

Maize Dwarf Mosaic Virus in Michigan

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ABSTRACT

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Maize dwarf mosaic virus (MDMV), detected for the first time in Michigan, was identified by host and serologic reactions. It reacted only with antiserum to strain B and produced characteristic symptoms in Golden Bantam and NK 199 sweet corn; SDP2 and OH28 dent corn inbreds; and Atlas, Rio, and Sart sorghum, but not in johnsongrass or Michigan Amber, Monon, and Little Club wheats.

Maize dwarf mosaic virus (MDMV), known to occur in the southern portion of the Corn Belt for well over a decade (19), has only recently caused concern in the northern states of this region (5). MDMV in late-planted corn (*Zea mays* L.) was reported in northern Ohio in 1976 (6) and in Minnesota (8,20), North Dakota (21), and Wisconsin (1) in 1977. Extensive surveys of Michigan corn following the discovery of MDMV in Ohio in 1963 (9,22) gave no evidence of the virus (3,4,18).

In 1977 and 1979, dwarfed corn plants with light and dark green mosaic on the uppermost leaves were observed in several Michigan counties. Foliar samples were collected for assays to determine the pathogen.

MATERIALS AND METHODS

For host range studies, seeds of sweet corn cultivars Golden Bantam and NK199; dent corn inbreds SDP2 and OH28; sorghum (*Sorghum bicolor* (L.) Moench.) cultivars Atlas, Rio, and Sart; johnsongrass (*Sorghum halepense* (L.) Pers.); and wheat (*Triticum aestivum* L.)

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cultivars Michigan Amber, Monon, and Little Club were planted in sterilized soil in 4-in. pots. The second youngest leaves of plants 1-2 wk old were mechanically inoculated with a crude extract containing 600-mesh Carborundum, prepared by triturating infected tissue in 0.01 M or 0.05 M potassium buffer, pH 7. Young Sart sorghum plants were used in back assays of inoculated johnsongrass. Test plants were rated for symptoms 7-21 days after inoculation.

Serologic identifications of virus isolates were made by the enzyme-linked immunosorbent assay (ELISA) (15), and antisera to strains A and B of MDMV were prepared as described previously (10). The MDMV-A and MDMV-B immunoglobulins were not cross-absorbed with the heterologous viral antigen.

RESULTS

Virus isolates from samples collected in Grand Traverse, Ingham, Missaukee, Presque Isle, and Tuscola counties produced characteristic symptoms of MDMV on Golden Bantam and NK199 sweet corn, SDP2 dent corn inbred, and Sart sorghum within 2 wk of inoculation, but failed to produce symptoms in Michigan Amber and Little Club wheats and johnsongrass. Sart sorghum plants inoculated with an extract from inoculated johnsongrass did not develop symptoms. MDMV strain A infects corn, sorghum, and johnsongrass; strain B, corn and sorghum; and wheat streak mosaic virus, corn and wheat (7).

In infectivity assays at Wooster, three isolates recovered from corn samples collected in 1977 infected OH28 corn and

Rio sorghum but not johnsongrass or Monon wheat; one isolate produced local lesions on Atlas sorghum. Further assays in which infected Rio sorghum served as the inoculum source gave identical test plant responses, except that all three isolates produced local lesions on Atlas sorghum. We concluded that the three isolates were the B strain of MDMV (10-13).

To confirm this identification, one of the isolates, maintained by several transfers in corn, was tested by ELISA with purified antibodies to MDMV-A and MDMV-B (Table 1). The isolate reacted positively to MDMV-B but not MDMV-A antibodies. The known isolates of MDMV-A and MDMV-B reacted positively in the homologous but not heterologous tests. The healthy corn control extract did not react with antibodies to either strain.

In 1979, two field-collected corn samples with mosaic symptoms from Ingham and Grand Traverse counties tested positive for MDMV-B but not MDMV-A by ELISA (Table 1). The isolates from Ingham County induced symptoms typical of MDMV in Sart sorghum. Because the MDMV-A, MDMV-B, and healthy corn controls reacted serologically as described for those of 1977, except that MDMV-B reacted weakly with immunoglobulins to MDMV-A, we concluded that the 1979 corn virus isolates were also MDMV-B.

DISCUSSION

Only wheat streak mosaic virus has previously been found naturally infecting corn in Michigan (E. E. Saari, *personal communication*). The isolates reported here, however, could not be wheat streak mosaic virus because they failed to infect the three wheat cultivars.

Maize dwarf mosaic occurrences in northern nonjohnsongrass areas of the Corn Belt and in the northeastern United States have involved MDMV-A (16,21), MDMV-B (14), or both strains (1,2,6,8,17,20; D. T. Gordon and D. C. Arny, *unpublished*). All these northern states except South Dakota (14) have

Table 1. Results of enzyme-linked immunosorbent assay (ELISA) of extracts of corn leaves infected with corn virus isolates collected in Michigan (MI) in 1977 and 1979 and tested for maize dwarf mosaic virus strains A (MDMV-A) and B (MDMV-B)

Isolate or antigen designation ^a	ELISA				
	Immunoglobulin (Ig)		Test results		
	MDMV-A Ig	MDMV-B Ig	Visual ^b	A_{405} ^c	
				\bar{x}	SD
MI-1977	+	-	CL	...	
MDMV-A	+	-	LY	...	
MDMV-B	+	-	CL	...	
Healthy corn	+	-	CL	...	
MI-1977	-	+	Y	...	
MDMV-A	-	+	CL	...	
MDMV-B	-	+	Y	...	
Healthy corn	-	+	CL	...	
MI-1979	+	-	CL	0.673	0.133
MDMV-A	+	-	LY	2.843	0.060
MDMV-B	+	-	VLY	1.739 ^e	
Healthy corn	+	-	CL	0.485	0.020
MI-1979	-	+	LY	2.912	0.092
MDMV-A	-	+	CL	1.544	0.102
MDMV-B	-	+	LY	2.970	0.014
Healthy corn	-	+	CL	0.826	0.049

^aThe MDMV strains and healthy corn extracts listed immediately beneath each MI isolate were included in the test for that isolate. The 1977 and 1979 isolates were tested at different times. Extracts were tested in duplicate wells.

^bVisual ratings for color were clear (CL), very light yellow (VLY), light yellow (LY), and yellow (Y). Ratings were made 30 min after addition of enzyme substrate.

^c \bar{x} is the mean absorbance at 405 nm for the two replicates; SD is the standard deviation from the mean. Absorbance readings were made on preparations incubated for 2 hr at room temperature.

^d... signifies that the A_{405} was not determined for the sample.

^eThis value was a single determination, since the replicate well was contaminated with MDMV-A.

reported occurrences of MDMV-A (5). It seems likely that MDMV-A also occurs in Michigan, but corn surveys (B. P. Singh, *unpublished*) during 1977-1979 have not shown this strain. Michigan's field and sweet corn production is limited relative to other Corn Belt states, reducing the chances of occurrence and discovery of MDMV-A, particularly where late plantings are extensive.

The sources of MDMV-B infections of corn in Michigan, as well as in other northern states reporting its occurrence, are unknown (5). Since the virus appears rarely in Michigan and does not seem to cause significant damage, either the primary source is limited or aphid vector populations are too small to disseminate the virus widely.

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