New Hosts and Taxonomic Analysis of the Mississippi Native Species Tested for Reaction to Maize Dwarf Mosaic and Sugarcane Mosaic Viruses

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ABSTRACT

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A collection of 106 grass species, representing 50 genera, was tested for reaction to manual inoculation with maize dwarf mosaic virus strains A (MDMV-A) and B (MDMV-B) and sugarcane mosaic virus strain B (SCMV-B) and was found to contain 70 host and 36 nonhost species. Among the 70 suscepts, 56 were previously unknown hosts, which were divided into 55 grasses susceptible to MDMV-A, 46 grasses susceptible to MDMV-B, and 45 grasses susceptible to SCMV-B; the three virus strains had 40 new host species in common. Of the 36 nonhosts, 19 species had not been reported previously as nonsusceptible. Most of the hosts of MDMV-A were more susceptible to the Mississippi isolate than to the Ohio isolate. Those host grasses (12 of 14) that were more susceptible to the Ohio isolate than to the Mississippi isolate of MDMV-A do not occur in Ohio. Among 10 grasses tested during the warm and again during the cold time of the year, a trend was apparent for plants of the same species to be more susceptible to these viruses at the lower temperature and shorter photoperiod than at the higher temperature and longer photoperiod. The 106 grasses separated into 25 annuals and 81 perennials. All annuals in the subfamilies Panicoideae and Eragrostoideae were susceptible to one or more of the virus strains, whereas 10 of 12 annuals in the subfamily Festucoideae were resistant to all strains. An analysis of the comparative susceptibility of annual versus perennial grasses is presented. Available differential hosts for the separation of MDMV-A, MDMV-B, and SCMV-B are examined for their usefulness. Inclusive of the eight genera not previously tested and included in this study, representative species of all 89 genera that compose the grass flora in Mississippi have been tested now. On the basis of 293 out of 333 Mississippi grass species tested to date, it is concluded that about 70% of all native Mississippi grasses are susceptible to MDMV-A, MDMV-B, and/or SCMV-B.

Additional key words: Arundinoideae, corn, cultivated grass, symptomless host, wild grass, *Zea mays*.

Maize dwarf mosaic virus (MDMV) was first discovered in southern Ohio in 1963 (26) and detected in Mississippi in 1965 (11). Since that time, many host range studies (3,4,7,8,13–16,22–25) revealed a vast number of grass hosts of this virus, but the selection of the grass species for these studies did not follow any detectable systematic pattern. In 1977, I embarked on a comprehensive investigation of the entire Mississippi grass flora to determine the distribution and concentration of host species of MDMV and of the closely related sugarcane mosaic virus (SCMV) among the six subfamilies of the Gramineae, from the native bamboos to the phylogenetically most advanced members of the tribe Andropogoneae. Because the Mississippi grass flora is rich in species and highly diverse, it represents a good cross section of the entire grass family.

As the project progressed, results from testing of the Mississippi grasses for their response to MDMV strains A (MDMV-A) and B (MDMV-B) and to SCMV strain B (SCMV-B) were reported

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(17,20). Two preceding papers provided information on 198 species. The present paper, which is the final in the series, reports infectivity data on an additional 95 Mississippi grass species. There remain 40 grasses reported as occurring in Mississippi that I either could not find or, when found, was unable to test so far for various technical reasons. With this concluding report, however, all 89 Mississippi grass genera (of 122 genera represented in the United States) will have been included in my investigation on the reaction of the Mississippi grasses to manual inoculation with two isolates of MDMV-A, MDMV-B, and SCMV-B.

Host range studies are basic to the characterization of a virus and its strains and are essential for the detection of new strains. Knowledge of the host range must include significant nonsusceptible species (19). A new strain of MDMV was recently detected by infection of a grass species not infected by known strains of the virus (10). Strain B of MDMV was discovered by its failure to infect several known hosts of MDMV-A (9).

This paper furnishes data on the response to MDMV-A, MDMV-B, and SCMV-B of 100 Mississippi grasses (95 of which had not been included in the two previous reports) (17,20) and six grass species that occur in the southeastern United States outside of Mississippi. It also summarizes in various ways, such as annuals vs. perennials and percentages of host species in each subfamily, the reaction to these viruses of all endemic Mississippi grasses tested by the author to date.

MATERIALS AND METHODS

Except for 10 species (*Avena sativa*, *Eragrostis tenella*, *Hordeum vulgare*, *Leptochloa dubia*, *Saccharum officinarum*, *Sacciolepis indica*, *Secale cereale*, *Sorghum bicolor*, *Sorghum sudanense*, and *Triticum aestivum*) obtained from various sources, all grasses were collected by the author. *Amphicarpum muhlenbergianum*, *Chloris glauca*, *Heteropogon contortus*, and *Paspalum setaceum* var. *villosissimum* were gathered in Florida; all other grasses were collected in Mississippi. Before being placed in the greenhouse for seed production, the wild plants were sprayed with dienchlor and a preparation of pyrethrins and piperonyl butoxide to eliminate any possible spider mites and insects, respectively. At least two plants of each species were grown in the greenhouse to provide for cross-pollination, if needed. Cross-pollination was facilitated by air currents generated by roof fans. Identification of the grass species was made with the aid of A. S. Hitchcock's Manual of the Grasses of the United States (6), F. W. Gould's The Grasses of Texas (5), or Manual of the Vascular Flora of the Carolinas by A. E. Radford et al (12). Uncertain identifications were checked by S. T. McDaniel, Department of Biological Sciences, Mississippi State University.

To ensure that the grass seeds were fully mature, harvesting was delayed until the seeds began to disarticulate. The procedure followed for germinating the grass seeds was essentially the same as described previously (20). Seeds of a number of grass species did not germinate under the adopted standard conditions. In these species, germination could be induced by the mechanical removal of the outer integuments (first and second glumes, lemma, and palea) performed under a dissecting microscope. Such grasses included *Ctenium aromaticum*, *Elyonurus tripsacoides*, *Panicum depauperatum*, *Panicum ravenelii*, *Paspalum bifidum*, *Paspalum praecox*, *Setaria corrugata*, and *Sorghastrum secundum*. A few grasses that did not produce viable seed in the greenhouse were propagated vegetatively.

Virus cultures were identical to the ones used in preceding parts of this study, as was the maintenance of the viruses in source plants (17,20). Preparation of the inocula and the inoculation procedure were described earlier (17,20). An attempt was made to have at least 15 seedlings of each species inoculated with each of the four virus isolates. Only four species (*Anthaenantia villosa*, *Digitaria ischaemum*, *Leptochloa dubia*, and *Setaria viridis*) had fewer seedlings per isolate than that number. At each inoculation time, at least 10 seedlings of sweet corn cultivar Seneca Chief were also inoculated with each of the four inocula to test the infectivity of the viruses in the source plants. All plants of the grasses were inoculated only once to reduce loss of seedlings due to mechanical injury among the more delicate grasses and to distinguish between highly susceptible and less susceptible species. For the back assay to Seneca Chief sweet corn, leaf tissue samples from all symptomless plants of a species were combined to prepare the inoculum for each virus. Grasses that remained uninfected by all viruses were retested at a different time of the year.

To help make the paper more readily understood, the following definition of terms is provided:

Affinity of plant species for a virus refers to a combination of susceptibility (vs. resistance) and a degree of susceptibility as expressed by the proportion of individuals in a population that become diseased or infected. This term is used in comparing the reaction of a group of species to two or more viruses. Example: If a selected group of grass species has a greater affinity for MDMV-A than for MDMV-B, it means that some of the species that are resistant (or immune) to MDMV-B are susceptible to MDMV-A, whereas other species are more susceptible to MDMV-A than to MDMV-B in terms of greater disease incidence or rate of infection.

Susceptible—plant that is infected by the virus.

Resistant—plant from which, after inoculation, no virus is detected.

Symptomatic—susceptible plant that reacts with symptoms to virus infection.

Tolerant—susceptible plant that does not react with symptoms to virus infection.

Asymptomatic—plant that has no virus symptoms; it can be either resistant or susceptible but tolerant.

RESULTS

This third and last paper on the response of the Mississippi grass flora to MDMV-A, MDMV-B, and SCMV-B contains information on 106 species in 50 genera, 12 tribes (of 19 represented in Mississippi), and four of six subfamilies of the Gramineae. Six of the species (*Amphicarpum muhlenbergianum*, *Chloris glauca*, *Heteropogon contortus*, *Leptochloa dubia*, *Paspalum setaceum* var. *villosissimum*, and *Sacciolepis indica*) do not occur in Mississippi but were included because seed was already available. The 106 grass species separated into 70 hosts, of which 56 are new hosts, and 36 nonhosts, of which 19 are new nonhosts (Table 1). Of the 56 new hosts, 55 were infected by MDMV-A, 46 were infected by MDMV-B, and 45 were infected by SCMV-B. The three virus strains had 40 new hosts in common. This assemblage of grasses included 22 species in the subfamily Festucoideae, 18 species in the subfamily Eragrostoideae, three species in the subfamily Arundinoideae, and 63 species in the subfamily Panicoideae, divided into 43 species in the tribe Paniceae and 20 species in the tribe Andropogoneae.

Species with the greatest susceptibility to all three virus strains were *Echinochloa crusgalli* var. *frumentacea*, *Erianthus strictus*, *Panicum consanguineum*, *Panicum strigosum*, *Paspalum dissectum*, *Paspalum setaceum* var. *villosissimum*, and *Zea mays* inbred SC 229. In addition, the following grasses had a disease incidence of 90–100% in response to MDMV-A or MDMV-B: *Andropogon brachystachys*, *Andropogon perangustatus*, *Erianthus brevibarbis*, *Muhlenbergia sylvatica*, *Panicum arenicoloides*, *Panicum depauperatum*, *Panicum laxiflorum*, *Panicum tenue*, *Panicum texanum*, *Panicum wrightianum*, *Paspalum fluitans*, *Setaria corrugata*, *Sorghastrum nutans*, *Sorghum bicolor* 'Dale', and *Tridens carolinianus*. Eleven grasses had a disease incidence of 90–100% when inoculated with SCMV-B; these were: *Echinochloa crusgalli* var. *frumentacea*, *Erianthus strictus*, *Panicum arenicoloides*, *Panicum consanguineum*, *Panicum strigosum*, *Panicum texanum*, *Paspalum dissectum*, *Paspalum fluitans*, *Paspalum setaceum* var. *villosissimum*, *Setaria viridis*, and corn inbred SC 229.

Most of the 69 host grasses of MDMV-A were somewhat more susceptible to the Mississippi isolate than to the Ohio isolate of MDMV-A, as determined by the proportion of plants that developed symptoms. The percentage of the aggregate number of plants of all 69 host species of MDMV-A that developed symptoms

TABLE 1. Susceptibility of native Mississippi grasses to inoculation with maize dwarf mosaic virus strain A (MDMV-A) and strain B (MDMV-B) and sugarcane mosiac virus strain B (SCMV-B)

Grass species and common names	Growth habit[b]	Subfamily (tribe)[c]	Month inoculated	Number of plants showing symptoms after inoculation with:[a] MDMV-A (Miss.)[d]	Back assay to corn[e]	MDMV-A (Ohio)	Back assay to corn	MDMV-B	Back assay to corn	SCMV-B	Back assay to corn
Agrostis scabra Willd. Rough bentgrass	P	F	April	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Aira caryophyllea L. Silver hairgrass[f]	A	F	May	0/15	0/10	0/15	0/10	0/15	2/10	0/15	0/10
Amphicarpum muhlenbergianum (Schult.) Hitchc.[f]	P	P(P)	Jan	15/18		5/18		15/18		5/18	
Andropogon brachystachys Chapm.[f]	P	P(A)	April	11/20		16/20		19/20		7/20	
A. gerardii Vitman Big bluestem	P	P(A)	March	0/18	0/10	0/18	0/10	0/18	0/10	0/18	0/10
A. glomeratus var. *glaucopsis* Mohr Bushy beardgrass[f]	P	P(A)	June	15/17		5/17		16/17		12/17	
A. perangustatus Nash[f]	P	P(A)	April	22/23		13/23		22/23		15/23	
Anthaenantia villosa (Michx.) Beauv. Green silkyscale[f]	P	P(P)	April	1/11	0/10	0/11	0/10	0/11	0/10	1/11	0/10
Anthoxanthum odoratum L. Sweet vernalgrass	P	F	March	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10
Aristida affinis (Schult.) Kunth Longleaf threeawn[f]	P	E	June	3/24		2/24		6/24		1/24	
A. purpurascens Poir. Arrowfeather[f]	P	E	April	13/24		6/24		14/24		12/24	
A. simpliciflora Chapm.[f]	P	E	April	14/20		13/20		9/20		4/20	
A. spiciformis Ell. Squirreltail threeawn[f]	P	E	March	5/19		2/19		3/19		3/19	
A. tuberculosa Nutt. Seabeach needlegrass[f]	A	E	Feb	6/15		10/15		3/15		6/15	
Avena sativa L. Oats	A	F	Nov	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Bromus purgans L. Canada brome[f]	P	F	March	5/24		5/24		1/24		0/24	0/10
B. rigidus Roth Ripgut grass	A	F	March	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10
Catapodium rigidum (L.) Hubb. Hardgrass	A	F	March	0/21	0/10	0/21	0/10	0/21	0/10	0/21	0/10
Cenchrus gracillimus Nash Slender sandbur	P	P(P)	Aug	0/15	0/10	0/15	0/10	0/15	0/10	0/15	0/10
Chloris glauca (Chapm.) Wood Smooth fingergrass[f]	P	E	March	8/20		2/20		2/20		0/20	0/10
Cortaderia selloana (Schult.) Aschers. & Graeb., pampasgrass[f]	P	A	April	0/16	6/10	0/16	0/10	0/16	0/10	0/16	0/10
Ctenium aromaticum (Walt.) Wood Toothache grass[f]	P	E	Nov	2/20	6/10	2/20	3/10	0/20	0/10	0/20	0/10
Dactylis glomerata L. Orchardgrass	P	F	July	0/22	0/10	0/22	0/10	0/22	0/10	0/22	0/10
Danthonia sericea Nutt. Downy oatgrass	P	A	June	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Digitaria ischaemum (Schreb.) Schreb. ex Muhl., smooth crabgrass	A	P(P)	May	7/14		6/14		7/14		7/14	
Echinochloa crusgalli var. *frumentacea* (Roxb.) Wight, Japanese millet	A	P(P)	April	24/24		24/24		24/24		24/24	
Elymus villosus Muhl. Hairy wildrye	P	F	April	0/18	0/10	0/18	0/10	0/18	0/10	0/18	0/10
Elyonurus tripsacoides Humb. & Bonpl. Panamerican balsamscale[f]	P	P(A)	April	7/24		3/24		8/24		12/24	
Eragrostis ciliaris (L.) R.Br. Gophertail lovegrass[f]	A	E	Jan	6/15		2/15		0/15	3/10	0/15	0/10
E. hypnoides (Lam.) B.S.P. Teal lovegrass[f]	A	E	Sept	0/18	9/10	0/18	5/10	0/18	0/10	0/18	0/10
E. tenella (L.) Beauv. Feather lovegrass	A	E	April	18/22		10/22		9/22		10/22	
Erianthus alopecuroides (L.) Ell. Silver plumegrass[f]	P	P(A)	March	4/20		4/20		9/20		13/20	
E. brevibarbis Michx. Short-bearded plumegrass[f]	P	P(A)	March	22/24		14/24		23/24		16/24	
E. ravennae (L.) Beauv. Ravennagrass	P	P(A)	June	0/21	0/10	0/21	0/10	0/21	0/10	0/21	0/10
E. strictus Baldw. Narrow plumegrass[f]	P	P(A)	May	24/24		24/24		22/24		24/24	
Glyceria arkansana Fern. Arkansas mannagrass[f]	P	F	Jan	0/15	10/10	0/15	10/10	0/15	0/10	0/15	1/10

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TABLE 1. (*continued from preceding page*)

Grass species and common names	Growth habit[b]	Sub-family (tribe)[c]	Month inoculated	Number of plants showing symptoms after inoculation with:[a] MDMV-A (Miss.)[d]	Back assay to corn[e]	MDMV-A (Ohio)	Back assay to corn	MDMV-B	Back assay to corn	SCMV-B	Back assay to corn
Heteropogon contortus (L.) Beauv. Tanglehead	P	P(A)	June	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Hordeum vulgare L. Barley 'Glenn'	A	F	Dec	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Imperata braziliensis Trin.	P	P(A)	April	0/18	0/10	0/18	0/10	0/18	0/10	0/18	0/10
Leptochloa dubia (H.B.K.) Nees Green sprangletop	P	E	May	6/14	6/10	0/14	0/10	4/14	10/10	2/14	4/10
Limnodea arkansana (Nutt.) H.L. Dewey, Ozarkgrass	A	F	May	0/18	0/10	0/18	0/10	0/18	0/10	0/18	0/10
Lolium perenne L. Perennial ryegrass	P	F	April	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
L. temulentum L. Darnel	A	F	April	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Miscanthus sinensis Anderss. Eulalia	P	P(A)	Aug	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10
Muhlenbergia glabriflora Scribn. Inland muhly[f]	P	E	June	2/24		0/24	0/10	0/24	0/10	0/24	0/10
M. sylvatica (Torr.) Torr. Forest muhly[f]	P	E	March	20/20		4/20		0/20	0/10	0/20	0/10
Panicum angustifolium Ell. Narrow-leaved panicum[f]	P	P(P)	Aug	4/24		16/24		6/24		10/24	
P. arenicoloides Ashe[f]	P	P(P)	April	16/16		10/16		13/16		16/16	
P. boscii var. *molle* (Vasey) Hitchc. Velvety panicum	P	P(P)	April	0/15	0/10	0/15	0/10	0/15	0/10	0/15	0/10
P. capillare L. Witchgrass	A	P(P)	April	14/16		10/16		10/16		13/16	
P. commonsianum Ashe[f]	P	P(P)	April	18/24		16/24		6/24		8/24	
P. consanguineum Kunth[f]	P	P(P)	Jan	20/20		20/20		18/20		19/20	
P. depauperatum Muhl. Starved panicum[f]	P	P(P)	March	17/24		24/24		16/24		14/24	
P. ensifolium Baldw. ex Ell. Delicate panicum[f]	P	P(P)	April	12/18		10/18		0/18	0/10	10/18	
P. erectifolium Nash Stiff-leaved panicum[f]	P	P(P)	Dec	18/24		5/24		12/24		15/24	
P. hians Ell. Gaping panicum	P	P(P)	Jan	0/19	0/10	0/19	0/10	0/19	0/10	0/19	0/10
P. laxiflorum Lam. Open-flowered panicum[f]	P	P(P)	June	16/20		18/20		20/20		10/20	
P. leucothrix Nash White-haired panicum[f]	P	P(P)	April	7/15		10/15		7/15		6/15	
P. longiligulatum Nash[f]	P	P(P)	April	14/23		19/23		3/23		11/23	
P. microcarpon Muhl. ex Ell. Tiny-seeded panicum	P	P(P)	March	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
P. ravenelii Scribn. ex Merr.[f]	P	P(P)	March	7/15		10/15		7/15		8/15	
P. strigosum Muhl.[f]	P	P(P)	Feb	24/24		24/24		24/24		23/24	
P. tenue Muhl. Slender panicum[f]	P	P(P)	March	9/20		11/20		20/20		12/20	
P. texanum Buckl. Texas millet	A	P(P)	April	13/15		15/15		10/15		15/15	
P. wrightianum Scribn.[f]	P	P(P)	June	18/18		14/18		16/18		6/18	
Paspalum bifidum (Bertol.) Nash Pitchfork paspalum[f]	P	P(P)	July	0/16	0/10	5/16		0/16	0/10	7/16	
P. conjugatum Bergius Sour paspalum	P	P(P)	March	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
P. dilatatum Poir. Dallisgrass	P	P(P)	June	0/24	0/10	2/24		2/24		0/24	0/10
P. dissectum (L.) L. Mudbank paspalum[f]	P	P(P)	March	17/20		20/20		20/20		20/20	
P. fluitans (Ell.) Kunth Water paspalum[f]	A	P(P)	April	16/16		12/16		8/16		16/16	
P. lentiferum Lam.[f]	P	P(P)	July	13/17		5/17		12/17		5/17	
P. lividum Trin. Longtom	P	P(P)	Sept	0/19	0/10	0/19	0/10	0/19	0/10	0/19	0/10
P. plicatulum Michx. Brownseed paspalum	P	P(P)	May	0/15	0/10	0/15	0/10	0/15	0/10	0/15	0/10
P. praecox Walt. Early paspalum[f]	P	P(P)	Sept	10/22		10/22		0/22	0/10	2/22	
P. setaceum var. *ciliatifolium* (Michx.) Vasey, fingerleaf paspalum	P	P(P)	Jan	1/18		2/18		0/18	0/10	5/18	
P. setaceum var. *longepedunculatum* (Le Conte) Wood	P	P(P)	Nov	0/19	0/10	0/19	0/10	0/19	0/10	0/19	0/10

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TABLE 1. *(continued from preceding page)*

Grass species and common names	Growth habit[b]	Sub-family (tribe)[c]	Month inoculated	Number of plants showing symptoms after inoculation with:[a] MDMV-A (Miss.)[d]	Back assay to corn[e]	MDMV-A (Ohio)	Back assay to corn	MDMV-B	Back assay to corn	SCMV-B	Back assay to corn
P. setaceum var. *muhlenbergii* (Nash) D. Banks	P	P(P)	May	0/23	0/10	0/23	0/10	0/23	0/10	0/23	0/10
P. setaceum var. *setaceum* Michx.[f]	P	P(P)	Dec	15/24		14/24		1/24		16/24	
P. setaceaum var. *stramineum* (Nash) D. Banks[f]	P	P(P)	April	8/24		1/24		0/24	0/10	15/24	
P. setaceum var. *supinum* (Bosc) Trin.	P	P(P)	April	0/17	0/10	0/17	0/10	0/17	0/10	0/17	0/10
P. setaceum var. *villosissimum* (Nash) D. Banks[f]	P	P(P)	Feb	20/20		18/20		18/20		18/20	
Phleum partense L. Timothy	P	F	Feb	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Phragmites australis (Cav.) Trin. ex Steud., common reed	P	A	April	0/15	0/10	0/15	0/10	0/15	0/10	0/15	0/10
Poa chapmaniana Scribn. Chapman bluegrass	A	F	Jan	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
P. pratensis L. Kentucky bluegrass	P	F	March	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Saccharum officinarum L. Sugarcane 'MER 67-500'	P	P(A)	April	0/16	0/10	0/16	0/10	0/16	0/10	0/16	0/10
Sacciolepis indica (L.) Chase Indian cupscale[f]	P	P(P)	March	2/20		0/20	0/10	10/20		14/20	
Schizachyrium scoparium (Michx.) Nash Little bluestem	P	P(A)	May	2/24		4/24		6/24		1/24	
Secale cereale L. Rye, 'Ealbon'	A	F	Dec	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Setaria corrugata (Ell.) Schult. Wrinkled bristlegrass[f]	A	P(P)	Aug	8/20		14/20		20/20		16/20	
S. viridis (L.) Beauv. Green bristlegrass	A	P(P)	Jan	11/13		10/13		2/13		12/13	
Sorghastrum apalachicolensis Hall Florida indiangrass[f]	P	P(A)	April	15/15		6/15		6/15		3/15	
S. nutans (L.) Nash Indiangrass[f]	P	P(A)	April	19/21		6/21		6/21		1/21	6/10
S. secundum (Ell.) Nash One-sided indiangrass[f]	P	P(A)	March	1/15	7/10	0/15	0/10	3/15	2/10	0/15	0/10
Sorghum bicolor (L.) Moench Sorgum 'Dale'	A	P(A)	Dec	24/24		24/24		0/24	0/10	15/24	
S. sudanense (Piper) Stapf Sudangrass 'NK Trudan'	A	P(A)	March	17/24		15/24		0/24	0/10	4/24	
Spartina alterniflora Loisel. Smooth cordgrass[f]	P	E	March	0/24	6/10	0/24	0/10	0/24	0/10	0/24	0/10
Sphenopholis filiformis (Chapm.) Scrib. Longleaf wedgescale	P	F	March	0/21	0/10	0/21	0/10	0/21	0/10	0/21	0/10
S. intermedia (Rydb.) Rydb. Slender wedgescale	P	F	Feb	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Sporobolus junceus (Michx.) Kunth Pineywoods dropseed[f]	P	E	April	0/16	9/10	0/16	0/10	0/16	5/10	0/16	0/10
Tridens carolinianus (Steud.) Henr. Carolina tridens[f]	P	E	Jan	15/15		15/15		0/15	10/10	1/15	10/10
T. chapmanii (Small) Chase Chapman tridens[f]	P	E	April	15/24		11/24		16/24		17/24	
Triticum aestivum L. Wheat 'Coker 916'	A	F	Jan	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
'Hunter'			Jan	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Uniola paniculata L. Sea oats[f]	P	E	March	6/24	10/10	0/24	10/10	4/24	10/10	0/24	6/10
Vulpia bromoides (L.) S.F. Gray Brome sixweeksgrass	A	F	May	0/20	10/10	0/20	0/10	0/20	2/10	0/20	0/10
Zea mays L. Corn, maize 'SC229'	A	P(A)	Nov	20/20		20/20		20/20		20/20	
'E663'			Jan	2/20		1/20		12/20		0/20	

[a] Fraction expresses disease incidence in response to manual inoculation; the numerator denotes the number of plants with symptoms and the denominator the number of plants inoculated.

[b] Abbreviations: P = perennial species, A = annual species.

[c] Abbreviations: F = Festucoideae, P(P) = Panicoideae (Paniceae), P(A) = Panicoideae (Andropogoneae), E = Eragrostoideae, and A = Arundinoideae.

[d] Two isolates of MDMV-A, one from Mississippi and one from Ohio, were used.

[e] Back assay to Seneca Chief sweet corn was made from each inoculated grass species that remained symptomless or showed uncertain symptoms; in the fraction, the numerator indicates the number of corn plants with symptoms and the denominator (constant: 10) the number of corn seedlings inoculated; each such fraction refers to the virus isolate to its left.

[f] New host of one or more virus strains.

after inoculation with MDMV-A from Mississippi [MDMV-A(MS)] was 53.0% (724/1,365). The comparable figure for MDMV-A from Ohio [MDMV-A(OH)] was 43.9% (599/1,365). However, there were 14 species that showed a greater susceptibility to MDMV-A(OH) than to MDMV-A(MS). These species were concentrated in the two genera *Panicum* and *Paspalum*. Except for two grasses, these latter species do not occur naturally in Ohio.

A number of differential host responses to the two isolates of MDMV-A were observed. Nine species (*Anthaenantia villosa*, *Cortaderia selloana*, *Leptochloa dubia*, *Muhlenbergia glabriflora*, *Sacciolepis indica*, *Sorghastrum secundum*, *Spartina alterniflora*, *Sporobolus junceus*, and *Vulpia bromoides*) were susceptible to MDMV-A(MS) but not to MDMV-A(OH), whereas two species (*Paspalum bifidum* and *Paspalum dilatatum*) were not infected by MDMV-A(MS) but were susceptible to MDMV-A(OH). *Cortaderia selloana*, *Spartina alterniflora*, *Sporobolus junceus*, and *Vulpia bromoides* were symptomless hosts of MDMV-A(MS). Because the percentage of plants with symptoms among the remaining seven species was relatively small, it is questionable whether these qualitative differences could be sustained on further testing. Additionally, sea oats (*Uniola paniculata*) produced 25% plants with symptoms when inoculated with MDMV-A(MS) but no plants developed symptoms when inoculated with MDMV-A(OH). The latter plants, however, proved infected as determined by assay to sweet corn. Without further testing, these results do not warrant the designation of MDMV-A(MS) and MDMV-A(OH) as separate strains.

The 106 grass species separated into 25 annuals and 81 perennials. In the panicoid subfamily, the annuals included some of the most susceptible species in this study, such as Japanese millet, Texas millet, water paspalum, sorghum, and corn, whereas in the festucoid subfamily most annuals were resistant to all three virus strains. The latter group of annuals included the small grains and other important cultivated species (orchardgrass, ryegrass, timothy, and Kentucky bluegrass). Annual grasses in the eragrostoid subfamily were intermediate in susceptibility between the other two subfamilies. The time of the year when inoculation of grasses with these viruses was carried out under natural light conditions in the greenhouse influenced the results, at times, profoundly. Conducting the tests during the cooler time of the year, when days were short, resulted in a higher disease incidence and a greater disease severity with most of the 10 grasses tested than when the tests were performed during the warm season with long days (Table 2). With a few species (*Andropogon glomeratus*, *Chloris canterai*, and *Phalaris caroliniana*), the difference in reaction was between susceptibility in the cool season and resistance in the warm season. Back assay to sweet corn showed that the plants without symptoms in these species inoculated during the warm season did not contain detectable virus. Strain B of MDMV seemed more sensitive to the influence of high temperature on its infection of and replication in these grasses than MDMV-A.

Based on the reaction to these viruses, the 106 grass species could be divided into six groups: (a) susceptible to all three virus strains (48 species); (b) susceptible to MDMV-A and MDMV-B and nonsusceptible to SCMV-B (seven species); (c) susceptible to MDMV-A and nonsusceptible to MDMV-B and SCMV-B (five species); (d) susceptible to MDMV-A and SCMV-B and nonsusceptible to MDMV-B (nine species); (e) susceptible to MDMV-B and nonsusceptible to MDMV-A and SCMV-B (one species); and (f) nonsusceptible to all three virus strains (36 species). However, not all of the host species of the three virus strains in the various categories developed symptoms; a number of grasses were latently infected, especially in group b, so that some groupings could be subdivided into symptomatic and asymptomatic hosts.

With the testing in this study of grass species in the genera *Catapodium*, *Cortaderia*, *Ctenium*, *Elyonurus*, *Limnodea*, *Miscanthus*, *Phragmites*, and *Uniola*, all 89 grass genera with representative species in Mississippi have been included now in this host range project. Of the above genera, *Elyonurus* and *Uniola* contained host species of MDMV-A, MDMV-B, and SCMV-B, whereas *Cortaderia selloana* and *Ctenium aromaticum* turned out to be symptomless hosts of only MDMV-A. The single species occurring in Mississippi in each of the remaining four genera (*Catapodium rigidum*, *Limnodea arkansana*, *Miscanthus sinensis*, and *Pharagmites australis*) proved nonsusceptible to MDMV and SCMV.

DISCUSSION

The selection of the grass species for this study was limited by two factors: The species must have been found in Mississippi and

TABLE 2. Differential susceptibility of selected grass species to maize dwarf mosaic virus strain A (MDMV-A) and strain B (MDMV-B) and sugarcane mosaic virus strain B (SCMV-B) when inoculated at different times of the year

		Percentage of plants with symptoms and disease severity index after inoculation with:							
Grass species	Date inoculated	MDMV-A (Miss.)	Disease severity index[a]	MDMV-A (Ohio)	Disease severity index	MDMV-B	Disease severity index	SCMV-B	Disease severity index
Andropogon glomeratus	23 July	0	0.0	14	3.0	0	0.0	0	0.0
	18 Dec	73	3.5	58	3.3	75	2.8	64	3.1
Briza minor	14 March	5	3.0	5	3.0	20	2.5	5	3.0
	3 Nov	37	2.6	21	2.9	87	3.8	20	3.8
Chloris canterai	16 Sept	0	0.0	0	0.0	0	0.0	0	0.0
	14 April	21	3.0	29	3.5	0	0.0	0	0.0
Chloris truncata	20 March	29	1.8	35	2.2	0	0.0	59	2.7
	31 Jan	100	4.0	91	3.9	91	4.0	73	2.5
Digitaria ciliaris	13 Nov	83	3.7	42	3.5	92	3.9	79	3.7
	2 April	100	3.1	74	3.1	100	4.0	48	2.5
Leptochloa uninervia	11 May	58	2.2	79	2.7	0	0.0	0	0.0
	17 Jan	100	4.0	92	3.9	0	0.0	0	0.0
Panicum bergii	17 April	77	2.7	43	2.8	0	0.0	57	3.2
	31 Jan	73	4.0	91	3.9	64	3.4	46	2.8
Panicum strigosum	8 July	8	2.0	8	2.0	17	3.0	42	2.0
	10 Feb	100	4.0	100	4.0	100	4.0	96	3.9
Phalaris caroliniana	1 June	0	0.0	0	0.0	73	1.0	13	1.0
	30 March	100	4.0	100	4.0	94	4.0	100	4.0
Setaria adhaerans	18 May	0	0.0	0	0.0	69	3.6	69	2.7
	27 March	0	0.0	0	0.0	96	4.0	92	4.0

[a] Diseased plants were rated for disease severity on a scale of 1 (mild) to 4 (severe), and the disease severity index was calculated by adding the severity ratings for each diseased plant and dividing the total score by the number of diseased plants; each disease severity index refers to the percentage of diseased plants to its left.

specimens deposited in a herbarium, and they must not have been tested by me previously (17,20). These limitations left about 135 grasses from which to choose. Within these constraints, the most difficult task was to locate many of the native species in the wild, which took about 3 yr to accomplish. Because the presence of the spikelets is a sine qua non for accurate identification of grasses, and some of the species flower early in the spring, whereas others flower late in the fall, search for the missing grass species stretched over the entire growing season, from the beginning of April to the end of November.

As in previous studies by the author (16,17,20), in this investigation MDMV-A also infected more grass species than did MDMV-B or SCMV-B. Of the 106 grass species tested, 69 grasses were susceptible to various degrees to MDMV-A. The susceptibility ranged from only about 5% diseased plants in *Paspalum setaceum* var. *ciliatifolium* to 100% diseased plants in such species as *Echinochloa crusgalli* var. *frumentacea*, *Erianthus strictus*, *Panicum consanguineum*, *Sorghum bicolor*, *Tridens carolinianus*, and *Zea mays*. In six species (*Cortaderia selloana*, *Eragrostis hypnoides*, *Glyceria arkansana*, *Spartina alterniflora*, *Sporobolus junceus*, and *Vulpia bromoides*) infection by MDMV-A was symptomless. In *Anthaenantia villosa*, which produced one diseased plant of 22 inoculated with MDMV-A, the virus could not be recovered from the one symptomatic plant. Host species of MDMV-A were located in all four subfamilies represented in this study but were concentrated in the subfamily Panicoideae.

TABLE 3. Comparative susceptibility of annual versus perennial Mississippi grass species in all six subfamilies of the Gramineae to maize dwarf mosaic virus strain A (MDMV-A), strain B (MDMV-B), and sugarcane mosaic virus strain B (SCMV-B)[a]

Subfamily (tribe)	Annuals: Species tested (no.)	Annuals: Hosts of MDMV and/or SCMV (no.)	Annuals: Hosts/species tested (%)	Perennials: Species tested (no.)	Perennials: Hosts of MDMV and/or SCMV (no.)	Perennials: Hosts/species tested (%)
Festucoideae	28	12	42.9	26	8	30.8
Panicoideae						
(Paniceae)	29	28	96.6	79	52	65.8
(Andropogoneae)	6	6	100.0	36	29	80.6
Eragrostoideae	24	23	95.8	45	33	73.3
Bambusoideae	0	0	0.0	2	1	50.0
Oryzoideae	2	2	100.0	7	6	85.7
Arundinoideae	0	0	0.0	9	4	44.4
Total (mean)	89	71	(80.0)	204	133	(65.2)

[a] Includes all Mississippi grass species tested by the author in this and two preceding studies (17,20).

The narrower host range of MDMV-B than that of MDMV-A was demonstrated in this investigation by the resistance to MDMV-B of 13 MDMV-A-susceptible species. These differences in susceptibility were particularly noticeable in the genus *Paspalum* and among members of the subfamily Eragrostoideae. In addition, many grasses that proved hosts of both MDMV-A and MDMV-B were susceptible to a lesser degree to MDMV-B than to MDMV-A. Five grasses (*Aira caryophyllea*, *Eragrostis ciliaris*, *Sporobolus junceus*, *Tridens carolinianus*, and *Vulpia bromoides*) reacted with symptomless infection when inoculated with MDMV-B. These grasses belong either to the subfamily Eragrostoideae or Festucoideae. Nevertheless, several host species showed a greater affinity for MDMV-B than for MDMV-A, among them *Andropogon brachystachys*, *Erianthus alopecuroides*, *Schizachyrium scoparium*, *Sorghastrum secundum*, and *Zea mays*. All of these species are members of the tribe Andropogoneae in the subfamily Panicoideae.

The means by which MDMV-B survives from season to season is still not understood. Winter annual grasses may be implicated in the overwintering of this virus (1,2,20). In the present study, a number of perennial grasses with a wide distribution in the southern and northern corn-growing areas proved susceptible to MDMV-B. These included *Aristida purpurascens*, *Bromus purgans*, *Erianthus alopecuroides*, *Panicum depauperatum*, *Panicum laxiflorum* (= *P. xalapense*), *Paspalum setaceum* var. *setaceum*, *Schizachyrium scoparium*, and *Sorghastrum nutans*. To these may be added another four perennial Mississippi grasses (*Andropogon virginicus*, *Glyceria striata*, *Muhlenbergia capillaris*, and *Panicum scribnerianum*) with an extensive distribution in the midwestern Corn Belt, all of which proved susceptible to MDMV-B as reported elsewhere (18). If seed transmission of MDMV-B occurs in annual host grasses (in addition to corn), the following species, found susceptible to MDMV-B in this study, may be involved in the ecology of this virus: *Aira caryophyllea*, *Aristida tuberculosa*, *Digitaria ischaemum*, *Panicum capillare*, and *Setaria viridia*. The distribution of these annual hosts overlaps with that of

TABLE 4. Grasses with differential reaction for the identification and separation of maize dwarf mosaic virus strain A (MDMV-A), strain B (MDMV-B), and sugarcane mosaic virus strain B (SCMV-B)[a]

Grass species	Growth habit[b]	MDMV-A (Miss.) Incidence[c]	MDMV-A (Miss.) Severity[d]	MDMV-A (Ohio) Incidence	MDMV-A (Ohio) Severity	MDMV-B Incidence	MDMV-B Severity	SCMV-B Incidence	SCMV-B Severity
Brachiaria platyphylla	A	21/21	4.0	21/21	4.0	21/21	4.0	21/21	4.0
Echinochloa colonum	A	20/20	4.0	20/20	4.0	20/20	4.0	20/20	4.0
Setaria grisebachii	A	19/20	4.0	15/20	4.0	20/20	4.0	20/20	3.7
Bromus catharticus	A	0/24		0/24		0/24		0/24	
Hordeum vulgare	A	0/24		0/24		0/24		0/24	
Lolium temulentum	A	0/24		0/24		0/24		0/24	
Eragrostis oxylepis	P	10/23	3.7	23/23	4.0	17/23	4.0	0/23	
Setaria lutescens	A	4/19	4.0	6/19	4.0	4/19	4.0	0/19	
Tridens flavus	P	5/21	3.6	2/21	4.0	9/21	3.4	0/21	
Eriochloa punctata	P	12/18	3.7	11/18	3.6	0/18		0/18	
Leptochloa uninervia	A	14/14	4.0	13/14	3.9	0/14		0/14	
Panicum miliaceaum	A	19/19	3.1	12/19	2.8	0/19		0/19	
Paspalum floridanum	P	11/13	3.6	7/13	3.4	0/13		3/13	2.3
Sorghum bicolor 'Dale'	A	23/24	3.9	23/24	4.0	0/24		14/24	2.9
Sorghum sudanense 'NK Trudan'	A	17/24	4.0	15/24	4.0	0/24		4/24	2.8
Hyparrhenia rufa	P	0/18		0/18		0/18		4/18	2.0
Paspalum laeve	P	0/21		0/21		1/21	3.0	0/21	
Panicum dichotomiflorum	A	1/17	2.0	1/17	4.0	14/17	3.1	14/17	3.9
Setaria adhaerans	A	0/24		0/24		23/24	4.0	22/24	4.0

[a] The differential host species were assembled from among grasses tested by the author in this and previous studies (16,17,20).
[b] Abbreviations: A = annual species, P = perennial species.
[c] The numerator in the fraction denotes the number of plants with symptoms and the denominator the number of plants inoculated.
[d] The disease severity index was calculated by adding the severity rating of each diseased plant, rated on a scale of 1 (mild) to 4 (severe), and dividing the total score by the number of diseased plants.

MDMV-B.

The infectivity profile of SCMV-B resembled more closely that of MDMV-B than that of MDMV-A. The main differences in the host ranges of SCMV-B and MDMV-B were with several species in the genera *Paspalum* and *Sorghum*, which SCMV-B infected and MDMV-B did not. Two of the 57 host species of SCMV-B (*Glyceria arkansana* and *Uniola paniculata*) were infected in a symptomless manner. The symptomatic hosts of SCMV-B could be divided into three categories: hosts that had a similar level of susceptibility to SCMV-B as to MDMV-A and MDMV-B (the majority); hosts that had a lesser susceptibility to SCMV-B than to MDMV-A and MDMV-B (10 species); and hosts that had a greater susceptibility to SCMV-B than to the two strains of MDMV (five species).

There is a lack of agreement in the literature on the response to MDMV-A, MDMV-B, and SCMV-B of a small number of grasses. In the present study, big bluestem, *Andropogon gerardii*, exhibited resistance to all three virus strains, which contrasts with the data by Tosic and Ford (25) who found this grass susceptible to both strains of MDMV and SCMV-B. In an earlier study, Ford (3) reported that *A. gerardii* was not infected by MDMV. On the other hand, little bluestem, *Schizachyrium scoparium*, which showed a low degree of susceptibility to MDMV-A, MDMV-B, and SCMV-B in this investigation, was found to be nonsusceptible to the two strains of MDMV by MacKenzie (8) and to MDMV-A by Roane and Tolin (13). Williams and Alexander (27), however, reported this species susceptible to MDMV-A. Another problematic grass in this respect is perennial ryegrass, *Lolium perenne*. Whereas Leisy and Toler (7) and Tosic and Ford (25) reported that this species was a host of MDMV-A, my data show it to be nonsusceptible to MDMV-A as well as to MDMV-B and SCMV-B. Other investigators (14,24) also found this grass nonsusceptible to MDMV-A. The lack of agreement on the reaction of *L. perenne* to MDMV-A is not surprising because it is a cultivated grass and many cultivars have been developed. It is likely that different cultivars or biotypes were involved in the testing of this species by the various researchers.

There was a tendency for the Mississippi grasses to be somewhat more susceptible to the MDMV-A isolate from Mississippi than to the MDMV-A isolate from Ohio. More than twice as many grass species had a higher disease incidence when inoculated with the Mississippi isolate (41 species) than when inoculated with the Ohio isolate (16 species) of MDMV-A. In a preceding paper (20), the ratio of grasses more susceptible to MDMV-A from Mississippi to grasses more susceptible to MDMV-A from Ohio was similar, namely 47:19. The response of corn genotypes to the two isolates of MDMV-A is in contrast to that of the wild grasses. When 20 corn inbreds were tested for their reaction to the two MDMV-A isolates, about twice as many inbreds showed a moderately higher disease incidence in response to the Ohio isolate than to the Mississippi isolate of MDMV-A (21).

Some fundamental questions arise from host range studies involving mechanical inoculation of aphid-transmitted viruses. Because very few researchers (11,14) have used aphids for inoculating prospective hosts, the host ranges of MDMV and SCMV in nature may be different from those determined with mechanical inoculation in the greenhouse. Another uncertainty about the "real" host ranges of these types of viruses concerns the time of year when inoculation of a prospective host occurs. Data presented in Table 2 support the generally held view that plants grown under short photoperiod in the greenhouse during winter are more susceptible to virus infection than at other times. Differences in susceptibility of a species (see *Andropogon glomeratus* and *Phalaris caroliniana* in Table 2) at different times of the year may be so profound as to render it highly susceptible during the winter and resistant during the summer. Thus, host ranges studied during the winter months would tend to be more extensive than those studied during the summer months. Clearly, a successful virus infection of an otherwise resistant or immune species mechanically inoculated in the greenhouse during the short days of the winter months would have little relevance to its reaction to the same virus in nature during the normal growing season, unless the efficiency of inoculation by aphids can overcome the natural resistance of prospective host species.

Among all the Mississippi grasses tested, a greater proportion of annual (80%) than perennial (65.2%) species was susceptible to MDMV and SCMV (Table 3). This trend was especially noticeable among members of the subfamilies Panicoideae and Eragrostoideae in which over 96% of the annual species turned out to be hosts compared with an average of 71% hosts among the perennial species in these two subfamilies. A few examples will illustrate the difference in susceptibility between the two types of grasses. Each of the seven annual Mississippi species tested in the genus *Panicum* was susceptible to MDMV-A, whereas 13 of 43 perennial Mississippi species tested in the same genus were nonsusceptible to this strain. There occur in Mississippi six species of *Setaria*, of which five are annuals and one perennial. The perennial species, *Setaria geniculata*, was the only one of the six that proved nonsusceptible to MDMV-A, MDMV-B, and SCMV-B. The tribe Andropogoneae of the subfamily Panicoideae is represented in Mississippi by six annual and 37 perennial species. All six annuals could be infected with MDMV-A and SCMV-B. Among the perennials, seven grasses resisted infection by all three virus strains. To date, I have tested 17 Mississippi species in the important genus *Eragrostis* of which 10 are annuals. All 10 annual grasses were susceptible to MDMV-A and MDMV-B, whereas only three of the seven perennials were so. The significance of the greater susceptibility of annual than perennial grasses to these viruses is not understood but may have some relation to the rate of growth, which is generally faster for annual than perennial grasses early in the life of the plants. As a result, annual grasses are usually more succulent and more tender than the slower growing perennials, and therefore may be more attractive to aphid vectors of MDMV and SCMV. Another factor favoring resistance of wild perennial over annual grasses is the chance of repeated exposure of perennial plants to these viruses, with the consequence that perennials are subjected to higher selection pressure for resistance than annuals. Among virus-susceptible annual species, on the other hand, many

TABLE 5. Taxonomic analysis of the Mississippi (MS) grass flora and summary of the MS grasses tested for their response to manual inoculation with maize dwarf mosaic virus strain A (MDMV-A), strain B (MDMV-B), and sugarcane mosaic virus strain B (SCMV-B)[a]

Subfamily (tribe)	Species in MS (no.)	MS species (%)	Species tested (no.)	MS species tested (%)	Hosts of MDMV and/or SCMV (no.)	Host species (%)	Hosts of MDMV-A (no.)	Hosts of MDMV-B (no.)	Hosts of SCMV-B (no.)	Nonhosts (no.)	Nonhosts (%)
Festucoideae	61	18.3	54	88.5	20	37.0	18	17	17	34	63.0
Panicoideae											
(Paniceae)	131	39.3	108	82.4	80	74.1	78	63	70	28	25.9
(Andropogoneae)	43	13.0	42	97.7	35	83.3	35	29	27	7	16.7
Eragrostoideae	78	23.4	69	88.5	56	81.2	54	41	32	13	18.8
Bambusoideae	2	0.6	2	100.0	1	50.0	1	0	0	1	50.0
Oryzoideae	9	2.7	9	100.0	8	88.9	6	4	6	1	11.1
Arundinoideae	9	2.7	9	100.0	4	44.4	3	3	2	5	55.6
Total (mean)	333	100.0	293	(88.0)	204	(69.6)	195	157	154	89	(30.4)

[a]This summary includes all Mississippi grass species tested and reported by the author in this and two previous publications (17,20).

individual plants, by virtue of their large populations, escape infection and reseed themselves each year, thus perpetuating susceptibility of the species. Moreover, annual grasses usually produce an abundance of seed that has a short or no dormant period and a high rate of germination. Although MDMV probably originated in a perennial species, such as sugarcane or johnsongrass, two of its major hosts now are corn and sorghum, both annuals.

Despite the vast number of grass species tested for their reaction to MDMV-A, MDMV-B, and SCMV-B and the many hosts detected, there are still no suitable differential hosts that would be highly susceptible to MDMV-B and nonsusceptible to MDMV-A. The opposite is true for corn genotypes: There are no known corn inbred lines that are susceptible to MDMV-A and nonsusceptible to MDMV-B. An ideal differential host would be one that was immune to one virus and completely susceptible (i.e., with 100% disease incidence) to the other related virus(es) under normally prevailing environmental conditions in the greenhouse at all times, and susceptibility in individual plants of that differential host should express itself with pronounced, lasting symptoms. In addition, seed of the differential host should be readily available or easy to produce, should have a high rate of germination, and the seedlings should have a fast rate of growth. These requirements are more likely to be met in an annual than in a perennial grass. As Table 4 shows, the presently available differential hosts fall short of the ideal for differentiating MDMV-A, MDMV-B, and SCMV-B. The species that on manual inoculation reacted with 100% disease incidence and the greatest severity of symptoms to one virus, did so also in response to the other two viruses. Like the first set of three species in Table 4, the second three grasses are also annuals and easy to grow; these have exhibited resistance to all three virus strains. Of the next three grasses, which separate MDMV from SCMV-B, *Eragrostis oxylepis* showed the highest disease incidence coupled with pronounced symptoms in response to MDMV-A and MDMV-B, but *Setaria lutescens*, an annual, has the advantage of being fast growing. The next three species, *Eriochloa punctata*, *Leptochloa uninervia*, and *Panicum miliaceum* would separate MDMV-A from MDMV-B and SCMV-B. Among these, *L. uninervia* would be the first choice if its seed were as readily available as that of *P. miliaceum*. Of the three hosts that would eliminate MDMV-B from MDMV-A and SCMV-B, *Sorghum bicolor* 'Dale' would be the preferred differential host. *Hyparrhenia rufa* as a host of only SCMV-B and *Paspalum laeve* as a host of only MDMV-B are of questionable usefulness, the former because of scarcity of seed and the latter because of very low degree of susceptibility. *Setaria adhaerans* is a very suitable annual grass to differentiate between MDMV-A on the one hand and MDMV-B and SCMV-B on the other hand.

A taxonomic analysis of the Mississippi grass flora in Table 5 shows the diversity and wealth of representation among the Mississippi grass species in all six subfamilies of the Gramineae. For example, of the 3, 11, and 13 grass species occurring in the United States in the subfamilies Bambusoideae, Oryzoideae, and Arundinoideae, two, nine, and nine species, respectively, are found in Mississippi, all of which have been tested for their response to MDMV-A, MDMV-B, and SCMV-B. Members of the subfamily Eragrostoideae constitute 28.5% of all U.S. grass species and 23.4% of the Mississippi grass species. Compared with the country as a whole, Mississippi grasses are underrepresented in the subfamily Festucoideae (18.3 and 36.0% of Mississippi and U.S. grasses, respectively, are festucoids) and overrepresented in the subfamily Panicoideae (52.3 and 33.0% of Mississippi and U.S. grasses, respectively, are panicoids).

Inclusive of the 100 Mississippi grass species contained in the present report, the author now has presented data on the response to MDMV-A, MDMV-B, and SCMV-B of 293 out of 333 (88%) grasses found in Mississippi (Table 5). With this high ratio of tested to untested grasses, a general statement on the reaction of the entire Mississippi grass flora to these viruses seems reasonable, especially because the 40 untested species are evenly distributed among only three subfamilies. The 40 missing grasses make up 11.5, 13.8, and 11.5% of all the festucoid, panicoid, and eragrostoid species, respectively, occurring in Mississippi. The probability that a hitherto untested festucoid grass will prove a host of MDMV and/or SCMV is only one-half as great as the probability that a member of the tribe Paniceae in the subfamily Panicoideae will do so. However, the greatest chance that an untested grass will be a host of these viruses would be among species of the tribe Andropogoneae in the subfamily Panicoideae among which 83.3% of the species proved hosts of MDMV and/or SCMV. Based on the available data, it appears that about 70% of all Mississippi grass species are susceptible in various degrees to MDMV-A, MDMV-B, and/or SCMV-B.

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