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PLANT DISEASE

POTATO LEAF ROLL

Potato leaf roll is a destructive viral disease of potatoes in Washington and is especially serious in the production of late potatoes. Losses are of two types: reduction in yields and poor quality tubers due to net necrosis.

Cause

Potato leaf roll is caused by potato leaf roll virus (PLRV). The virus belongs to genus *Polerovirus* (derived from **Po**tato **le**af **ro**ll) in the family *Luteoviridae*. PLRV, like other plant viruses, is extremely small and cannot be seen even with the help of a compound microscope. A more sophisticated and powerful electron microscope is needed that magnifies the image several thousand times. The virus is phloem-limited and, as a result, is somewhat difficult to purify. However, there have been significant improvements in accurately diagnosing the virus infection in laboratory tests.

Disease Spread

Infected seed tubers and volunteer potato plants serve as over-wintering and primary sources of PLRV inoculum. Some weeds in the nightshade family are hosts of the virus. Insects play a very important role in virus spread, particularly several aphid species.

The green peach aphid (GPA), *Myzus persicae*, is the most efficient and important vector. This aphid feeds on a large number of plants and is widely distributed. A virus-free aphid must feed in the phloem tissue of an infected plant for several hours before it can efficiently transmit leaf roll, but once it acquires the virus it may retain the ability to infect healthy plants for the rest of its life.

The virus is confined mostly to the phloem of the plant. Daughter tubers are infected through the vascular system. Viruliferous (carrying the virus) migratory winged aphids spread the virus between fields and over long distances. Non-winged aphids spread the virus from infected source plants to adjacent plants, primarily within rows. The virus cannot pass through the egg, so each progeny aphid has to acquire the virus by feeding on an infected plant.

Symptoms

Potato plants from infected tubers develop primary leaf roll symptoms in June or early July in the Columbia Basin. The plant may be infected when it develops from the eye and then is "chronically" infected. Infected plants are stunted and have a light yellow to pale green color. Lower leaflets are stiff, roll upwards, become leathery in texture, and rattle when shaken. The upper leaflets also roll. Chronically infected plants provide sources of virus for spread by aphids to healthy plants during the current growing season.

Plants infected during the current season (current season leaf roll) develop symptoms on the upper leaves. Plants infected early in the season may have a slight rolling of the new leaves at the shoot tips. Later, a yellowish or reddish color may develop near the base of the rolled leaflets. Leaflets roll,

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Figure 1. Chlorosis and rolling of leaves infected with leaf roll virus (center, left). Healthy leaf on right.

Figure 2. Net necrosis symptoms in tubers infected with leaf roll virus (center, left). Healthy tuber on right.

become pale green, and are stiffer than normal. Rolling and discoloration continue downward until the plant resembles those that are chronically infected. The underside of the rolled leaflets usually turns purple, which may be confused with purple top wilt. Symptoms of leaf roll may not develop on plants infected late in the growing season.

In storage, tubers from plants infected during the current season often develop a discoloration of the tissue called net necrosis. This appears as brown strands arranged in a double ring about a centimeter (0.4 in) beneath the skin. It usually is most easily seen in the stem-end half of the tuber. The degree of net necrosis depends on the potato cultivar, when infection occurred, length of time tubers have been stored, and storage temperature.

Symptoms of two other potato diseases result in a rolling of leaves and may be confused with potato leaf roll. One disease is caused by a phytoplasma and is known as purple top wilt or aster yellows. In certain cultivars, purple top wilt results in wilting and purpling of the undersides of leaves and eventual collapse of the plant. Other diagnostic symptoms of purple top wilt include swollen nodes and zig-zag internodes as well as small aerial tubers produced in the axils of stems above the ground.

The second disease, Rhizoctonia stem canker, is caused by a fungus and also results in the formation of aerial tubers but this disease is always associated with stem lesions below the soil line. The net necrosis symptoms in tubers may be confused with vascular necrosis caused by Verticillium wilt or environmental stresses, such as heat necrosis or vine desiccant injury.

Resistant Cultivars and Potential Disease Spread

Potato cultivars differ in their susceptibility to leaf roll and net necrosis. Russet Burbank is highly susceptible to net necrosis. Some cultivars such as Sebago, Pontiac, White Rose, and Kennebec are susceptible to leaf roll infection but do not develop net necrosis. Cultivars such as Umatilla, Bannock, Atlantic, Chipeta, Gem, Ida Rose Norkotah, and Ranger are also susceptible but tubers develop less severe net necrosis than Russet Burbank tubers. A few cultivars such as Katahdin, Calrose, and Essex are somewhat resistant to all phases of the disease.

Several cultivars with reduced symptom development of net necrosis are harvested early in the growing season rather than grown for the full season and eventual storage. These cultivars are used either for fresh packing or for direct delivery to processors. The combination of early harvest and a lesser threat of net necrosis provide the opportunity to slacken GPA control programs in fields of these cultivars. Since these cultivars are hosts for the GPA, they can serve as a source of GPA and in some cases PLRV.

As a host for the GPA, fields of these cultivars can provide a place for the accumulation of large numbers of GPA, which can ultimately move into fields of PLRV susceptible cultivars. Some of these aphids could be carrying PLRV. The high GPA population, with or without PLRV, provides the potential for extensive spread of PLRV.

Management

Potato leaf roll is managed by a combination of planting seed tubers free of leaf roll virus, eliminating volunteer potatoes and weeds, eliminating refuse tubers, and managing aphids. Some of these decisions depend upon regular and timely scouting for aphid vectors as well as diseased plants. Scouting should begin early in the season and should continue until mid to late season, as late season infection can still result in tuber symptoms.

Only seed tubers certified to be free or nearly free of leaf roll virus should be used. This is the only practical means of reducing the number of chronically infected plants, which is a main source of infection in commercial potato fields. The Washington Seed Lot Trials, sponsored by the Washington State Potato Commission in Othello, have been a valuable tool in determining PLRV content in seedlots of participating growers.

Volunteer potatoes also constitute an important source of leaf roll virus and should be eliminated by either rotating fields out of potatoes for one or more years so that volunteer plants can be destroyed, or by treating the potato crop with maleic hydrazide to reduce sprouting of tubers the following season. Spread from one plant to another within a season is entirely by aphids, so insect control is one of the chief means of reducing current season spread of leaf roll. Control of current season leaf roll reduces the development of net necrosis.

Effective early season control of aphid vectors can be achieved by using systemic insecticides at planting, according to research in Washington State. Based on field trials conducted in the Pacific Northwest, aldicarb and neonictinoid-based insecticides provide good control. Foliar insecticides are available that are usually effective in controlling aphids in late season potatoes. Threshold levels of aphid populations should be taken into account before deciding when to spray. Resistance to insecticides is an issue; the risk of such development is quite possible and caution should be exercised to avoid excessive or inappropriate use of these chemicals.

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