GROWING KNOWLEDGE

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Villains of the greenhouse II

When seedlings fail, *Fusarium* damping-off or wilt could be another cause

BY JAY W. PSCHEIDT

THERE ARE MANY FUNGI that live and survive in the soil that can be responsible for seedling failure. The usual suspects include *Rhizoctonia* species, *Fusarium* spp., and *Pythium* spp. Each is favored by different conditions, even though the symptoms are similar. In this article, we will focus on diseases of greenhouse grown ornamentals caused by *Fusarium*.

Many different plants are susceptible, from woody perennials to herbaceous annuals. Damping-off (pre- or post-emergence) due to *Fusarium* has been a problem in the Pacific Northwest on *Delphinium*, Douglas fir, *Petunia*, and pine as well as vegetables, all grown in the greenhouse. Wilt and root rots have been a problem on these same plants, as well as on carnation, *Cyclamen*, marigold, and *Zinnia*. Basal rots of bulbs or corms grown in containers have been a problem for *Gladiolus*, iris, and tulip.

Symptoms

Poor emergence or seedling collapse are indicative of damping-off. Seeds or emerging radicles may be rotted. After emergence, stem, root, and cotyledon may rot at or below the soil line. In *Petunia*, darker-red lesions that become brown with reddish borders develop, or brown lesions with diffuse margins, or simi-

Part two of a series. Part one of *Villains of the greenhouse*, published in the April 2021 issue of Digger, covered *Rhizoconia* damping-off, root rot and stem rot. It can be viewed at **www.diggermagazine.com/villains-of-the-greenhouse**.

Figure 1: *Osteospermum* with *Fusarium* basal rot where both roots and the base of the stem/root crown had decay. OSU PLANT CLINIC IMAGE, 2020.

Figure 2: These young Sedum plants had Fusarium crown and root rot with small, rotting root systems and decay extending into the crown. OSU PLANT CLINIC IMAGE, 2020.

larly discolored longitudinal streaks.

Osteospermum plants may develop root and crown rot when infected by *Fusarium* (Figure 1). It is difficult to determine which organism(s) might be involved by causal observation, so it's a good idea to send them to the Oregon State University (OSU) Plant Clinic for an accurate diagnosis.

Lower leaves of carnation yellow, wilt, and dry up one side of the plant. Symptoms progress up the plant. The stem often shrivels and turns grayish, and the xylem tissues turn brown. Shoots may be stunted and grow abnormally. The top of the main shoot grows at a right angle to the main stem. Plants may curl when symptoms develop on one side of the plant. *Sedum* plants may develop similar symptoms when infected by *Fusarium* (Figure 2).

Cyclamen corms in cross-section show patches of reddish-brown-to-black, or purple, discoloration in the vascular system (Figure 3). Roots exhibit vascular discoloration and may be totally discolored and darkened.

Plants in general can be yellowed and stunted and show irregular growth within a planting. Late in disease development, the carnation roots and stems rot, and the plant dies. In marigold, root production is greatly reduced, and a dark-colored root rot may be observed. In wet weather, salmon-color spore masses may form on infected stems.

When diseased tulip bulbs are forced in the greenhouse for flowering, stunted growth and leaf yellowing occurs within a few weeks. Plants generally die before flowering. The basal plate and roots decay and become a dull gray. The decay spreads to the bulb scales and lower stem.

The fungus

Fusarium spp. are soilborne fungi that infect plant roots or wounded cuttings. They survive in the soil as thick-walled, dormant chlamydospores, and on wooden benches used for plant production in the greenhouse. Chlamydospores germinate in response to exudates from nearby plant roots.

Hyphae then penetrate the roots (wounded or not), colonize the cortex, and move into the xylem tissue, which becomes brown. Small spores (microconidia) are produced and carried up into the plant.

Infection of the vascular system interferes with water and nutrient absorption. As the plant dies, the fungus erupts through the epidermis and forms tuft-like structures called sporodochia. Spores formed on these tufts can become airborne and infect nearby soils and plants. These macrospores and mycelium in the host tissue convert to chlamydospores and are released into the environment as the tissue decomposes. In the absence of a host, these spores can still persist in the soil for years.

The fungus can be spread by soil, wind, water, infected cuttings; and contaminated tools, equipment, and clothing. Growing media often gets contaminated by field soil when it is introduced via seeds, tools or even surface sources of irrigation water. Poorly cleaned containers from a previous crop may also contain enough of the fungus to affect the next crop. Fungus gnats may also spread propagules of *Fusarium*.

Warm temperatures and conditions favor these diseases. *Fusarium* are stimulated by high temperatures, near neutral pH conditions, and by nitrogen (especially ammonia) fertilization, particularly early in the growth cycle. Potting media with peat or coir fiber are also conducive to disease development.

Most *Fusarium* spp. can colonize

seedling root systems without eliciting disease symptoms. Severe root disease symptoms often become evident when seedlings are stressed. This is especially true for woody perennials stressed to initiate bud formation and begin hardening. Stresses from media being too wet or fertilizer burn can induce disease development.

Symptoms typical of *Fusarium*, however, can be due to other pathogens, including *Rhizoctonia*, *Pythium* and *Phytophthora*. It is not easy to tell these organisms apart by visual inspection, so send samples to the OSU Plant Clinic for diagnosis.

Management

Good sanitation and cultural practices are essential, including clean growing surfaces, clean water and handling practices, along with soilless media.

First things first: Start with culture-indexed plants free of the pathogen. This includes the purchase of new, clean seeds.

Next, plan to use a new soilless potting mix. If you must use soil or reuse media it has to be steam-treated for at least 30 minutes at 180 F. Once it has been purchased or treated keep field soil out of contact with clean media. Also, avoid reusing pots or trays from a previous crop for propagation.

If pots or trays must be reused, then wash off all debris and soak them in a sanitizing solution, or treat them with aerated steam for 30 minutes. Disinfect any tools and equipment that might be used, as these could contaminate the media.

During production, use sound horticultural practices that have been successful in your facility. Maintain adequate fertility for moderate plant growth using nitrogen sources derived from nitrate. Monitor soluble salt concentrations regularly. Use media pH and soil wetness appropriate for good crop growth. Water plants such that they are not wet for extended periods of time. Also, manage fungus gnats especially during rooting.

Remove plant debris during production and thoroughly clean and sterilize the greenhouse between production cycles.

These cultural control practices »

Figure 3: Vascular discoloration develops inside the corm of this *Cyclamen* with *Fusarium* wilt.
OSU PLANT CLINIC IMAGE, 2018.

reduce or eliminate the need for chemical drenches. Chemical treatment should be preceded by an accurate diagnosis, since most of the chemicals are not effective against all the pathogens that might cause damping-off. If used, treatments must be made before infection occurs. Rotate among fungicides from different groups with different modes of action. Be sure to check labels for crop safety before application.

A few chemicals are registered for the management of *Fusarium*. These include: Heritage (FRAC group 11) applied as a drench or drip application, Medallion (group 12), Terraguard (group 3), and Thiophanate-methyl-based products (group 1) such as Cleary's 3336 OR OHP 6672. Trinity (group 3) is also registered for crown and basal rots.

Biological control

Several biocontrol products are registered and are considered organic, but they must be used in conjunction with other control tactics such as thorough sanitation.

The fungal-based products include: Asperello T34 (*Trichoderma asperellum* strain T34) which can be incorporated into the potting media; Bio-Tam 2.0 or Tenet WP or Obtego (*Trichoderma asperellum* and *T. gamsii*); LALStop G46 WG or Prestop (*Gliocladium catenulatum* strain J1446) can be applied as long as other products are not in the same tank (rated very good to excellent for begonia.); RootShield Plus Granules (*Trichoderma harzianum* Rifai strain T-22 and *T. virens* strain G-41) but IR-4 reports poor to mediocre efficacy; and SoilGard 12 (*Gliocladium virens* strain GL-21).

The bacterial based products include: Actinovate SP (*Streptomyces lydicus* strain WYEC 108) used as a soil drench; Howler (*Pseudomonas chlororaphis* strain AFS009) as a soil drench; Mycostop or LALStop K61 WP (*Streptomyces* Strain K61) which must be applied with enough water to move the product into the root zone; Subtilex NG (*Bacillus subtilis* stain MBI 600) as a drench; and Triathlon BA (*Bacillus amyloliquefaciens* strain D747).

Immersing cuttings in a fungicide or disinfectant solution is not generally recommended. A few infected cuttings can contaminate the entire batch with disastrous results. It is better to use products before cuttings are taken and/or after sticking them.

Summary

With good sanitation and attention to the horticultural needs of the crop, these diseases can be avoided. If disease develops, get an accurate diagnosis and follow appropriate recommendations accordingly.

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