

DIAGNOSIS OF STRAWBERRY DISEASES



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Strawberries constitute one of the most widely grown fruit crops in the United States. In North Carolina, strawberries are grown for fruit and plant production. Diseases are a major factor limiting both fruit and plant production in North Carolina, and diseases are often difficult to control. Without accurate disease diagnosis, proper control measures cannot be used at the appropriate time. This publication is intended to aid in the diagnosis of strawberry diseases.

LEAF DISEASES

Leaf diseases develop in the summer and fall in all areas of North Carolina. These diseases seldom cause much damage on vigorous plantings of recommended cultivars.

SCORCH, the most common leaf disease, is caused by the fungus *Diplocarpon earliana* (Fig. 1). Symptoms appear as small dark-purple spots, 1/16-1/4 of an inch in diameter on upper leaf surfaces. If the spots become numerous, large areas of the leaf become reddish-purple to brown and the entire leaf may turn brown and die. Reddish colored, circular to elliptical spots may also appear on the leaf petiole and runners but generally do not cause much damage.

LEAF SPOT, caused by the fungus *Mycosphaerella fragariae*, has been the second most important leaf disease and can be severe on some cultivars (Fig. 2). Lesions appear as circular spots 1/8-1/4 inch in diameter. The spots are purple with a white to gray center.

LEAF BLIGHT, caused by the fungus *Dendrophoma obscurans*, is becoming more important (Fig. 3). Leaf blight appears as circular to wedge-shaped spots 3/8-1/2 inch in diameter. The spots have a dark brown center surrounded by a light brown ring and a purple border. Black to purple lesions may also appear on runners. Severely affected runners may be killed. Symptoms of leaf blight on runners may be confused with those caused by anthracnose (see anthracnose under crown diseases).

POWDERY MILDEW, caused by the fungus *Sphaerotheca macularis* f. sp. *fragariae*, is becoming more common. It causes leaves to curl upward along the margin but causes little damage to the plant (Fig. 4). Powdery

mildew is a problem as a leaf disease only on the cultivar Titan and is more common in the fall and winter months. Factors other than powdery mildew can also cause strawberry leaves to curl upward. A white fluffy fungus growth develops on the lower leaf surface; however, some magnification may be required to observe the white fungal mycelium and spores (also see powdery mildew under Fruit Diseases).

Leaf diseases are usually controlled by maintaining vigorous plantings of recommended cultivars.

FRUIT DISEASES

Diseases of strawberry fruit occur across North Carolina and can cause severe losses. The incidence and severity of fruit rot diseases are greater during or just after wet periods. Fruit diseases can cause 50 percent or more reduction in yield.

GRAY MOLD or BOTRYTIS FRUIT ROT, caused by the fungus *Botrytis cinerea*, is the most common and important strawberry fruit rot in North Carolina (Fig. 5). Gray mold often starts early as a blossom blight. Later, losses result from blighting of the flowers and rotting of green and ripe fruit. The fungus can progress downward killing berry stems and leaves. Gray mold losses can be very severe if ripe and over-ripe fruit accumulate in the field. In wet weather, diseased plant parts are covered with the characteristic fuzzy brown to gray mass of fungal spores. Gray mold fruit rot is very difficult to control in wet weather where there is an accumulation of dead leaves and a thick stand of excessively vigorous plants.

LEATHER ROT, caused by the fungus *Phytophthora cactorum*, occurs sporadically and may occasionally cause economical losses (Fig. 6). Leather rot occurs on flower buds and green or ripe fruit. The rotted area is light brown and shades to purple at the edge. In late stages of the decay, the fruit becomes tough and leathery. Disease development is very dependent on wet weather. Leather rot occurs across North Carolina but occurs more in the piedmont and mountains.

POWDERY MILDEW, caused by the fungus *Sphaerotheca macularis* f. sp. *fragariae*, occasionally causes fruit damage (Fig. 7). This damage occurs only when the cultivar Titan is present. If powdery mildew develops on

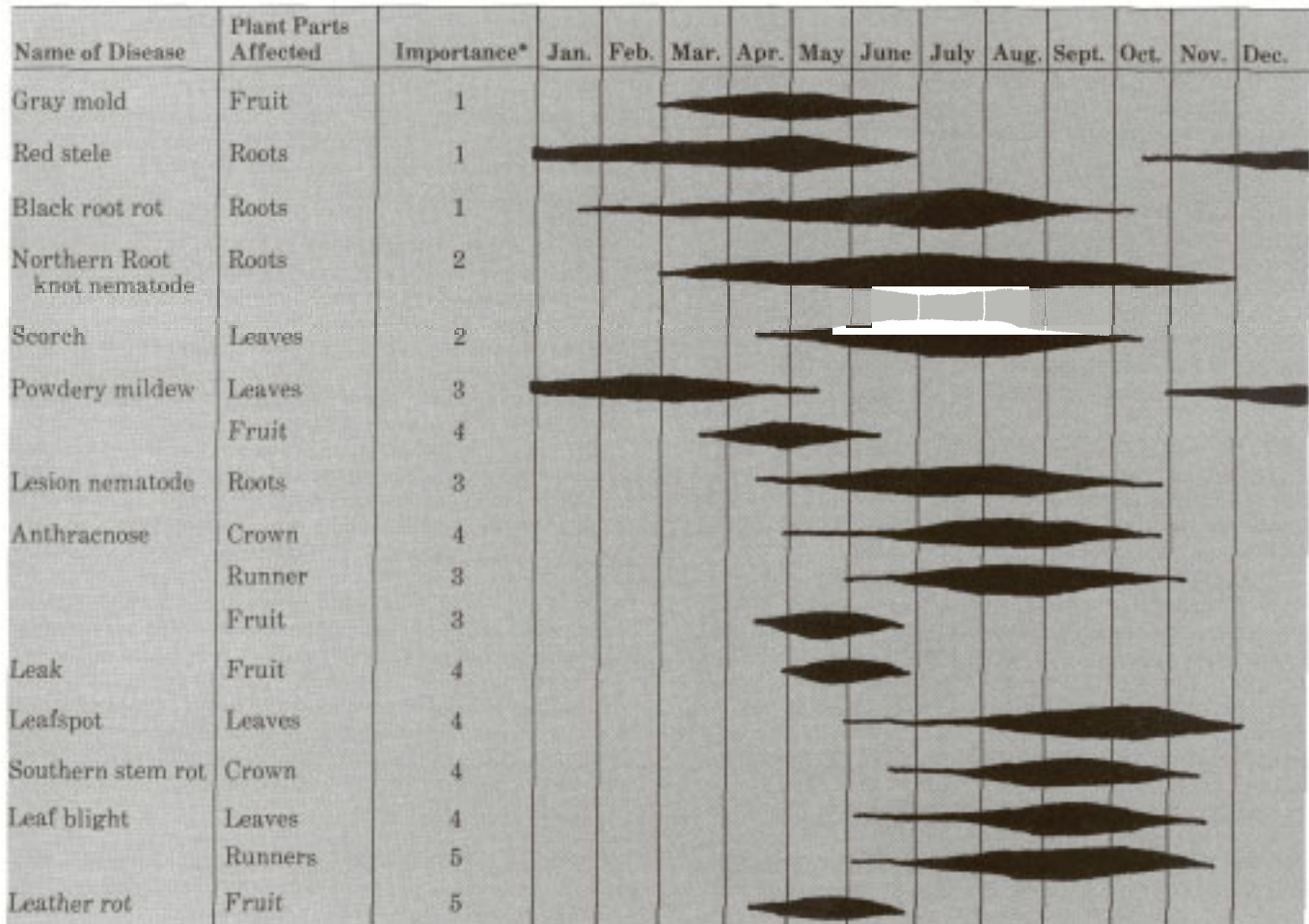
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Chart 1. Seasonal Occurrence and Relative Importance of Strawberry Diseases.

Plant Growth Stage

Flowering

Fruiting



*Importance is based on the average occurrence and losses across the state over several years (1 = occurs very frequently and/or causes severe losses, 5 = occurs rarely and/or causes little loss).



Fig. 1 Scorch



Fig. 2 Leaf spot



Fig. 3 Leaf blight

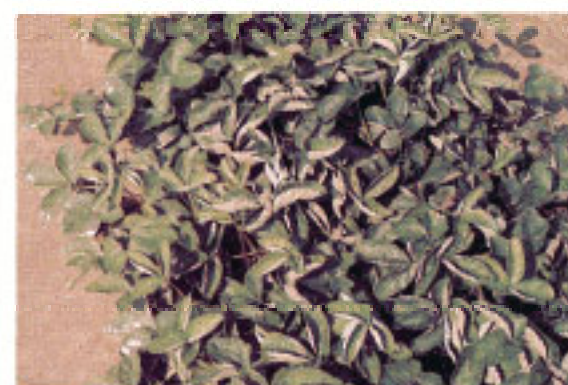


Fig. 4 Powdery mildew



Fig. 5 Gray mold



Fig. 6 Leather rot



Fig. 7 Powdery mildew

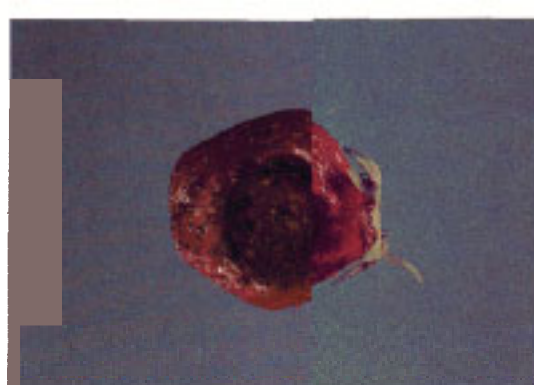


Fig. 8 Anthracnose fruit rot

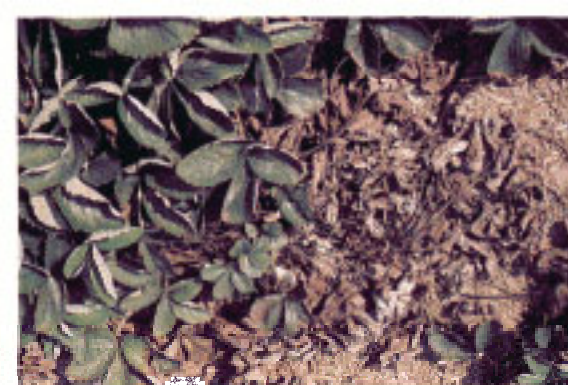


Fig. 9 Southern stem blight



Fig. 10 Southern stem blight sclerotia



Fig. 11 Anthracnose



Fig. 12 Anthracnose petiole lesions



Fig. 13 Anthracnose crown symptoms



Fig. 14 Red stele in field

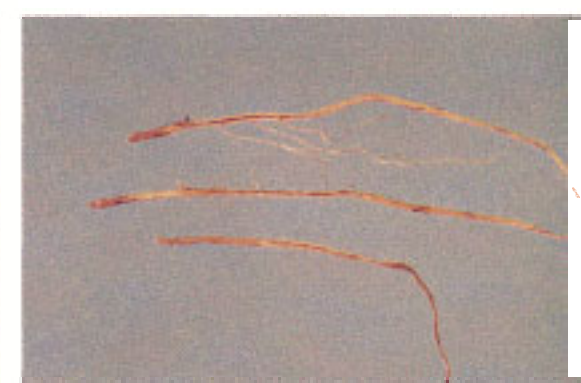


Fig. 15 Red stele in roots



Fig. 16 Black root rot



Fig. 17 Root knot nematode



Fig. 18 Slime mold



Fig. 19 Strawberry healthy roots

the leaves of the Titan cultivar, damage to fruit of Titan and other cultivars may appear. Damage to the fruit appears as a dull reddish-brown surface on ripe fruit with numerous surface cracks. Green fruit may also have a dull brown or russet surface. White fluffy growth of the powdery mildew fungus is seldom seen on the fruit. Fruit infection and surface damage occur during and soon after bloom.

ANTHRACNOSE FRUIT ROT, caused by the fungus *Colletotrichum* spp., is a problem along the coast on some California cultivars at the present time but may become increasingly important (Fig. 8). Anthracnose fruit rot appears as a firm dark purple rotten spot that is slightly sunken. In late stages of the disease slimy orange spore masses may be seen in the center of the rotten area. Anthracnose fruit rot is favored by warm wet weather.

Fruit rots are controlled through a combination of disease control practices such as: mulching, thinning plant stands, picking ripe fruit promptly, avoiding excessive plant vigor, providing good air circulation to promote fast drying, and regular preventive fungicide sprays.

CROWN DISEASES

Diseases affecting the strawberry crown are important because they occur frequently and kill entire plants. These diseases occur mostly in the piedmont and coastal plain areas of North Carolina.

SOUTHERN STEM BLIGHT, caused by the fungus *Sclerotium rolfsii*, occurs in the piedmont and coastal plain during hot summer months (Fig. 9). Diseased plants collapse, turn brown and die suddenly. The presence of white to brown 1/8 inch diameter sclerotia of the fungus around the dying crown is characteristic of the disease on strawberry (Fig. 10). This fungus has an extensive host range, and it is present in many soils. The fungus usually kills one or two plants in scattered spots rather than killing an entire field.

ANTHRACNOSE, caused by several species of closely related fungi, *Colletotrichum gloeosporioides* and *C. fragariae*, can be a serious problem in hot wet weather, particularly along the coast (Fig. 11). Different phases of anthracnose can occur on leaves, petioles, fruit (see fruit diseases), runners, and crowns. On runners, the disease starts as black elliptical lesions that quickly girdle and kill runners (Fig. 12) and young runner plants. Plants with crown infections wilt and die suddenly. A reddish-brown discoloration in the crown is characteristic (Fig. 13). If hot wet weather continues, the fungus can spread rapidly killing plants over large areas, particularly in wet parts of the field. Anthracnose has been more of a problem in plant production than in fruit production. Young runner lesions can be confused with those caused by scorch, leaf blight, and other fungal diseases.

Southern stem blight can be controlled by avoiding fields with a history of this disease. Anthracnose is controlled by purchasing certified planting stock, separation from diseased plantings, and avoiding excessive growth during the summer.

ROOT DISEASES

Root diseases of strawberry are extremely important because they not only reduce plant vigor and yields but can kill plants. These diseases occur in all parts of North Carolina. All of the root diseases cause similar above-ground symptoms (stunting, low yield, plant death, etc.)

and specific diagnoses can only be made by root and soil examination.

RED STELE, caused by the fungus *Phytophthora fragariae*, is one of the most serious diseases of strawberry (Fig. 14). It can occur anywhere in North Carolina where previous strawberry plants have had the disease. Diseased plants may be very stunted, produce few runners and fruit, wilt even with adequate soil moisture, and finally die. The most characteristic symptom is the reddish-brown discoloration of the central stele of otherwise white roots (Fig. 15). The red stele symptoms in the roots are only present during the winter and spring. In later stages of the disease, roots die and turn black, progressing from the root tip to the crown. Infected roots may have few if any small feeder roots. The presence of fungal reproductive structures (oospores) in the stele is the most critical indicator of infection. The disease often appears first in low or poorly drained areas of the field. Once soil becomes infested, the red stele fungus can survive in that soil for many years in the absence of strawberries.

BLACK ROOT ROT is a disease caused by a combination of one or more pathogens such as *Pythium* spp., *Fusarium* spp., *Rhizoctonia*-like fungi, and several species of nematodes (Fig. 16). Development of black root rot is enhanced by root damage caused by repeated root freezing or poor soil drainage. The disease is generally more severe in older plantings and is one of the most common diseases occurring wherever strawberries are grown in North Carolina.

Symptoms of black root rot are stunted plants, low yield, small fruit, numerous dead older leaves, very few runners, etc. There will be very few large new roots or white feeder roots. Infected plants will not respond to fertilizer or improved growing conditions. Plants with black root rot will seldom improve.

NORTHERN ROOT-KNOT NEMATODE, *Meloidogyne hapla*, is not wide-spread except in the northeastern peanut growing area of North Carolina and in fields where strawberries have been repeatedly planted and nematodes introduced on the strawberry transplants (Fig. 17). The southern root-knot nematode (*Meloidogyne incognita*), found all across North Carolina, does not damage strawberry.

Symptoms of root-knot nematode include general stunting, low yield, and plant death. Root systems are bushy, and on close examination 1/16 inch diameter galls can be seen on the roots.

THE LESION NEMATODE, *Pratylenchus* spp., is also very damaging to strawberry. Symptoms are general stunting, low yield, and plant death. Lesion nematodes cause dark dead areas on the roots. High populations can kill the entire root system. The lesion nematode occurs across North Carolina but is most common in the mountain counties. The sting nematodes, *Belonolaimus* spp., also cause severe damage to strawberry roots. These nematodes occur in the coastal plain section of North Carolina.

Root diseases are generally difficult to control on strawberries. All of the control practices are completed before planting. The first step is to select a field with a well-drained soil that does not have a history of red stele. Use only certified plants of well adapted cultivars. Pre-plant soil fumigation is an important part of strawberry root disease control. Resistant cultivars must also be selected to help control red stele. Older plantings with

black root rot should be reset, possibly using another field or fumigating the present field before resetting.

MINOR DISEASES

Thirty-one virus and virus-like diseases have been reported in strawberry. Historically these diseases have been important problems in the strawberry industry. The symptoms of these vary from no visible symptoms to stunting, chlorosis, and deformed growth. These diseases are more likely to be problems in old plantings or where transplants are saved from old plantings. Virus diseases are rarely seen now in North Carolina plantings due to the widespread use of certified plants and frequent replanting.

SPRING DWARF (*Aphelenchoides fragariae*), **SUMMER DWARF** or **SUMMER CRIMP** (*Aphelenchoides besseyi*), and **LEAF AND STEM NEMATODE** (*Ditylenchus dipsaci*) historically have been common and serious problems on strawberry. Symptoms of these diseases are

stunted and distorted new growth. These problems are rarely seen today because of the widespread use of certified plants.

LEAK, caused by the fungus *Rhizopus nigricans*, has been a very common and destructive post-harvest fruit rot of berries commercially picked and shipped, but leak is of much less importance now with the use of good refrigeration. Leak is of little importance in pick-your-own operations.

SLIME MOLD, caused by several fungi, is frequently evident during warm wet weather in spring and fall (Fig. 18). Slime molds appear as variously colored slimy or dry powdery growth on leaves and petioles. They cause little or no damage and will usually disappear with dry weather.

For information on specific control measures and chemical recommendations see North Carolina Agricultural Chemical Manual and Plant Pathology Information Note 199.

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