Biology and Management of Stubby-Root Nematodes on Onion

Abolfazl Hajihassani, Department of Plant Pathology
Chris Tyson, Vidalia Onion and Vegetable Research Center
Aubrey C. Shirley, Tattnall County Extension

UNIVERSITY OF GEORGIA
EXTENSION

Sweet onion (*Allium cepa* L.) is an important vegetable crop for Georgia, and it is cultivated primarily to be sold at fresh market after harvest or for marketing after a few weeks of storage. Numerous soilborne pathogens cause damage to onions. Since 2017, several growers in Tattnall and Toombs counties have reported reduced yields of onion crops during the growing season, from October to May, but the lower yields didn't correlate with any previously reported diseases of onion in Georgia. Recent surveys of nematodes occurring in onion fields in these counties have indicated that stubby-root (*Paratichodorus* spp.) and root-knot (*Meloidogyne* spp.) nematodes are widely distributed in coarse-textured, sandy soils. Of these two nematodes, stubby-root nematode appears to be involved in reducing onion productivity due to their high population levels, so it is now considered an important pest of Vidalia onions in Georgia. For more information on the occurrence and distribution of plant-parasitic nematodes associated with onion, refer to pages 26-27 of UGA Extension Annual Publication 114-1, the 2019 Vidalia Onion Extension and Research Report. Stubby-root nematodes, *Trichodorus* or *Paratrichodorus* (synonyms: *Nanidorus*), are ectoparasites (the nematode's body remains in the soil and feeds on roots) of many vegetable, field, and fruit crops. Different species of stubby-root nematode are generally found in the U.S.; however, two species of *Paratrichodorus minor* (Figure 1) and *P. allius* have been reported to be associated with onion yield losses. *Paratrichodorus minor* appears to be the most common species recovered from onion fields in Georgia. Although low to high population densities of this nematode species were observed in multiple fields, their high population pressures have been associated with areas of severely stunted onion seedlings.

Damage symptoms

The most obvious aboveground symptoms of nematode infection are poor, stunted growth of onion seedlings (Figure 2). Depending on nematode population density, infected plants will produce roots of varying lengths due to nematode feeding specifically on the root tips using a solid, curved stylet or spear. Reduced root growth, excessive lateral root growth, branched and "stubby"-appearing root systems are common symptoms of nematode damage (Figure 3A). Stubby-root nematodes also feed on the whole root system and cause swelling (Figure 3B). Stunted root systems are not able to take up water and nutrients from soil, so plants show signs of nutrient or water deficiencies. Later in the season when warm weather appears, onion leaves become yellow with necrotic leaf tips, and variable sizes of onion plants can be seen across the field depending on the degree of nematode damage (Figure 4).

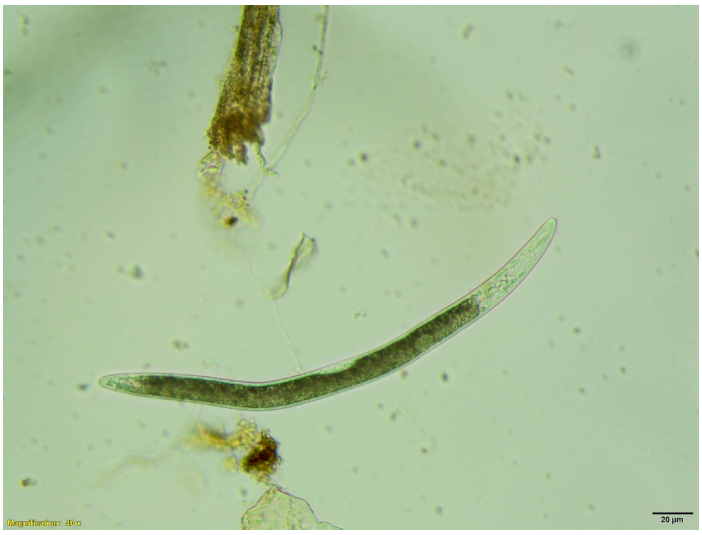

Figure 1. A micrograph of a female stubby-root nematode, *Paratrichodorus minor.*

Figure 2. This drone image of a Vidalia onion seedbed field located in Tattnall County, Georgia, was taken in the fall prior to transplanting. This field was severely infested with stubby-root nematode, *Paratrichodorus minor.*

Figure 3A. Onion plants affected by stubby-root nematode (*Paratrichodorus minor*) infestation. Stunted root systems (right) can be easily differentiated from healthy roots (left).

Figure 3B. Nematode feeding can cause root swelling, as shown by the arrows.

Figure 4. A transplanted field of Vidalia onions infested with stubby-root nematodes become yellow (right) and produce onions of varying sizes with necrotic leaf tips (left).

These disease symptoms appear in patches or irregular patterns throughout the field, which suggests that nematodes can adversely impact onion production alone or in combination with other biotic (e.g., bacterial diseases) and abiotic (e.g., soil type) factors.

Biology

Stubby-root nematodes spend their entire life cycle in the soil. The life cycle begins with an egg. Like other plant-parasitic nematodes, the stubby-root nematode has four vermiform (worm-like) juvenile stages that feed externally on root systems and develop. Each generation of a life cycle is completed between 16 to 22 days depending on the soil temperature. Optimal conditions for nematode growth include sandy and moist soils with temperatures ranging from 69° to 87° F (20° to 30° C). Stubby-root nematodes appear to be very sensitive to low soil moisture, and in the absence of host crops, their populations can decline quickly in the soil. Coarse-textured soils such as sandy and sandy loam are ideal for nematode development and reproduction. Newly emerged onion seedlings are very vulnerable to nematode infection. In Georgia, sweet onions are seeded in plant beds from the end of September through October when the soil is cool and wet enough for optimal development and reproduction of the nematode. Therefore, severe root injuries occur in the first few weeks after planting and the degree of damage varies with nematode population densities and the susceptibility of onion varieties.

Host range

Stubby-root nematodes have a wide host range, including sugar beets, potatos, corn, cotton, peanuts, wheat, onions, grasses and some other vegetable crops that are commonly grown in Georgia. Some weeds can also serve as good hosts or provide an alternate survival host for stubby-root nematodes. The nematode is very mobile in the soil and can migrate vertically, making it difficult to quantify the pest population. An excellent strategy for monitoring the nematode population is sampling soil during the harvest of crops grown before onion in the summer and fall, when large numbers of the nematode can be found in the upper 6 to 10 inches of the soil.

Management

To avoid economic losses from stubby-root nematodes, inspect onions and other rotational crops grown in the field prior to planting onions. The management strategy must focus on reducing the nematode populations in soil because eradicating nematodes is not likely. In Georgia, onions are often planted from seed in high-density seedbeds for transplant production. Once seedlings reach the appropriate size, they are removed from the seedbed by pulling the plants by hand and then transplanted into another field. This process removes most of the root mass of the plant. Once the onion seedlings are transplanted, the onion will generate a new root system and the old remaining root mass dies. This planting method may stop the spread of stubby-root nematodes and lessen nematode injury, if infested transplants are transplanted into a nematode-free field, since the stubby-root nematode only survives in soil and not roots. However, transplanting nematode-damaged seedlings and seeding or transplanting onions into nematode-infested fields should be avoided.

Soil solarization may not be an effective method of control because the nematodes are deep in the soil when there are no susceptible crops, and they can travel to the upper soil layers. Our limited observations show that leaving the infested fields fallow for several months appears to suppress the nematode population enough to provide good control. Resistant cultivars of oat, pearl millet, velvet bean, cowpea, and sunn hemp can be grown as cover or green manure crops in rotation with onion for suppressing *P. minor* in soil. However, avoid growing sorghum-sudangrass and hairy vetch, as they can help to build up the nematode population.

Pre-plant soil fumigation and the use of non-fumigant nematicides can reduce nematode populations. In Georgia, shallow (6-inch-deep) application of metam sodium (Vapam) is common in onion production for the control of weeds; however, Vapam appears to have little efficacy on stubby-root nematodes. This may be due to the mobility of nematodes in the soil, which makes soil fumigation difficult. The use of non-fumigant nematicides for the control of stubby-root nematodes on onion is being studied in Georgia. Preliminary results from our greenhouse trials have shown that oxamyl (Vydate) and fluopyram (Velum Prime) have good efficacy in *P. minor* control. Nematode-resistant onion varieties are not currently available, but there may be available varieties with lower susceptibility to nematode infection, which warrants further investigation.

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