

POTATO EARLY DYING IN THE COLUMBIA BASIN
1995 SURVEY RESULTS

by

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During 1995, Dr. Randall C. Rowe, Professor of Plant Pathology at Ohio State University, spent an 8-month sabbatical leave in the laboratory of Dr. Dennis A. Johnson, Dept. Of Plant Pathology, Washington State University. Together, they pursued a research project, partially funded by the Washington State Potato Commission, to investigate the existence and role of various strains of the fungus *Verticillium dahliae* that might infect potatoes in the Columbia Basin of Washington and Oregon. *V. dahliae* is the primary cause of potato early dying which is a serious problem limiting potato production in many areas in the U.S. including the Midwest and the Pacific Northwest, especially the Columbia Basin. At present, the primary control method for this disease in many areas is soil fumigation. Because of the high costs of this management option and the possible loss of soil fumigants due to future regulatory decisions, new management options are needed. In all probability, *Verticillium*-resistant cultivars will play a key role in future management systems for potato early dying. To be successful, breeding efforts require a thorough understanding of the fungal pathogen and the pathogenic capabilities of various strains within the population. Improved knowledge of strains of *V. dahliae* will also help to better understand the role of rotational crops in management of this disease.

In recent years, Dr. Rowe and others have come to realize that much wider pathogenic variability exists among isolates of *Verticillium* than was previously suspected. By using a genetic technique called vegetative compatibility analysis, various strains have been identified within the population of *V. dahliae*. These are called "vegetative compatibility groups" or VCGs. Work in Ohio has shown that at least 4-5 different VCGs exist and that only 2-3 of these are significant in causing disease in potato. One in particular, referred to as VCG 4A, is highly virulent on potato and may be the strains that is primarily responsible for potato early dying. These findings have been confirmed by work in several other laboratories. Just recently, Dr. Rowe's group has obtained evidence that the greatly increased disease severity that results from simultaneous infection with *V. dahliae* and certain species of root-lesion nematodes, primarily *Pratylenchus penetrans*, occurs only with *V. dahliae* isolates in VCG 4A. No work has been done in the Columbia Basin to assess which strains of *V. dahliae* are causing disease on potato here and the goal of this project was to determine if the disease situation here was similar to that in the Midwest.

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Objectives of the study were (1) to assemble a large collection of isolates of *V. dahliae* from seed tubers coming into the Columbia Basin and from potato plants growing in fields scattered across Basin production areas, and (2) to determine which strains of *V. dahliae* were present in this collection and evaluate their pathogenicity to potato.

Seed tubers were obtained from the potato seedlot performance trials conducted at the Othello station by Dr. Robert Thornton's research group. Twenty tubers were selected at random from each of 108 seedlots that had originated from nine U.S. states and two Canadian provinces. Tubers were washed, surface sterilized in a bleach solution, and about 1/4 inch of the stem end was removed from each. Four pieces of the vascular tissues of each tuber were then cut out with a scalpel and placed on a semi-selective agar medium for isolation of *Verticillium*. By this process, *V. dahliae* was recovered from 26 of the 108 seedlots tested. In most cases, the fungus was recovered from only one or two of the 20 tubers assayed from each lot, but sometimes it was found in as many as five tubers. The recovery of *V. dahliae* from seedlots of the four major potato cultivars grown in the Basin is summarized in Table 1. Norkotah and Shepody seem to be major carriers of the fungus, while Ranger is less affected. The fungus was isolated from seed obtained from all major seed-producing areas in the test, indicating that at least some seed is infected from all areas. Interestingly, the fungus *Colletotrichum coccoides*, was recovered from 49 of the 108 seed lots tested. Dr. Johnson is investigating the possible role of this fungus in the potato early dying syndrome. Although its role, if any, is as yet unknown, the fungus certainly is present within the vascular tissues of many seed tubers.

TABLE 1 - RECOVERY OF VERTICILLIUM DAHLIAE FROM POTATO SEEDLOTS

VARIETY	SEEDLOTS TESTED	% WITH <i>V. DAHLIAE</i>
Norkotah	18	33
Ranger	11	9
R. Burbank	31	23
Shepody	13	46
TOTALS	73	27

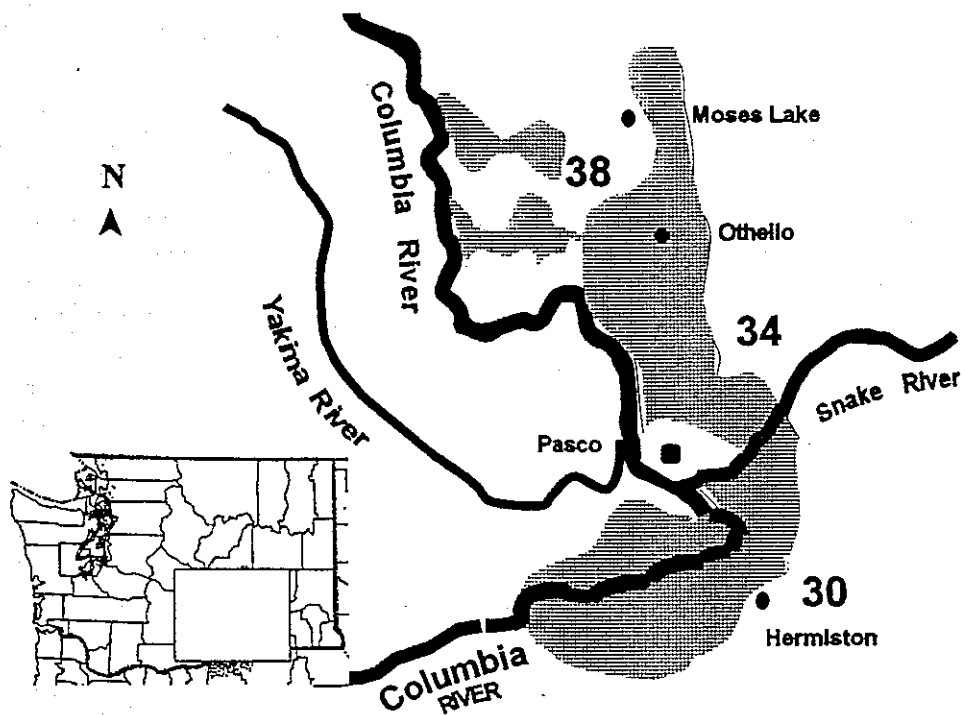
The importance of potato seedlots carrying significant amount of *V. dahliae* is twofold. First, this is the primary method by which virulent strains of the fungal pathogen are distributed across the industry. Our studies indicate that one particular strain may be the most important one on potato and this is the most likely way in which it is distributed. Whether seed tubers contaminated with *V. dahliae* lead to the development of potato early dying in a particular crop is not well understood. There is considerable inoculum of the fungus in the soil and the role of tuber infection as an added risk is unclear. More research is needed in this area, especially with regard to recontamination following soil fumigation.

An extensive sampling of potato fields in the Columbia Basin also was carried out in 1995. Sampling efforts were coordinated with the assistance of Phil Hamm in the Hermiston, Oregon area, Erik Sorenson in the Pasco area, and Gary Pelter in the Othello/Moses Lake area. A total of 102 fields were sampled, with 30, 34, and 38 fields sampled, respectively, in each of the three Columbia Basin areas (Fig. 1). Growers were contacted in advance in most areas and many personal contacts were made. Fields were selected to represent diversity in each area with regard to variety, location, soil type, and irrigation method and were not selected based on previous problems with potato early dying (except in a few cases). The purpose of the sampling was to obtain isolates of *V. dahliae* from as many fields as possible, not to extensively sample any one field to assess its particular disease status. Thus, a sample of only 10-20 stems was collected from a portion of each field. Fields were entered at any convenient point and a plant was selected every 50 feet or so, generally by walking in several directions. Plants were selected at random, and not because of any apparent disease symptoms. The basal 4-6 inch segment of each stem was removed, placed in a plastic bag, and kept in an iced cooler until returned to the lab in 1-3 days. In the lab, each stem was washed, surfaced sterilized 2 minutes in a bleach solution, and a basal 1-inch piece was then cut from each and placed in a separate small plastic ziplock bag. Each piece was then crushed in a vice and the juice pipetted onto the surface of a semi-selective agar medium, both straight and diluted 1:10. After 7-10 days incubation, plates were evaluated for growth of *V. dahliae* and representative colonies were removed, subcultured and purified. By this method, a large collection of over 200 isolates of *V. dahliae* was obtained that we consider very representative of those infecting potatoes across the Columbia Basin. Results of these isolations by variety are summarized in Table 2. It is interesting to note that *V. dahliae* was obtained from an increasing percentage of fields that were sampled as the season progressed, and that even in June, the fungus was obtained from about 1/3 of the Burbank and 2/3 of the Norkotah fields. By August, nearly every field was well infected. The data on severe infection indicate that at least one stem in the sample yielded a plate with at least 50 colonies of *V. dahliae* (sometimes hundreds), indicating that the plant was very well colonized by the fungus at the time of sampling. Trend data on Ranger and Shepody are not as obvious because of the small number of fields of those varieties sampled. These data are especially significant because the plants in this study were sampled at random and, in nearly all cases, appeared healthy. It is obvious that, in spite of the soil fumigation being done, *V. dahliae* is still infecting many or most potato plants grown in the Basin. This indicates the extent of the problem that growers face with this fungal pathogen, the current dependency of the industry on soil fumigation, and the need for the development of new varieties that are less susceptible to early dying.

The entire collection of isolates of *V. dahliae* obtained from both seed potatoes and plants was taken to Ohio by Dr. Rowe. Genetic studies are underway in his laboratory to determine the distribution of strains of the fungus and compare results from the Columbia Basin with those found in the Midwest. Initial studies have been completed with the nearly 50 isolates obtained from 26 lots of seed tubers. Thus far we found that all the isolates obtained from seed tubers belonged to either VCG 4A or VCG 4B. This is very similar to results of studies performed in the Midwest where VCG 4A and 4B were found to be the predominant strains infecting potatoes and VCG 4A was found to be a highly virulent potato pathogen. These results are preliminary and will have to be confirmed by analyses of the entire collection as well as by pathogenicity studies.

Drs. Rowe and Johnson intend to continue this collaboration and pursue further research objectives. We thank the Washington State Potato Commission for its financial support of these studies in 1995. We also thank Ms. Kate Pritchard for extensive technical support throughout these studies and additional help from Mr. Tom Cummings, Mr. Brad Geary, and Mr. Jeff Miller.

Figure 1.



Verticillium Field Sampling - 1995

Table 2.

Recovery of *V. dahliae* from ten randomly selected stems each from 102 potato fields in the Columbia Basin of Washington and Oregon, 1995.

VARIETY	MONTH	FIELDS SAMPLED	% <i>V. dahliae</i> PRESENT	% <i>V. dahliae</i> SEVERE
R.BURBANK	June	10	30	10
	July	10	70	60
	Aug	42	93	81
NORKOTAH	June	9	67	44
	July	17	88	65
	Aug	1	100	100
RANGER	June	3	33	0
	July	1	100	100
	Aug	1	100	100
SHEPODY	June	4	100	25
	July	1	0	0
	Aug	3	100	100