Agronomic Spotlight

Lettuce

Pythium Diseases of Lettuce

- Species of *Pythium* cause damping-off and wilt diseases of lettuce.
- Pythium wilt has become an important soilborne disease in parts of California.
- Pythium diseases are favored by cool, wet soil conditions.

Several species of *Pythium* can infect lettuce and cause distinct diseases, including damping-off, root rot, leaf blight, and wilt.[1,2] Pythium is a water mold belonging to the Oomycete group of fungal-like organisms that also includes *Phytophthora* and the downy mildew pathogens. Pythium damping-off has been a persistent problem for many years, but Pythium wilt is a relatively new disease that has become an important problem in parts of California within the last decade.[3]

Damping-Off

Damping-off of lettuce is typically caused by the fungus *Rhizoctonia solani* or a species of *Pythium*. *Pythium ultimum* is the most common cause of Pythium damping-off of lettuce; however, several other species may also be involved, including *P. irregulare, P. myriotylum,* and *P. sylvaticum*.[2,4] The symptoms of pre-emergence damping-off include rotting of the seed before germination and rotting of the radicle and hypocotyl before emergence. Post-emergence damping-off occurs when plants wilt and collapse after emerging. The outer layer of cells of the stem near the soil line becomes water-soaked, soft, and discolored. The stem may be constricted near the soil line. Partial girdling of the stem and rotting of root tips can result in stunting of young plants. Seedlings gradually become resistant to damping-off as they get older. Both pre- and post-emergence damping-off can result in uneven plant stands with gaps in the row (Figure 1).[2,4]

Figure 1. Uneven stands of lettuce resulting from damping-off. Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org.

Pythium ultimum and other *Pythium* species have broad host ranges and can also colonize fresh organic matter. *Pythium* pathogens usually survive as spores or sporangia in the soil or crop debris. The sporangia germinate and produce swimming zoospores that can move in films of water in the soil or on plant surfaces to reach infection sites. Infection is favored by cool, wet soil conditions, and the disease occurs more frequently in fields with high organic matter content and/or poor soil drainage.[2,4]

One strategy for managing damping-off is to plant lettuce when conditions favor rapid seed germination and seedling growth. Delaying planting until soil temperatures are warmer and planting on raised beds covered with plastic mulch can help minimize problems with damping-off.[2,4] Avoid planting in areas with soil compaction and other soil drainage issues and avoid excessive irrigation after planting. Seed treatments that contain fungicides effective against Oomycete pathogens (metalaxyl and mefenoxam) can help protect seeds and seedlings when they are most susceptible to infection. In-furrow applications and over-the-row banded applications of fungicides effective against Oomycetes can also be used to help suppress damping-off.[2,4] Soil applications of biological control products such as formulations of *Bacillus subtilis* strain QST 713, *Bacillus amyloliquefaciens* strain D747, or *Gliocladium catenulatum* strain J1446 may also help control damping-off on lettuce.[4] Pythium damping-off has not shown to be a common problem for lettuce grown in the coastal areas of California.

Root Rot and Leaf Blight

Several species of *Pythium* are also associated with infection of the roots and lower leaves, causing root rots and leaf blights. Damage from these pathogens is usually minor, and control measures are usually not required for root and crown rot on lettuce because yield losses are typically minimal.[1]

Pythium Wilt

A more severe form of Pythium wilt was observed on lettuce plants in Japan in 2007, and the causal agent was determined to be *Pythium uncinulatum*, the same pathogen that causes root and crown rot.[3,5] The disease was first observed in California in 2011.[6] Another species, *P. tracheiphilum*, has been identified as a cause of Pythium wilt in Argentina.[7] Pythium wilt has been observed in California for over ten years and is now

(Continued on page 2)

(Continued from page 1)

considered to be a major soilborne disease of lettuce in the Salinas Valley. Pythium wilt resulted in up to 100% yield losses in lettuce plantings in the Salinas Valley in 2020.

Pythium wilt typically develops initially on plants in the rosette stage or older. Symptoms include stunting of plants and yellowing and wilting of the outer, older leaves (Figure 2). The leaves will then turn brown and die. With time the plants will collapse. Sometimes the older affected leaves will collapse, but the younger leaves will remain upright. A dark-yellow to brown discoloration develops on the tap root (Figure 3), and infected plants have reduced root systems and some necrosis of the root tips on small feeder roots. With Pythium wilt, the crown of the plant does not rot, and plants do not break off at the soil line when tugged, as they do with Sclerotinia rot (drop).[1,3,6]

Figure 2. Older leaves wilting on lettuce plants infected with *Pythium uncinulatum*. Steven Koike, TriCal Diagnostics.

The host range of *P. uncinulatum* is poorly understood, but lettuce is the only crop species identified as a host. The pathogen survives as spores in the soil, and plants are infected by swimming zoospores. Pythium wilt is often most severe in wetter parts of the field, at the bottom ends of fields, and in areas with poor drainage. The incidence and severity of the disease may increase after periods of hot temperatures.

Figure 3. Rotting of the tap and lateral roots on a lettuce plant affected by Pythium wilt. Steve Koike, TriCal Diagnostics.

Co-infection with other soilborne pathogens or with impatiens necrotic spot virus (INSV) can occur.[3] Symptoms of INSV infection include chlorosis (yellowing) and necrosis of the inner leaves and significant stunting of the plant. Wilting of the older leaves, root rot and root discoloration are not symptoms associated with INSV infection. The presence of typical INSV foliar symptoms along with wilting of the older leaves may be an indication that the plant is coinfected by both INSV and *Pythium uncinulatum*.[8] In such situations, laboratory tests may be necessary to correctly identify the pathogens involved.

Studies are underway to evaluate methods for managing Pythium wilt. There are some differences in susceptibility among lettuce varieties, but no varieties are completely resistant. Some head types of lettuce appear to be less susceptible to the disease. Trials with Oomycete-specific fungicides have shown some efficacy for slowing the growth of the pathogen in laboratory experiments, and the effectiveness of fungicide seed treatments and soil drenches are being evaluated.[3,9]

Sources:

[1] Davis, R. 2017. Pythium wilt, leaf blight, and root rot. In *Compendium of Lettuce Diseases and Pests, Second Edition,* Subbarao, K., Davis, M., Gilbertson, R., and Raid, R. editors. The American Phytopathological Society, St. Paul.

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[4] Lettuce (*Lactuca sativa*)-damping-off. Pacific Northwest Pest Management Handbook. https://pnwhandbooks.org/plantdisease/host-disease/lettuce-lactuca-sativa-damping.

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[6] Koike, S. 2018. Pythium wilt: main root rot disease of lettuce. TriCal Diagnostics. https://www.tricaldiagnostics.com/2018/10/26/pythium-wilt-main-root-rot-disease-of-lettuce/.

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[8] Smith, R. Dundore-Arias, J., and Koike, S. 2020. Pythium & INSV infections in Salinas lettuce fields. Vegetables West Grower & PCA. 9/24/2020. https://vegetableswest.com/2020/09/24/pythium-insv-infections-in-salinas-lettuce-fields/.

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Websites verified 03-02-2023

For additional agronomic information, please contact your local seed representative.

Performance may vary from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields. The recommendations in this article are based upon information obtained from the cited sources and should be used as a quick reference for information about vegetable production. The content of this article should not be substituted for the professional opinion of a producer, grower, agronomist, pathologist and similar professional dealing with vegetable crops.

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