COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT

Plant Pathology Fact Sheet PPFS-OR-H-10

Garden Mum Production: Diseases and Nutritional Disorders

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Introduction

Many Kentucky vegetable and greenhouse producers are beginning to include fall chrysanthemum production in their operations. Garden mums are usually planted in June and sold in September when fall color is in demand. Production can vary in size; small scale growers may produce as few as 200 plants per season. Size of the operation influences cultural practices, as well as initial investments in important practices (e.g., surface drainage, pre-plant fungicide dips, and pre-emergent herbicides); all of which can impact disease management.

Most garden mums produced in Kentucky are container-grown. Typically, these plants are set outdoors onto nursery cloth that is in direct contact with natural ground. The most common mum diseases are caused by soilborne pathogens, which overwinter in soil beneath nursery cloth. If plants are set into the same areas year after year, inoculum (fungal and bacterial survival structures) builds up and disease risk increases with each passing season. In these cases, disease losses can be as much as 50%, while average losses range from 10% to 25%.

Diseases

Bacterial Blight

Symptoms

Cuttings of highly susceptible cultivars develop a brown to black stem decay (Figure 1), resulting in stunting (Figure 2) or death. In other cultivars, the pathogen may invade the vascular system and pith while cuttings appear symptomless. As plants become established, infection spreads; plants may wilt during sunny days but recover at night. As the disease progresses, terminal shoots collapse and darken.

Cause and Disease Development

The pathogen (*Erwinia chrysanthemi*) survives in crop debris and is easily spread by infested tools and hands. Visually symptomless cuttings and stock plants can serve as sources for transmission. Disease is favored by surface moisture, high temperatures, and high relative humidity.

Disease Management

- Purchase culture-indexed cuttings that are free of pathogens.
- Avoid wetting foliage; opt for drip irrigation instead of overhead irrigation.
- Inspect plants and cuttings regularly; discard infected plant material and plant debris.
- Replace nursery ground cloth and disinfect propagation beds between crops.
- Space plants for increased air circulation; this promotes rapid drying and reduces relative humidity.
- A bactericide or antimicrobial may be used as a protectant when environmental conditions are conducive for disease or bacterial blight was diagnosed within the nursery or greenhouse. Once infection occurs, chemical control is not effective.

Figure 1. Brown to black stem decay is a common symptom of bacterial blight; often plant death results.

Figure 2. Seedlings infected with the bacterial blight pathogen often become stunted.

Bacterial Leaf Spot

Symptoms

Small tan to dark brown circular to elliptical spots initially appear on lower leaves. As spots enlarge and coalesce, they become irregular in shape (Figure 3) and are often limited by major veins. When leaf spots become dry, they crack and centers may drop out leaving a shot-hole appearance. Infection may extend to flower buds and stems.

Cause and Disease Development

The bacterium, *Pseudomonas cichorrii*, is spread via infected plants, plant debris, contaminated soil, and infested pots and tools. Disease development is favored by extended periods of moisture.

Disease Management

- Purchase cuttings that are certified disease-free.
- Grow resistant cultivars (ask supplier for listing).
- Avoid wetting foliage; opt for drip irrigation instead of overhead irrigation.
- Inspect plants and cuttings regularly; discard infected plant material and plant debris. Plants near infected mums, even if they appear healthy, should also be removed to limit further spread.

Figure 3. Bacterial leaf spot symptoms include spots that rapidly enlarge and coalesce.

- Space plants for increased air circulation; this promotes rapid drying and reduces relative humidity.
- A bactericide or antimicrobial may be used as a protectant when environmental conditions are conducive for disease or if bacterial leaf spot was diagnosed within the nursery or greenhouse. Once infection occurs, chemical control is not effective.

Fungal Leaf Spots and Blight

Symptoms

Leaf spotting often first begins on lower foliage and then moves upward. Depending on the pathogen species, spots may initially be yellow, bronze, or reddish. Later, spots turn brown to black and may have lighter centers (Figure 4). Numerous spots result in necrosis of large areas of leaves and, finally, death of entire leaves. Ray blight may affect one side of unopened flower buds, resulting in delayed development and browning of petals. Blossoms droop as infection spreads down the stem.

Cause and Disease Development

Several fungi may cause leaf spots on mum, including *Alternaria* spp., *Septoria* spp., and *Cercospora chrysanthemi. Ascochyta* causes leaf and ray blight. These fungi overwinter in plant debris and infected stock plants. Fungal spores are spread by splashing rain, overhead irrigation water, and air currents.

Disease Management

- Remove leaves from plants with mild symptoms; dispose of heavily infected plants.

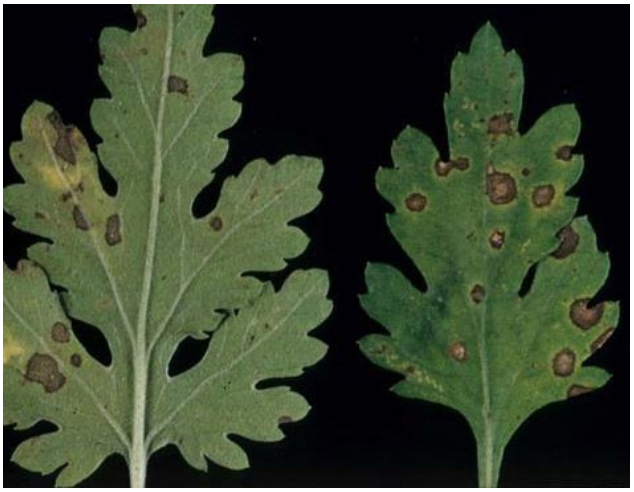

Figure 4. Fungal leaf spots are often brown to black with lighter centers. This photo shows Septoria leaf spot.

- Remove and destroy plant debris in pots and on the ground.
- Avoid wetting foliage; opt for drip irrigation instead of overhead irrigation.
- Use fungicides as protectants. Contact your county Extension agent for current recommendations.

Fusarium Wilt

Symptoms

Affected plants wilt and turn yellow (Figure 5). Often, a single branch or plantlet will show symptoms before the rest of the plant. Necrosis or brown streaks may be visible on outer surfaces of stems, and cross sections usually indicate necrotic (brown decay) vascular tissue. Often, Fusarium wilt is present with other soilborne diseases, such as Pythium root rot.

Cause and Disease Development

The pathogen (*Fusarium oxysporum*) is a soilborne fungus that infects plant roots and then invades vascular systems. Collapse of these water and nutrient "highways" can result in starvation of upper plant parts, resulting in stunting, yellowing foliage, wilting (Figure 6), and plant death.

Disease Management

- Adjust pH to 6.5 to 7.0 (avoid highly acidic soil).
- Avoid infection by preventing contact with soil or surface water.
- Fungicides are ineffective in managing Fusarium wilt because they only temporarily suppress the disease; symptoms will return as soon as plants are sold.

Figure 5. Fusarium wilt causes yellowing and subsequent wilting.

Figure 6. Wilting results when plant vascular systems collapse (diseased plants at arrows).

Pythium Root Rot

Symptoms

Decaying roots turn black and the root cortex may slough off (Figure 7). Black stem lesions may be visible without a hand lens. Affected plants may be stunted, and foliage may turn yellow and wilt. Plant death can result.

Cause and Disease Development

The pathogens, *Pythium* spp., are water molds (fungus-like, but not fungi) that favor cool, wet conditions. Water molds produce swimming spores that move freely in water and moist soil, increasing risk of infection when water puddles underneath pots. *Pythium* infects at root tips and then colonizes root systems, causing root loss. Plants wilt from lack of water uptake.

Disease Management

- Cultural practices, including proper soil drainage and increased sanitation, are critical components for a preventative disease management program.

Figure 7. Pythium root rot results in decaying roots; root cortex may slough off (examples at arrows).

- Preventative fungicides labeled for water molds should be used at planting. Contact your county Extension agent for current recommendations.
- Infected plants are not curable.

Rhizoctonia Stem Rot

Symptoms

Roots decay and reddish-brown cankers develop on lower stems at or near the soil line (Figure 8). As stem cankers enlarge, they girdle plants and impede flow of water and nutrients to upper plant parts.

Cause and Disease Development

The pathogen, *Rhizoctonia solani*, does not produce spores but can produce tiny structures called sclerotia that enable it to survive for long periods in cold or drought. Disease spread of mycelia (thread-like fungal bodies) and sclerotia occurs via infested soil and crop debris.

Disease Management

- Use pasteurized/sterile soil or soilless potting media.
- Sanitation is important in reducing carry-over from one planting cycle to the next.

Figure 8. Rhizoctonia stem rot causes reddish brown cankers to develop on lower stems.

- Preventative fungicides should be used at planting. Contact your county Extension agent for current recommendations.

Rhizoctonia Web Blight

Symptoms and Signs

Web blight usually advances as plants mature and canopies become dense so that inner foliage remains wet. Large parts of plants wilt and become necrotic (brown) as the fungus invades branches (Figure 9). The pathogen produces mycelia (thread-like fungal strands), which can often be seen without a microscope; mycelia appear as "webbing" (Figure 10).

Cause and Disease Development

The causal fungus, *Rhizoctonia solani*, does not produce spores, but moves via the growth of mycelia. Initial infections begin at the soil surface; crown rot may develop. Fungal webbing often expands to upper plant parts when plant canopies become dense and humid.

Disease Management

- Space plants to increase air circulation and promote rapid drying to help reduce disease development.
- Sanitation is important in reducing carry-over from one planting cycle to the next.
- Preventative fungicides may be used at planting and during early stages of growth, especially if the site has a history of disease. Contact your county Extension agent for fungicides currently labeled for this disease.

Figure 9. (top) Rhizoctonia web blight produces distinct symptoms on upper branches, leaves, and flowers. **Figure 10.** (bottom) The fungus produces mycelia that appear as webbing.

Nutritional Disorders

High Soluble Salts

Injury caused by high soluble salts commonly occurs when plants are over-fertilized. High salt levels in irrigation water or growing media can also result in high soluble salt levels. Injured plants may initially show a mild chlorosis (yellowing). As salts continue to build up within plants, the salts accumulate at leaf margins and leaf tips, causing them to turn brown (Figure 11). Roots may also be injured by high soluble salts, resulting in wilt. Root damage may predispose plants to root rot pathogens.

Soil pH

Recommended soil pH for garden mums grown in soilless mixes is between 5.8 and 6.2, while 6.0 to 6.5 is recommended for soil-based media.

Soil pH affects the solubility of nutrients in soil and their availability for plant uptake. Even when sufficient minerals are present, plants may not be able absorb them. In other cases, improper pH can result in increased nutrient uptake, and thereby nutrient toxicity. For example, soil pH below 5.5 can result in calcium, magnesium, or phosphorus deficiencies, while toxicities of aluminum, iron, or boron can occur. High soil pH, on the other hand, may cause deficiencies of phosphorus, boron, manganese, copper, and iron.

Calcium Deficiency

Initial symptoms appear on new growth as undersized, thickened, chlorotic leaves (Figure 12). Brown spots may appear on leaf margins within a few days and leaves cup downward. In severe cases, the growing point dies and growth ceases. Flower stems are also affected and flowers may have an abbreviated shelf-life. Roots of affected plants turn brown while new root growth appears stubby.

Iron deficiency

Interveinal chlorosis of young leaves is the first indication of iron deficiency. When severe, entire leaves may turn yellow or nearly white and irregularly shaped necrotic (dead) areas appear between veins. Plant growth is slowed and flowering is delayed.

Figure 11. High soluble salts accumulate at leaf margins and leaf tips, causing them to turn brown.

Manganese Deficiency

Affected plants are pale green with marginal and interveinal chlorosis of the new growth. Foliage eventually becomes uniformly chlorotic and necrotic spots may develop along leaf margins. Newly formed leaves are smaller than normal and flowering is delayed. As the deficiency continues, lower leaves gradually become necrotic, cup downward, and wilt. Root systems are undersized, but otherwise appear healthy.

Figure 12. Calcium deficiency results in new growth that is undersized, thickened, and chlorotic.

Additional Resources

- Plant Pathology Extension Publications: Herbaceous Ornamentals
http://www2.ca.uky.edu/agcollege/plantpathology/extension/pubs.html#OrnamentalHerbaceous

- Plant Pathology Extension Publications: Greenhouse Crops
http://www2.ca.uky.edu/agcollege/plantpathology/extension/pubs.html#Green

- Garden Mum Production for Fall Sales (HortFacts 3-02)
http://www.uky.edu/hort/sites/www.uky.edu.hort/files/documents/gardenmums.pdf

- Garden Mums
http://www.uky.edu/Ag/CCD/introsheets/mumsintro.pdf

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