

## **Virus and Virus-like Diseases of Blueberries**

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Highbush blueberries are afflicted with numerous virus and virus-like diseases. Virus diseases are especially problematic because they are brought into a field on infected plant material and the virus can be spread via insect vectors. The virus can be present in the plant without causing symptoms while replicating and spreading itself throughout the plant for several years until symptoms are finally visible. There are no chemicals that can be sprayed to control virus diseases and once an infection by a virus becomes systemic in the plant, it is there forever and the plant must be removed and destroyed.

Six virus or virus-like diseases most likely to be found in New England have been chosen for detailed description – Necrotic Ringspot, Tomato Ringspot, Red Ringspot, Scorch, Shock, and Mosaic. Five other diseases will be mentioned, as they might possibly be observed in rare instances – Shoestring, Leaf Mottle, Fruit Drop, Necrotic Ring Blotch and Bronze Leaf Curl. For the purposes of this discussion, only the symptoms of the different diseases will be described, and management strategies will be discussed during the oral presentation.

*Necrotic Ringspot.* Affected leaves are often misshapen, crinkled or cupped downward and have small necrotic spots. The necrotic spots may fall out, creating a shot hole effect. Small twigs may also show small necrotic areas. Leaves that do not show necrotic spots may be small and rosette. In some cultivars, a severe stem dieback may occur. Infected bushes of all cultivars show a steady decline in productivity and may die eventually. The virus (Tobacco Ringspot Virus) occurs in a wide range of herbaceous and woody hosts. The disease is spread by the dagger nematode.

*Tomato Ringspot.* The intensity of symptoms varies significantly among blueberry cultivars. Infected leaves are often cupped and malformed, with circular spots. Young leaves may be strap-shaped and mottled and confused with shoestring. Necrotic spots may occur on infected canes. Infection is rarely uniform within a plant. Some shoots may be defoliated, others may have necrotic leaves, and still others may appear normal. Fruit production and quality are reduced in infected plants. Diseased plants may be defoliated by mid-harvest, and infected plants may eventually die, succumbing to winter injury. Symptoms of Tomato Ringspot are similar to those of Necrotic Ringspot. The two viruses are readily distinguished by the enzyme-linked immunosorbent assay (ELISA). It is also spread by dagger nematodes.

*Red Ringspot.* Stems often develop red ringspots or red blotches that are roughly circular in outline. Reddish circular spots appear on older leaves in midsummer to late summer. Younger leaves usually remain symptomless. The powdery mildew fungus can cause similar symptoms, but the fungus-induced leaf spots are prominent on both sides of leaves and tend not to be circular. The virus-induced red ringspots can coalesce, causing the leaves to appear prematurely red in late summer and early fall. Circular, light-colored areas of blotching may develop on affected fruit of some cultivars. Aphids or mealybugs are possible means of transmission of the pathogen.

*Scorch.* Symptoms vary depending on strain of the virus as well as plant cultivar. Symptoms range from complete necrosis of flowers and leaves, which eventually leads to the death of the bush in some cultivars, to symptomless infection that does not cause significant yield loss in other cultivars. Flower and leaf necrosis may be combined with marginal leaf chlorosis. In the Pacific Northwest, the scorched blossoms often are retained throughout the summer. In severe blossom blight, the twigs will often die back. On the East Coast, an 'oak leaf' line pattern often appears on the leaves in early fall and blossoms are not retained. Infected plants generally decline each year and eventually produce little or no fruit. There is a latent period of one to two years between infection and the expression of symptoms. Symptoms usually appear on one or a few branches and progressively spread to affect the entire bush in subsequent years. Affected bushes show symptoms every year, but severity can vary considerably from year to year. Any of several aphid species may transmit the virus with differing efficiencies.

*Shock.* A complete flower and leaf necrosis of the bush during the bloom period may occur, very similar to scorch symptoms. Affected young leaves wilt, with blackened veins and black streaks down the petiole, or they blight to an orange color. Blighted blossoms and leaves drop, resulting in complete defoliation. As the season progresses, the plants appear to recover as a second flush of leaves is produced. By late summer, these plants appear normal except that they produce little or no fruit and prior to harvest they may appear more vigorous than adjacent healthy plants. The severe symptoms only develop once on a given bush or part of a bush. In some cultivars, bushes may exhibit a red leaf spot symptom the year following the severe shock reaction. Leaves that do not blight are often slightly chlorotic, with thin red ring spots. It is common for bushes in the field to exhibit symptoms for two years and in some cases even three years. However, in such cases any one part of the bush only develops the severe shock reaction once. It is suspected that this virus is spread via pollen

*Mosaic.* Symptoms on foliage include mild to brilliant mottle and mosaic patterns of chrome yellow, yellow and yellow-green. Occasionally, leaves may display areas of pink coloration. Symptomatic shoots may develop erratically throughout the bush. Mosaic symptoms are not produced every year and presumably depend on specific environmental factors especially sunlight intensity. Fruit will ripen later than usual. It is not known how the virus is spread.

*Shoestring.* This disease causes a very slow decline in the bush with low yields. The most reliable symptom is elongated reddish streaks on current-year and one-year-old stems. During the blossom period, flowers on infected bushes exhibit pinkish to reddish corollas. Infected leaves are elongated or strap-like (shoestring). Some leaves may show a red oak leaf pattern on the leaf blade. Some leaves may be crescent shaped and partially or entirely reddened. Fruit does not ripen normally and remains reddish purple instead of turning blue. The virus is spread via aphids.

*Leaf Mottle.* Leaves show a mottled pattern and may be malformed. In some cultivars, the leaves may be small in a rosetted pattern. The virus is spread by planting infected material and via infected pollen.

*Fruit Drop.* Plants affected with fruit drop disease show a reddening of the young leaves early in the season and a candy striping of the corolla similar to shoestring. After flowering, the young leaves lose the red coloration and the bushes appear normal. Approximately three weeks prior to ripening, the fruit turns blue and drops from the bush. Prior to harvest, affected bushes can be seen from the edge of the field since the branches, not having any fruit, are upright and the bushes appear taller than neighboring bushes that are laden with fruit. Affected bushes grow more vigorously than fruiting bushes, presumably because they are allocating fewer resources to fruit production and more to vegetative growth. No vector has been identified in the spread of the disease.

*Necrotic Ring Blotch.* Necrotic rings on leaves can progress to complete defoliation of the bush. Most of the information on this virus comes from rabbiteye blueberries. An eriophyd mite is suspected as the vector. Very little is known about this disease.

*Bronze Leaf Curl.* This is a relatively new disease and much is not known. Leaves turn a mottled bronze color with upturned leaves the entire circumference of the leaf. Symptoms may take several years to develop. Aphids are suspected as vectors of the virus.