K-STATE
Research and Extension

Steinernema feltiae
Biological Control Agent of Fungus Gnat Larvae

Steinernema feltiae is a beneficial nematode used to manage fungus gnat, *Bradysia* spp., populations in greenhouse production systems. This publication discusses the biology and behavior, effect of growing medium moisture and temperature, commercial availability and use in greenhouses, and quality assessment associated with *S. feltiae.*

Biology and Behavior

Steinernema feltiae is 1/64 of an inch (0.5 millimeters) long, slender, transparent, unsegmented, and difficult to see with the naked eye (Figure 1). Infective juveniles enter the body cavity of a fungus gnat larva (Figure 2) through the mouth, anus, or breathing pores (spiracles). Once inside, *S. feltiae* releases a bacterium, which multiplies in the bloodstream and can kill a fungus gnat larva within 24 to 48 hours. The third-stage infective juveniles inside the fungus gnat larva feed on the bacterium and liquefied insect tissues, which increases their numbers. The fungus gnat larva eventually dies.

The infective juveniles become adults and produce a new generation inside the dead fungus gnat larva. In 10 to 14 days (two to three generations), more than 1,000 *S. feltiae* are produced. The infective juveniles leave the dead fungus gnat larva and search the growing medium for new fungus gnat larvae.

Effect of Growing Medium Moisture and Temperature

The ability of *S. feltiae* to locate fungus gnat larvae in the growing medium is affected by growing medium moisture and temperature. *Steinernema feltiae* requires a moist growing medium for survival and persistence. A growing medium with a low moisture content affects the ability of *S. feltiae* to move through the growing medium profile (matrix), which can affect management of fungus gnat larval populations. Furthermore, a low moisture content in the growing medium may induce inactivity or cause mortality of *S. feltiae*. Consequently, it is important to irrigate before applying *S. feltiae* and again immediately afterward. If the growing medium retains too much water, infective juveniles will drown. Therefore, avoid overwatering and use a well-drained growing medium.

Growing medium temperature can influence the effectiveness of *S. feltiae* in managing fungus gnat larval populations. Growing medium temperature should be between 46 and 86 degrees Fahrenheit (8 and 30 degrees Celsius) for infection and reproduction. A growing medium temperature above 90 degrees Fahrenheit (30 degrees Celsius) can negatively affect survival and reproduction, reducing the ability of *S. feltiae* to manage fungus gnat larval populations. *Steinernema feltiae* is most effective in managing fungus gnat larval populations when the growing medium temperature is between 59 and 79 degrees Fahrenheit (15 and 26 degrees Celsius).

Availability and Use in Greenhouses

Steinernema feltiae can be purchased from biological control suppliers as sealed plastic trays containing 50, 150, or 250 million individuals (Figure 3). Check the expiration date on the package. If the expiration date has passed, contact the biological control supplier. Release *S. feltiae* immediately after arrival to avoid storing for an extended length of time. However, if necessary, store in a refrigerator

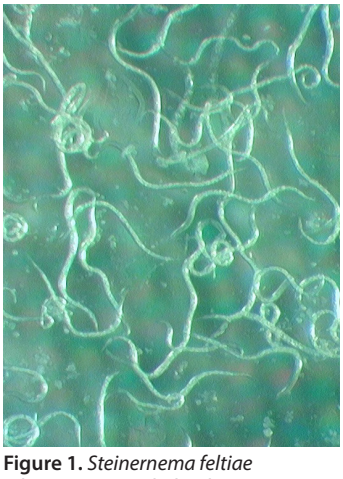

Figure 1. *Steinernema feltiae* (Photo: Raymond Cloyd).

Figure 2. Fungus gnat larva (Photo: Raymond Cloyd).

Figure 3. Commercially available product that contains *Steinernema feltiae* (Photo: Raymond Cloyd).

Figure 4. Removing a corner of the product inside the sealed plastic tray (Photo: Raymond Cloyd).

at 38 to 42 degrees Fahrenheit (3 to 6 degrees Celsius) for no more than a week. The contents of the tray should be placed into tap water that is tepid to cool (less than 55 degrees Fahrenheit or 12 degrees Celsius). After mixing, apply *S. feltiae* in the morning or evening to avoid exposure to sunlight, which can cause desiccation.

Steinernema feltiae can be applied through any irrigation system. Remove all filters and screens that are 50 mesh or less so *S. feltiae* can move through the irrigation system. To avoid injuring *S. feltiae*, the pump pressure should be less than 300 pounds per square inch. Agitate the solution during application to prevent *S. feltiae* from settling to the bottom of the application system. Agitation ensures even distribution of *S. feltiae* so that each container receives similar numbers of *S. feltiae*. Do not water heavily after applying *S. feltiae* to avoid leaching beneficial nematodes out through the bottom of the container.

Steinernema feltiae should provide management of fungus gnat larvae for up to four weeks. However, if no fungus gnat larvae are present, then *S. feltiae* populations will decline and eventually die. Consequently, fungus gnat populations may return, and *S. feltiae* will have to be released again.

Quality Assessment

To verify that *S. feltiae* are alive after receiving them from the supplier, follow these procedures:

1. Open the sealed plastic tray to expose the contents and remove a section from the corner (Figure 4). Place into a glass beaker (e.g., 500 milliliters) half filled with tap water. Stir the contents for about two minutes, and then fill the glass beaker (Figure 5).
2. Remove a 1.0-milliliter aliquot of the solution using a 1.0-milliliter syringe (Figure 6), and place into a glass Petri dish (Figure 7).
3. Place the Petri dish under a stereomicroscope and use a black background so *S. feltiae* are easily seen moving around (Figure 8), which indicates they are alive. If *S. feltiae* are straight and not moving around, then contact the biological control supplier immediately to inform them that the *S. feltiae* are dead.

Steinernema feltiae is effective in greenhouse production systems when applied before fungus larval populations have established in the growing medium.

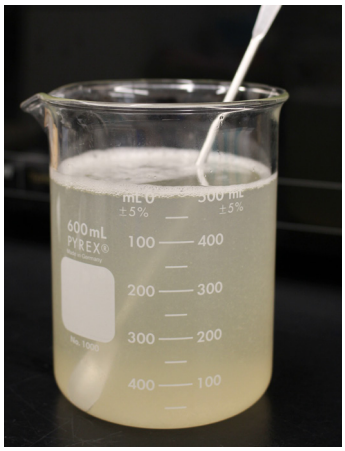

Figure 5. Glass beaker filled with water containing *Steinernema feltiae* (Photo: Raymond Cloyd).

Figure 6. Removing 1.0-milliliter aliquot of solution using 1.0-milliliter syringe (Photo: Raymond Cloyd).

Figure 7. Placing 1.0-milliliter aliquot of solution into glass Petri dish (Photo: Raymond Cloyd).

Figure 8. Close up of *Steinernema feltiae* moving around (Photo: Raymond Cloyd).

Raymond A. Cloyd
Horticultural Entomology and Plant Protection Specialist

K-STATE
Research and Extension

Publications from Kansas State University are available at *bookstore.ksre.ksu.edu*.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service
K-State Research and Extension is an equal opportunity provider and employer. Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of K-State Research and Extension, Kansas State University, County Extension Councils, Extension Districts.

MF3649 October 2023