

SCHULTZ POTATO VIRUS COLLECTION¹R. E. WEBB²

The most complete collection of potato viruses in the United States is maintained on Aroostook Farm, Presque Isle, Maine, and at Beltsville, Maryland. The collection contains 15 distinct viruses, some of which occur as strains, that cause certain diseases of the potato (Table 1). Most of the viruses were originally obtained by natural selections and later intensively studied by E. S. Schultz, United States Department of Agriculture, in collaboration with Donald Folsom, Maine Agricultural Experiment Station. A few of the viruses were submitted for study by other investigators and then entered in the collection as stock cultures.

This collection has become virtually the type culture collection of potato viruses for the United States. Certainly no other group of potato viruses in this country has been maintained, tested, and selected for type symptoms induced in the host while under the continuous personal supervision of one of its founders for almost 40 years. Most potato pathologists in the United States and some in foreign countries at one time or another have obtained virus cultures from the collection.³ Some potato-disease investigators who are unable to maintain virus cultures in their laboratories request them regularly each year. In 1956 alone, cultures of 18 strains of 8 viruses were requested by pathologists in 8 States and 1 foreign country.

Dr. Schultz is co-founder of the collection and maintained the cultures alone from 1936⁴ until his retirement in 1954. It may therefore be considered as largely his personal collection of potato viruses. In recognition of the tireless efforts of Dr. Schultz in preserving this valuable collection and his invaluable services to the industry, the collection has been named the Schultz Potato Virus Collection.

Description of the Collection. The name of each virus or strain in the collection, date of its selection or receipt, potato variety from which each was selected, date entered in the collection and the publication in which appeared the original description of the disease incited are listed in table 1. Most of the viruses and strains were isolated from naturally occurring diseased specimens in Maine. Cultures of viruses identified in other areas were supplied by the following contributors; Witches'-broom virus by B. F. Dana, Pullman, Washington; calico mosaic virus by T. P. Dykstra, Corvallis, Oregon; yellow dwarf virus by F. M. Blodgett, Ithaca, New York.

The virus collection actually dates from 1916. Dr. Schultz and Dr. Folsom were then collaborating on a study of the causes and control of the degeneration diseases affecting potatoes in Maine. That year they recognized in the variety Green Mountain, the first distinct degenerative disease, mild mosaic. In the next decade, these 2 workers selected and studied 10

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¹In cooperation with Maine Agricultural Experiment Station.

²Senior Pathologist, Crops Research Division, Agricultural Research Service, United States Department of Agriculture, Beltsville, Md.

³Requests are submitted to Chief, Plant Quarantine Branch, for approval prior to shipment of infected material.

⁴Dr. Reiner Bonde, Maine Agricultural Experiment Station, assisted Dr. Schultz in maintaining the virus cultures from 1924-1935.

different virus diseases of the potato in Maine and worked out the basic principles for their control (7,8). During this period it was first realized that insects were important carriers of viruses and the virus cultures therefore were placed under insect-proof cages to prevent contamination and insure against loss of the original virus and plant specimen.

Maintenance. Each virus culture has been maintained in tuber progeny, and plants of the original variety in which it was first selected. Subinoculation from the original cultures to other potato varieties and seedlings were necessary for study and identification. Two seedlings, one designated S 41956 (immune from virus X) and another of Green Mountain (virus X-free) closely resembling the commercial variety Green Mountain, proved adaptable for the maintenance of the viruses free of virus X. Since virus S has been reported, some of the viruses have been transferred to the variety Saco, which is immune from viruses A, S, and X.

Each potato variety or seedling containing a virus culture is grown under 2 separate insect-proof cages in the field (Figure 1). Four plants are grown in each cage. This usually supplies sufficient tubers of each variety for study, for replanting the cages and for distribution to other investigators.

Prior to 1955, propagation of the virus culture was done under cages enclosed with fine-mesh copper wire and heavy muslin (right rear, Figure 1). It was found that only a few varieties and seedlings would tuberize under these cages, and furthermore during cool, moist, cloudy seasons some cultures were in serious danger of being lost. Twelve cages were modified in 1955 to provide a 12-inch pliofilm (acetate, .10 weight) strip



FIGURE 1.—Virus culture maintenance plot on Aroostook Farm, Presque Isle, Maine. Cultures have been maintained under these insect-proof cages since 1922 to prevent contamination, and insure against loss of the original virus and plant specimen.

TABLE 1.—*Potato viruses and strains in the Schultz Collection.*

Virus or Strain	Original Host Variety	Year Selected or Received	Year Placed in Insect-proof Cages	Citation for Original Description of Disease Caused by Virus or Strain
Apical leaf roll	Katahdin	1925	1928	Schultz and Bonde (9)
Aucuba mosaic	Green Mountain	1925	1925	Quanjer (6)
Calico mosaic	Green Mountain	1929	1930	Porter (5)
Intervinal mosaic	Green Mountain	1923	1924	Schultz (10)
Latent mosaic (virus X); ¹				Smith (11)
weak strain	Green Mountain	1931	1932	
faint strain	Green Mountain	1931	1932	
medium strain	Green Mountain	1936	1936	
severe strain	Green Mountain	1934	1935	
virulent strain	Early Rose	1933	1934	
Leaf roll;				
mild (1) strain	Green Mountain	1921	1930	Schultz and Folsom (7)
moderate (2) strain	Green Mountain	1951	1955	Webb, Larson and Walker (12)
severe (3) strain	Green Mountain	1951	1955	
Leaf rolling mosaic	Green Mountain	1922	1931	
Potato virus A;				
mild strain	Green Mountain	1916	1922	Schultz and Folsom (7)
crinkle strain	Green Mountain	1922	1922	Schultz and Folsom (7)
Potato virus S	S 41956	1956	1956	DeBruyn Ouboter (3)
Spindle tuber	Green Mountain	1921	1929	Schultz and Folsom (7)
Unmottled curly dwarf	Green Mountain	1921	1929	Schultz and Folsom (7)
Potato virus Y;				
common strain	Green Mountain	1921	1922	Schultz and Folsom (7)
stipple streak strain	Green Mountain	1921	1925	
Witches'-Broom	Cobbler	1923	1924	Hungerford and Dana (4)
Yellow dwarf	Russet Burbank	1935	1935	Barrus and Chupp (1)
Yellow spot	Katahdin	1955	1955	Bonde and Merriam (2)

¹Strains identified by E. S. Schultz by inoculation to *Datura stramonium* L.

around the upper half of the cage for better illumination of plants. An 8-inch strip of fine-mesh copper wire just below the plicofilm and one on each side of the top provided ventilation. Heavy muslin with an 18-inch closely meshed zipper sewn in the middle was used to cover the top center portion of the cage. This facilitated close inspection of the enclosed plants and allowed for periodic application of an insecticide and fungicide. Figure 2 shows the increased yields of tubers produced by healthy Katahdin plants under the newer type cage.

The collection is observed closely during the growing season and when the cages are removed at harvest time, each plant is closely inspected for insects, particularly aphids. The vines are removed, and the tubers from each plant in each cage are harvested separately and divided into 2 lots, one for replanting the same hill in the cage the following year and the other for distribution to investigators and for greenhouse tests at Beltsville, Maryland.

One tuber from each hill in the collection is planted in the greenhouse at Beltsville for observation of plant symptoms and tests for purity of the virus culture. Variations in plant type or virus symptom characteristics are noted. Tubers from the affected plants are removed in order to maintain the original type virus. Similar observations are conducted in a small observational plot planted at Presque Isle, Maine.

Maintenance of the present stock culture collection of potato viruses requires approximately 100 insect-proof cages. These are all of the newer type which permits better illumination of the growing plants. About 10 to 15 medium-sized tubers are usually obtained from each cage, and experience has shown that these are sufficient to insure maintenance of each culture and furnish infected material for disease investigations.

Value of the Collection. This virus collection has been and still is of immeasurable value to potato disease investigators and the potato industry. Type cultures secured from the collection have been used in basic research on potato viruses such as physical properties, strain variations, serological studies, virus-vector relationships, genetic studies and studies of the nature of host resistance. Pure cultures of viruses maintained in the collection have played an important part in the development of disease control through use of insecticides and the development of disease-resistant varieties. Most potato varieties resistant to virus diseases that have been released jointly by the United States Department of Agriculture and cooperating States since 1930 were initially evaluated by inoculation with virus cultures from this collection.

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FIGURE 2.—Yield of tubers produced by healthy Katahdin plants grown under insect-proof cages. Left, wire-covered; right, pliofilm- and wire-covered.

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