

CLOVER VIRUSES IN EASTERN CANADA IN 1967¹

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Abstract

A limited survey of clover fields in Ontario, Quebec and the Maritime provinces in June, 1967, showed the presence of eight identifiable viruses, some widespread and others localized. Pea streak virus was the most commonly found virus in red clover (*Trifolium pratense*) stands, followed by red clover vein mosaic, bean yellow mosaic and pea mosaic viruses. Clover phyllody virus was the important virus of red, white (*T. repens*) and alsike (*T. hybridum*) clovers in Prince Edward Island, but its incidence decreased in fields westward to central Quebec. Clover yellow vein virus, which was recently described in England, was found occasionally in clovers in Quebec, New Brunswick and Prince Edward Island. Alfalfa mosaic and white clover mosaic viruses were sporadically present in most of the areas surveyed. Although none of the viruses could be considered a prime limiting factor in yield and maintenance of clover, losses were evident in some areas and the infected clovers provide a source of infection for annual legumes.

Introduction

Recent surveys of forage legume diseases in Quebec (1) and Prince Edward Island (7) have indicated the presence of virus diseases, but with the exception of clover phyllody the viruses were not identified. In Wisconsin six virus diseases were found in red clover (3). In decreasing order of prevalence these were: red clover vein mosaic, pea mosaic, bean yellow mosaic, Wisconsin pea streak, alsike clover mosaic and alfalfa mosaic viruses.

The present survey was undertaken in order to identify the main viruses infecting clover in Eastern Ontario, Quebec and the Maritime provinces.

Materials and methods

Red clover (*Trifolium pratense* L.) was the main species examined, followed by white clover (*T. repens* L.), alsike clover (*T. hybridum* L.), and sweetclover (*Melilotus* spp.).

Fields were surveyed during early June in areas where clover is an important crop. The incidence of virus diseases in and around the fields was estimated from symptoms, and sample plants were taken to identify the viruses present. The viruses were identified by their host range and symptoms produced on a series of inoculated test plants, by

electron microscopic examination of virus particles, and by serology. The test plants used were *Chenopodium amaranticolor* Coste & Reyn., *Gomphrena globosa* L., *Nicotiana tabacum* L. 'Haranova', *Pisum sativum* L. 'Lincoln', *Phaseolus vulgaris* L. 'Black Turtle', and *Vicia faba* L. Some inoculations were made to *Nicotiana clevelandii* Gray, *Phaseolus vulgaris* L. 'Top Crop', *Pisum sativum* L. 'Little Marvel' and *Trifolium incarnatum* L. Virus particles were obtained from cut leaves by the dip method. Serological identifications were made by the precipitin test on clarified sap. The author is grateful to Dr. R. E. Ford, Iowa State University, for antisera against pea streak virus (PSV) and red clover vein mosaic virus (RCVMV) and to Dr. M. Hollings, Glasshouse Crops Research Institute, Rustington, England for antiserum against clover yellow vein virus (CYVV). Antisera against other viruses were produced in this laboratory.

Results and discussion

Regional differences in the distribution of clover viruses are evident (Tables 1-5). Pea streak virus (PSV) is widespread in red clover in the Ottawa Valley in Ontario and along the St. John Valley in New Brunswick, but is less common in Quebec and southern Ontario and was not found in Prince Edward Island. Moderate stunting of clover plants infected with PSV was evident in southern New Brunswick but in other areas the growth was not noticeably affected. This virus can reduce the yields of peas (6), and infected clover serves as a source of inoculum.

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Table 1. Clover viruses found in Ontario

Location	Culture	Estimated age (yr)	Clover* host	Viruses**	Index of occurrence***
Ottawa	hay	2	red	PSV, BYMV	2
	roadside		red	PSV	nq
South March	hay	2	red	PSV, PMV	3
Arnprior	roadside		red	PSV, BYMV	nq
Renfrew	hay	2	red	PSV	2
Pembroke	hay	1	red	PSV	1
Havelock	hay	5	red	BYMV, PSV	3
Brampton	hay	1	red, sweet-clover	BYMV	1
Brampton	hay	3	red	PSV	2
Peterborough	hay	1	red	BYMV	1
Peterborough	hay	2	red	BYMV	2
Hamilton	hay	4	white	PSV, RCVMV	2
Hamilton	hay	2	red, white	PSV	1
Haldimand Co.	hay	1	red	PMV	1
Haldimand Co.	roadside		red	BYMV, PSV	nq
Niagara Falls	lawn		white	WCMV	nq

The following footnotes are applicable to Tables 1 to 5:

* Red = Trifolium pratense, white = T. repens, alsike = T. hybridum, sweet = Melilotus spp.

** AMV = alfalfa mosaic virus, BYMV = bean yellow mosaic virus, CPV = clover phyllody virus, CYVV = clover yellow vein virus, PMV = pea mosaic virus, PSV = pea streak virus, RCVMV = red clover vein mosaic virus, WCMV = white clover mosaic virus.

*** The frequency of plants with virus symptoms is indicated as follows: 1 = less than 1%, 2 = 1-5%, 3 = 5-25%, 4 = more than 25%, nq = not quantitative.

Table 2. Clover viruses found in Quebec

Location	Culture	Estimated age (yr)	Clover host	Viruses	Index of occurrence
Macdonald College	hay	2	red	PSV	2
St. Hyacinthe	roadside		white	CYVV	nq
Victoriaville	hay	3	white, red alsike	RCVMV	2
	roadside		white	CPV	nq
Larochelle	hay	1	whitr, red alsike	0	
Gentilly	hay	4	red	BYMV, CYVV, RCVMV	2
Lotbinibre	pasture	5+	white	AMV, WCMV	4
	hay	2	white	WCMV	1
St. Antoine	pasture	5	white	CYVV	2
Montmagny	hay	1	red white	0 CPV	1
Montmagny	hay	3	red, white	AMV, RCVMV CPV	2 2
St. Augustin (Laval farm)	hay hay	3 1	red, white red, alsike	AMV CPV, CYVV	1 1
La Pocatière (CDA farm)	hay	3	red white red, white white	PSV CYVV RCVMV CPV	2 1 2 1

Clover phyllody virus was widespread in Prince Edward Island, where it could be seen to be a limiting factor in stand maintenance in some fields. In northern Nova Scotia and in southern New Brunswick it was less of an economic factor but was present in most of the fields surveyed. The virus was uncommon in the parts of Quebec surveyed although it is known to be common in the Lac St. Jean area. It was not found in Ontario.

Common white clover with an unusual chlorotic blotching of the leaves was collected near St. Hyacinthe, Quebec, and from the vicinity of the CDA

Research Station, Fredericton, New Brunswick. Inoculation of the test plants gave host reactions which were similar to those described for clover yellow vein virus (CYVV) in England (2, 4). Virus particles from leaves infected with these isolates were flexuous rods about 750 m μ long, which corresponds to length determined for CYVV by Gibbs et al. (2). Antiserum against CYVV obtained from Dr. M. Hollings reacted positively with the Canadian isolates. Typical bean yellow mosaic virus (BYMV) and pea mosaic virus (PMV) isolates obtained in the

Table 3. Clover viruses found in New Brunswick

Location	Culture	Estimated age (yr)	Clover host	Viruses	Index of occurrence
Moncton	hay	5 t	red, alsike	PSV	2
			red	RCVMV, CPV	2
Petitcodiac	hay	1	red, alsike	PSV	1
				CPV	3
Sussex	hay	1	red	CPV	1
Cambridge	hay	5 t	red	RCVMV	1
			red, white	PSV	2
Fredericton (CDA station)	hay	1	red	PSV	2
	roadside		alsike, white	CPV CYVV	3 3
Hartland	hay	4	red	CPV	2
				PSV	1
Perth	hay	3	alsike, red	PSV	3
			red, white	CPV	2
Centreville	hay	3	red, white	PSV	4
				CPV	3
Centreville	hay	1	red	CPV	1

survey have some similar host reactions to CYVV and a similar particle length, but they did not react with the CYVV antiserum. It is possible that CYVV has been collected in North America before, but has been called BYMV or PMV. A virus isolated from beans in Idaho resembled CYVV in infecting white clover and in producing chlorotic blotch local lesions on tobacco (5). It was called a strain of BYMV but it did not cross-protect from other strains of the virus.

BYMV, PMV and RCVMV were found in red clover in many of the areas surveyed. RCVMV was also found occasionally in white clover. Yield reductions due to infection by these viruses were minor, but aphid transmission to peas and beans could be economically important. Alfalfa mosaic virus was sparsely distributed, occurring mainly in white clover in old stands or in the vicinity of alfalfa fields. White clover mosaic virus, which does not

Table 4. Clover viruses found in Nova Scotia

Location	Culture	Estimated age (yr)	Clover host	Viruses	Index of occurrence
Westville	hay	2	red, white	RCVMV, CPV	1
Truro	lawn		white	WCMV	nq
	roadside		white	WCMV, CPV	nq
Truro	pasture	5	white	unident.	nq
	hay	3	rrd	0	
Glenholme	hay	5	red, white	CPV	2
Glenholme	hay	1	red	CPV	1
Glenholme	hay	1	red	CPV	1
Wentworth Centre	hay	1	red	PMV, PSV	1
Wentworth C.	hay	2	red	CPV	2
Oxford	hay	1	red	CPV	1
Springhill	pasture	5	alsike	unident.	1
			red	PSV	1
Amherst	hay	5	red	0	
Amherst	hay	1	red	PMV	1

appear to have an insect vector but which is easily transmitted mechanically, was found mainly in white clover in lawns, pastures and on roadsides.

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Table 5. Clover viruses found in Prince Edward Island

Location	Culture	Estimated age (yr)	Clover host	Viruses	Index of occurrence
Charlottetown (CDA station)	hay	1	red, white	AMV	2
	pasture	5 t	white	CYVV	nq
Green Gables	lawn		white	WCMV	nq
Cavendish Beach	roadside		white	RCVMV	nq
Cavendish	hay	2	red	CPV	4
				RCVMV	1
Summerside	hay	1	red	CPV	3
Central Bedeque	hay	1	red, alsike	CPV	1
Bonshaw	hay	1	red	CPV	1
Upton (CDA farm)	hay	2	red, alsike	CPV	3
			white	AMV	2
			red	unident.	1
Vernon	hay	3	red	CPV	4
Flat River	hay	1	red	CPV	2

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