Raspberry Diseases in Michigan
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Virus Diseases

Virus diseases are the main cause for losses in raspberry production. They are largely responsible for the decline in Michigan raspberry production from about 14,000 acres in 1950 to less than 1,000 acres in 1980. Certain steps can be taken to minimize virus infection and thereby maintain healthy plants and good production. Following are the most common raspberry diseases. For recommended pesticides, rates and times of application, see Extension Bulletin E-154, "Fruit Pesticide Handbook."

Raspberry Mosaic Virus

This is the most widespread and damaging raspberry virus. All commonly grown cultivars can be infected by the mosaic virus, except for Canby, which is resistant. High quality, mosaic-resistant, Canadian, red cultivars — Skeena, Nootka, Haida and Chilcotin — should be available in 1984. Mosaic symptoms consist of light green to dark green or yellow to green mottling of the leaves on infected canes (Fig. 1A); blistering of leaves as well as a mosaic pattern are also evident (Fig. 1B). The plants show a progressive stunting of growth and poor yield. Fruits on infected bushes are small and crumbly. The common raspberry aphid (a rather large, greenish aphid found on shoot tips and on the undersides of the leaves) spreads the virus from diseased cultivated and wild raspberry plants.

Raspberry Leaf Curl Virus

Leaves on infected canes are rounded, curl downward and are usually of a greasy, dark green color (Fig. 2). Growth is stunted and fruit production is reduced. A small, yellow-green aphid found on the undersides of leaves spreads this disease.

Tobacco Streak Virus

Tobacco streak virus symptoms are: somewhat deformed leaves blotched with yellow areas (Fig. 3) and poor fruit production. Since the virus is pollen-borne, healthy plants can become infected by pollen from a diseased plant.

Tomato Ringspot Virus

This virus is widespread throughout the Michigan fruit growing area. It causes disease in stone fruits (peaches, cherries, etc.), pome fruits (apples, pears, etc.), and grapes. Symptoms in raspberries are not very strong. A few leaves on infected bushes may show some pale ringspots in the spring, but these later disappear. The main effect is a general stunting of the bush, a general yellowing of leaves (Fig. 4) and production of small, crumbly fruit. Virtually all raspberry varieties are susceptible. Tomato ringspot virus has a very wide host

Figure 1a. Mottling of leaves is a typical symptom of Raspberry Mosaic Virus infection.

Figure 1b. Blistering of leaves as well as mosaic pattern can occur with Raspberry Mosaic Virus.

Figure 2. Leaves are rounded, curl downward and dark green in color with Raspberry Leaf Curl Virus infection.

Figure 3. Deformed leaves blotched with yellow are symptoms of Tobacco Streak Virus infection.

Figure 4. Tomato Ringspot Virus infection causes plant stunting and general yellowing of leaves.

range, including many weeds such as dandelion, curly dock, plantain and chickweed. The virus is spread by the dagger nematode *Xiphinema americanum* from the roots of diseased raspberry bushes or weeds to the roots of healthy bushes.

Control: Purchase and plant only "Michigan Certified Virus-Tested" raspberry stock. Grown under the supervision of MSU and the Michigan State Department of Agriculture, this stock has been tested for the presence of known virus and other systemic diseases. If planting stocks are not certified, they probably will contain one or more of the viruses described in this publication. Plant stock in soil free of virus-vector nematodes *(Xiphinema americanum* — dagger nematode). If soil is found to contain this or other plant pathogenic nematodes, use a pre-plant soil fumigant. Locate new plantings 400 yards from other cultivated raspberries which may harbor the virus. Eliminate any wild raspberries *(Rubus* spp.) that are within this distance, using an appropriate herbicide. Use insecticides, such as Diazinon or Malathion, on a regular basis beginning in mid-May and ending after the first killing frost in the autumn. This will help prevent build-up of virus-carrying aphids. Pull out and burn any plants that show virus disease symptoms.

Fungal Diseases

Anthracnose

Black and purple raspberry varieties are most seriously affected by anthracnose *(Elsinoe veneta),* but the disease can be economically significant on red varieties also. Symptoms appear on canes, leaves, and sometimes on the fruit. Infected canes show tiny purple spots which progress to light grey round spots about 1/8 inch in diameter. The spots enlarge to about 1/4 inch, have ash-grey centers and may have purple borders (Fig. 5A). As the canes age, the spots appear sunken and the borders raised. Leaves will develop similar small round spots or lesions about 1/16

Figure 5a. Gray spots with purple borders will occur on canes infected with Anthracnose.

Figure 5b. Shot-hole appearance of leaves infected with Anthracnose.

inch in diameter (Fig. 5B). Diseased tissue frequently drops out leaving a "shot-hole" appearance. If the disease is not controlled, canes become cracked and the drupelets of the berries become infected, resulting in worthless fruit. The fungus survives the winter in infected canes and produces spores (both conidia and ascospores) in the spring at the time of leafing out. The disease can become serious with abundant rain in late spring and early summer, or under sprinkler irrigation.

Control: Use disease-free plants. After harvest, cut out and burn old fruiting canes and new canes that show disease symptoms.

Spur Blight

Spur blight *(Didymella applanata),* is a serious disease of red raspberry varieties. Infected canes release ascospores and conidia in May and June during rainy periods. Conidia release continues throughout the growing season during wet weather. Small, brown or purple spots appear around the nodes on the lower portions of the canes. These areas turn brown, causing the leaf and flower buds to shrivel and die. Leaf lesions appear as brown wedge-shaped areas. Diseased canes dry out and crack as they mature; the lesions turn brownish purple and enlarge to cover much of the cane (Fig. 6A).

Figure 6a. Brownish purple cane lesions of Spur Blight start at a spur but can extend up or down the cane.

Cane Blight

The symptoms of cane blight *(Coniothyrium fuckelii)* can easily be confused with those of spur blight. Both diseases cause considerable damage to Michigan raspberries. The fungus can live for several years in cane debris left in the field. Spore release (both ascospores and conidia) and subsequent infection begins in the spring. Conidial infection continues throughout the growing season during rainy weather. Wounds from pruning, insect feeding or cane rubbing are the initial sites of infection. Brown or black infected areas extend down one side of the cane for several inches (Fig. 6B). Fruiting canes infected the previous season have light colored, cracked bark. Lateral shoots on infected canes grow poorly and may wilt and die during hot weather.

Control: Never prune during wet

Figure 6b. The long brown or black cane lesions of Cane Blight can be easily confused with those of spur blight.

weather. To prevent infection, canes should remain dry for at least 3 days after pruning so wounds will callus. Prune out and burn infected canes in the spring.

Orange Rust

Orange rust *(Kunkelia nitens)* attacks black and purple raspberries, but not red varieties. Leaf symptoms develop toward the end of June. Infected leaves are small and yellowish with orange pustules of waxy rust spores on the underside of the leaves (Fig. 7). The spores are shed and cause new infections over a 2 to 3 week period. Leaf symptoms disappear from the field by mid- to late-summer. The fungus invades all parts of the plant (including the roots). Infected plants never recover. Newly infected canes are weak, spindly and lack spines (thorns). Infected canes will not blossom the following year.

Figure 7. Small yellow infected leaves with orange spore pustules are typical symptoms of Orange Rust.

Control: Plant rust-free raspberries. Remove and burn any plants that show symptoms. Kill nearby wild raspberry plants. Fungicidal control is not effective.

Late Leaf Rust

Late leaf rust *(Pucciniastrum americanum)* causes disease in red raspberries, usually later in the season. Older (basal) leaves are covered with fine, light-yellow, powdery masses of spores in midsummer (Fig. 8). The spore masses can appear on leaf petioles, shoots, calyces (fruit caps) and even on the fruits. The popularity of the Heritage cultivar of red raspberry has made this disease more prevalent. Rust disease builds up on the leaves of this fall bearing variety because of the long growing season.

Figure 8. Orange rust pustules on back of Late Leaf Rust infected leaf.

Control: No official control recommendations are available at the present time.

Verticillium Wilt

Verticillium wilt *(Verticillium albo-atrum)* of raspberries is caused by a soil-borne fungus. The fungus penetrates the roots of raspberry plants and moves into the cane through water conducting vessels. It is particularly damaging to black raspberries. Leaves on infected fruiting canes turn yellow, gradually wither and fall. Symptoms begin on lower portions of the canes and continue upward until the canes turn blue and die (Fig. 9).

Control: Use disease-free plants. Avoid planting raspberries for at least three years in soil that has grown tomatoes, potatoes, peppers or eggplants. Remove and burn diseased plants. Use a preplant soil fumigant if the Verticil-

Figure 9. Leaf yellowing and blue stems are the symptoms of Verticillium Wilt.

Figure 10. Injection of soil fumigant using a shank-type applicator.

lium fungus is known to be a problem in the area to be planted. To control verticillium wilt disease in new plantings, fumigate in late summer or early autumn with Vorlex (MIC) at 30-35 gallons/acre. Apply with a shank applicator (Fig. 10) at a depth of 8 inches and immediately seal with a drag float or cultipacker. The soil should be in excellent tilth and shouldn't have had a crop on it for about 6 months before fumigation. Soil temperature should not be below 50°F (at the 8 inch depth) at fumigation time. Do not plant until the spring following late summer or autumn fumigation.

Phytophthora Root Rot

Phytophthora root rot *(Phytophthora erythroseptica* or *cactorum*) is of minor importance in Michigan. The fungus lives in the soil and may infect raspberry roots in fields with low-lying, poorly drained areas. Symptoms appear in the summer and consist of either wilting back of entire large canes (Fig. 11) or wilt of only a few terminals.

Control: Plant bushes in sandy, well-drained soils. Install drainage tile or dig drainage ditches where soil is poorly drained. No effective chemical treatment program exists at this time.

Fruit Rots

Botrytis & Penicillium

Botrytis *(Botrytis cinerea)* or Grey mold symptoms on ripening fruit appear as a grey, fuzzy mold on the fruit surface. Penicillium rot *(Penicillium* sp.) consists of whitish areas on the surface of ripening fruit. Warm, wet weather favors disease development.

Crown Gall and Cane Gall

The bacteria of crown and cane gall *(Agrobacterium* spp.) cause galls on roots (Fig. 12) or on canes. Infected bushes become weakened, stunted or unproductive as a result of the gall tissue interfering with water and nutrient

Figure 11. Phytophthora Root Rot can cause entire canes to wilt and die in mid-summer.

flow in the plants. The bacteria can live in the soil for years and infect raspberry plants through root wounds. Infested soil may be splashed higher up on the plant, producing cane galls. Nursery stock may arrive already infected with crown gall which will then serve as an inoculum source for uninfested soil.

Control: Check Planting stock for suspicious swellings or galls on roots and

Figure 12. Galls on crown and roots of Crown Gall infected plant.

canes. "Michigan Certified Virus-Tested" stock will be as free of the pathogen as any available stock. Dip the stocks in a suspension of Galltrol® or other brand of antagonistic *Agrobacterium* sp. at planting time. This is a nonpathogenic strain of the bacterium that protects the plants against infection by the naturally pathogenic strains that may be in the soil at the planting site. The antagonistic strains act only to protect disease free plants from future infection by the crown gall bacterium; they cannot cure infected plants.

Nematodes

Several species of nematodes cause economic loss in Michigan raspberries. *Xiphinema americanum* (the dagger nematode) is a root-infecting pathogenic nematode, and also acts as a virus vector by spreading tomato ringspot virus. Root knot nematode *(Meloidogyne* spp.) causes galling symptoms and stunting of plants. The root galls are usually smaller than those caused by crown gall bacteria. Stubby root nematode *(Trichodorus* spp.) causes a stunting and stubbiness of roots and thereby weakens plants. The ring nematode *(Criconemella* spp.) is found in high populations in the raspberry root zone, but its importance is not known. The lesion nematode *(Pratylenchus* spp.) is very damaging, because it feeds inside the roots, causing considerable root destruction. Bushes infected with the lesion nematode become very stunted and may die.

Nematodes feeding on raspberry roots cause wounds which allow soil fungi, i.e. *Verticillium* sp. and *Phytophthora* sp., to more easily infect the roots.

Control: Plant clean stock. Nursery stock can be a source of nematode infestation. Ask the nursery that sells the stock to provide a copy of nematode soil tests from their growing sites. Prior to planting, take soil samples as described in MSU Extension Bulletin E-800, "Nematode Detection."

Fumigate the soil if pathogenic or virus vector nematodes are present.

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