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Virus and Nematode Diseases of Raspberries

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Raspberries grown in Idaho by market gardeners and home gardeners are subject to several diseases caused by viruses and nematodes. This publication discusses the most common of these diseases.

Virus Diseases

Red, purple and black raspberries, both wild and cultivated, are susceptible to at least 30 known plant viruses. Many are transmitted by aphids or nematodes; others, by leafhoppers or pollen. A few have no known vector. Some viruses may be present in the plant without producing any symptoms. These latent viruses can be detected only by transmitting them to sensitive indicator plants or by serological testing. Other viruses produce distinct symptoms on cultivated raspberries and are more easily diagnosed.

Whether showing symptoms or not, all the parts of an infected plant carry the virus. Infected plants never recover. Occasionally, symptoms resembling virus infection may be caused by cool weather and late spring frosts, powdery mildew, iron, boron or zinc deficiency, pesticide or herbicide injury, genetic abnormalities (leaf yellowing, leaf crinkle and crumbly berries), infestation by leafhoppers, aphids and red spider mites or root damage by plant parasitic nematodes.

Most raspberry plantings in Idaho are infected by one or more viruses that cause varying degrees of damage. The most important of these virus diseases are raspberry mosaic, raspberry leaf curl and tomato ring spot.

Raspberry Mosaic

Raspberry mosaic, induced by infection with a complex of viruses, occurs commonly in plantings of aphid-susceptible varieties. It is rare where climate and raspberry varieties do not favor colonization by the aphid vector. The symptoms of raspberry mosaic vary considerably depending upon the mixture of viruses present, the raspberry variety grown, the time of year and other environ-

mental conditions. Red raspberries are, in general, more tolerant to the mosaic disease than black raspberries, and purple raspberries show an intermediate reaction. Viruses that show no symptoms in red raspberries may cause severe symptoms in black and purple varieties.

Mosaic is most readily seen on new canes during the cooler parts of early spring and late fall. Although plants remain infected, symptoms usually diminish or disappear in the summer during hot weather. Infected canes are usually stunted and lack vigor. Infected leaves usually appear mottled with yellowish or light green spots on a darker green background. On more susceptible varieties, the leaves show large, dark green blisters surrounded by yellowish tissue (see Fig. 1 on next page). These leaves are usually smaller than normal and may be cupped or otherwise deformed. Leaves produced in the summer during hot weather generally do not show symptoms.

In black and purple raspberries, virus infection stops growth of the shoot tip and causes it to blacken and bend. These damaged tips eventually may die. The dwarfed canes on infected plants may be barely noticeable the first year, but the dwarfing becomes progressively more pronounced as new shoots develop each season. The fruits on plants infected more than one year usually are dry, seedy and of inferior flavor. Yield reduction of up to 39 percent has been observed in some infected red raspberry varieties.

The viruses that induce raspberry mosaic are transmitted in nature almost exclusively (in North America) by the aphid *Amphorophora agathonica*. The insect often occurs in large numbers, feeding on the underside of the leaves near the tip of the cane. The aphids themselves rarely cause noticeable feeding injury to the plant, but are important as carriers of the viruses from infected cultivated or wild raspberry plants in the vicinity. Symptoms resembling those of raspberry mosaic may be caused by other factors, and definitive diagnosis normally requires transmission of the virus to sensitive indicator hosts via aphids or grafting.



Figures: (1) Left, black raspberry seedling infected with mosaic virus, showing blotching and blistering of leaves; (2) Center, red raspberry infected with leaf curl virus, showing severe distortion, dwarfing and yellowing of infected shoot tip; (3) Right, red raspberry infected with tomato ringspot virus, showing a bronze ring pattern on foliage. (Figures 1-3 courtesy of Dr. R. H. Converse, USDA.)

Raspberry Leaf Curl

Although raspberry leaf curl is less common than raspberry mosaic, it is potentially more destructive. Two strains of the leaf curl virus are known, one infecting only red and purple raspberries and the other infecting red, purple and black raspberries. Yield reductions of up to 40 percent have been reported in red raspberries infected with leaf curl.

Leaves on fruiting canes and primocanes of infected plants are small, curled downward and yellow (Fig. 2). The fruiting laterals are shortened and more upright, while new canes are stunted, numerous and branched. Infected plants are stunted and may be killed during the following winter. Chronically infected plants are severely dwarfed, produce few main stems and have tightly curled foliage. Fruit from diseased plants is small, seedy and crumbly. Symptoms of leaf curl are milder in purple raspberry than in either red or black varieties.

Leaf curl is spread in nature primarily by the aphid *Aphis rubicola*. Full-grown adults of this aphid species are no larger than a pinhead. Winged forms, although rather inactive, can be carried long distances by wind.

Tomato Ringspot Virus

Tomato ringspot virus (Tom RSV) is a nematode-borne virus. The virus and its nematode vector have a wide host range, including peach, grape, geranium, apple and blueberry. Tom RSV is the most widespread and economically important virus disease of red raspberries and may reduce fruit yields by up to 50 percent.

Symptoms of Tom RSV in red raspberry vary depending on the variety and the duration of infection. New leaves produced in the spring on infected plants show yellow or bronze rings, line patterns or a fine yellow vein chlorosis (Fig. 3). Infected leaves that develop during hot weather usually show no symptoms. Patches of infected plants are often circular with chronically infected plants near the center and recently infected plants, showing shock symptoms, at the margin. Chronically infected plants of some varieties are dwarfed. Their foliage is slow to develop and

and their primocanes show a distinct bronze cast. Severely affected varieties bear dead canes in the spring and surviving canes produce small downcurled leaves that mature and fall early in the autumn. The effect of Tom RSV infection on yield depends largely on the variety. Some varieties show reduced druplet set, abnormally shaped and small-sized fruit or crumbly berry condition that reduces both yield and harvestability.

Tom RSV is transmitted in nature by nematodes belonging to the genus *Xiphinema*, particularly *X. americanum* and *X. rivesi*. The disease spreads more rapidly from plant to plant within rows than between rows, producing oblong patches. The nematode vectors acquire Tom RSV from infected weed hosts as well as from raspberries.

Nematode Diseases

Several nematodes cause damage to raspberries. These include the dagger, root-lesion, root-knot and needle nematodes. These nematodes damage raspberries either by being vectors of viruses or as parasites feeding directly on roots. The most common nematodes affecting raspberry in Idaho are the dagger and root-lesion nematodes.

Dagger Nematodes

Dagger nematodes are widespread in most agricultural soils. They can act indirectly as vectors of viruses or directly as parasites on raspberry roots. *Xiphinema bakeri* causes considerable damage by feeding mainly on root tips where it causes swelling and curling (Fig. 4), reducing root and top growth. *X. americanum* does not cause direct feeding damage to raspberry but acts as a vector of Tom RSV.

Root-Lesion Nematodes

The root-lesion nematodes *Pratylenchus penetrans* and *P. crenatus* cause lesions, especially on feeder roots (Fig. 5), that result in stunted plants with small and yellowish leaves. The affected plants are spindly with fewer and smaller canes, small fruit and poor yields. Damage caused by these nematodes depends on the variety, age of the crop and initial nematode populations in the soil.



Figures: (4) Left, swelling and curling of affected roots are typical symptoms of dagger nematode damage to the roots of raspberry; (5) Right, these dark brown lesions are symptoms of lesion nematode damage to roots of raspberry.

Control of Virus and Nematode Diseases

1. Select planting stock that has been virus-indexed and certified virus-free. Avoid using plants with an unknown history since they may not be virus-free. Consult the State Department of Agriculture for information about nurseries that have virus-tested stock.
2. Isolate new plantings at least 500 feet from old or infected plantings and from wild brambles.
3. Do not plant black or purple raspberries near red raspberries even though the red raspberries appear to be free of virus.
4. Rogue infected raspberry plants in mid-June and again in August or September. Before roguing, spray plants with an approved insecticide to kill the aphids. If possible, remove all canes and roots of diseased plants and burn them. In established plantings where more than 5 to 10 percent of the plants show virus symptoms, removing infected plants probably will not be helpful. Such plantings may be destroyed once fruit yield becomes unprofitable.
5. Keep aphid populations under control with approved insecticides, especially in late spring and early summer.
6. Select planting sites free of nematodes or treat the soil with an approved nematicide if soil tests show the presence of harmful nematodes. Contact your county

Extension agricultural agent for help in selecting a nematicide and follow the manufacturer's label directions for application.

7. Select varieties, if available, that are known to be resistant to the vector or virus.
8. Rotate crops and control weeds to eliminate or reduce sources of virus and vectors.
9. Remove nearby wild raspberries and blackberries that may harbor raspberry diseases and insects.

Additional Sources of Information:

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- Scheer, W.P.A., and R. Garren, eds. 1987. Commercial red raspberry production. Pacific Northwest Cooperative Extension Bull. 176.

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