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

report on
PLANT
DISEASE

RPD No. 922
May 1989

DEPARTMENT OF CROP SCIENCES
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

# ROOT AND STEM ROTS OF GARDEN BEANS

Three common and destructive root and stem rots may damage garden beans in Illinois when conditions do not favor the best growth of the plants. These rots are caused by common soil-inhabiting fungi that attack bean plants at any stage of growth. Infection usually occurs early in the growing season when the soil moisture content is high. The causal fungi may live for several years in the soil in the absence of beans or other cultivated crops. The fungi causing these diseases are spread from plant to plant and from field to field by surface-drainage water, farm equipment or tools, feet of humans or animals, and other means whereby infested soil or bean debris is moved from one location to another. Losses are greatest where little or no rotation is practiced (Figure 1). It is possible to have a complete loss of stand in a field and then reseed and have little or no problem due to a change in growing conditions.

*Figure 1. Severe Fusarium root rot in a bean field (courtesy Dr. B.J. Jacobsen).*

For the proper examination of bean roots, the plants should be dug up carefully and the soil gently washed from the fibrous roots. Roots of severely infected plants are reduced in size, discolored, and show different degrees of decay. The symptoms of the three most common root rot diseases and the biology of causal fungi are described:

1. **Fusarium Dry Root Rot and Stem Rot** (*Fusarium solani* f. sp. *phaseoli*). A slight reddish discoloration on the taproot appears a week or more after the seedling emerges. The discoloration gradually becomes brick red as the diseased area enlarges to cover most of the taproot; or narrow, reddish streaks develop on the stem and taproot below the soil surface. The taproot later turns dark brown, and lengthwise cracks generally develop. The small lateral roots and the end of the taproot usually shrivel and die (Figure 2). Affected plants are somewhat stunted, have an unthrifty color, and grow more slowly than healthy plants. Later, clusters of fibrous roots may form just under the soil surface and above decay on the stem. These roots frequently keep the plant alive, although in a weakened state, until harvest. Unless soil moisture is deficient, an almost normal crop may be produced. If extended dry weather occurs, however, the

*Figure 2. Fusarium dry root rot.*

*For further information contact Mohammad Babadoost, Extension Specialist in Fruit and Vegetable Pathology, Department of Crop Sciences, University of Illinois at Urbana-Champaign. (Phone: 217-333-1523; email: babadoos@uiuc.edu).*

leaves turn yellow and may drop prematurely, and pods are few and poorly filled; all due to the loss of nutrient and water absorbing capacity of the root system. In severe attacks, many young plants are stunted and killed, reducing the number of plants in the row (Figure 1). In general, plant damage is usually increased under environmental conditions that reduce crop growth. Examples include deep planting, soil compaction, hardpan layers, temperatures below 71°F (22°C), high or low pH, low fertility, pesticide or fertilizer injury, flooding, or an extended drought.

The *Fusarium* fungus survives from year to year in debris from diseased bean plants, bean-straw manure, infested compost, and on organic matter in the soil. The fungus produces three types of microscopic spores: small, thin-walled, one-celled macroconidia; larger, multi-celled, slightly curved macroconidia; and round, thick-walled chlamydospores (Figure 3). The fungus rarely produces its spores, however, until affected bean stems or roots have started to decompose. The fungus spores and mycelium are disseminated by farm equipment and tools, bean-straw manure, by animals, and by splashing rains or surface-drainage water. Despite the numerous methods of dissemination, the fungus spreads slowly. However, once introduced into a field or garden, it can live indefinitely on organic matter in the soil, even if beans are no longer planted. The *Fusarium* fungus overwinters by forming the thick-walled chlamydospores in bean stubble or manure. Chlamydospores serve as primary inoculum. The germination of chlamydospores is stimulated by exudates from nearby bean seeds and seedlings. Hyphae from germinated chlamydospores penetrate the epidermis and disease development follows. Contaminated seeds serve to disseminate the fungus to previously healthy field.

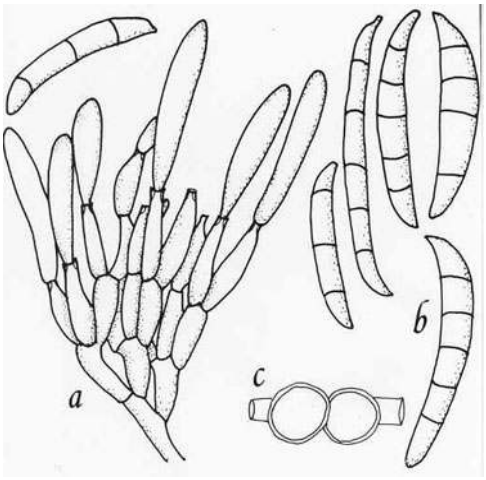


*Figure 3. Fusarium solani: (a) conidiophores bearing immature macroconidia; (b) macroconidia; (c) chlamydospores (drawing by Lenore Gray).*

Hosts of this root rot fungus include cowpea and the following beans: common or snap, lima, adzuki, kulti, moth, scarlet runner, and tepary. The disease is often found in association with other root and stem rots of bean, especially Pythium root rot.

2. **Rhizoctonia Root Rot and Stem Canker, Damping-off** (*Rhizoctonia solani = Thanetophorus cucumeris*). Infected seeds may rot, and young bean seedlings wilt and collapse (damp-off) from a water-soaked rotting of the roots and stem near the soil line; or seedlings may be twisted and stunted. Adjoining plants may later become affected. On older plants cankers develop on the stem and taproot which are reddish brown to brick red, slightly sunken, and extend lengthwise (Figure 4). The pith inside the stems of diseased plants may turn brick red. Older affected plants are often stunted, and their leaves turn yellow. Losses vary greatly from year to year with a possible 5 to 19 percent loss. The disease tends to be more prevalent in warm, relatively dry soils at temperatures cooler than those favorable for Fusarium dry rot.

*Figure 4. Rhizoctonia root rot and stem canker.*

The *Rhizoctonia solani* fungus (sexual stage *Thanetophorus cucumeris*) is found in practically all soils and is capable of causing diseases in hundreds of different plants including all known vegetables. The fungus is subdivided into many strains that differ in the hosts and the tissues they attack. It persists indefinitely in soil and survives as small, brown, rounded sclerotia, which are highly resistant to heat, cold, drought, and most chemicals. Under favorable conditions, the sclerotia germinate by producing delicate hyphae (Figure 5) that grow through the soil and invade bean hypocotyls, roots, and stems through intact tissues as well as wounds or natural openings when sufficient moisture is present for penetration to occur. Once inside, *Rhizoctonia* continues to develop and cause decay regardless of external moisture. On infected plant parts, under moist conditions, the hyphae can be seen with a hand lens as a brownish tuft. The sexual stage plays little or no role in the disease cycle.

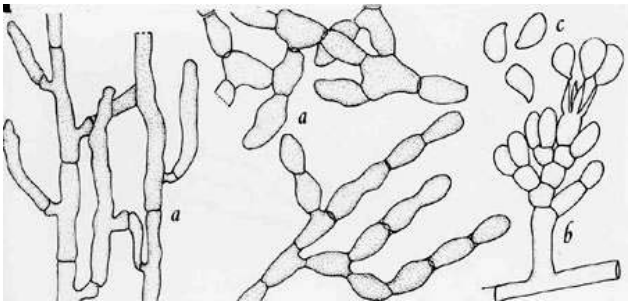


*Figure 5. Rhizoctonia solani (sexual stage Thanetophorus cucumeris): (a) young and old hypae of Rhizoctonia solani; (b) the sexual stage with a basidium bearing three basidiospores; (c) basidiospores (drawing by L. Gray).*

3. **Pythium Root Rot, Damping-off** (*Pythium* species). Infected seeds may decay or seedlings quickly wilt and die (damping-off) before or after emergence from a watery root and stem rot that is colorless to dark brown (Figure 6). The slimy outer tissue of the stem slips easily from the central core. When half-mature plants become infected, they may survive for a week or more, but eventually they wilt and die. In hot, moist weather they may wilt and die rapidly from a soft, water-soaked rot of the stem at and below the soil line. A cottony growth can sometimes be seen on infected stems early in the morning.

*Figure 6. The young bean plants to the left have wilted and died from Pythium root rot (Purdue University photograph).*

Pythium diseases are most severe in wet soils since the causal fungi produce masses of microscopic, motile zoospores that can swim short distances to attack bean root hairs, small rootlets, and stems (Figure 7). The disease may occur over a broad range of temperatures (60° to 90°F or 15° to 32°C) because each of the several species of *Pythium* involved have their own optimum range. For example, *Pythium ultimum* and *P. debaryanum* are most prevalent and damaging at cooler temperatures (about 60°F or 15°C) while *P. aphanidermatum* and *P. myriotylum* are more commonly destructive at high temperatures (around 80° to 85°F or 26° to 30°C).

All species of *Pythium* attack a wide range of crop and weed plants especially in the seedling stage. The fungi produce enzymes which cause a breakdown of pectin, giving rise to a soft, watery rot. In the absence of a host plant, species of *Pythium* are capable of surviving indefinitely in soil as saprophytes, feeding on organic matter in the soil, and remaining viable as dormant, thick-walled oospores (Figure 7). Oospores are sexual spores and the primary overwintering structure. *Pythium* species are not vigorous competitors with other microorganisms in the soil. The fungi are disseminated in surface-drainage water and in infested soil on farm equipment, tools, feet of humans and animals, and by any agency that moves soil from one location to another.

## CONTROL

A total disease management program is needed to reduce losses from these soilborne fungi. The following practices, collectively, will reduce losses to a minimum:

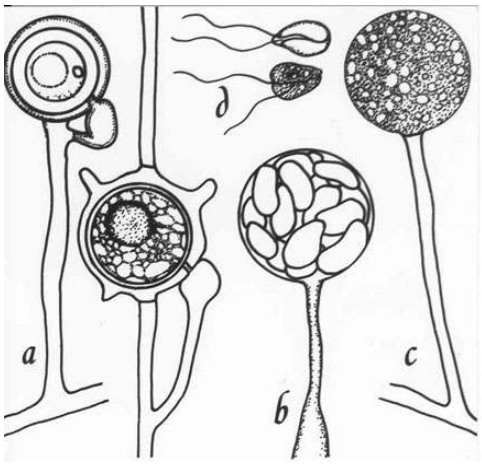


*Figure 7. Pythium species: (a) oogonia fertilized with monoclinous antheridia; (b) inflated sporangium (vesicle) containing immature zoospores; (c) typical sporangium; (d) two zoospores (drawing by L. Gray).*

1. If possible, practice a 4- or 5-year or preferably longer rotation between bean crops. Where feasible, include cereals, grasses, corn, or sorghum in the rotation.

2. The addition of soil amendments, such as sawdust, bark, crop residues and green manure, can be effective for Pythium control, probably by encouraging soil flora antagonistic to *Pythium* species. Incorporation of barley straw into infested soil has been reported to reduce *F. solani* activity on host roots.

3. Cut all cover crops and let them dry completely. Plow down crop residues 6 to 8 weeks before planting.

4. Plant only certified, western-grown, disease-free seed as shallow as soil moisture will permit. Treat the seed with a seed-protectant fungicide before planting. For current fungicide recommendations and procedures for seed treatment, refer to C1373 Midwest Vegetable Production Guide for Commercial Growers (revised annually).

5. Plant only in a warm (60° to 65°F or 15° to 18°C), well-prepared, well-drained, and well-fertilized seedbed capable of supporting excellent vine growth. Fertilize on the basis of a soil test. For fertilizer suggestions read Circular 1354, Illinois Homeowners' Guide for Pest Management. Maintain optimal soil fertility. The soil reaction should be around pH 6.5. Growing beans on raised ridges or beds will be beneficial during cool, wet weather. Close spacing and high plant canopy will increase root rot and foliar diseases by maintaining high soil moisture and reducing air movement, especially late in the growing season.

6. The use of herbicides dinoseb and trifluralin, preplant incorporated, have provided good control of Fusarium dry root rot and increased yields. Refer to Circular 1354, mentioned above, for current recommendations.

7. In-furrow or band applications of fungicides at planting have provided effective control of *Pythium*. For current fungicide recommendations refer to above mentioned publications or contact your nearest Extension office.

8. Avoid deep and close cultivation, which shears off fibrous roots and provides wounds through which root-rotting fungi may enter. Cultivation should cease as soon as root rot appears unless oil compaction is limiting root growth.

9. Do not feed infected bean straw and refuse to livestock or use it in the bedding.

10. In the fall, where feasible, cleanly plow down all diseased bean refuse left on the field or garden.

11. At present, no commercially acceptable cultivars with resistance to root-rotting fungi are available. However, planting cultivars that perform well in Illinois may prevent some loss due to disease. Consult current seed catalogs and trade publications. A list of seed companies is listed in the Illinois Homeowners' Guide to Pest Management.

For information on availability of any publications mentioned above, contact your nearest Extension office or ITCS, University of Illinois P345, 1917 S. Wright St., Champaign, IL 61820.