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RING ROT OF POTATOES

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Ring rot, caused by *Corynebacterium sepedonicum* (a new name proposed is *Clavibacter michiganense* subsp. *sepedonicum*), is a disease known in Germany since 1904. It was found in Canada in 1931 and in the United States in 1932. Since then it has been reported from every potato producing area in the United States, including North Dakota in 1939.

It can be one of the most serious diseases of potatoes, chiefly because of the ease and rapidity with which it can spread during a single growing season and the total devastation that it can cause. It is also an important consideration from an export point of view because importing countries have a zero tolerance on bacterial ring rot. It presents a very difficult problem to the grower of certified seed potatoes and is a serious menace to commercial producers of both table and processing stocks.

Ring rot is difficult for inspectors to estimate at shipping points, because they often cannot detect it without first cutting the tuber. At terminal markets, tubers which are affected with ring rot and decay due to secondary invasion of soft rot bacteria and fungi are occasionally responsible for important market losses.

From a marketing standpoint, potato lots known to contain any appreciable amounts of ring rot should be removed and/or sold early and promptly. This may avoid increased losses from advanced stages of ring rot and from secondary bacterial soft rot that frequently follows. It is often best to harvest infected fields

last to maximize decay in the field rather than in storage.

Symptoms

Symptoms of ring rot are not generally expressed under cool, wet conditions nor until the plant is nearly full grown. Development of ring rot in stems, stolons and tubers is favored by soil temperatures of 64 to 72° F. One or more stems in a hill may wilt and may be more or less stunted while the rest appear normal. Long days inhibit symptom development.

Initially, wilting of foliage on the lower portions of infected plants may occur during hot periods of the day with recovery at night. As symptoms develop, the areas between the leaf veins become pale yellow. Later, a more pronounced yellowing and drying of these areas occurs, followed by the upward rolling of leaf margins. It is not uncommon to observe only a few stems of a plant expressing ring rot symptoms.

Leaf discoloration is accompanied by progressive wilting which continues until all of the leaves on the stem are wilted. This condition ultimately kills the plant. Some potato cultivars, such as Russet Burbank, may show atypical symptoms of dwarfing and rosetting. In some cultivars (Belrus, Teton, etc.) symptoms are not well expressed. Plants can be infected without showing any symptoms.

If the stem of a plant showing advanced stages of the disease is cut across the base and squeezed, a creamy exudate can be expelled from the vascular area. Some strains of *C. sepe-*

donicum, such as non-mucoid ones, cause mild symptoms or none at all.

Infection of the tubers in growing plants begins at the stem end and progresses through the vascular tissue. The vascular ring at the stem end of infected tubers may show a cheesy rot, which is creamy yellow or light brown in color. In advanced cases, when pressure is applied to the tuber, there will be a creamy exudate from the vascular area and a definite separation of the tissue at the vascular ring (Figure 1). Severely affected tubers may be cracked on the outer surface (Figure 2), be infected by secondary rots and eventually rot completely in the field. Some tuber infections may be mild (Figure 3) or even symptomless (latent). These kinds of infections generally occur when low numbers of bacteria infect or are present. Absence of symptoms may persist for one to two generations. Plants with symptoms may occur in low numbers and not be seen in the field or storage.

Cause

The bacterium that causes ring rot lives from season to season in infected tubers and bacterial slime on production and handling equipment. When infected tubers are planted, bacteria move through the vascular tissue, eventually reaching all lower portions of the growing plant. Populations of ring rot bacteria rise rapidly as much as a month ahead of symptom development. Late in the season, bacteria migrate from the stem through the stolons, infecting the new tubers and continuing the disease from year to year.



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Figure 1

Wounds are necessary for infection by the ring rot bacterium. Bacteria are readily transmitted from diseased tubers to healthy seed pieces during the cutting of seed tubers. A knife used to cut an infected tuber may infect the next 20 to 100 seed tubers. Likewise, they may spread during the planting operation, particularly if a picker-type planter is used. The pathogen may also spread and infect by injury of healthy seed potatoes and physical contact with contaminated bins, crates, baskets, tools and other potato production equipment and facilities.

Recent research at North Dakota State University has demonstrated that sugar beet can act as a symptomless host for the ring rot bacterium. Current research is being directed at determining the importance of this finding in the persistence of bacterial ring rot of potato.

Bacteria causing ring rot do not overwinter in the soil, although an occasional infected tuber which survives from the previous crop may give rise to a diseased plant. There is no evidence of spread from plant to plant in the field. Bacteria can survive at least three years in dried stem or tuber tissue or on contaminated surfaces of equipment, storage facilities and bags. Survival is longest under cool, dry conditions and is retarded by warm, moist conditions.

At times, the incubation period of bacteria within the tuber may extend from two to three months. Consequently, infected tubers showing no visible evidence of the disease at harvest may develop positive symptoms during storage. Although healthy tubers can be infected through fresh wounds that penetrate as far as the vascular ring, there is usually little spread from diseased to healthy tubers during the storage period.



Figure 2

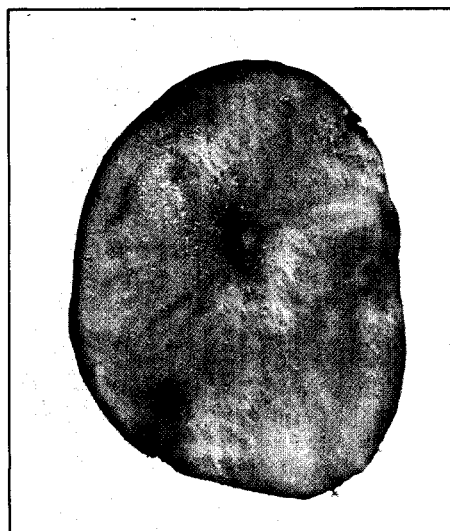


Figure 3

Diagnosis

Diagnosis of ring rot is based initially on foliar symptoms (wilting) and tuber symptoms (discolored vascular ring and cheesy squeeze). Laboratory tests are necessary to confirm ring rot. The easiest confirmatory test is called the gram stain. The appearance of blue-stained bacteria from a suspect squeeze from vine or tuber is a positive test. The appearance of red-stained bacteria is a negative test. Further confirmatory tests include serological tests such as immunofluorescence, double diffusion, ELISA, and/or latex agglutination. Inoculation of eggplant and isolation of the bacteria can also be used but requires 10 to 14 days. These tests should be utilized by trained personnel, partic-

ularly for diagnosis of latent or mild infections. Because secondary microorganisms can rapidly invade ring rot-infected tubers, severely rotted tubers are often difficult to diagnose. Brown rot, which does not occur in North Dakota, and freezing injury can cause vascular discoloration and may be confused with ring rot. Wilted plants can result from other diseases such as Verticillium wilt, or drought conditions.

Control Measures

The most important method of controlling ring rot is to plant disease-free tubers. **Certified seed potatoes** can be relied upon for this purpose more than uncertified seed. Do not plant seed lots which have not been certified. Since tubers may be infected with the ring rot organism and not show symptoms, diseased tubers cannot be detected by external examination of the tubers at planting time. Certified seed has a zero tolerance for ring rot, which means none is permitted. The presence of only one plant or tuber infected with ring rot means the whole field or seed lot is ineligible for certification. This does not guarantee freedom from ring rot; only that ring rot has not been found. The Plant Health Testing Laboratory at North Dakota State University offers a fee-based service to detect symptomless infections of ring rot in seed lots. Laboratory testing of seed potato lots may be desirable in situations where exposure to ring rot is suspected.

Before handling new seed lots, thoroughly disinfect with a suitable disinfectant all containers, tools and implements such as diggers, planters and sorters used in handling the crop. Special attention is required for open-cell, foam-rubber rollers which are extremely difficult to disinfect. Replacement with closed-cell foam-rubber rollers may be necessary. Also carefully disinfect storage houses to avoid contaminating new seed potatoes. It is **essential** to take these precautions each year, even though the disease is not present.

Before a new crop of seed is placed in storage, especially if ring rot was present the previous year, clean out the storage completely by disposing of all remaining old tubers and debris. Wash the storage to remove dirt and other organic matter and spray liberally with a disinfectant to kill any ring rot bacteria that may be present. The disinfectant must be in place 10 minutes to kill bacteria.

Information on disinfectants and seed potato handling is available in extension circular PP-877, **Disease Control Guidelines for Seed Potato Selection, Handling and Planting**.