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Description of Males of *Heterodera zeae*[1]

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Abstract: The male of *Heterodera zeae*, the corn cyst nematode, is described and illustrated for the first time. Specimens were obtained from a culture originating from cysts collected in Kent County, Maryland, at the site of the first known infestation of *H. zeae* in the United States.

Key words: taxonomy, morphology, *Heterodera*, cyst nematode, corn, *Zea mays*.

In February 1981 the corn cyst nematode, *Heterodera zeae* Koshy et al., 1971, was detected in Kent County, Maryland (10). This was the first reported occurrence of *H. zeae* in the Western Hemisphere. Until that time the species was known only in India (5) and Egypt (Oteifa, unpubl.), where it is considered to be an economically important pest of corn; limited host range studies there have shown that some cultivars of several small grains and certain weeds are also hosts (1,11,13). *H. zeae* was reported from Pakistan in 1981 in association with the roots of corn, citrus, pear, garlic, and gram (7).

The research program initiated after detection of the corn cyst nematode in Maryland has included ongoing surveys during which the nematode was detected in three additional Maryland counties. To date it has been detected on 22 farms on approximately 1,800 acres (S. Sardanelli, pers. comm.). Golden and Mulvey (3) recently redescribed and illustrated females, cysts, and juveniles of *H. zeae*, but males have not been described because they have never been found in infested field soil or in greenhouse cultures. In a report on the life cycle of *H. zeae* on axenic corn root explants, Lauritis et al. (6) noted the rare occurrence of males in these cultures, but did not describe them. They suggested that reproduction in this nematode is parthenogenetic.

This report includes a description, morphometric data, and illustrations of males of *H. zeae* produced in cultures maintained on corn (*Zea mays*) under growth chamber conditions and completes the taxonomic description of this species.

MATERIALS AND METHODS

Specimens used for morphometric data and description were obtained from cultures of *H. zeae* initiated with material collected from the original detection site in

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Kent County, Maryland, and propagated on corn variety 'Pioneer 3184.' Plants were grown in sand and kept in a growth chamber at 29 C. Nematodes were sieved from the sand, and males were relaxed by heating to 43 C for 12 minutes and then prepared and measured using the procedures outlined by Golden and Birchfield (2). Drawings were prepared with a camera lucida.

Description

Measurements (40): Length 640.8–993.6 μm (806.9 μm, SD 77.6); a = 18.9–39.9 (32.1, SD 4.3); b = 3.6–6.6 (5.1, SD 0.7); c = 105–207 (132.8, SD 27.5); stylet 24.0–24.8 μm (24.2 μm, SD 0.32); DGO 3.2–4.8 μm (4.0 μm, SD 0.35) from base of stylet; center of median bulb 71.2–93.6 μm (82.7 μm, SD 5.0) from anterior end; width of stylet knobs 4.0–5.6 μm (4.7 μm, SD 0.31); head width (hw) 8.8–9.6 μm (9.0 μm, SD 0.36); head height (hh) 4.8–5.7 μm (5.0 μm, SD 0.35); hw/hh ratio 1.6–2.0 (1.8, SD 0.13); spicules 24.8–32.0 μm (27.8 μm, SD 1.6); gubernaculum 8–11.2 μm (9.4 μm, SD 1.3); tail 4–7.2 μm (5.8 μm, SD 0.7).

Description: Body usually slender, vermiform, tapering slightly at both extremities. Head rounded, offset, with four annules and large oral disc. Cephalic framework heavily sclerotized. Width at midbody 23.2–43.2 μm (27.8 μm, SD 6.5). Cuticle distinct, with regular annulation. Lateral field with four lines, center annule often narrower than outer two. Lateral field slightly more than ¼ body width at midbody. Stylet well developed with prominent rounded knobs. Anterior cephalids at position of 2–3 body annules behind head and posterior cephalids 8–9 annules behind head. Excretory pore averages 15% of body length from anterior end. Hemizonid 2–6 annules anterior to excretory pore. Hemizonion visible in a few specimens, 2–6 annules behind excretory pore. Stylet, stylet knobs, anterior and posterior cephalids, excretory pore, hemizonid and hemizonion typically appear as shown in Fig. 1. One testis, spermatozoa apparently present. Spicules slightly arcuate, tips pointed, nondentate. Phasmid small and indistinct, located slightly anterior to cloacal opening, observed in only a few specimens. Tail short, with bluntly rounded terminus (Fig. 2).

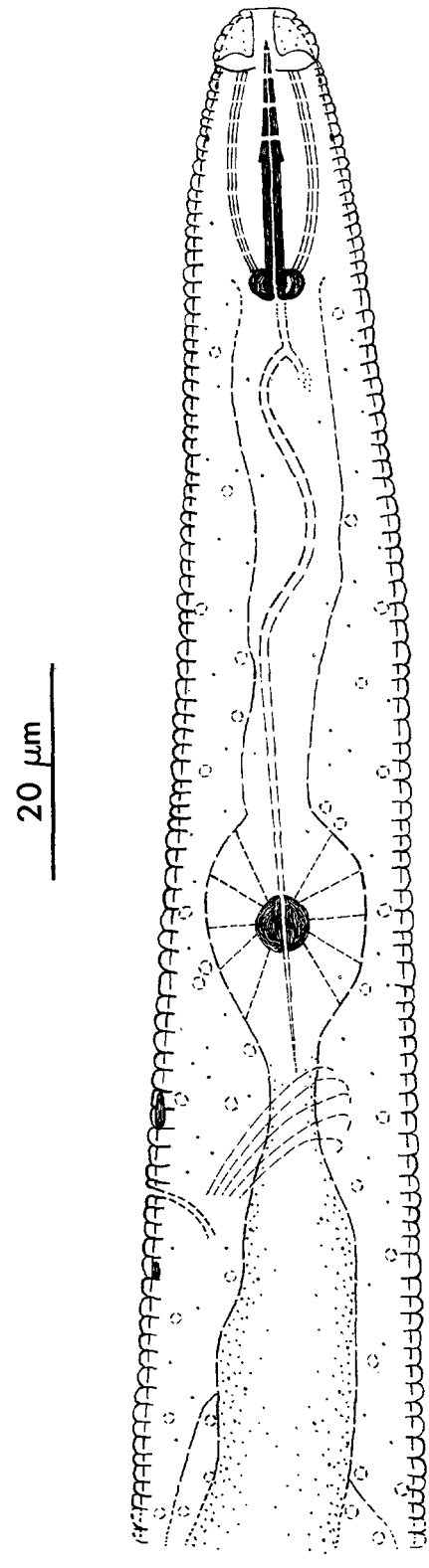

FIG. 1. Drawing of *Heterodera zeae* male anterior region.

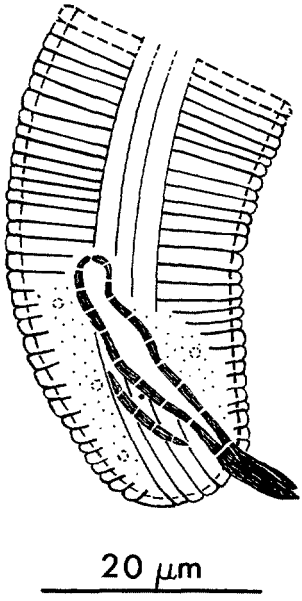

FIG. 2. Drawing of *Heterodera zeae* male posterior portion.

About 5 percent of the males examined were aberrant in morphology, being very short and sausage-shaped. Measurements for these were not included in those reported above so as not to skew the data. Some measurements for a few of these specimens are listed here: Length 325–538 μm (448.7 μm, SD 88.6); a = 7.5–12.9 (10.9, SD 2.4); b = 4.25–4.9 (4.6, SD 0.33); c = 58.1–102.8 (81.1, SD 18.3). Aside from the abnormality in size and shape, other structures such as stylet, esophagus, testis, and spicules appeared to be well developed. A single testis was present. Measurements of stylet, DGO, spicules, hh, and hw all fell within the ranges reported for normal specimens.

Specimens will be placed in the U.S. Department of Agriculture Nematode Collection, Beltsville, Maryland 20705, USA.

DISCUSSION

Males of *H. zeae* differ from those of the morphologically closely related species *H. glycines* and *H. schachtii*; average length 807 μm for *H. zeae* vs. 1,265 μm (8) or 1,330 μm (4) for *H. glycines* and 1,120–1,440 μm for *H. schachtii* (8). The stylet is shorter in *H. zeae* (av. length 24.2 μm) than in *H. glycines* (av. length 26.9 μm) and *H. schachtii* (av. length 29.0 μm). The average length of the spicules in *H. glycines* and *H. schachtii* (34.3 μm and 34–38 μm, respectively) is greater than that of *H. zeae* (27.8 μm). The DGO of *H. zeae* averages 4.0 μm from the base of the stylet, while in *H. glycines* it averages 3.9 μm and in *H. schachtii* 4.5 μm from the base of the stylet (8).

Males are involved in reproduction of both *H. glycines* and *H. schachtii* (9,12). Males of *H. trifolii*, another species closely related to *H. zeae*, are rarely found (8). The role of males in the life cycle of *H. zeae* has not been studied extensively. However, it is likely that they are not required for reproduction, since their occurrence is very sporadic. Also, Lauritis et al. (6) rarely observed *H. zeae* males (only one male per 10 cultures) in cultures maintained on axenic corn root explants. Furthermore, males were never observed mating with female nematodes.

The occurrence of males as reported here may have resulted because the cultures contained very large populations of nematodes. Single corn plants grown in 6-inch pots yielded as many as 20,000 cysts. A relationship seems to exist between the number of males produced and nematode population density, since a higher proportion of males was recovered from cultures containing greater numbers of cysts and larvae. Thus, males could have developed in response to the crowded conditions of infection existing in these cultures.

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