedentary parasites (4). However, anatomical examinations of the food cells induced by these species did not reveal nuclear enlargement (5). The in-

Received for publication 8 October 1984.

[1] Nematologist, Istituto Nematologia Agraria CNR, 70126 Bari, Italy.

[2] Nematologist, Plant Science Department, USDA ARS, Crops Research Laboratory, Utah State University, UMC 63, Logan, UT 84322.



FIGS. 1–5. Corn roots infected with *Helicotylenchus pseudorobustus*. Scale bars = 25 μm. 1) Female nematode partially penetrated into a corn root with the posterior portion of the body protruding from root surface. 2) Root cross section showing a food cell (FC) in the cortex (CO). Note deeply stained walls of endodermal cells (SW) in proximity of the food cell. 3) Root cross section showing a food cell (FC) with hypertrophied nucleus (HN), dense cytoplasm, and wall indentation (WI) at the nematode feeding site. Note deeply stained walls (SW) of cortical (CO) and endodermal (EN) cells in proximity of the food cell. 4) Root cross section showing a nematode (N) with the stylet (arrow) penetrated into a food cell (FC). Note dense deposit around the stylet and along the food cell wall. 5) Root cross section showing a nematode with its lips in contact with a food cell (FC). Note dense deposit along the food cell wall. ST = stylet.

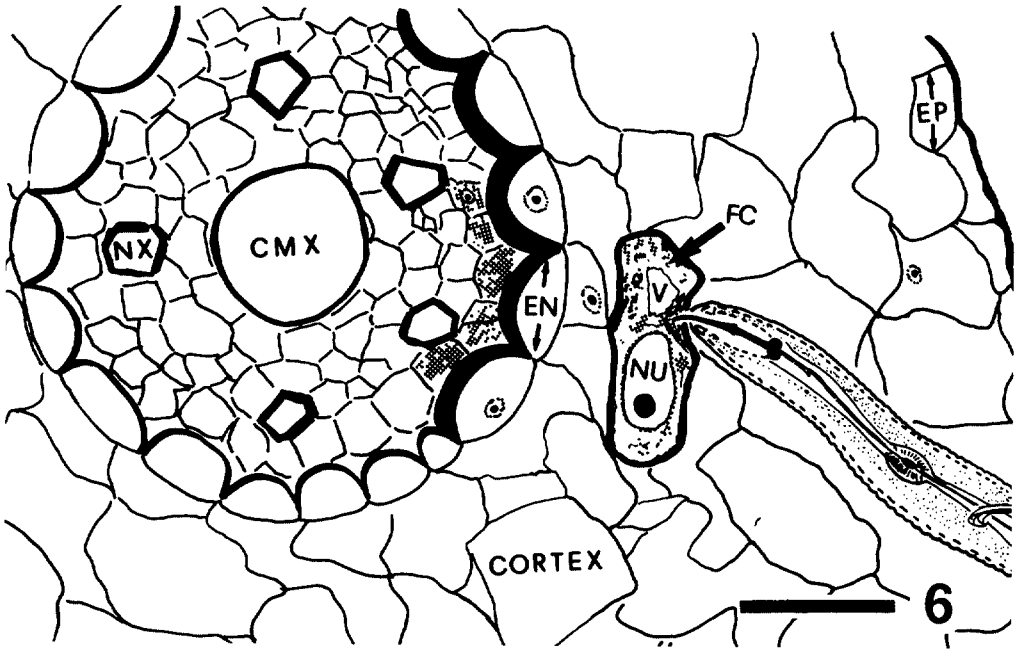


FIG. 6. Composite camera lucida drawing from serial sections of *Helicotylenchus pseudorobustus* feeding area in a corn root. CMX = central metaxylem, EN = endodermis, EP = epidermis, FC = feeding cell, NU = hypertrophic nucleus, NX = narrow metaxylem, V = vacuole. Scale bar = 25 μm.

duction of a single specialized food cell with a single hypertrophied nucleus and dense cytoplasm in *H. pseudorobustus*-infected corn roots confirms that occasionally *Helicotylenchus* spp. have feeding behavior similar to that of sedentary nematodes as reported by Jones (4).

LITERATURE CITED

1. Himmelhoch, S., E. Cohn, M. Mordechai, and B. M. Zuckerman. 1979. Changes in fine structure of citrus root cells induced by *Tylenchulus semipenetrans*. Nematologica 25:333–335.

2. Inserra, R. N., and N. Vovlas. 1980. The biology of *Rotylenchulus macrodoratus*. Journal of Nematology 12:97–102.

3. Johansen, D. A. 1940. Plant microtechnique. New York: McGraw-Hill.

4. Jones, R. V. 1978. The feeding behaviour of *Helicotylenchus* spp. on wheat roots. Nematologica 24: 88–94.

5. Jones, R. V. 1978. Histological and ultrastructural changes in cereal roots caused by feeding of *Helicotylenchus* spp. Nematologica 24:393–397.

6. Mundo-Ocampo, M., and J. G. Baldwin. 1984. Comparison of host response of *Cryphodera utahensis* with other Heteroderidae, and a discussion of phylogeny. Proceedings of Heminthological Society of Washington 51:25–31.

7. Norton, D. C. 1984. Nematode parasites of corn. Pp. 61–94 *in* W. Nickle, ed. Plant and insect nematodes. New York: Marcel Dekker.

8. Schurger, A. C., and M. A. McClure. 1983. Ultrastructural changes induced by *Scuhellonema brachyurum* in potato roots. Phytopathology 73:70–81.

9. Taylor, D. P. 1961. Biology and host-parasite relationships of the spiral nematode *Helicotylenchus microlobus*. Proceedings of the Helminthological Society of Washington 28:60–66.