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Coleus:
Lower Foliage Dark, Angular Leaf Spots

An infection by foliar nematodes which resulted in lower leaf, black, angular leaf spots is highlighted in this article.

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Plant Symptoms

During a visit to a greenhouse, dark angular leaf spots were observed on two coleus cultivars (Fig. 1&5). Necrotic spotting was more pronounced on the lower foliage than the upper foliage. Upon closer inspection, it was easy to see that the necrotic spots were confined between the secondary veins, which gave them a blocky appearance (Fig. 2). These plants had been held over from the previous season.

Figure 1. Dark angular leaf spots observed on coleus plants growing in a greenhouse.

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Possibilities

The pattern of necrosis being confined between veins can occur with three different diseases.

The first possibility is a bacterial disease. Bacterial leaf spots, such as those caused by *Acidovorax*, *Pseudomonas*, and *Xanthomonas*, will often times have lesions which appear to be water soaked. Many times with bacterial disorders, the surrounding tissue will also have a yellow halo (Fig. 3). With these coleus plants, the necrotic areas were more of a brown coloration than water soaked, and no yellow halo was observed.

At some stages, downy mildew can cause angular leaf spots, but there was no evidence of sporulation on the underside of these coleus leaves.

The third possibility is foliar nematodes (*Aphelenchoides spp.*). Infestations will result in the angular necrotic spots on most plant species. Discoloration starts as a blotchy yellow before the tissue dies completely. In plants with parallel leaf veination, spots tend to be linear. Bedding plants with reported foliar nematode infections include: agastache, ageratum, antirrhinum (snapdragon), argyranthemum, begonia, chrysanthemum, dahlia, ferns, gerbera, gomphrena, helichrysum, hellebore, hosta, lantana, mimulus, pentas, petunia, salvia, solenostemon (coleus), strobilanthes, tithonia, torenia, verbena, and zinnia. Even butterfly bush can become infected. (*For a complete listing of plants with confirmed infestations by Aphelenchoides spp., see L.M. Kohl references.*)

Diagnosis

Foliar nematodes are colorless, microscopic roundworms 0.5 to 0.8 mm long (Fig. 4). They reside in the mesophyll region of leaves. Leaf veins are natural barriers to their movement within a leaf, consequently infections develop the angular pattern between veins. Foliar nematodes are spread by splashing water and require a film of moisture in which to swim to new infection sites. They typically enter through the stomata. Dormant foliar nematodes can

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survive in dried plant debris for several years.

To positively identify a possible foliar nematode, bacterial infection, or downy mildew, send in a few plants to a commercial diagnostic lab. For greenhouses with a microscope with at least 40X magnification, an in-house diagnosis is possible. You will also need a flat clear container such as a petri dish, scissors, and clear water. Simply remove two to three leaves with ne-

Additional Foliar Nematode Information

North Carolina State University and USDA
Kohl, L.M., 2008. Population dynamics and dispersal gradient of Aphelenchoides fragariae in the woody ornamental Lantana camera. (http://www.lib.ncsu.edu/resolver/1840.16/1457) For host listing, please refer to pages 22-58.

A descriptive article by L.M. Kohl also with a host link. http://www.plantmanagementnetwork.org/pub/php/review/2011/nematodes/

Penn State
http://extension.psu.edu/pests/plant-diseases/all-fact-sheets/copy_of_foliar-nematodes

University of California
http://ucanr.edu/sites/UCNFAnews/Feature_Stories/Foliar_Nematodes/

University of Florida
http://ipm.ifas.ufl.edu/pdfs/IN03600.pdf

University of Kentucky
http://www2.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/PPFS-OR-H-3.pdf

BASF
http://betterplants.basf.us/news-&-events/featured-stories/current-featured-stories/2014-foliar-nematodes.html

Figure 2. Distinctive pattern of angular necrotic spots on leaves.

Figure 3. Bacterial diseases (such as *Xanthomonas* and others) have lesions that appear to be water soaked and a yellow halo sometimes is present.

crotic spots, cut the leaves into 1 cm wide strips, and place them in the petri dish containing about 0.5 cm deep water. Allow the leaves to sit in the water for at least 30 minutes to allow the foliar nematodes to move out of the leaf and into the water. With the microscope, clear, slender roundworms will be visible moving around in the water. Note: do not use leaves that have been in contact with the ground or soil, as they may contain secondary nematodes.

Management

The first control step is to discard infected plants along with the potting substrate. Clean and then disinfest or steam pots before re-use. You may want to quarantine plants that had grown adjacent to the symptomatic ones. In addition, thoroughly remove any plant debris from propagation and production areas. This dead tissue can harbor dormant foliar nematodes that can lead to re-infection. Weeds can also support foliar nematode populations. Foliar nematodes require a film of moisture to be able to move from plant to plant, therefore avoid overhead irrigation.

While some chemicals may be labeled for control of foliar nematodes, there are none that are effective at eliminating them. The most effective product no longer has an ornamentals label and has yet to be replaced with a comparable chemical. Chemical control options are listed in the BASF article (*see BASF reference for examples*).

Figure 4. Magnified view of a foliar nematode (*Aphelenchoides* spp.).

Avoid foliar nematode infestation in the future by working only with clean stock. Inspect and isolate any incoming material that looks suspicious and has symptoms of foliar nematodes until you can confirm the diagnosis.

Summary

In greenhouse production, foliar nematode infestations are uncommon. Most incidences occur when pet plants or stock plants are held over from year to year. In situations in which foliar nematodes gain a foothold in a greenhouse, clean up of the infestation can be a major challenge.

Figure 5. Dark angular leaf spots on a red and yellow colored coleus cultivar.

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