Tomato Disease Identification

1. **Early blight**, caused by the fungus **Alternaria solani**, usually begins on older leaves as dark, irregularly shaped spots. Spots enlarge up to ½ inch in diameter and are characterized by a black, target-like, concentric ring pattern (Figure 1A). Spots are surrounded by a yellow halo (Figure 1B). Zonate spots may also occur on stems, leaf petioles, and fruit (Figure 1C). If early blight is severe, whole leaves turn yellow and quickly dry (Figure 1D). The resulting leaf shed causes sunscald on the fruit.

2. **Septoria leaf spot** is caused by the fungus **Septoria lycopersici**, and symptoms are seen mainly on leaves. Symptoms first appear on older leaves as small grayish white spots surrounded by a dark brown border. Black pepper-size dots can be seen in the center of each spot (Figure 2A).

3. **Bacterial spot and bacterial speck** produce similar symptoms on leaves and fruit. Bacterial spot is caused by **Xanthomonas campestris pv. vesicatoria**. Initially, leaf spots appear as small, circular to irregular, dark green areas on the lower leaf surface. With age, spots become purplish-gray with black centers and are sometimes surrounded by a narrow yellow halo (Figure 3A). Spots will coalesce, causing whole leaves to die and drop prematurely (Figure 3B). Spots can also form on stems and petioles. Fruit spots first appear as small, dark, raised areas, which can be surrounded by a water-soaked border (Figure 3C). Spots later become slightly larger and take on a scabby, sunken appearance.

   Bacterial speck is caused by **Pseudomonas syringae pv. tomato**, although leaf and fruit symptoms are similar to bacterial spot, with bacterial speck large areas of tissue that borders leaf and fruit lesions may become yellow or white (Figure 3D).

4. **Fusarium wilt**, caused by the fungus **Fusarium oxysporum**, initially causes a yellowing and wilting of lower leaves on infected plants (Figure 4A). Symptoms can be seen either on a single branch, on several branches on one side of the plant, or on all the lower branches. The yellowing and wilting progress up the plant as the fungus spreads within its host. Yellow, wilted leaves often dry and drop prematurely (Figure 4B). Eventually, the entire plant wiltst and dies, producing few, if any, fruit. When the epidermis and cortical tissue (bark) on the main stem above the soil line are cut and peeled back, the area beneath the epidermis will have a distinct brown discoloration. (Figure 4C). The discoloration can extend from the roots, up the stem, through the branches, and into the petioles of the plant.

5. **Bacterial wilt** is caused by the bacterium **Pseudomonas solanacearum**. A characteristic of this disease is that plants wilt and die rapidly without yellowing or spotting of the foliage (Figure 5A). To identify bacterial wilt, a section of the epidermis and cortical tissue (bark) just above the soil line can be cut and peeled back. The center of the stem (pith) will appear water soaked in early stages; later, the pith will turn brown and sometimes become hollow (Figure 5B). If a portion of the affected stem is cut and placed in a clear-sided glass container filled with water, a white, milky ooze will stream out of the cut end of the discolored vascular tissue (Figure 5C).

6. **Southern blight** is caused by the fungus **Sclerotium rolfsii**. The first aboveground symptoms are leaf yellowing and wilting of infected plants (Figure 6A). The stem at the soil line often appears soft and sunken and develops a brown-to-black discoloration both internally and externally. Under moist conditions, a white fungal growth can be seen on the lower stem near the soil surface (Figure 6B), on fruit in contact with the soil, and on crop debris on the soil around the base of the plant. Spherical, light brown, mustard seed-size (1 to 2 mm) sclerotia often form on the mycelial mat (Figure 6C). Southern blight commonly spreads down the row (Figure 6D).

7. **Bacterial canker** is caused by **Clavibacter michiganensis subsp. michiganensis**. Vascular infections cause wilting, chlorosis, and eventual death of the plant. If the stem is cut open longitudinally, a yellow to reddish brown discoloration may be observed in the vascular tissue. In later stages, canker lesions may develop on the stem, petioles, and underside of the foliage (Figures 7A-B). Superficial foliar infections cause necrosis of the foliage, usually from the leaf margins inward. The necrosis can advance until the entire leaf and petiole dies. Early infection of the fruit can cause bird's-eye spots. Bird's-eye spots are characteristically white, necrotic lesions about ⅛ inch in diameter that soon develop dark centers surrounded by a white halo (Figure 7C).
8. **Late blight** is caused by the fungus *Phytophthora infestans*. Symptoms on leaves begin as greenish black, water-soaked, irregular blotches, which rapidly develop into large, purple black, papery lesions. The lesion margin is often purple black and pale yellow (Figures 8A-B). Lesions also appear on stems and leaf petioles (Figure 8C). During moist conditions, white, glistening, weblike fungal growth appears on the lower leaf surface at the lesion’s edge. If cool, moist conditions persist, blight will spread rapidly and kill the plant. On fruit, gray green, water-soaked, greasy spots appear near the stem end (Figure 8D). As lesions develop, they become brown and wrinkled. Under moist conditions, lesions expand, covering up to half the fruit surface. Decay may extend several inches deep into the fruit.

9. **Buckeye rot**, caused by the fungus *Phytophthora parasitica*, starts as a grayish green or brown spot on fruit that has come into contact with soil. Light and dark brown concentric bands appear in the affected area (Figure 9A). This firm, leathery rot is characterized by a smooth surface and lack of sharply defined margins.

10. **Tomato pith necrosis**, caused by the bacterium *Pseudomonas corrugata*, is sometimes confused with bacterial canker. Initial symptoms include yellowing of young leaves. These symptoms may progress into yellowing and wilting of the top part of the plant. Black streaking may be apparent on the main stem, which often splits. When the stem is cut open longitudinally, the center of the stem (pith) will be hollow and often have a chambered (ladderlike) appearance (Figure 10A). Profuse development of adventitious roots can be associated with the affected pith areas, and the stem may appear swollen.

11. **Tomato spotted wilt virus (TSWV)** is usually spread by thrips. Tomato plants infected with TSWV become stunted and often die (Figure 11A). Initially, leaves in the terminal part of the plant stop growing, become distorted, and turn pale green. In young leaves, veins thicken and turn purple, causing the leaves to appear bronze (Figures 11B-C). Necrotic spots, or ring spots, are frequently present on infected leaves, and stems often have purplish brown streaks (Figure 11D). Infected fruit may exhibit numerous ring spots and blotches. Fruit may become distorted if it is infected when immature (Figure 11E).

12. **Cucumber mosaic virus (CMV)** is usually spread by aphids. Plants are often stunted and bushy (with shortened internodes) and may have distorted and malformed leaves (Figure 12A). Leaves may appear mottled (intermingling of dark green, light green, and yellow tissue) and slightly to severely distorted (Figures 12B-C). The most characteristic symptom of CMV is extreme filiformity, or shoestringing, of leaf blades (Figure 12D). Plants infected early in their development produce few fruit.

13. **Root-knot nematode**, *Meloidogyne* spp., can attack tomatoes as well as more than 2,000 other plant species. When root-knot nematode populations are high, tomato plants often are stunted and exhibit nitrogen deficiency symptoms. Tomato plants may wilt during dry weather or during the hottest part of the day (Figure 13A). The nematode causes knots or galls to develop on both large and small roots; knots range in size from the head of a pin to an inch in diameter (Figure 13B).

14. **Blossom-end rot** is caused when soil conditions, such as high and low soil moisture or low soil pH, affect the plant’s ability to take up calcium. Dark brown sunken areas appear on the blossom end of the fruit (Figure 14A). Spots become leathery and may be covered with a black mold. Symptoms first appear on fruit that are half developed.

15. **Blotchy ripening or gray wall** is caused by adverse growing conditions, such as high nitrogen, low potassium, soil compaction, or low light intensity. Grayish brown, blotchy areas develop on infected green fruit. As fruit mature, these areas remain gray or turn yellow, and fruit appear to have ripened unevenly (Figure 15A). When fruit are cut open, the internal wall tissue is brownish (Figure 15B).

16. **Catfacing** is caused by adverse environmental conditions during initial fruit development, such as cool weather during fruit set and wide differences in day and night temperatures. Symptoms can include extreme fruit malformation, scarring, and concentric cracks around the stem end of the fruit (Figures 16A-B).