UNIVERSITY OF ILLINOIS EXTENSION
College of Agricultural, Consumer and Environmental Sciences

report on
PLANT
DISEASE

RPD No. 1102
July 2000

DEPARTMENT OF CROP SCIENCES
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

FOLIAR NEMATODE DISEASE OF ORNAMENTALS

The foliar nematodes, also known as bud and leaf nematodes, attack plant parts that are above ground. Two species of these microscopic roundworms are serious pathogens of many ornamentals, particularly in greenhouses, gardens, and homes. The chrysanthemum foliar nematode (*Aphelenchoides ritzemabosi*) is widely distributed in the United States and can cause severe losses to chrysanthemum growers. This nematode occurs both indoors and outdoors in Illinois. The strawberry crimp nematode (*A. fragariae*) is also known as the fern nematode because it attacks at least 100 species of ferns. That nematode is mainly an indoor pest in Illinois, seldom occurring on plants grown continuously outdoors. Both species, however, are important pathogens of the strawberry plant in certain parts of the world.

Figure 1. V-shaped necrotic lesions caused by Aphelenchoides Ritzemabosi.

These two species of foliar nematodes are difficult to differentiate, but in general their host ranges do not overlap to a great extent. The ornamental plants that can be seriously damaged by both species include African violets, begonias, gloxinias, Siberian bugloss, violets, and verbenas. The two nematodes sometimes occur together on these plants. *A. fragariae* is not known to parasitize chrysanthemums. Only one species of fern (*Strutheropteris orientale*) is attacked by both species of nematodes.

Other ornamental hosts of *A. ritzemabosi* are anemones, asters, carnations, Chinaster, cinerarias, coneflowers, crassulas, creeping bellflower, dahlias, delphiniums, elders, lupines, monkeyflower, phlox, pouchflower, rhododendrons, sages, Siberian wallflower, water peperomia, and zinnias. Other hosts of *A. fragariae* are alumroot, anise, anthusiums, arrowwood, Australian banyan tree, azaleas, bunchberries, buttercups, China-rose, geraniums, lilies, liverleaf, lucky clover, mints, monkshoods, orchids, ourisia, peonies, primroses, rubber plant, saxifrages, and Siberian tea, as well as most species of ferns. Many other ornamentals probably serve as hosts for one or both foliar nematodes but have not been reported as such.

Foliar nematodes are easily disseminated in propagation material, such as stem cuttings from chrysanthemums and begonias and leaf cuttings from African violets. Foliar nematodes are also spread from plant to plant by splashing water and through leaf contact. Both species can swim up the surface of

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plant stems in a thin film of water to infect the upper leaves, buds, and growing points. These nematodes are extremely active for plant-parasitic forms, and can move rapidly over the plant surface when moisture is present.

Symptoms

On chrysanthemums, *A. ritzemabosi* causes the first stems to be dwarfed. The plant is forced to produce other basal stems, thus acquiring a bushy appearance. Early nematode feeding in the buds and growing points causes growth retardation, resulting in distorted and deformed leaves. The growing points may be so damaged that they blacken and eventually die. Nematode injury induces the growth of side shoots, which also become infected. Later on, infection of the leaves causes the formation of yellowed spots or blotches (Figure 1) that are first noticeable on lower leaf surfaces. The often wedge-shaped discolored areas gradually expand, turn yellowish brown, and finally blacken. Developing leaves become distorted and crinkled. The entire leaf soon becomes infected, shrivels, dies, and hangs downward or falls to the ground. The destruction of the leaves usually progresses upward as the stems elongate. The nematodes may eventually infect the terminal flower buds, producing deformed and undersized flowers.

On ferns, *A. fragariae* produces water-soaked bands and blotches that become dark reddish brown to black, usually in stripes and between the leaf veins. These areas vary in their size and pattern with different fern species. On flowering plants, *A. fragariae* causes irregular leaf blotches that may be yellow, tan, red, violet, or purple, depending on the plant. Infected leaves later turn brown or black and die.

On lilies, the disease is known as dieback or "bunchy top." Nematodes are carried in dormant buds within the bulbs. The nematode damage first appears as blotched, yellow to bronze, or purplish leaves. These soon curl against the stem, become blackish brown, and die. The lower leaf whorls are usually the ones most seriously affected. Plant growth is stunted, infected buds fail to produce flowers, and death of the plant may follow.

Figure 2. Begonia foliar nematode (courtesy C.E. Williamson, Cornell University).

In plants attacked by both species of foliar nematodes, *A. fragariae* usually produces the more severe symptoms. Most types of begonias exhibit extensive, water-soaked blotches that turn grayish or reddish green to dark brown. These form between the veins, frequently involving large portions of the leaf (Figure 2). Infected leaves may curl, wither, and drop prematurely. Rieger begonias may show a distinct reddening of the foliage. Begonia plants infected with nematodes are often stunted and unsightly and produce few if any flowers.

On African violets, the lower surface of an infected leaf shows sunken, brown, water-soaked, rounded blotches between the veins. These later show through to the upper surface. The leaves curl downward and inward at the margins and eventually wither and die. Plants may become dwarfed and malformed and produce few if any flowers. A similar stunting disease occurs on cultivated violets. If severe, the entire violet plant may resemble a tiny cauliflower. Serious infections on either type of violet may cause death, especially if the plants are young.

Foliar nematode infections may remain very localized in a plant when dry conditions follow the initial entrance of the nematodes into the tissue. Under such conditions, the nematodes are confined to the

leaves they have infected (because surface moisture is necessary for migration to uninfected leaves), and there is little or no movement through the stems and petioles. Thus, infected leaves may die while new leaves never display any symptoms. Conversely, the symptoms are most severe under very moist conditions, which favor nematode activity. Under these conditions, foliar nematodes interact with several species of bacteria, often greatly enhancing the severity of the damage caused by the nematodes alone on many types of plants.

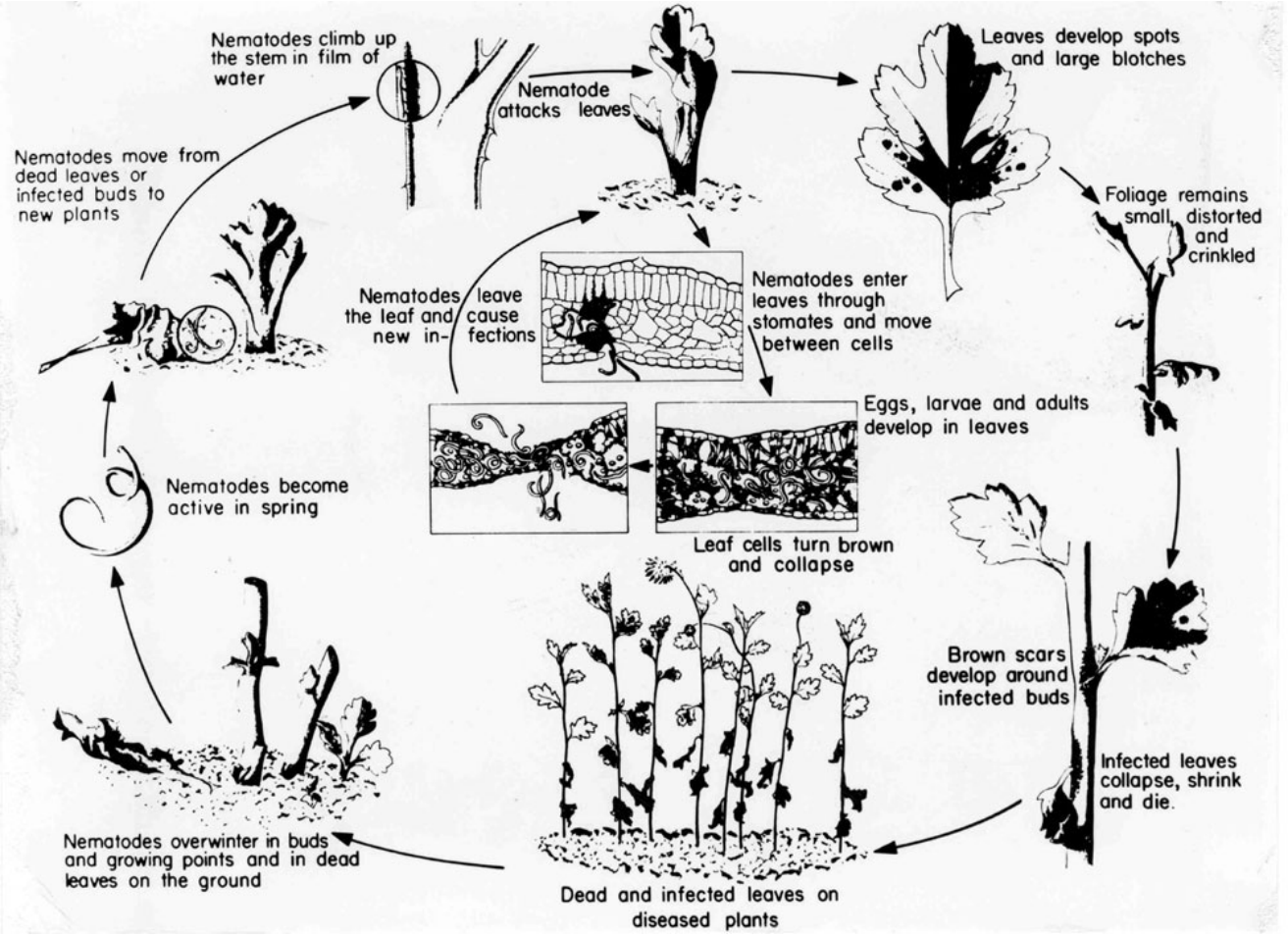

Figure 3. Disease (life) cycle of foliar nematode (Aphelanchoides ritzemabosi) on chrysanthemum (courtesy Dr. G.N. Agrios, published in Plant Pathology, Academic Press, Inc., San Diego, CA).

Disease Cycle

On Chrysanthemums and probably most other perennial host plants grown outdoors, foliar nematodes overwinter in dormant buds and the growing points, as well as in dead leaves on the ground. The nematodes become active again in the spring with resumption of plant growth, migrating up the stems of infected plants or to new plants in a film of water. Early in the cycle, the nematodes feed within the buds and on and in tender growing points. This feeding can cause severe deformations of young plants. Later, under moist conditions, the nematodes invade leaves through the stomata or epidermis on the lower surface and feed within the interveinal tissue. Moving between cells, the nematodes reproduce within the tissues and the population expands, eventually destroying the entire leaf. As infection progresses, there is a gradual transition from healthy to dead leaves, a shortening of the stems, and the production of abnormal flower buds. Dead leaves usually fall to the ground. The nematodes emerge through the stomata and cracks in the tissue and migrate back up the stem, completing the cycle (Figure 3).

The disease cycle on plants grown indoors is similar to that on plants grown outdoors, except there is no interruption of the cycle by plant dormancy during the winter months. Breaks in the cycle occur only when infected plants are removed, such as between different crops grown in greenhouses or when temperatures are too high for nematode reproduction.

Unlike other plant-parasitic nematodes, foliar nematodes can live in the soil for only a short time. Therefore, very few are found in the inorganic fraction of the soil beneath infected plants. However, foliar nematodes possess a remarkable ability to survive for relatively long periods in an inactive state in dry plant tissues, especially under cool conditions. Hence, dry plant debris from a prior crop, indoors or out, serves as a source of infection in later crops.

Foliar nematode diseases tend to be more severe indoors in Illinois because most plants are grown year around at a temperature range that highly favors the nematodes. Many indoor ornamentals are favored hosts. In addition, particularly in greenhouses, humidity is relatively high and plant foliage is frequently wet for lengthy periods, an ideal situation for infection and for the spread of nematodes between plants.

The life cycles of the foliar nematodes *A. ritzemabosi* and *A. fragariae* are similar. Adult females lay 25 or more eggs within plant tissues of the host. The young nematodes that hatch from the eggs pass through three juvenile stages, maturing into slender, wormlike adults that are about 2/30 of an inch long. At the optimum temperature of about 65°F (18°C), the life cycle is completed in as few as 10 days, considerably faster than that of most plant-parasitic nematodes. Therefore, populations of foliar nematodes can build up rapidly in plants grown indoors. The cycle is somewhat longer outdoors, with fewer generations per year, since nematode activity is greatly affected by diurnal and seasonal fluctuations in temperatures.

Control

Once foliar nematodes become established in a commercial planting, their eradication becomes laborious, time-consuming, and costly. Sanitation is imperative for control in all situations.

1. All infected plants and fallen leaves should be carefully removed from the garden or greenhouse and burned. Soil in affected nursery plantings should be fumigated. For suggested chemicals and procedures see the Illinois Urban Pest Management Handbook. Carefully follow all the manufacturer's precautions and directions. Greenhouse soil must be thoroughly treated with steam. Floors, benches, and storage areas should be thoroughly cleaned of plant debris. Containers and tools should be steamed or fumigated.

2. In most cases house plants in a home or apartment should be destroyed since it is difficult to salvage these plants. Pots, potting soil, and tools must be baked in an oven or steamed at 180-200°F (82-93°C) for 30 minutes. The immediate area around the plant must be thoroughly cleaned. Suspect plants should be kept isolated from healthy plants until they are confirmed to be noninfected. Certain types of ornamentals with woody stems and widely spaced leaves, such as the rubber plant, can often be repropagated nematode-free from terminal parts that are free of infection. The same technique can be applied to more compact, heavily foliated plants with some degree of success when such plants are maintained in a relatively dry atmosphere and are free of surface moisture for several weeks. Under those growing conditions, the removal of any foliage showing any symptoms will greatly reduce nematode populations and sometimes eliminate them. Such plants may fully recover from the disease.

3. Foliar nematode diseases can be minimized with good cultural practices. Only carefully selected, nematode-free plants or plant parts should be used for propagation. Excessive humidity, splashing water on stems and leaves, and contact between plants should be avoided. Moisture should not be allowed to stand on the foliage for over a few minutes. Outdoor and greenhouse plantings must be free of weeds since several species of weeds are known hosts of foliar nematodes. Keeping infested ground free of all plants for several months will eliminate most foliar nematodes from the soil. The use of a dry surface mulch or a ring of petroleum jelly around the base of stems helps prevent the nematodes from migrating up the plant stems.

4. A hot-water treatment of propagative parts can be used to control and sometimes to eliminate foliar nematodes from certain plants. The table on the next page lists water temperatures and immersion times for a number of ornamentals that generally can withstand a heat treatment. Success demands exact temperature control if the nematodes are to be killed and undue plant injury avoided. With most of the plants listed, however, some degree of heat injury can be expected, usually in the form of retarded early growth. Because of varietal differences in withstanding heat, large-scale treatment **should not** be undertaken until the procedure is tested on a few plants.

5. Commercial growers who are certified for handling toxic pesticides can control foliar nematodes by applying nematicides.

6. Varietal (cultivar) resistance to foliar nematodes in ornamental plants is known only in chrysanthemums. The cultivars 'Amy Shoesmith', 'Delightful', 'Orange Beauty', and 'Orange Peach Blossom' are relatively resistant, but not immune, to *A. ritzemabosi*. Nematodes that invade these cultivars feed on the tissues, but the females produce few eggs and subsequent juveniles usually fail to mature. Thus, the population soon falls to a very low level. Early in the disease cycle, however, resistant varieties often exhibit disease symptoms more rapidly than susceptible cultivars.

Temperatures and Submersion Times to Control Foliar Nematodes in Selected Plants by a Hot-Water Treatment

Plant species	Plant part	Temperature F°	Temperature C°	Time
African violet	Small potted plants	115.0	46.0[a]	15 min
Anthurium	Bare-root seedlings	116.0	46.6	12 min
Begonias	Small potted plants	117.0	47.0[a]	3 min
Chrysanthemum	Dormant stock plants (stools)	115.0	46.0	5-15 min
Chrysanthemum	Dormant stock plants (stools)	109.0	43.0	20-30 min
Ferns	Small potted plants	109.0	43.0[a]	10-15 min
Lilies	Bulbs	97.0	36.0	6 hrs
Lilies	Bulbs	111.0	44.0	1 hr
Phlox	Dormant stock plants (stools)	111.0	44.0	1 hr
Strawberry	Dormant runner plants	117.0	47.0	15 min
Tree peony	Dormant roots	117.0	47.0	40 min
Violet	Dormant plants	109.0	43.0	30 min

[a]Submerge the pots and plants. After treatment, the pots and plants should be plunged into clean, cool water.

For information on how and where to obtain the Illinois publications mentioned above, all of which are revised frequently, contact your nearest Extension personnel.