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DISEASE CONTROL FOR HOME APPLE ORCHARDS

There are a number of diseases that commonly occur year after year in both commercial and backyard plantings of apples. These diseases do not infect at the same time but appear in a fairly regular sequence depending upon the weather and the development or phenology of the apple host, beginning at dormancy and continuing until fruit are harvested. As a consequence, a season-long program for disease management is often necessary in order to harvest a high percentage of useable fruit. The diseases which are common in apple include apple scab, cedar-apple rust, black rot, and the summer diseases, sooty blotch and flyspeck. Powdery mildew is an occasional problem on certain apple cultivars. Fire blight is another sporadic problem but when it occurs, it can be extremely destructive. Weather conditions greatly influence both the occurrence and severity of plant diseases. Consequently, diseases are generally most difficult to control in years of prevailing high temperature, high humidity, and abundant rainfall and cloud-cover.

I. CONTROL STRATEGIES:

Apple diseases can be effectively managed through the combined use of culture, sanitation, resistance, and fungicide sprays. This integrated approach to disease control minimizes the reliance upon one type of control over the others and usually results in a high percentage of quality fruit.

A. CULTURE-

Cultural methods include maintaining tree vigor by proper planting, fertilizing, and pruning and by following general practices that help to minimize tree stress.

B. SANITATION-

Sanitation involves pruning and removing affected or dead portions of the tree and removing diseased foliage or fruit which are often important sources of inoculum for the next season.

C. RESISTANCE-

Resistance involves selection and planting of varieties with genetic resistance to specific diseases. This effectively reduces or eliminates occurrence of the disease in question.

D. FUNGICIDE SPRAYS-

Proper selection, timing, and application of these sprays are important. Thorough coverage of all parts of the tree is necessary and sprays should be applied until run-off. The fungicide label will contain information on plant hosts and diseases, dosage rates, days to harvest interval, and safety precautions.

II. COMMON DISEASES:

A. APPLE SCAB-

Apple scab, caused by the fungus *Venturia inaequalis*, is the most important disease of apple in New England and is most severe in wet weather. The fungus causes circular, olive-black spots on the leaves, fruit, and young fruit stems. Heavy infections can result in defoliation and affected fruit can drop, become distorted, and crack. The fungus overwinters on dead, fallen leaves and produces spores (primary) in the spring which can infect sepals, young leaves, and young fruit during periods of rain. Infection from these primary spores can take place at any time after apple growth begins until mid to late June if suitable weather conditions exist. During the summer a different spore (secondary) is produced by the fungus which is capable of inciting more new infections when splashed onto leaves and fruits by rain.

Apple scab is most effectively controlled by planting resistant varieties such as Jonafree, Priscilla, Macfree, and Liberty. A good sanitation program in which diseased leaves and fruit are removed from the vicinity of the tree will also help to eliminate sources of inoculum in the spring. Scab can also be controlled with properly selected and timed fungicide sprays (refer to spray guide on page 5).

B. GYMNOSPORANGIUM RUSTS (Cedar-apple rust, hawthorn rust, and quince rust)

Several rusts commonly infect apples. Cedar-apple rust, caused by the fungus *Gymnosporangium juniperi-virginianae*, is a problem when apple and certain species of juniper and red cedar grow in close proximity. This rust requires two different hosts to complete its life cycle. The fungus causes brilliant yellow-orange or reddish spots or lesions on apple leaves and occasional lesions on the calyx end of fruit. On cedar, the fungus produces brown to reddish-brown galls, ¼ - 2" in diameter. During rainy periods in the spring, distinctive bright orange, gelatinous, spore-horns protrude from the surface of these galls. The spores are blown by the wind to apple trees where they infect and produce their characteristic lesions.

Hawthorn rust is caused by *Gymnosporangium globosum*, a fungus which is related to the cedar-apple rust fungus. Because these fungi are so closely related, the diseases caused by them are very similar. Cedar-hawthorn rust also requires two different hosts in order to complete its life cycle—these include *Juniperus* species (e.g., eastern red cedar) as well as many rosaceous species such as apple, crabapple, hawthorn, pear, quince, and serviceberry. The disease cycle is essentially the same as previously described for cedar-apple rust. Cedar-hawthorn rust usually infects leaves but can also produce symptoms on fruit and green stems which results in deformity. These symptoms help to distinguish hawthorn rust from cedar-apple rust. Additionally, hawthorn rust produces slightly smaller, more flattened galls on the juniper hosts.

Quince rust is caused by another *Gymnosporangium* species, *G. clavipes*. This rust also has a similar life cycle to cedar-apple and hawthorn rust and requires two different hosts, junipers and

several members of the Rose family. Quince rust infects fruit but not leaves of apple but both fruit and leaves of other hosts such as quince, hawthorn, and other Roseaceous species. Symptoms appear on apple fruit as dark green lesions at the calyx end. These lesions cause puckering and distortion of the fruit and are brown and spongy down to the core. This fungus produces spindle-shaped or cylindrical galls or swellings on the juniper hosts.

Removal of red cedars located in close proximity to and up to one mile from the apple tree or planting usually reduces the number of spores capable of infecting apple although this is often not practical. Therefore, selecting and planting resistant varieties is the most effective way to control rust diseases. Unfortunately apple cultivars resistant to one type of *Gymnosporangium* rust are not necessarily resistant to all of them. For example, cultivars Delicious, Empire, Jonamac, McIntosh, and Paulared are resistant to cedar-apple rust but McIntosh is susceptible to hawthorn rust.

Protective fungicide sprays applied to apple can also prevent infection (refer to spray guide on page 5).

C. POWDERY MILDEW-

Powdery mildew, caused by the fungus *Podosphaera leucotricha*, is usually only a problem in fairly dry, hot summers. This fungus produces a superficial white powdery growth on the foliage, blossom buds, and immature twigs of apple. Fruits show russetting in cases of severe infection. This fungus overwinters as mycelium (fungal strands) in the dormant buds. As these infected buds open in the spring, spores called conidia are produced and are carried by the wind to newly emerging leaves and blossoms where they cause disease.

This disease can be controlled by planting mildew-resistant varieties such as Freedom, Jonafree, Liberty, and Priscilla. In addition, sanitation by pruning to remove infected terminals and to increase air circulation within the canopy and fungicide sprays can greatly reduce the inoculum (refer to spray guide on page 5).

D. BLACK ROT-

Black rot, caused by the fungus *Botryosphaeria obtusa*, is also known as frog-eye leaf spot and is often associated with unusually warm seasons. Leaf lesions first appear as small purple specks which enlarge to 1/8-1/4" in diameter. Older lesions have irregular purple margins and centers with alternating bands of light and dark giving a "frog-eye" appearance. On limbs, the disease appears as slightly sunken, reddish brown cankers which darken as they increase in size. Infected fruit develop a brown to black rot with alternating light and dark bands around the calyx. These rotted fruit may dry up and persist on the trees as mummies. This fungus overwinters in dead wood, in cankers, and in mummied apples. In spring, spores (conidia) are formed and are spread by splashing raindrops and wind to developing tissues during storms where they cause infection.

Sanitation through the removal of dead and infected branches and of mummied fruit is essential for disease control. All prunings should be immediately removed from the vicinity of the planting or tree. Fungicide sprays can also be incorporated into a control program (refer to spray guide on page 5).

E. SUMMER DISEASES: SOOTY BLOTCH AND FLYSPECK-

Sooty blotch is caused by a complex of fungi which include *Peltaster fructicola*, *Leptodontium elatius*, and *Geastrumia polystigmatis*. This disease is recognized as black, sooty smudges on the surface of the apple fruit. Flyspeck, caused by the fungus *Zygophiala jamaicensis*, appears as clusters of tiny, pinpoint black dots on fruit. These fungal diseases usually occur together and are particularly severe when rainy weather occurs early in the season and continues into the summer.

Control measures are the same for both diseases. The fruit infections are superficial and can often be removed with vigorous washing and rubbing. In addition, practices which promote air circulation such as pruning and mowing the grass around the tree are usually enough to keep these diseases in check. Fungicide sprays can be applied if the tree has a history of severe disease and blemish-free fruit are important (refer to spray guide on page 5).

F. FIRE BLIGHT-

Fire blight, caused by the bacterium *Erwinia amylovora*, can be a devastating disease of apple. Fortunately, this disease is only an occasional problem and when it does occur, it is often isolated to specific geographical locations. However, when infection does occur, the disease can develop quite rapidly and can destroy individual trees or entire orchards blocks in a single season. The bacteria survive the winter in old cankers on apple and other plant hosts and in healthy buds. As weather becomes favorable for growth in spring, the bacteria begin to rapidly multiply and can be seen oozing out of tissues. This creamy bacterial ooze is attractive to insects and they pick it up and carry it to open flower buds where infection occurs. The bacteria are also carried by wind and rain to open blossoms. Infected tissues are characterized by their blackened, "burned" appearance, hence the name "fire blight".

The most effective method for control of this disease is to select and plant cultivars and rootstocks which are resistant. Among the resistant cultivars are Liberty, Empire, and Winesap and the rootstocks MM.111 and M.7 EMLA. Sanitation is also very important aspect for control. Any cankered or infected branches or twigs should be cut back to healthy wood during the dormant season. All pruning cuts should be made at least 8-12 inches below visible symptoms. Tools should be disinfested with 10% household bleach (1 part bleach: 9 parts water) or 70% alcohol. Prunings should be removed from the vicinity of the tree. The effects of this disease can also be minimized by maintaining overall tree health by following proper cultural practices that avoid excessive vigor. It is especially important to avoid heavy applications of nitrogen in spring.

III. SPRAY GUIDE:

A. PESTICIDES-

A **general purpose tree fruit spray**, available under a variety of trade names, is effective for control of many of the common diseases and insect pests of apple. This mixture usually contains **captan** as the fungicide component and **methoxychlor** and **malathion** or **carbaryl** as the insecticide component.

Alternative fungicides for control of specific diseases can be used to supplement or can substitute for the general purpose mix. These include:

1. **coppers (fixed)**- early season control of scab and fire blight;
2. **fenarimol**- control of scab, mildew, and rust;
3. **ferbam**- some control of scab, rust, black rot, and the summer diseases; causes undesirable black residue when used late in season;
4. **maneb, mancozeb**- control of rust, scab, fruit rots, and summer diseases;
5. **myclobutanil**- control of scab, powdery mildew and cedar-apple rust;
6. **sulfur**- for control of mildew; some control of scab, summer diseases, and fruit rots; can be phytotoxic to some cultivars and may cause fruit russetting and/or yield reduction when sprayed after bloom;
7. **thiram**- some control of scab, rust, and summer diseases;
8. **thiophanate-methyl**- control of scab, fruit rots, and summer diseases;
9. **triadimefon**- very good control of powdery mildew and rust;

CAREFULLY READ THE LABEL ON EACH PESTICIDE BEFORE USE !!!!

B. SPRAY SCHEDULE-

<u>GROWTH STAGE¹</u>	<u>DISEASE</u>	<u>MATERIALS</u>
HALF-INCH GREEN - when half an inch of green tissue is visible in the bud	Scab	General purpose mix
TIGHT CLUSTER - about 7 days after Half-Inch Green when blossom buds appear in a tight cluster. Center bud may show some pink color.	Scab, rusts black rot, and powdery mildew	General purpose mix plus rust and/or mildew fungicides if necessary
PINK - when blossom buds separate from the cluster and all show a pink color but before blossoms open.	Same as above	Same as above
BLOOM - when 25% or more of the blossom buds are in bloom.	Same as above	Fungicide(s) for scab and/or rust and mildew. DO NOT APPLY GENERAL PURPOSE MIX OR AN INSECTICIDE to avoid harming pollinators.
PETAL FALL - when 90% or more of the blossoms have fallen. Sprays applied sooner may kill pollinators	Same as above	General purpose mix plus a rust fungicide, if necessary
FIRST COVER - 7-10 days after Petal Fall	Same as above plus summer diseases	Same as above
SECOND COVER - 7-14 days after First Cover	Same as above plus summer diseases	General purpose mix
THIRD COVER - 7-14 days after Second Cover	Scab, fruit rots, and summer diseases	Same as above
FOURTH to EIGHTH COVERS - apply on a 14-21 day schedule until harvest depending upon the weather. Refer to "days to harvest interval"	Same as above	Same as above

on fungicide label.

¹ Refer to page 6 for a pictorial representation of apple growth and developmental stages

C. APPLE GROWTH STAGES-

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