PYTHIUM SEEDPIECE DECAY AND ROOT ROT OF POTATO AND ADVANCES IN ITS CONTROL

by
David J. Rhodes and Dennis C. Gross [1]

The Pythium species are soil-inhabiting fungi which attack a wide range of crops throughout the world, including wheat and peas in state of Washington. This report will demonstrate that Pythium is common in potato fields in the Columbia Basin, and is pathogenic to potato seedpieces, roots and stored tubers. It will also describe our attempts to develop biological control strategies directed against this disease.

Pythium Diseases

Pythium species are lower fungi which are pathogenic on a very wide range of agricultural and horticultural crops and are common inhabitants of cultivated soils throughout the world. They typically attack roots, young seedlings and fleshy vegetables causing root rots, damping-off and soft rots (2). The detrimental effects of Pythium may not always be obvious; for example the damage caused to wheat roots and seedlings by Pythium is common in Washington, but was only detected by eliminating the fungus and noting the increased growth and yield (1).

On potato, Pythium ultimum is known to cause a soft rot known as "leak" of tubers in store (3). Tissue becomes wet and spongy, and the tubers exude large quantities of liquid. Eventually the tuber may be reduced to a shell. Decay of seedpieces due to Pythium has also been noted in England and Canada (7).

Field Observations

We observed a very poor emergence rate in one of our field plots in the South Basin in 1986; only 63% of plants had emerged by early June. Plants which did emerge were often stunted and had poorly-developed root systems. When weak plants or non-emerged hills were dug, the seedpieces were found in most cases to be completely decayed. The seedpieces were not liquified as in bacterial soft rot caused by Erwinia carotovora, or shrivelled as in dry rot caused by Fusarium species, but remained fairly intact. The decayed tissue from which Pythium was isolated was white with a dark edge in the early stages, later brown to black. Although the fungus is usually difficult to detect, Pythium grew from 52% of the decayed seedpieces.

---

[1] Research Associate and Associate Professor, Department of Plant Pathology, Washington State University, Pullman, Wa.

This Presentation is part of the Proceedings of the 1987 Washington State Potato Conference & Trade Fair.

Other plots planted with the same seedlot showed similar symptoms. The fungus may have been carried on the seed, but more probably came from the soil, since the fungus was detected in soil even in nearby uncultivated areas. Some factor such as low temperature injury to the seed may account for the fact that one seedlot was attacked whereas others were not. The fungus was also isolated from roots of stunted plants, especially from discolored areas. Seedpiece decay and poor root development had been observed in this field in previous years, but had not been investigated further.

Pythium was very common in potato crops surveyed in the Columbia Basin in 1986; it was detected on roots in 16 out of 21 crops surveyed, and in soils of 19 out of 21 tested. The proportion of roots infected was in general related to the density of propagules in soil (Fig. 1). However, certain fields were noted in which soil populations of Pythium were high while very little root infection was observed, possibly suggesting the presence of a suppressive factor in the rhizosphere. The highest rate of root infection (92%) was noted in a field near Quincy which showed similar symptoms to those described previously.

Pythium was also isolated in the fall of 1986 from tubers showing typical "leak" symptoms in two potato stores in the Moses Lake area. Such tubers occurred sporadically throughout the pile, forming areas of wet tubers which were frequently covered with superficial molds. In contrast to bacterial soft rot, tubers were comparatively odorless. However, Erwinia carotovora was isolated from rotting tubers, suggesting that tubers affected by Pythium leak might act as foci of infection for bacterial soft rot.

Laboratory Tests

All Pythium isolates from decaying seedpieces were fast growing and rotted tuber tissue in laboratory tests, indicating that the fungus was Pythium ultimum. This fungus was also the most common type isolated from roots and potato field soils. Sixteen Pythium isolates, taken from roots, which rotted tuber tissue were grown in sand/cornmeal and tested for pathogenicity to potato roots. Most isolates were pathogenic to roots, although differences in virulence were noted; between 12 and 68% of roots showed symptoms, depending on the strain. The fungicide metalaxyl had a marked effect on root injury; when naturally infested field soil was drenched with 1.4% Ridomil (metalaxyl), the number of diseased roots was 32% less on metalaxyl-treated plants.

Biological Control

We are particularly interested in the possibility of using fluorescent pseudomonads for biological control of Pythium on potatoes. These bacteria aggressively colonize the rhizosphere, produce antibiotics and other substances which are inhibitory to Pythium (4), can protect seed tubers from bacterial soft rot (5,6) and have been shown to increase potato yields in the Columbia Basin (8,9).

Almost 800 of these bacteria are now being tested for suppression of rot caused by Pythium on tuber slices. Two strains which are particularly inhibitory to Pythium were found to increase marketable yield by 18% in field plots which had been subject to poor emergence and growth due to Pythium seedpiece decay.

In summary, we have demonstrated that Pythium is a common inhabitant of potato roots and field soils in the Columbia Basin and is pathogenic to seedpieces and roots as well as stored tubers. These effects may often go unnoticed or may be confused with other diseases, but almost certainly result in economic loss. The invasion of roots may predispose the plant to early dying; we consider this to be an important priority in future research. Biological control appears to be a promising strategy for alleviating the effects of Pythium and this aspect will be incorporated into our ongoing biocontrol program.

References

1. Cook, R. J. and W. A. Haglund. 1982. Pythium root rot; a barrier to yield of Pacific Northwest wheat. W.SU.A.R.C. Research Bulletin XBO913.

2. Hendrix, F.F. Jr. and W.A. Campbell. 1973. Pythiums as plant pathogens. Annual Review of Phytopathology 2:77-98.

3. Hooker, W.J. (Ed.). 1981. Compendium of Potato Diseases. American Phytopathological Society, St. Paul, Mn.

4. James, D.W. Jr. and N.I. Gutterson. 1986. Multiple antibiotics produced by Pseudomonas fluorescens HV37a and their differential regulation by glucose. Applied and Environmental Microbiology 52:1183-1189.

5. Rhodes, D.J. and C. Logan. 1986. Effects of fluorescent pseudomonads on the potato blackleg syndrome. Annals of Applied Biology 108:511-518.

6. Rhode, D.J., C. Logan and D.C. Gross, 1986. Selection of Pseudomonas spp. inhibitory to seed tuber decay. Phytopathology 76:1078 (Abstr.).

7. Rich, A.E. 1982. Potato Diseases. Academic Press, New York.

8. Xu, G.-W. and D.C. Gross. 1986. Selection of fluorescent pseudomonads antagonistic to Erwinia carotovora and suppressive of potato seed piece decay. Phytopathology 76:414-422.

9. Xu, G.-W. and D.C. Gross. 1986. Field evaluations of the interactions among fluorescent pseudomonads, Erwinia carotovora and potato yields. Phytopathology 76 : 423-432.

Table 1. Effect of pseudomonads antagonistic to Pythium ultimum on yield of Russet Burbank at Plymouth, Wa. 1986[a].

Treatment	Plants emerged (%)[b]	Height of plants (cm)[c]	U.S. No. 1 (Kg/plot)	Yield increase (%)
Check	63.1	46.8	65.9	--
I-12	71.0	51.3	72.8	10.5
R4a-80	75.9	48.7	77.8*	18.1
W4R-80	70.4	49.0	77.9*	18.2

[a] All data are based on six replicates per treatment. Asterisk (*) indicates data significantly different from check at P=0.05.
[b] Emergence was recorded at six weeks after planting.
[c] Height of plants was measured nine weeks after planting.

Figure 1. Propagule density and percent root infection in 21 potato crops in the Columbia Basin, 1986.