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BIOLOGY AND CONTROL OF CYTOSPORA FUNGI IN PEACH PLANTINGS

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WARNING: PEACHES ARE AN ENDANGERED CROP!

Peach growers and persons thinking of planting peaches should be aware that New York is on the northern fringe of the geographic area suitable for peaches. Winter injury and the attendant cytospora canker are persistant threats for peach plantings in New York but are considerably less important in Pennsylvania, New Jersey, and Long Island. The acreage of peaches in New York State has declined steadily from an estimated 46,740 acres in 1909 to about 22,000 acres in 1935 and to 2,275 acres in 1975. Despite a strong demand for fresh-market peaches in recent years, growers have been reluctant to plant peaches because cytospora canker and X-disease cause significant tree losses in many plantings.

Because of the climatic stresses in New York, peaches require more meticulous care than hardier fruits such as apples and pears. A single mistake such as missing peach tree borer sprays or over-fertilizing can severely damage a peach planting, and damaged plantings may never recover their full productive potential. Despite the climatic handicaps, individual growers throughout the state have demonstrated that New York peach orchards located on good peach sites can be kept relatively free of cytospora canker if given the proper care. The increased productivity and longer tree life in well managed orchards more than compensates for the extra work required.

This publication is designed to help peach growers understand and avoid cytospora canker. The information has been compiled from research publications and observations made by scientists, extension specialists, and growers. Understanding the biology of the *Cytospora* fungi as outlined in the first part of the publication is essential for understanding the rationale behind the integrated control recommendations outlined in the second part of the publication.

BIOLOGY OF CYTOSPORA CANKER FUNGI

The pathogens

Cytospora canker, also known as valsa canker and perennial canker, is caused by either of two species of fungi, *Cytospora cincta* or *C. leucostoma.* These two *Cytospora* species are closely related and can be definitively separated only by microscopic examination of the sexual fruiting structures. In Ontario and western New York, *C. cincta* is more common whereas *C. leucostoma* is the major pathogen in eastern New York, New Jersey, Michigan, and Illinois. Because symptoms, disease cycles, and control methods are similar for both species, the following discussion is applicable to canker caused by either species of *Cytospora.*

Disease symptoms

Symptoms of cytospora canker vary depending on the part of the tree attacked. On the trunk, scaffold limbs, and older branches, the first external symptom is an amber-colored gum produced at the site of the infection. This gum is darker than the gum produced around an uninfected wound, and the gum around a cytospora canker turns a dark or brown color with age. The inner bark invaded by the fungus collapses leaving an elongated, depressed area in the bark. As the bark dries out, it cracks open and exposes the blackened tissues beneath (Fig. 1). Cankers are usually elongated because the fungus grows more rapidly along, rather than around, the limbs or trunks. During late spring and summer, the tree may form callus tissue around the canker, but the fungus often reinvades healthy tissue during fall and early spring. This alternation of callus formation and canker extension sometimes produces a canker with concentric callus rings.

Figure 1 .—Elongate cytospora canker in a peach scaffold. In the lower half of the canker, note the two distinct ridges of callus formed by the tree in attempts to limit canker expansion.

Cytospora infections on small twigs are less noticeable. These infections may first appear as sunken, light-colored areas around infected nodes (Fig. 2). The infected tissues turn dark with age and an amber gum may be present if the twig is not entirely killed. Weak, shaded twigs in the center of trees are especially sensitive to winter injury, and winter killed twigs are rapidly colonized by *Cytospora.* From small twig infections, *Cytospora* can invade the scaffold limbs and large branches to which the twigs are attached. Limb cankers initiated in this way have dead twigs or stubs of twigs at their centers (Fig. 3).

Limbs infected with cytospora canker show reduced vigor. Leaves beyond the canker often turn yellow and may suddenly wilt and die. The dead leaves remain attached to branches which die suddenly. Cankers may also invade

Figure 2.—Nodal canker developing around a winter-killed bud. A shiny drop of gum exudate is already evident just below the bud.

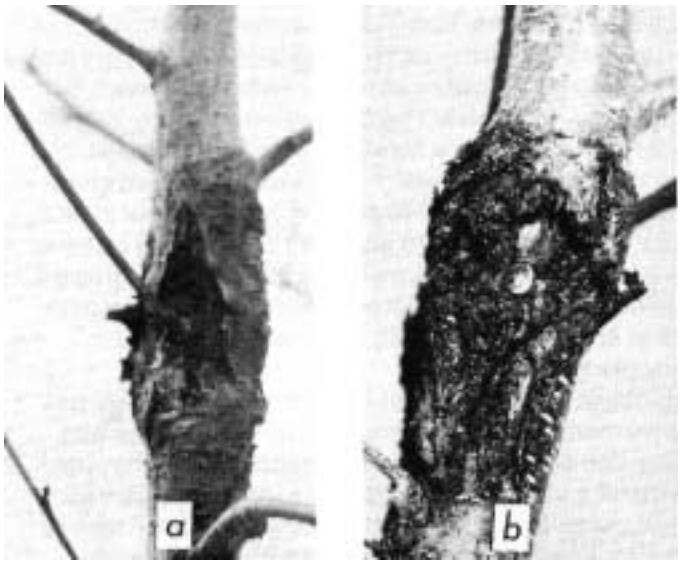

Figure 3.— A cytospora canker developing around a cytospora infected twig (A), and a similar canker several years after removal of the dead twig on which the canker was initiated (B).

and weaken narrow-angled limb crotches, thus increasing the chances that crotches will split apart under heavy crop loads.

Disease Cycle

The *Cytospora* fungi attacking stone fruits are weak parasites and cannot invade healthy, intact bark. Cankers are usually initiated in weak, dead, or dying tissue or in

Figure 4.—Pruning stubs such as this one fail to callus properly and often become infected with Cytospora. *The cut should have been made at the point indicated by the dotted line. If the side branch had been removed instead of main branch, the cut should have been at the arrow just beyond the ridge of thickened tissue.*

wounds. The fungus invades trees more rapidly during cool weather when trees are not actively growing. The most common infection sites are pruning cuts (especially stubs, Fig. 4), insect injuries, twigs weakened by shading in tree centers, winter-killed buds, and bark killed or injured by low winter temperatures. Wounds resulting from cultivation, picking ladders, wire mouse guards, and broken limbs often become infected. Short branch stubs left during pruning do not callus over and result in dying tissue ideal for invasion by *Cytospora.* Brown rot cankers and injuries from oriental fruit moth and peach tree borers also afford entry sites for cytospora canker. The predominant infection site in any orchard depends on orchard management practices and local weather conditions.

Recent evidence suggests that *Cytospora* spores may infect twigs through leaf scars after leaves drop in autumn. The timing and environmental conditions required for leaf scar infections are not known, but infections occur primarily on twigs weakened by shading or winter damage. Leaf scar infections result in inconspicuous cankers (Fig. 2) which may at first go unnoticed. The leaf scar infections may extend down the twigs and invade larger limbs, or they may persist as small cankers which enlarge only after the infected twig has grown to be a large limb.

Once established in dead or weakend tissue, the *Cytospora* fungi will slowly invade adjacent healthy tissue. Considerable gum is formed in the woody tissues at the margins of cankers, and either the plugging action of the gum itself or toxins produced in the canker cause foliage on severely infected branches to turn yellow and eventually die. Once dead, entire branches are rapidly colonized by the *Cytospora* fungi.

Fruiting structures called pycnidia are produced on colonized dead limbs and in cankers. Pycnidia are small, grey-white, pimple-like structures each capable of producing several million pycnidiospores which exude from a single small pore or ostiole. Pycnidia are produced in cankers within 7 weeks following a summer infection. New pycnidia are formed continuously as the canker extends, and each pydnidium produces spores for several months under moist conditions. Spores are therefore present in abundance throughout the year, even in winter.

During humid weather, spores are exuded from pycnidia in a brown gelatinous matrix which forms long tendrils or cirri. Spores are dispersed primarily by rainfall, wind-blown rain, and insects, although some spores may also be spread by wind. Spores may be discharged at temperatures close to freezing, can germinate at 39 F, and remain viable even after they have been frozen.

Sexual fruiting structures called perithecia are sometimes formed in dead tissue. Perithecia are much less common than pycnidia, and the ascospores which form in perithecia probably play a minor role in disease spread.

CONTROL PRACTICES

Because the *Cytospora* fungi attack any injured or weakened tissues in trees and because spores are present throughout the year, control practices must be integrated into all aspects of orchard managementfrom planning new plantings to care of bearing orchards. There is no "cure" for cytospora canker, and coverage with the protectant fungicides now available cannot be maintained throughout the year. Control is based on preventative measures with the objective of decreasing winter injury, insect damage, and other wounds which result in *Cytospora* infection sites. Any weak link in orchard management practices increases the likelihood of cytospora canker. Once a young orchard becomes infected with canker, the presence of inoculum in the orchard leads to increasing difficulty in controlling further infections.

Planning New Orchards

1. Select a site that is reasonably isolated from sources of *Cytospora* inoculum. In addition to peaches, *Cytospora* also commonly infects prunes, apricots, nectarines, cherries, wild black cherries, and chokecherries. Cankered wild cherries should be removed from adjacent hedgerows, and young trees should not be planted adjacent to old, bad-

ly infected peach blocks. The down-wind side of old blocks should especially be avoided.

2. The proposed site should have deep, well-drained soil, and good air drainage to reduce the likelihood of winter in jury. If peaches must be planted on soil with imperfect drainage, plum rootstocks such as St. Julien A should be used.

3. Plant only the hardier varieties suited for northern peach growing areas. Hardiness should be one of the primary characteristics considered when choosing peach varieties for New York plantings. Excellent fruit characteristics are of little value in a variety if the trees are destroyed by winter injury and canker before they reach fruiting age.

Planting New Orchards

1. Plant only disease-free nursery stock. Trees with small cankers should not be planted unless the cankers and several inches of healthy tissue below the canker are removed. Preferably, trees with obvious cankers should be returned to the nursery.

2. Prior to planting, peaches should be root-dipped in endosulfan (Thiodan) to protect against peach tree borer. Thiodan should be used at the rate of 5 pounds per 100 gallons to make a dipping solution.

3. Planting stock should be moderate-sized (3/8-5/8 inch caliper), 1 -year-old trees. Pruning cuts on newly planted trees are common *Cytospora* infection sites because transplanting weakens the trees and increases their susceptibility to canker. Newly planted trees should be pruned when their buds begin to break, or about the time mature orchards are blooming. Trees should be headed back to 25-30 inches to promote wide-angled branch development. Small trees should be pruned to whips. The side branches on larger trees should be pruned to two or three nodes since buds on the trunk of large trees may fail to develop. Trees not pruned to whips must be carefully in spected soon after growth begins, and any dead stubs must be removed.

Care of Young Orchard

1. Maintain good insect control, even in the first few non-bearing years. Oriental fruit moth and peach tree borer lar vae not only inflict serious damage by feeding activities, but they also provide entry sites for the canker fungi.

2. Before the first winter, fill depressions around the tree with soil (not gravel.) to avoid ice collars and consequent winter damage.

3. Develop wide crotch angles by carefully training young trees. Snap-type clothespins may be used to spread shoots during the first season by clipping them to the tree trunk above lateral shoots which will develop into scaffolds (Fig. 5). The clothespins must be removed before they in jure branches and at least by late August. Tie-downs and careful selection of wide-angled scaffolds by pruning may also provide acceptable crotch angles. Attempting to visualize how the young scaffolds will fit together when they are 4 inches in diameter may help in determining what is an acceptable crotch angle on a young tree. Do not use wire spreaders or wooden spreaders with nails because the punctures made by the spreaders may become infected with *Cytospora.* Tissue in narrow crotch angles is very susceptible to winter injury and attack by borers. Bark inclusions which develop in narrow crotches may allow trees to split under heavy crop loads. Narrow crotch angles (Fig. 6) are one of the most common problems in peach orchards, and every effort should be made to avoid the problem by proper training of young trees.

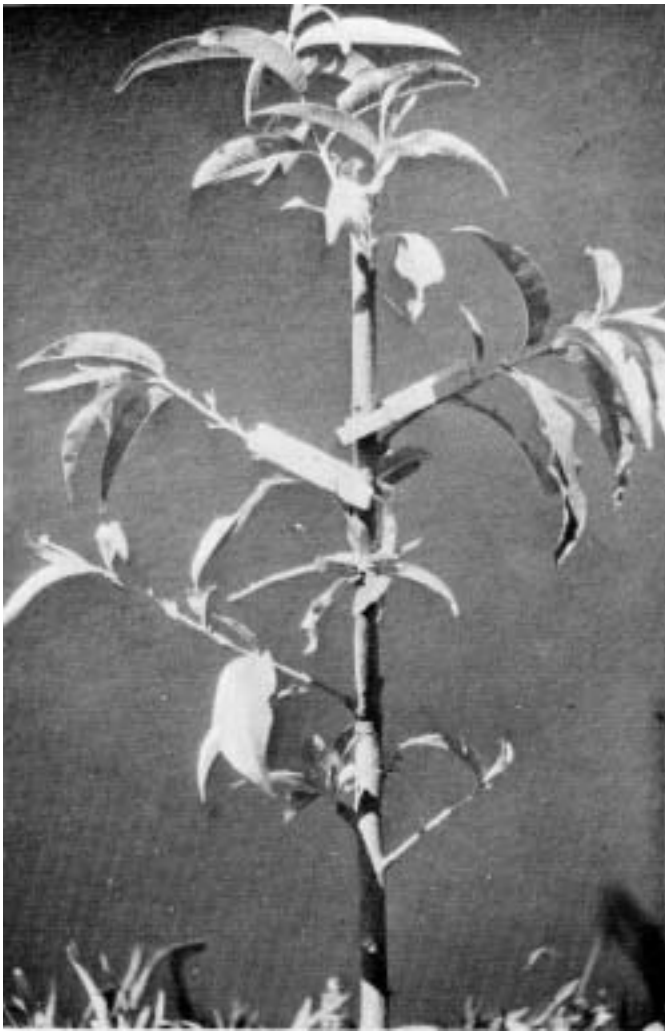

Figure 5.—*Clothespins attached to the main trunk jusi above young shoots on newly planted trees will encourage wide crotch angles in branches chosen as potential scaffold limbs.*

4. Mouse guards may be needed to prevent mouse damage, but they should not be so high that the trunk and lower scaffolds limbs are injured by the guards when the tree sways in heavy winds. Plastic wrap-around guards are not recommended for peaches unless they are removed each summer. They tend to harbor boring insects, interfere with trunk sprays applied for borer control, and may delay hardening of the wood in late fall.

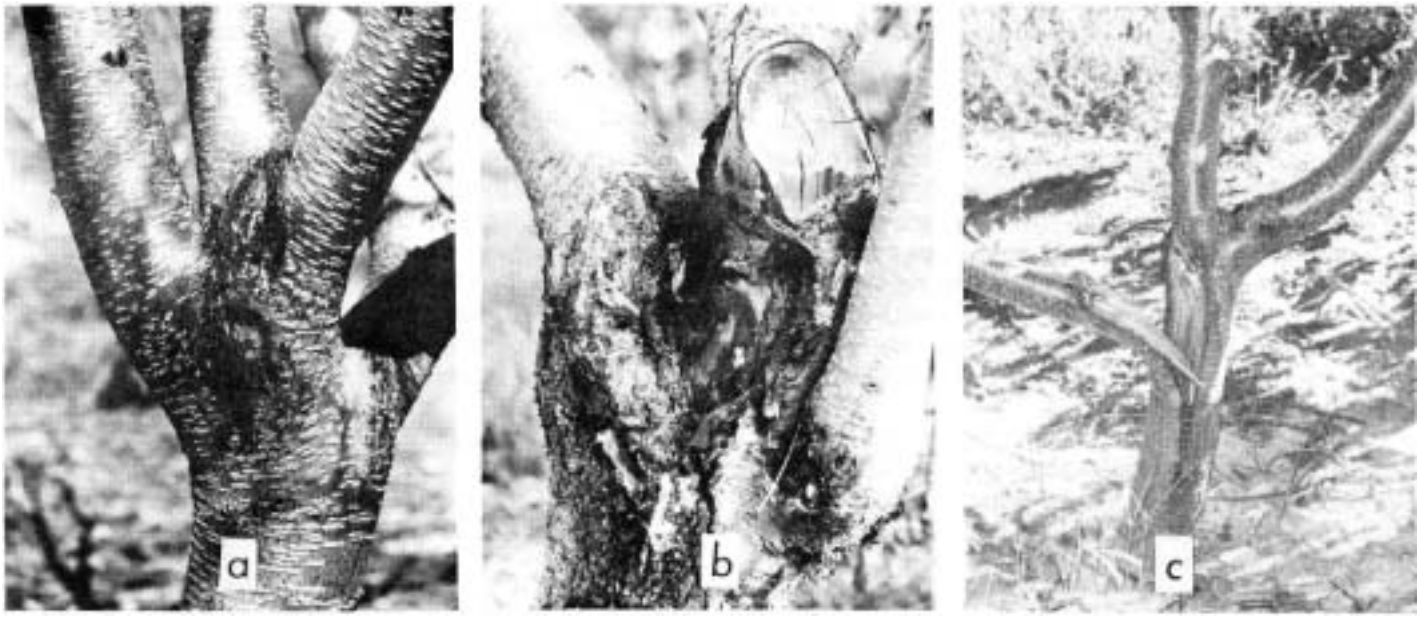

Figure 6.—*Narrow crotch angles in a poorly trained tree (A) show darkened areas typical of developing cytospora canker. Cankers in narrow crotches may eventually girdle some of the scaffolds (B). Trees with narrow crotch angles often split apart under heavy crop loads (C).*

Pruning

1. Delay pruning until trees are near bloom. Trees are ac tively growing at this stage and pruning wounds will heal more rapidly, thus allowing less time for invasion by *Cytospora.* Avoid pruning in wet weather because dis semination and germination of *Cytospora* conidia is favored by wet conditions.

2. Spray trees immediately after pruning (the same day if possible and at least before the next rain) with 8 ounces Dichlone 50WP, 5 pounds KOLO 100, or 8 ounces of Benlate per 100 gallons of water to protect fresh pruning wounds from *Cytospora* infection.

3. Trees should be pruned on a regular program so that large cuts will not be needed. Pruning cuts should be nearly flush with the adjoining branch to avoid stubs which may easily become infected. In removing side branches from larger limbs, the cut should be made just beyond the ridge of thickened bark where the side branch joins the larger limb (Fig. 4). The ridge of thickened tissue should not be removed because the thick tissue at the joint has the physiological function of promoting rapid wound closure when a side branch is removed. Trees should be pruned to an open center to avoid shading and weakening branches in the tree center. All dead and weak wood especially on scaffold limbs in the trees' center, should be removed.

4. All cankers should be pruned out and burned, buried, or moved well away from the orchard. Cankers on the trunk or scaffold limbs may require surgery which should be done in late May, June, or July when trees rapidly form a callus around wounds. Remove all diseased tissue, both park and wood. Disinfect cutting tools between cuts with alcohol or a clorox solution. Wounds should be left with a smooth margin and should be tapered to a point above and below to favor rapid closure with callus. Large wounds should be painted with a tree wound paint or sealer.

Fertilizing and Other Cultural Practices

1. Apply fertilizer only in late winter or early spring (before April 15) to avoid inducing late, cold-tender growth in the fall.

2. Avoid excessive fertilization, but maintain healthy foliage color and terminal growth. Non-bearing trees should show 18-24 inches of terminal growth peryear, and terminals on bearing trees should grow 12 inches. Trees with yellowed, nitrogen-deficient leaves in the fall are more susceptible to *Cytospora* infections than properly fertilized trees.

3. Root injury which results from cultivation can be avoid ed by planting a sod cover and using herbicides beneath the trees. Where herbicides are used, however, residual herbicides should be used sparingly so that at least a sparse vegetation will become established beneath trees during late summer. Trees on completely bare ground are more susceptible to winter damage when snow cover is ab sent. A sod cover with no herbicide beneath trees may weaken trees and reduce yields due to competition for water and nutrients.

If clean cultivation is practiced, cultivation should be shallow and should end by late June. A cover crop should be sown to promote hardening off of trees. Mowers and cultivation equipment must not contact either trunks or low scaffold limbs. Any wounds resulting from cultivation are likely to become cankered.

4. Trunks and scaffold limbs should be painted with white latex paint to prevent southwest injury. The dark wood of trunks and larger limbs absorbs considerable heat on sun-

ny winter days and bark temperatures may exceed 100 F during the day, then cool to below freezing at night. Serious trunk injury follows these temperature fluctuations, and this type of injury may occur even during relatively mild winters. Trees seriously affected by such winter injury may begin growing in spring, then suddenly collapse. In other cases, trees are only weakened or partially killed, and *Cytospora* fungi quickly invade the winter-injured tissues. White paint on trunks can reduce bark temperature by as much as 80 F during winter and will reduce winter injury problems on trunks and scaffolds. Latex paint used to paint trees should not contain acrylic resins because some acrylics may injure woody tissue. The cheapest latex paint available is often the safest for painting trees.

5. Trees under water stress are more susceptible to cytospora canker than trees with an adequate soil moisture level. Irrigation used to improve tree growth and fruit size has the added benefit of making trees more resistant to cytospora canker.

6. Sprays for borer control, both peach tree borer and lesser peach tree borer, must be applied through the life of the orchard including years when the crop may be lost dur ing a spring freeze. In mature orchards, airblast application of peach tree borer sprays may not provide adequate coverage of the trunk. Better coverage is achieved with handgun application of a spray directed to the trunks and scaffold limbs.

7. Some evidence suggests that lime-sulfur or Bordeaux sprays applied for control of peach leaf curl may possibly protect against leaf-scar infection by cytospora canker.

SUMMARY

Cytospora canker can be prevented only through an integrated control program which involves every aspect of peach growing. Site selection, planting, early tree training, fertilization, pruning, insect control, and other practices which reduce winter injury are all *critical* components of a cytospora canker control program. The meticulous care required to keep cytospora canker out of peach orchards will be repaid by increased productivity and longer orchard life.

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