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Fusarium Root Rot of Common Beans

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Soilborne fungal pathogens are widespread throughout dry bean and snap bean production areas. They can affect quality as well as yield. Pathogens that predominate and limit production differ from one bean-growing region to another. *Fusarium* root rot (caused by *Fusarium solani* [Mart.] Sacc. f. sp. *phaseoli* [Burk.] W.C. Snyder & H.M. Hans.) is one of the most prevalent soilborne bean diseases in Michigan, sometimes as part of a complex with *Rhizoctonia solani* and *Pythium* spp. Root rot can cause severe yield losses, especially when adverse environmental conditions (such as soil moisture and soil compaction) persist after planting and through flowering.

Disease symptoms

Unlike other root-rotting diseases, *Fusarium* root rot does not cause seed rot or damping-off of seedlings. Symptoms do not appear until two or three weeks after planting. The first symptoms are narrow, long, red to brown lesions on the stems; lengthwise cracks often develop (Fig. 1). Lesions extend down the main taproot, which may shrivel, decay and die. The symptoms in some cases extend up the hypocotyl to the soil surface. Clusters of fibrous roots (lateral roots or adventitious roots) commonly develop above the shriveled taproot (Fig. 1). These roots can compensate to some extent for dead roots, and under ideal growing conditions they will limit aboveground symptoms. Infected plants are frequently stunted, grow slowly compared with healthy plants, and are light green to yellow. Poor root function deprives plants of nutrients and water, which can result in uneven plant stands and reduce yield.

Figure 1. Severe *Fusarium* root rot kills primary and secondary roots of beans, and most times only adventitious roots are visible. Note the typical red-brown symptoms of *Fusarium* root rot on the taproot.

Conditions that favor disease

Factors that reduce root growth increase susceptibility to *Fusarium* root rot, particularly in soils where beans were grown previously. The severity of root rot depends on cultural and climatic factors such as plant spacing, soil moisture, depth of planting and stress from low or high temperature. Soil factors are very important as well, such as the presence of hardpan layers, low fertility, pesticide or fertilizer injury, flooding

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or extended drought, and soil compaction that restricts root growth. The effect of *Fusarium* root rot is most apparent during flowering and early pod set.

Management practices to avoid

- Dense plant populations that increase plant stress and favor infection.
- Improper cultivation that injures roots.
- Short rotations, which build up populations of soilborne pathogens.
- Use of herbicides that may suppress root expansion in cool weather — e.g., Dual, Prowl, Treflan.
- Early planting in cool, wet or heavy soil, which favors the disease, particularly if the soil is compacted from being worked when it is wet.

Cultural control

1. The best prevention strategy is to plant beans after soils have warmed up (55ºF) at a depth of 1/2 inch in a coarse, well-drained soil that has been optimally fertilized. A well-prepared seedbed promotes rapid seedling growth and minimizes root rot.
2. It is critical to minimize soil compaction and prevent or break hardpans. These physical factors severely limit root growth and can decrease oxygen to the roots, further stressing the plant.
3. Avoid close cultivation. If the base of the plant rots off and new roots (Fig. 2) form above the lesion, the plant may survive if the newly formed roots are not cut off.
4. Manage irrigation, plant spacing and soil moisture to provide enough water to the developing plant without causing moisture stress — either too little or too much. Drought or flooding stress predisposes plants to infection.
5. Use a long rotation (more than 3 years) of beans with non-host crops such as corn, wheat, barley or alfalfa, combined with grass or cereal cover crops.
6. Use of resistant varieties is recommended, though only moderate tolerance to *Fusarium* root rot has been identified in dry or snap beans.
7. Planting beans on ridges or using planting beds tends to promote adventitious rooting and minimize root rot infection. It is challenging to harvest this planting system, however.

Chemical control

There are no cost-effective chemicals for *Fusarium* root rot control. Seedling root health can be protected, and damping-off prevented, through seed treatments.

Persistence and transmission

Fusarium solani can survive in soil for many years as a resistant spore (the chlamydospore). The host range of *Fusarium solani* is relatively narrow — it is restricted to roots and residues of beans and related species such as soybean. The pathogen is moved around the field by wind, rain, irrigation water, farm implements, crop residues, and any other agent or process capable of moving soil. With each successive crop of beans, the pathogen population increases and the disease can become more severe.

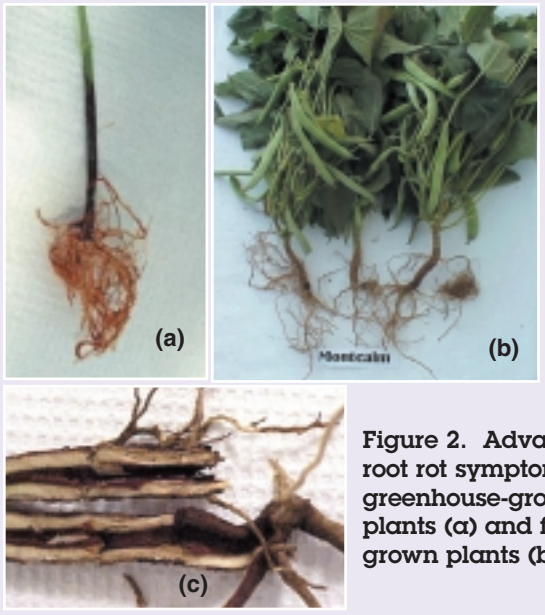

Figure 2. Advanced root rot symptoms in greenhouse-grown plants (a) and field-grown plants (b and c).

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