Distribution of Beet Western Yellows Virus in Potatoes Affected by Potato Leaf Roll

JAMES E. DUFFUS, Plant Pathologist, Agricultural Research Service, U.S. Department of Agriculture, Agricultural Research Station, Salinas, CA 93915

ABSTRACT

Duffus, J. E. Distribution of beet western yellows virus in potatoes affected by potato leaf roll. Plant Disease 65:819-820.

Beet western yellows virus (BWYV) was isolated from most potato leaf roll-affected potatoes assayed from California, Oregon, Wisconsin, Maine, and British Columbia. These BWYV entities that cause typical leaf roll in potato may represent a continuum of isolates varying in host range and serologic reaction.

Duffus (2,3) demonstrated that potato leaf roll (PLR) has a complex etiology. Beet western yellows virus (BWYV) was discovered through host range and serologic tests in all of five PLR-inducing isolates from California and Oregon. Serologically, the BWYV isolates from PLR-affected potatoes (*Solanum tuberosum* L.) reacted similarly to other BWYV isolates from beets, crucifers, and composites but also differed from each other in their specific reactions. Host range studies of one PLR-inducing isolate indicated that many plant species in a number of families may serve as reservoirs of leaf roll-inducing agents in potato-producing and isolated seed potato-producing areas. The implications of these findings for virus-free potato production and indexing procedures prompted further study of the distribution of BWYV in potato stocks.

MATERIALS AND METHODS

Foliage and/or tubers of PLR-affected potatoes were obtained from a wide geographic range. The plant material was selected as representative of typical PLR. I made selections from commercial fields in the San Joaquin Valley growing area of California; F. E. Manzer, University of Maine, submitted selections from Maine; and S. A. Slack, University of Wisconsin, submitted selections from Wisconsin. Index plot material representing seed lots under index by the California State Department of Agriculture and selected by W. L. Callison was obtained from Half Moon Bay, California. The Canadian isolate in tubers, provided by A. Rowhani, was the isolate used in PLR characterization studies in British Columbia (4).

Virus assays were conducted with detached leaves and stems. The samples were washed, and surface moisture was removed. Samples were placed on moistened filter paper in petri dishes. About 200 nonviruliferous green peach aphids (*Myzus persicae* (Sulzer)) reared on radish (*Raphanus sativus* L.) were placed in the dishes, and the dishes were sealed with tape. After a 24-hr acquisition feeding, aphids were transferred to the test plants, ground cherry (*Physalis floridana* Rydb.) and shepherd's purse (*Capsella bursa-pastoris* (L.) Medik.), in screened sleeve cages for a 48-hr infection feeding. Ground cherry is a commonly used indicator host for potato leaf roll virus (PLRV); shepherd's purse is a commonly used indicator host for BWYV but is not known to be a host for PLRV.

Serologic assays were conducted to determine affinities of selected shepherd's purse-infecting isolates. Extracts for antigen-antibody scanning pattern analyses were prepared from shepherd's purse. Plant material was ground in a food grinder with 0.1 M phosphate buffer (1:1), pH 7.0, containing 0.01 M glycine (PBG) and then homogenized at 45,000 rpm in a Virtis homogenizer. Crude extracts were heated to 45 C, clarified by low-speed centrifugation (20 min, 12,100 *g*), and then pelleted by high-speed centrifugation (2 hr, 80,000 g). Pellets were resuspended in PBG.

Gradients were made by layering 4, 7, 7, and 7 ml, respectively, of 10, 20, 30, and 40% sucrose dissolved in PBG. Centrifugation was done in a Beckman SW-27 rotor for 2 hr at 75,000 *g*. Gradients were scanned photometrically with an ISCO Model 640 density-gradient fractionator operated on the sensitive scale (A_{254} = 0.5nm).

Two antisera prepared against typical BWYV strains from crucifers (ST-1 and ST-9) were tested against the shepherd's purse-infecting isolates obtained from potato. Virus-antiserum mixtures were subjected to density-gradient centrifugation and analyzed photometrically. A positive assay was based on the elimination of virus antigens in the scanning patterns of density-gradient columns (1,3).

RESULTS

Virus isolation. Virus was isolated from all 56 diseased selections assayed; 41 contained isolates that infected shepherd's purse (Table 1). The shepherd's purse-infecting isolates occurred in commercial PLR-affected stocks from California, Wisconsin, Maine, and British Columbia. The incidence of isolates that infected shepherd's purse appeared to be greater than that of isolates that did not infect shepherd's purse; however, mixtures of

Accepted for publication 15 January 1981.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "*advertisement*" in accordance with 18 U.S.C. § 1734 solely to indicate this fact.

Table 1. Occurrence of aphid-transmitted yellowing viruses in selected field-grown potatoes with potato leaf roll symptoms[a]

State or province of origin Field type	Cultivar	Plants tested (no.)	Plants with isolates infecting:	
			Physalis	*Capsella*
California				
Commercial	White Rose	8	8	5
Index plots	White Rose	8	8	7
Index plots	Norgold Russet	1	1	0
Index plots	Russet Burbank	1	1	1
Index plots	Entomology; mixed	10	10	5
Index plots	Horticulture; mixed	8	8	5
Maine				
Commercial	Green Mountain	4	4	4
Commercial	Russet Burbank	3	3	3
Commercial	Kennebec	2	2	2
Commercial	Katahdin	2	2	2
Missouri				
Index plots	Russet Burbank	1	1	0
Wisconsin				
Commercial	Katahdin	3	3	2
Commercial	Russet Sebago	2	2	2
Index plots	Atlantic	2	2	2
British Columbia				
Commercial	Netted Gem (Russet Burbank)	1	1	1
California				
Commercial	Mixed (healthy)	125	1	1

[a] Virus isolations were made from detached leaves and stems. Green peach aphids were allowed a 24-hr acquisition feeding before being transferred to test plants *Physalis floridana* and *Capsella bursa-pastoris* for a 48-hr infection feeding.

the two in the same potato would not be detected.

An isolate that infected both *Physalis* and shepherd's purse was recovered from one of 125 apparently healthy potatoes selected from the southern San Joaquin Valley (Table 1).

Serologic tests. Twelve shepherd's purse-infecting isolates from potato were tested serologically: three isolates from California commercial fields, cultivar White Rose; four from Maine commercial fields, cultivars Green Mountain, Russet Burbank, Kennebec, and Katahdin; two from Wisconsin commercial fields, cultivars Katahdin and Russet Sebago; one from Wisconsin (index plots in California), cultivar Atlantic; one from California (index plots in California), cultivar Russet Burbank; and one from a Canadian commercial source, cultivar Netted Gem (Russet Burbank in the United States). Antisera prepared against strains ST-1 and ST-9 of BWYV reacted with all 12 isolates in a manner identical to that in which these antisera reacted with other isolates of BWYV.

DISCUSSION

The implication of the earlier study (3) that a complex of yellowing agents is responsible for PLR disease was confirmed and expanded. Most of the isolates from suspected PLR-affected potatoes infected shepherd's purse. Serologic tests indicated a close affinity between these isolates and common BWYV isolates from beets, crucifers, and composites. The BWYV isolates in potato are widespread in North America, extending from California, Oregon, and British Columbia to Wisconsin and Maine.

Several isolates did not infect shepherd's purse. The questions arise whether these isolates represent what has been regarded as PLRV, or whether a continuum of BWYV isolates varying in host range and serologic reaction makes up PLR disease. Preliminary serologic tests (3) indicated the occurrence of different serotypes in BWYV isolates obtained from potatoes. Serologic comparisons and host range tests will have to be greatly expanded to answer these questions.

No simple method has yet been devised to separate isolates that do not infect shepherd's purse from BWYV isolates in mixed infection in the same potato or *Physalis* plant; thus, the incidence of these isolates may be higher than indicated herein.

The wide distribution of PLR-inducing BWYV isolates in North America emphasizes the need to determine the impact of these isolates, one of which has been shown to have a wide host range among wild plant and crop species in a number of families (3), on potato-producing and isolated seed potato-producing areas.

LITERATURE CITED

1. Ball, E. M., and Brakke, M. K. 1969. Analysis of antigen-antibody reactions of two plant viruses by density-gradient centrifugation and electron microscopy. Virology 39:756-758.
2. Duffus, J. E. 1981. Beet western yellows virus isolated from potatoes with the leaf roll syndrome. (Abstr.) Phytopathology 71:105.
3. Duffus, J. E. 1981. Beet western yellows virus—A major component of some potato leaf roll-affected plants. Phytopathology 71:193-196.
4. Rowhani, A., and Stace-Smith, R. 1979. Purification and characterization of potato leaf roll virus. Virology 98:45-54.