



AGRONOMIC SPOTLIGHT



FUSARIUM ROTS IN PROCESSING TOMATOES

- » Fusarium crown and root rot and Fusarium foot rot are important root infecting diseases of tomato.
- » Fusarium crown and root rot causes symptoms similar to those of Fusarium wilt.
- » Management strategies for both of these rot diseases focus on minimizing the spread of the pathogens.

FUSARIUM CROWN AND ROOT ROT

Fusarium crown and root rot is caused by the fungus *Fusarium oxysporum* f. sp. *radicis-lycopersici*, a close relative of the Fusarium wilt pathogen. Fusarium crown and root rot (FCRR) has become one of the most damaging soilborne diseases of tomato.¹ FCRR is found in most of the major tomato growing regions of the world, including the U. S., Canada, Mexico, Israel, Japan, and many countries in Europe. In the U. S., the disease occurs in California, Colorado, Florida, New Jersey, New York, New Hampshire, Ohio, Pennsylvania, and Texas.^{1,2,3} FCRR is becoming more common and widespread in California and Florida. The disease causes significant yield losses in both greenhouse and field-grown tomato production systems, and yield reductions of 15 to 65% have been reported.^{1,4}

Symptoms, including yellowing and premature dropping of cotyledons, can be seen on infected seedlings at the time of transplanting.³ However, symptoms typically begin to show when plants are nearing the mature-green fruit stage. On these more mature plants, the initial symptoms include a yellowing of the oldest leaves. The yellowing gradually progresses up the plant to the younger leaves as the disease develops, and symptoms may be restricted to a single branch of the plant (Figure 1).^{2,5} Affected leaves may wilt during the heat of the day but recover overnight, and in some cases, flowers may wilt and die. These symptoms are similar to those associated with Fusarium wilt.



Figure 1. Foliar yellowing and wilt symptoms start on the lower leaves and progress upward on the plant.

Prominent lesions develop on the hypocotyl (lower stem) and on the tap- and lateral-roots (Figure 2A). These lesions are typically round in shape and chocolate brown in color. A brown discoloration in the cortex (Figure 2B) can extend beyond the externally visible lesions, up to 10 inches above the soil-line, but the discoloration will not move up into the upper parts of the plant as is seen with Fusarium wilt.^{2,3} Adventitious roots may proliferate above the affected



Figure 2. (A) external root rot symptoms of Fusarium crown and root rot; (B) internal discoloration of the root cortex.

stem tissues., and sometimes white mats of fungal growth with pink spore masses will develop on dead tissues. Plants can be killed by FCRR when the disease is severe.

The FCRR pathogen survives in the soil as spores and on the roots of alternate hosts including eggplant, peppers, some legumes and cucurbits, beets, spinach, carrot, cabbage, wheat, and several weed species. The pathogen can spread by infected transplants and through the movement of infested soil and equipment.^{1,2}

The FCRR pathogen infects tomato root systems through wounds created by emerging lateral roots. Infection and disease development are favored by cool temperatures (59°F to 68°F). The disease develops best in areas with low soil pH levels, high chlorine salt levels, applications of ammonia forms of nitrogen, and water-logged soils. The pathogen can spread from plant to plant during the season through root contact.^{1,2} The pathogen can also spread through wind-blown spores to re-infest steam-sterilized or fumigated soils.

Management strategies for FCRR focus on preventing infection and limiting the spread of the pathogen.¹ Growers should plant only pathogen-free seed and transplants. Transplant production houses should not be located near production fields, and stringent sanitation practices, including disinfecting pots and trays and cleaning and sanitizing benches and tools, should be used between transplant crops. Avoid overwatering transplants, as that makes them more susceptible to FCRR. Transplant seedlings when soil temperatures are above 68°F, and avoid injuring seedlings during transplanting.^{1,2,3}

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In the field, maintain soil pH levels in the 6 to 7 range, and avoid the use of ammonia-based fertilizers. Minimize plant stress throughout the growing season. Incorporate crop debris promptly after harvest to promote rapid decomposition. Long-term rotation to non-host crops, such as corn and other monocots, can help prevent the buildup of inoculum in the soil. Soil fumigation is usually not effective for controlling FCRR because the fungus can quickly recolonize fumigated soil. A single dominant gene for resistance to FCRR (*Fr1*) has been identified, and it is used in some tomato varieties. However, most commercial tomato varieties are susceptible to this disease.^{1,2,6}

FUSARIUM FOOT ROT

Fusarium foot rot (FFR) is caused by the fungus *Fusarium solani* f. sp. *eumartii*, which also causes Eumartii wilt on potatoes. This pathogen also infects the roots of peppers and eggplant. FFR occurs in Australia, India, Israel, Ivory Coast, Turkey, and the U.S.^{2,7}



Figure 3. Fusarium foot rot causing a brown lesion on the tap root.

The root symptoms of FFR include reddish-brown lesions moving into the cortex of tap roots and large lateral root (Figure 3). Vascular discoloration can be seen extending 1 to 4 inches above and below the externally visible lesions.² Foliar symptoms of FFR distinguish this disease from FCRR and Fusarium wilt. Leaves of FFR infected plants show interveinal chlorosis and necrosis (Figure 4). These foliar symptoms are often restricted to a single branch,

at least initially. As the root rot phase advances, the leaves turn brown and collapse, but plant death is unusual.²

The FFR fungus can survive in the soil for two to three years in the absence of a susceptible host. However, the fungus can survive on a wide range of plant species, even though it does not cause disease symptoms on most of them. Once introduced into an area, the FFR pathogen is difficult to eradicate. Like the Fusarium crown rot pathogen, this fungus infects through naturally occurring root wounds. In California, the disease is most severe at temperatures between 77°F and 86°F. In Australia, the severity of the disease increases as the temperature decreases to 59°F.²

All currently available commercial tomato varieties are susceptible to Fusarium foot rot. However, some varieties are more tolerant of the disease than others.² Rotation to non-



Figure 4. Interveinal chlorosis and necrosis of leaflets on a plant infected with Fusarium foot rot. Courtesy of Brenna Aegerter, University of California Cooperative Extension. Division of Agriculture and Natural Resources.

host crops for at least four years can help prevent the buildup of inoculum in the soil. Some studies have shown partial control of FFR using a combination of fungicide applications following soil fumigation or soil solarization treatments. The primary strategy for managing Fusarium foot rot in commercial tomato operations is to limit the spread of the pathogen within and between fields by minimizing the movement of infested soil. This requires the thorough cleaning of equipment and workers shoes and clothing before entering pathogen free areas.

Sources:

- ¹ Ozbay, N. and Newman, S. 2004. Fusarium crown and root rot of tomato and control methods. *Plant Pathology Journal* 3(1):9-18.
- ² Jones, J., Zitter, T., Momol, T., and Miller, S. 2014. Compendium of tomato diseases and pests, 2nd Ed. American Phytopathological Society, St. Paul.
- ³ Zhang, S., Roberts, P., McGovern, R., and Datnoff, L. 2014. Fusarium crown and root rot of tomato in Florida 1 2 UF-IFAS Extension. PP52.
- ⁴ Davis, R. M., Miyao, G., Subbarao, K., Stapleton J., and Aegerter, B. 2103. Tomato: Fusarium crown and root rot. UC Pest Management Guidelines.
- ⁵ Davis, R. M., Miyao, G., Subbarao, K., Stapleton J., and Aegerter, B. 2103. Tomato: Fusarium foot rot. UC Pest Management Guidelines.
- ⁶ Vakalounakis D. 1988. The genetic analysis of resistance to Fusarium crown and root rot of tomato. *Plant Pathology* 37:71-73.
- ⁷ Romberg, M. K., and Davis, R. M. 2007. Host range and phylogeny of *Fusarium solani* f. sp. *eumartii* from potato and tomato in California. *Plant Dis.* 91:585-592.

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 tomato 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 this specific crop.

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