Isolation and characterization of a new necrotic strain (NL-8) of bean common mosaic virus in Southwestern Ontario

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Several isolates of bean common mosaic virus (BCMV) were obtained from 'Sanilac' bean plants showing severe mosaic and occasionally vein necrosis. Based on their pathogenicity to a series of differential host, the isolates were determined to be the NL-8 race of BCMV. This is the first report of this race in Canada.

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L'on a obtenu plusieurs isolats du virus de la mosaïque commune du haricot (BCMV) à partir de plants 'Sanilac' montrant des symptômes de mosaïque sévères et quelquefois une nécrose des nervures. En se basant sur leur pathogénicité envers une série d'hôte différentiel, l'on a determine que les isolats font partie de la race NL-8 du BCMV. Ceci est la premiere mention de la présence de cette race au Canada.

Introduction

Recommended cultivars of white bean in Ontario can be divided into two groups according to their reaction to bean common mosaic virus (BCMV). One group (i.e., Sanilac and Kentwood) that does not carry 'I' gene develops typical mosaic when infected with NY-15 but, in any case, no vein necrosis and black root are apparent. The other group (i.e. Fleetwood, Seafarer, Harofleet, and Harokent) carries I gene which confers resistance to the two prevalent races (the type and NY-15) as well as all other known races of BCMV. Plants that carry I gene react to BCMV infection in two ways depending on the races of the virus. One develops tip and vein necrosis at moderate temperatures (20-26°C) and the other develops hypersensitive death at high temperature (1,3,4). The latter is referred to as black root because the affected plants exhibit dark brown or chocolate brown coloration of stems and roots (3). Cultivars such as Fleetwood and Seafarer fall into this category. Unfortunately, on many occasions, some infected plants develop tip and vein necrosis at moderate temperatures (20-26°C). This phenomenon indicates possible existence of a different race of BCMV. Moreover in the past 4 years, both black root and mosaic increased substantially in both experimental plots and in commercial fields. Aside from mosaic, death of plant stands due to black root in the resistant cultivars could reach as high as 30% in some fields. Undoubtedly, the disease has reached an epidemic proportion and a new type of resistance may be needed to control this disease, particularly in view of the discovery of new races NL-3 in Michigan and NL-8 in New York (5, 6) and the occurrence of NL-8 in Ontario reported herewith. The rational breeding program for BCMV resistance may have to incorporate 'bc22' gene together with 'I' gene. Plants carrying these two genes will resist all known races and not develop black root and mosaic.

This note reports the isolation and characterization of a new necrotic race of BCMV not previously found in Canada.

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Materials and methods

Isolation and inoculation. Leaves of Sanilac plants showing mosaic and vein necrosis were collected. Each sample of leaves was triturated in 0.01 M phosphate buffer, pH 7.0 at the ratio of 1 gm leaf tissue to 3 ml buffer. A small amount of 400 mesh Carborundum was added to the sap. Inoculation was made first to greenhouse grown Sanilac plants by rubbing the sap onto fully expanded primary leaves. Inoculated leaves were rinsed 5-10 min later with tap water.

Assay on differential cultivars. Race characterization followed the differential schemes of Drijfhout et *al.* (1). The differential cultivars used were listed in Tables 1 and 2. The method of inoculation was the same as described previously. All assays were conducted in a 22 ± 2°C greenhouse. For comparative purposes a differential series was similarly inoculated with race NY-15. Disease reactions were observed 10 days after inoculation.

Results and discussion

Reactions of the series of differential cultivars to the new necrotic isolate are summarized in Tables 1 and 2. Based on the differential host reactions described by Drijfhout et *al.* (1), the new necrotic isolate was determined to be race NL-8 of BCMV. A known race (NY-15) was employed to indicate the adequacy of the testing methods. Results are also included in Tables 1 and 2 for comparison. The results showed clearly that NL-8 was present in the Ontario bean field. This race was first discovered in The Netherlands by Drijfhout and Bos (2) in 1977.

All isolates induced similar reaction in both sets of differentials listed in Table 1 and 2. Thus, they were considered to the same strain (NL-8).

The new strain (NL-8) differs from strain (NL-3) reported in Michigan by Kelly *et al.* (5) by virtue of its inability to infect cultivars such as Redland Green Leaf-C, Puregold Wax, Redland Green Leaf-B and GN-123 (Table 1). It also differs from NL-3 by its inability to induce tip necrosis on Jubila, Topcrop, and Imperial Tendergreen (Table 2). The new strain, like NL-3, causes veinal necrosis on inoculated leaves and severe tip necrosis of Ontario cultivars such as Fleetwood, Seafarer, Harfleet, Harokent, ExRico-23, OAC-Seaforth, and OAC Rico which carry I gene.

Table 1. Disease reaction of a new isolate of bean common mosaic virus on differential bean cultivars compared with known races of the pathogens[a].

			Races									
Dubbele Witte	S	S	S	S	S	S	S	S	S	S	S	S
Sutter Pink	S	S	S	S	S	S	S	S	S	S	S	S
Redland Green Leaf-C	R	S	R	R	R	R	S	S	S	S	S	S
Puregold Wax	R	S	R	R	R	R	S	S	S	S	S	S
Redland Green Leaf-B	R	R	R	R	R	R	S	R	R	S	S	S
GN-123	R	R	R	R	R	R	S	R	R	S	S	S
Sanilac	S	S	R	R	R	S	R	S	S	S	S	R
RM-34	S	S	R	R	R	S	R	S	S	S	S	R
Monroe	R	R	R	R	R	R	R	R	R	R	R	R
GN-31	R	R	R	R	R	R	R	R	R	R	R	S

[a] Differential host reactions based on Drijfhout *et* a/. (1); R = resistant and S = susceptible.

Table 2. Systemic reactions of new isolate of bean common mosaic virus on bean cultivars compared with known races of the pathogen[a].

			Races									
Bean Cultivar[b]	New Isolate	NY-15	I Type	I NL 1	II NL 7	III NL 8	IV NL 6	V NY 15	V NL 2	VI NL 3	VI NL 5	VII NL 4
Jubila	I[c]											
Topcrop	I											
Improved Tendergreen	I											
Widusa	N	I	I	I	I	N	V	I	I	N	N	I
Black Turtle Soap	N	I	I	I	I	N	V	I	I	N	N	I
Amanda	1	I	1	I	I	I	I	1	I	1	N	I

[a] Differential host reactions based on Drijhout *et* a/. (1).
[b] Cultivars carry dominant alleles of "I" gene.
[c] I = Resistant, no systemic symptoms, virus not recoverable from tips; v = variably sensitive, some plants show systemic necrosis at some temperatures, virus not recoverable from tips; and N = necrotic tip kill of most or all plants, virus not recoverable from tips.

Undoubtedly, a breeding program to incorporate '$bc2^2$' gene into the cultivar with I gene is urgently needed to alleviate the hypersensitive reaction caused by resistant I gene, and to head off the new NL-8 and NL-3 strain in Ontario, New York and in Michigan, respectively.

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