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Reniform Nematode, *Rotylenchulus reniformis* Linford and Oliveira (Nematoda: Tylenchida: Tylenchoidea: Hoplolaimidae: Rotylenchulinae)[1]

Koon-Hui Wang[2]

The Featured Creatures collection provides in-depth profiles of insects, nematodes, arachnids and other organisms relevant to Florida. These profiles are intended for the use of interested laypersons with some knowledge of biology as well as academic audiences.

Introduction

Reniform nematodes in the genus *Rotylenchulus* are semiendoparasitic (partially inside roots) species in which the females penetrate the root cortex, establish a permanent-feeding site in the stele region of the root and become sedentary or immobile. The anterior portion (head region) of the body remains embedded in the root whereas the posterior portion (tail region) protrudes from the root surface and swells during maturation. The term "reniform" refers to the kidney-shaped body of the mature female.

There are ten species in the genus *Rotylenchulus*. *Rotylenchulus reniformis* is the most economically important species (Robinson 1997) and is called the reniform nematode.

Figure 1. Young female of reniform nematode, *Rotylenchulus reniformis* Linford & Oliveira, with swollen body. The female penetrates the root of cowpea and the anterior portion (head region) of the body remains embedded in the root whereas the posterior portion (tail region) protrudes from the root surface.
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Distribution and Host Range

Rotylenchulus reniformis is largely distributed in tropical, subtropical and warm temperate zones in South America, North America, the Caribbean Basin, Africa, southern Europe, the Middle East, Asia, Australia, and the Pacific

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2. Koon-Hui Wang, Entomology and Nematology Department; UF/IFAS Extension, Gainesville, FL 32611.

(Ayala and Ramirez 1964). It was first found on cowpea roots in Hawaii (Linford and Oliveira 1940), and first reported as a parasite of cotton in Georgia and of tomato in Florida. Today, it is found throughout the southern United States.

In Florida, reniform nematodes are especially common in the southernmost counties, Miami-Dade and Monroe, where Rockdale soils favor reniform nematode population development. Reniform nematodes are also common in the northwestern counties of Florida (Panhandle region), from Jefferson to Santa Rosa, especially in the cotton production area with heavier soils such as sandy loam, sandy clay and clay loam (Kinloch and Sprenkel 1994).

At least 314 plant species can act as hosts to reniform nematodes. Among them, cotton, cowpea, soybean, pineapple, tea and various vegetables are the most common hosts. A list of hosts and nonhosts for reniform nematode was recently published by Robinson et al. (1997). Many weed and ornamental hosts to reniform nematode in Florida have been reported by Inserra et al. (1989, 1994a, 1994b). In southern Florida, sweet potato, papaya, and several edible aroids are excellent hosts to reniform nematodes. The reniform nematode was also associated with several kinds of tropical fruit trees (McSorley 1980; McSorley et al. 1982; McSorley et al. 1983).

Life Cycle

Eggs hatch one to two weeks after being laid. The first-stage juvenile molts within the egg, producing the second-stage juvenile (J2) that emerges from the egg. The infective stage is reached one to two weeks after hatching. Once root penetration occurs, one or two more weeks are required for females to reach maturity. The male, which remains outside of the root, can inseminate the female before female gonad maturation. Sperms are stored in the spermatheca. Soon after female gonad maturation, the eggs are fertilized with sperm, and about 60 to 200 eggs are deposited into a gelatinous matrix. Typically, there is an equal number of females and males in a population. Some populations of reniform nematodes reproduce parthenogenetically (egg production without fertilization). The life cycle of this nematode is usually shorter than three weeks, but depends on soil temperature. However, it can survive at least two years in the absence of a host in dry soil through anhydrobiosis, a survival mechanism that allows the nematode to enter an ametabolic state and live without water for extended periods of time (Radewald and Takeshita 1964).

Figure 2. Life stages of reniform nematode, *Rotylenchulus reniformis* Linford & Oliveira. Ranging from left to right is egg, juvenile, young female with swollen body, and mature female in kidney shape.
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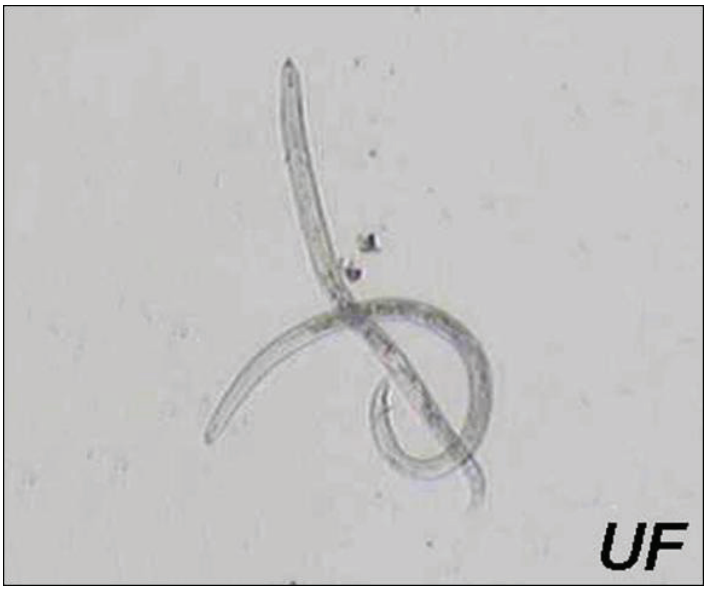

Figure 3. Male and young female of reniform nematode, *Rotylenchulus reniformis* Linford & Oliveira, stages typically found in soil. Female has a strong stylet (needle-shaped mouthpart). Male (curved specimen) has a weak stylet and a spicule (at posterior) for insemination.
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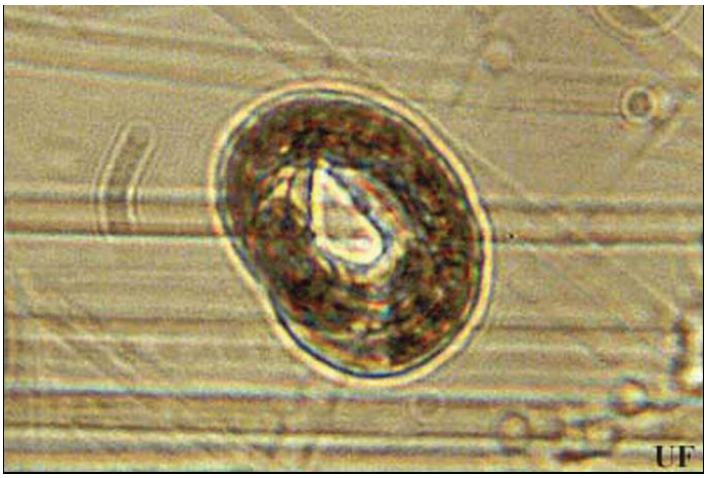

Figure 4. Reniform nematode, *Rotylenchulus reniformis* Linford & Oliveira, tightly coiled to undergo anhydrobiosis under drought conditions.
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Technical Description

The average body length is about 0.34 to 0.42 mm for juveniles and males, and 0.38 to 0.52 mm for mature female nematodes. Nematodes rest in a C shape when killed by heat. The lip region of the young female is not offset, and the cephalic framework is conspicuous. The stylet is 16 to 21 µm long and of moderate strength with a small rounded knob. The dorsal gland orifice is more than one-half the stylet length and is posterior to the base of the stylet knobs. The basal glands overlap the intestine laterally or, less often, ventrally. The vulva is post-median (V > 63%). The female reproductive system is amphidelphic with two flexures in immature females and highly convoluted in mature females. The female tail is usually more than twice the length of the anal body diameter. The juvenile tail tapers to a narrow, rounded terminus with about 20 to 24 annules. Phasmids are pore-like, about the body width or less, behind the anus. Males have weak stylets and stylet knobs, a reduced esophagus, and an indistinct median bulb and valve. Caudal alae are adanal. The lateral field of males, young females, and juveniles has four incisures which are not areolated (Mai and Mullin 1996).

Economic Impact

Only females infect plant roots. After infection, a feeding site composed of syncytial cells is formed. A syncytial cell is a multinucleated cell resulting from cell wall dissolution of several surrounding cells.

Among the crops most severely affected by reniform nematode are upland cotton, pineapple and many vegetable crops including tomato, okra, squash, and lettuce. The university extension services in Mississppi and Alabama recommend nematicide treatment for cotton fields if population density exceeds two nematodes/cm^3 soil in the spring and 10 nematodes/cm^3 in fall or winter. Economic threshold for reniform nematode on pineapple is 310 nematodes /250 cm^3 soil (Sipes and Schmitt 2000). Reniform nematode population densities reduced snap bean yield by 10% in south Florida (McSorley et al. 1981). Besides the direct damage, reniform nematodes are also an important factor in the incidence of *Fusarium* and *Verticillium* wilts of cotton, causing the *Fusarium*-wilt resistant varieties of cotton to become susceptible.

Management

No cotton or pineapple cultivars are resistant to reniform nematodes. However, cotton breeding lines tolerant of reniform nematodes have been developed. Soybean cultivars 'Peking', 'Dyer', 'Custer', and 'Pickett' are highly resistant to reniform nematode (Rebois *et al.* 1970). Certain tomato cultivars are resistant to this nematode (Balsubramanian and Ramakrishnan 1983).

Crop rotation with resistant or immune plant species is recommended. These include mustard (*Brassica nigra*), oats, rhodesgrass (*Chloris gayana*), onion, sugarcane, and sun hemp (*Crotalaria juncea*) (Robinson et al. 1997, Caswell *et al.* 1991). Pineapple is rotated with sugarcane or pagolagrass in Puerto Rico (Roman 1964). Sorghum, maize and reniform nematode resistant soybeans are recommended as rotation crops for cotton (Starr and Page 1990).

Currently, Hawaiian pineapple plantations manage plant-parasitic nematodes by fallowing after pineapple for six to 12 months, then fumigating before planting, and applying post-plant non-fumigant nematicides (Apt and Caswell 1988). However, dry fallow may be ineffective as a means of control since this nematode can enter into anhydrobiosis in slowly drying soils and revives when environmental conditions are favorable (Apt 1976). Apt suggested that moist fallow would be more effective as a means of control. Fallow with weeds is also unfavorable because many weeds could be hosts to reniform nematodes.

Areas free of reniform nematode impose regulation against this nematode. Chile and Switzerland are among the countries that have quarantine against reniform nematode. The United States, Arizona, California and New Mexico restrict possible importation of reniform nematode to protect their cotton industries. Due to this regulation, the ornamental industries of southern Florida and Hawaii must undergo extensive sanitation of their plants and facilities to be sure they are not exporting plants contaminated with reniform nematode. For more information see:

Nematode Management Guide for Cotton (https://edis.ifas.ufl.edu/publication/NG015).

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