Taxonomic Distribution of Native Mississippi Grass Species Susceptible to Maize Dwarf Mosaic and Sugarcane Mosaic Viruses

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ABSTRACT

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A systematic collection of 100 grass species, which represents 50 genera, 13 tribes, and all six subfamilies of the Gramineae occurring naturally in Mississippi, was tested for reaction to maize dwarf mosaic virus strains A (MDMV-A) and B (MDMV-B) and sugarcane mosaic virus B (SCMV-B). These grasses included 76 hosts (56 of them new) of MDMV-A, MDMV-B, or SCMV-B. Of the 76 host species, belonging to 40 genera, 71 were susceptible to MDMV-A, 62 were susceptible to MDMV-B, and 58 were susceptible to SCMV-B. The three virus strains infected 50 of the same species; 24 grasses were immune to all three viruses and represent new nonhosts. The following 12 genera are reported for the first time to contain host species of MDMV or SCMV: *Brachyelytrum, Chasmanthium, Dichanthelium, Distichlis, Eremochloa, Gymnopogon, Imperata, Leptoloma, Manisuris, Microstegium, Oplismenus,* and *Sacciolepis.* Susceptible species were found in five of the six subfamilies. The subfamilies Panicoideae and Festucoideae contained the highest and the lowest percentage of host species, respectively. The greatest differences in the host ranges of MDMV and SCMV were observed in the subfamily Eragrostoideae (Chlorideae). Several new perennial hosts with extensive distribution in the USA are suggested as potential overwintering hosts of MDMV-B. With the addition of the new hosts, there are now 251 grass species reported to be hosts of MDMV and 197 grass species reported as hosts of SCMV.

Additional key words: corn, Zea mays, differential host, symptomless host, Arundinoideae, Bambusoideae, Oryzoideae.

Most of the grasses studied as possible hosts of maize dwarf mosaic virus (MDMV) either have a wide distribution in the USA or occur predominately in northern latitudes. Since some diseases of corn (*Zea mays* L.) in the USA originate in the southern states, where climatic and biotic factors may be particularly favorable for disease development, it is useful to study various ecological and epidemiological aspects of such diseases in the South. MDMV strain A (MDMV-A) is intimately associated with johnsongrass (*Sorghum halepense* [L.] Pers.), a species adapted essentially to warmer regions. There are scores of other grasses, primarily adapted to the southern USA, that have not been studied in relation to MDMV or the closely related sugarcane mosaic virus (SCMV). Moreover, many of these grasses are extensively distributed in northern corn-growing states.

The objectives of this study were: to collect a large number of taxonomically diverse grass species endemic to Mississippi and to produce their seed; to determine the response of these grasses to inoculation with MDMV-A, MDMV strain B (MDMV-B), and SCMV strain B (SCMV-B); to discern taxonomic patterns among susceptible species within the Gramineae; and to find potential overwintering hosts of MDMV-B, a virus whose ecology and epidemiology are not well understood. In the collection of the native grasses, a special effort was made to locate species of subfamilies that have not been well represented in previous studies and to include grasses for which data on their reaction to the three viruses are incomplete. Since little information is available on the degree of susceptibility to MDMV and SCMV among host grasses, this paper also provides data on the incidence of infection for manual inoculation and on attempted virus recovery from inoculated symptomless grass species.

MATERIALS AND METHODS

Except for 12 species acquired from various sources as seed or vegetative material, all grasses were collected by the author in Mississippi. Whole plants were dug up in the wild, transplanted into clay pots, and grown in a greenhouse until seeds were harvested. A few of the grasses that did not produce viable seed in the greenhouse, were propagated vegetatively. Grass identifications were based on A. S. Hitchcock's Manual of the Grasses of the United States (4) and F. W. Gould's The Grasses of Texas (3), or were corroborated by S. T. McDaniel, Department of Botany, Mississippi State University.

Grass seeds were plated on moist blotter paper in petri dishes, and seedlings were transplanted individually into round 7.5 cm (3-inch) peat pots containing a soil-sand-peat moss mixture (3:1:1, v/v). Plants were fertilized and maintained in a vigorous state of growth. Virus cultures used included two isolates of MDMV-A, one from Mississippi and one from Ohio; an MDMV-B isolate from R. E. Ford, University of Illinois, Urbana; and an SCMV-B isolate from the U.S. Sugar Crops Field Station, Meridian, Mississippi. Strain B of SCMV was chosen because it is the most common strain of SCMV in Mississippi. Maintenance of virus source plants, preparation of inocula, inoculation procedure, and subsequent treatment of inoculated plants were essentially as described previously (10). The grasses, at the two- to three-leaf stage, were mechanically inoculated with all four virus isolates on the same day. Depending on availability of seedlings, five to 10 grass species were tested at a time. An attempt was made to have at least 10 seedlings of each species inoculated with each virus isolate.

Grasses were inspected for symptoms daily from the 5th day after inoculation, and the final reading was made 6 wk after inoculation, when the incidence and severity of infection were recorded. Grasses that remained symptomless to all virus strains or developed questionable symptoms were back-assayed to seedlings of Seneca Chief sweet corn (10 corn seedlings were used for each back-assay) which were observed for 4 wk. Grass species showing immunity to all three viruses were retested at a different time of the year.

RESULTS

The 100 grass species tested in this study represent 50 genera, 13 tribes (of 19 reported in Mississippi), and all six subfamilies of the Gramineae. In order to bring together as many Mississippi grasses as possible, four host species (*Brachiaria platyphylla, Leersia*

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

Grass species and common names	Growth habit[a]	Subfamily[b]	Number of plants showing symptoms when inoculated with: MDMV-A (Miss.)	Back assay to corn[d]	MDMV-A (Ohio)	Back assay to corn	MDMV-B	Back assay to corn	SCMV-B	Back assay to corn
Agrostis perennans (Walt.) Tuckerm. Autumn bentgrass	P	F	0/20[c]	0/10	0/20	0/10	0/20	0/10	0/20	0/10
Andropogon glomeratus (Walt.) B.S.P. Bushy beardgrass	P	P	8/12		7/12		7/12		6/12	
A. ternarius Michx. Splitbeard bluestem	P	P	3/10		6/10		10/10		3/10	
Aristida dichotoma Michx. Churchmouse threeawn	A	E	5/13		8/13		3/13		2/13	
A. longespica Poir. Slimspike threeawn	A	E	2/15	3/10	1/15	2/10	0/15	0/10	0/15	0/10
A. oligantha Michx. Prairie threeawn	A	E	7/14		6/14		7/14		13/14	
Anthraxon hispidus var. *cryptatherus* (Hack.) Honda	A	P	19/24		12/24		16/24		10/24	
Arundinaria gigantea (Walt.) Muhl. Giant cane	P	B	0/11	0/10	0/11	0/10	0/11	0/10	0/11	0/10
Axonopus compressus (Swartz) Beauv. Carpetgrass	P	P	0/22	0/10	0/22	0/10	0/22	0/10	0/22	0/10
Bothriochloa pertusa (L.) A. Camus Pitted bluestem	P	P	0/27	0/10	0/27	0/10	0/27	0/10	0/27	0/10
B. saccharoides (Swartz) Rydb. Silver beardgrass	P	P	12/12		8/12		10/12		7/12	
Brachiaria platyphylla (Griseb.) Nash Broadleaf signalgrass	A	P	14/14		14/14		14/14		14/14	
Brachyelytrum erectum (Schreb.) Beauv.	P	F	1/19	3/10	1/19	2/10	4/19	10/10	3/19	8/10
Briza minor L. Little quakinggrass	A	F	8/24	9/10	2/24	10/10	21/24	10/10	5/24	10/10
Bromus catharticus Vahl Rescuegrass	A	F	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
B. secalinus L. Cheat	A	F	12/24		9/24		23/24		12/24	
Cenchrus incertus M. A. Curtis Coast sandbur	P	P	1/11	1/10	1/11	1/10	0/11	0/10	0/11	0/10
Chasmanthium latifolium (Michx.) Yates Broadleaf uniola	P	A	8/19		6/19		3/19		3/19	
C. sessiliflorum (Poir.) Yates	P	A	6/20		2/20		1/20		0/20	
Chloris petraea Swartz	P	E	10/15		11/15		3/15		6/15	
C. virgata Swartz Feather fingergrass	A	E	4/9		5/9		3/9		2/9	
Cynodon dactylon (L.) Pers. Bermudagrass	P	E	10/24	8/10	6/24	5/10	4/24	2/10	2/24	1/10
Dactyloctenium aegyptium (L.) Beauv. Crawfootgrass	A	E	15/21		10/21		8/21		2/21	
Dichanthelium clandestinum (L.) Gould Deertongue dichanthelium	P	P	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10
D. commutatum (Schult.) Gould Variable dichanthelium	P	P	3/12		7/12		1/12		0/12	
D. lindheimeri (Nash) Gould Lindheimer dichanthelium	P	P	8/8		7/8		6/8		6/8	
D. scoparium (Lam.) Gould Velvet dichanthelium	P	P	0/18	0/10	0/18	0/10	0/18	0/10	0/18	0/10
Digitaria sanguinalis (L.) Scop. Large crabgrass	A	P	9/15		5/15		12/15		1/15	
D. violascens Link Violet crabgrass	A	P	4/7		3/7		7/7		3/7	
Distichlis spicata (L.) Greene Seashore saltgrass	P	E	0/14	0/10	0/14	0/10	0/14	0/10	0/14	2/10
Echinochloa colonum (L.) Link Junglerice	A	P	20/20		20/20		20/20		20/20	
E. crus-pavonis (H.B.K.) Schult.	A	P	10/10		10/10		10/10		10/10	
Eleusine indica (L.) Gaertn. Goosegrass	A	E	9/20		15/20		7/20		9/20	
Elymus virginicus L. Virginia wildrye	P	F	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Eragrostis cilianensis (All.) Lutati Stinkgrass	A	E	15/17		11/17		12/17		11/17	
E. glomerata (Walt.) L. H. Dewey	A	E	7/10		6/10		9/10		0/10	
E. hirsuta (Michx.) Nees Bigtop lovegrass	P	E	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10

(continued)

TABLE 1 (continued)

Grass species and common names	Growth habit[a]	Subfamily[b]	MDMV-A (Miss.)	Back assay to corn[d]	MDMV-A (Ohio)	Back assay to corn	MDMV-B	Back assay to corn	SCMV-B	Back assay to corn
			Number of plants showing symptoms when inoculated with:							
E. lugens Nees										
Mourning lovegrass	P	E	7/20		16/20		10/20		0/20	
E. oxylepis (Torr.) Torr.										
Red lovegrass	P	E	10/23		23/23		17/23		0/23	
E. pilosa (L.) Beauv.										
India lovegrass	A	E	7/9		2/9		5/9		2/9	
E. refracta (Muhl.) Scribr.										
Coastal lovegrass	P	E	0/18	0/10	0/18	0/10	0/18	0/10	0/18	0/10
E. stenophylla Hochst.	A	E	13/27		18/27		14/27		18/27	
Eremochloa ophiuroides (Munro) Hack.										
Centipedegrass	P	P	6/14		7/14		5/14		6/14	
Erianthus contortus Baldw. ex Ell.										
Bentawn plumegrass	P	P	4/10		3/10		3/10		3/10	
E. giganteus (Walt.) Muhl.										
Sugarcane plumegrass	P	P	14/20		8/20		9/20		8/20	
Festuca octoflora Walt.										
Six-weeks fescue	A	F	0/18	0/10	0/18	0/10	0/18	0/10	0/18	0/10
Gymnopogon ambiguus (Michx.) B.S.P.										
Bearded skeletongrass	P	E	4/10		5/10		3/10		3/10	
G. brevifolius Trin.										
Short-awned skeletongrass	P	E	4/10		5/10		6/10		2/10	
Holcus lanatus L.										
Velvetgrass	P	F	0/23	0/10	0/23	0/10	0/23	0/10	0/23	0/10
Imperata cylindrica (L.) Beauv.										
Cogongrass	P	P	0/10	1/10	0/10	1/10	0/10	0/10	0/10	0/10
Leersia hexandra Swartz										
Southern cutgrass	P	O	18/23		20/23		6/23		15/23	
L. lenticularis Michx.										
Catchfly grass	P	O	4/18		3/18		2/18		2/18	
L. oryzoides (L.) Swartz										
Rice cutgrass	P	O	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10
L. virginica Willd.										
Whitegrass	P	O	11/20		17/20		19/20		7/20	
Leptochloa uninervia (Presl) Hitchc. & Chase										
Mexican sprangletop	A	E	11/19	10/10	15/19	10/10	0/19	0/10	0/19	0/10
Leptoloma cognatum (Schult.) Chase										
Fall witchgrass	P	P	2/13		2/13		2/13		6/13	
Manisuris rugosa (Nutt.) Kuntze										
Wrinkled jointtail	P	P	1/11		1/11		5/11		0/11	0/10
M. tessellata (Steud.) Scribn.	P	P	3/10		5/10		7/10		5/10	
Microstegium vimineum (Trin.) A. Camus	A	P	11/20		9/20		13/20		10/20	
Muhlenbergia sobolifera (Muhl.) Trin.										
Rock muhly	P	E	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10
Oplismenus setarius (Lam.) Roem. & Schult.	P	P	9/20		4/20		11/20		10/20	
Panicum agrostoides Spreng.										
Redtop panicum	P	P	0/12	0/10	0/12	0/10	0/12	0/10	0/12	0/10
P. amarulum Hitchc. & Chase										
Bitter panicgrass	P	P	8/10		8/10		4/10		1/10	
P. amarum Ell.										
Seaside panicum	P	P	1/10		2/10		0/10		0/10	
P. anceps Michx.										
Beaked panicum	P	P	0/17		0/17		0/17		2/17	
P. dichotomiflorum Michx.										
Fall panicum	A	P	2/17		1/17		14/17		14/17	
P. polyanthes Schult.										
Leafy panicum	P	P	5/20		7/20		5/20		9/20	
P. repens L.										
Torpedograss	P	P	0/27	0/10	0/27	0/10	0/27	0/10	0/27	0/10
P. rhizomatum Hitchc. & Chase	P	P	1/22	2/10	1/22	1/10	0/22	0/10	0/22	0/10
P. verrucosum Muhl.										
Warty panicum	A	P	10/24		5/24		5/24		11/24	
Paspalum boscianum Flügge										
Bull paspalum	A	P	3/8		3/8		2/8		2/8	
P. ciliatifolium Michx.										
Fringeleaf paspalum	P	P	1/18		2/18		0/18		5/18	
P. floridanum Michx.										
Florida paspalum	P	P	11/13		7/13		0/13		1/13	
P. floridanum var. *glabratum* Engelm. ex Vasey	P	P	1/13		1/13		0/13		1/13	
P. laeve Michx.										
Field paspalum	P	P	0/21	0/10	0/21	0/10	1/21	5/10	0/21	0/10

(continued)

TABLE 1 (continued)

Grass species and common names	Growth habit[a]	Subfamily[b]	Number of plants showing symptoms when inoculated with: MDMV-A (Miss.)	Back assay to corn[d]	MDMV-A (Ohio)	Back assay to corn	MDMV-B	Back assay to corn	SCMV-B	Back assay to corn
P. minus Fourn. Mat paspalum	P	P	0/22	1/10	0/22	0/10	0/22	0/10	0/22	2/10
P. notatum var. *saurae* Parodi Bahiagrass (Pensacola strain)	P	P	0/24	0/10	0/24	2/10	0/24	0/10	0/24	2/10
P. urvillei Steud. Vaseygrass	P	P	0/11	0/10	0/11	0/10	0/11	0/10	0/11	0/10
P. vaginatum Swartz Seashore paspalum	P	P	0/22	0/10	0/22	0/10	0/22	0/10	0/22	0/10
Pennisetum setaceum (Forsk.) Chiov. Fountaingrass	P	P	2/13	0/10	4/13	0/10	3/13	10/10	0/13	1/10
Phalaris angusta Nees ex Trin. Timothy canarygrass	A	F	0/24	0/10	0/24	0/10	0/24	0/10	0/24	0/10
Polypogon monspeliensis (L.) Desf. Rabbitfoot grass	A	F	2/19		9/19		10/19		13/19	
Sacciolepis striata (L.) Nash American cupscale	P	P	9/21		4/21		17/21		3/21	
Setaria geniculata (Lam.) Beauv. Knotroot bristlegrass	P	P	0/18	0/10	0/18	0/10	0/18	0/10	0/18	0/10
Sorghastrum elliottii (Mohr) Nash Slender indiangrass	P	P	4/19		5/19		4/19		6/19	
Sorghum halepense (L.) Pers. Johnsongrass	P	P	15/20		10/20		0/20	0/10	0/20	0/10
Spartina patens (Ait.) Muhl. Saltmeadow cordgrass	P	E	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10
Sporobolus asper (Michx.) Kunth Tall dropseed	P	E	6/24		2/24		10/24		0/24	0/10
S. asper var. *hookeri* (Trin.) Vasey Meadow dropseed	P	E	4/24		2/24		11/24		0/24	0/10
S. clandestinus (Biehler) Hitchc. Concealed dropseed	P	E	13/21	10/10	7/21	10/10	7/21	10/10	2/21	9/10
S. cryptandrus (Torr.) A. Gray Sand dropseed	P	E	6/18		10/18		6/18		9/18	
S. junceus (Michx.) Kunth Pineywoods dropseed	P	E	0/20	0/10	0/20	0/10	3/20	5/10	0/20	0/10
S. poiretii (Roem. & Schult.) Hitchc. Smutgrass	P	E	2/21	4/10	4/21	7/10	1/21	10/10	0/21	0/10
S. vaginiflorus (Torr.) Wood Poverty dropseed	A	E	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10
S. virginicus (L.) Kunth Seashore dropseed	P	E	0/21	0/10	0/21	0/10	0/21	0/10	0/21	0/10
Stenotaphrum secundatum (Walt.) Kuntze St. Augustinegrass	P	P	17/21	10/10	12/21	10/10	11/21	10/10	14/21	10/10
Tridens ambiguus (Ell.) Schult. Pinebarren tridens	P	E	4/24		2/24		3/24		1/24	
T. flavus (L.) Hitchc. Purpletop	P	E	5/21		2/21		9/21		0/21	
T. strictus (Nutt.) Nash Longspike tridens	P	E	0/20	0/10	0/20	0/10	0/20	0/10	0/20	0/10
Zea mays L. 'Mp488'	A	P	15/15		15/15		15/15		15/15	
Corn, maize 'Tx601'	A	P	10/15		4/15		5/15		6/15	

[a] Abbreviations: P = perennial species, A = annual species.
[b] Abbreviations: F = Festucoideae, P = Panicoideae, E = Eragrostoideae, B = Bambusoideae, A = Arundinoideae, and O = Oryzoideae.
[c] Fraction expresses disease incidence in response to inoculation; the numerator denotes the number of plants with symptoms and the denominator the number of plants inoculated.
[d] Back assay to Seneca Chief sweet corn from 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.

virginica, Sporobolus cryptandrus, and *Zea mays*) which were included in a previous publication by the author (10) reappear here with new data. Another four hosts (*Dactylectenium aegyptium, Polypogon monspeliensis, Sorghum halepense,* and *Sporobolus asper*) for which Tosic and Ford (11) had published data on their reaction to the three virus strains here studied were incorporated into this study because no published information exists on their degree of susceptibility to these viruses. This paper thus presents new information on the response of 92 grasses to MDMV-A, MDMV-B, and SCMV-B. A total of 76 species in 40 genera were found to be hosts of one or more of these viruses (Table 1). Among the 76 host grasses, MDMV-A had the widest host range with 71 susceptible species. This was followed by MDMV-B which infected 62 grasses, and SCMV-B caused infection in 58 grasses. The three virus strains had 50 hosts in common. The remaining 24 species proved immune to infection and are being reported, for the first time, as nonhosts of MDMV-A, MDMV-B, and SCMV-B.

Of the 76 host species, 50 were new hosts. An additional six grasses (*Echinochloa colonum, Eragrostis cilianensis, Panicum dichotomiflorum, Paspalum floridanum* var. *glabratum, Paspalum laeve,* and *Tridens flavus*) had been reported by various authors (5,6,8,9) as being susceptible to MDMV, but they did not specify what strain was involved. In addition, since no information has been available on the reaction of the six species to SCMV, these will be included among the new hosts. The taxonomic distribution of the 56 new host species extends over 30 genera, 12 of which are being listed here for the first time as containing species susceptible to these viruses: *Brachyelytrum, Chasmanthium* (formerly *Uniola*), *Dichanthelium* (formerly a subgenus of *Panicum*), *Distichlis, Eremochloa, Gymnopogon, Imperata, Leptoloma, Manisuris, Microstegium, Oplismenus*, and *Sacciolepis*.

This collection of grasses contained 71 perennial and 29 annual species. A greater proportion of the annuals (86%) than of the perennials (72%) was susceptible to these viruses. Moreover, the annual hosts tended to have a greater disease incidence and to show more severe symptoms than the perennial hosts. All species that reacted with 100% infection to all four virus isolates were annual grasses.

The data presented in Table 1 show not only what species were susceptible to MDMV-A, MDMV-B, and SCMV-B but also the disease incidence in the host species and what species were immune. The hosts varied widely in susceptibility and symptom expression. All plants of *Echinochloa colonum, Echinochloa crus-pavonis, Brachiaria platyphylla* and *Zea mays* (inbred Mp488) developed severe symptoms when inoculated with any of the four virus isolates. Additionally, MDMV-A induced symptoms in all inoculated plants of *Bothriochloa saccharoides, Dichanthelium lindheimeri*, and *Eragrostis oxylepis*, whereas MDMV-B induced symptoms in all inoculated plants of *Andropogon ternarius, Digitaria violascens*, and *Leersia virginica*. Most plants of *Aristida oligantha* (93%) and *Panicum dichotomiflorum* (82%) showed severe symptoms when inoculated with SCMV-B. On the other hand, there were symptomless hosts in which the presence of the virus could be detected only by return inoculation to sweet corn, and even then in only one or two of 10 inoculated corn seedlings. In the latter category were species such as *Distichlis spicata* (host of SCMV-B), *Imperata cylindrica* (host of MDMV-A), *Paspalum minus* (host of MDMV-A and SCMV-B), and *Paspalum notatum* var. *saurae* (host of MDMV-A and SCMV-B).

From the differences in the host reactions to the three viruses, a set of grasses was selected to differentiate these viruses (Table 2).

TABLE 2. Grass species with differential reactions to maize dwarf mosaic virus strain A (MDMV-A), strain B (MDMV-B), and sugarcane mosaic virus strain B (SCMV-B)

Grass host	Reaction to virus MDMV-A	MDMV-B	SCMV-B
Eragrostis oxylepis	+[a]	+	–
Sporobolus poiretii	+	+	–
Tridens flavus	+	+	–
Leptochloa univervia	+	–	–
Sorghum halepense	+	–	–
Paspalum ciliatifolium	+	–	+
P. floridanum	+	–	+
P. laeve	–	+	–
Sporobolus junceus	–	+	–
Tridens strictus	–	–	–
Echinochloa crus-pavonis	+	+	+

[a]Symbols: + = susceptible; – = immune.

TABLE 3. Taxonomic grouping of Mississippi (MS) grass hosts of maize dwarf mosaic virus (MDMV) and sugarcane mosaic virus (SCMV)

Subfamily (tribe)	Species in MS (no.)	Species tested (no.)	Hosts of MDMV and SCMV (no.)	Hosts of MDMV (no.)	Hosts of SCMV (no.)
Festucoideae	67	10	4	4	4
Panicoideae					
(Paniceae)	125	35	27	25	21
(Andropogoneae)	42	15	14	14	11
Eragrostoideae	81	33	26	25	15
Bambusoideae	2	1	0	0	0
Oryzoideae	9	4	3	3	3
Arundinoideae	9	2	2	2	1
Total	334	100	76	72	55

Unfortunately, the two species (*Paspalum laeva* and *Sporobolus junceus*) that were susceptible to MDMV-B and not susceptible to MDMV-A and SCMV-B produced symptoms infrequently when inoculated with MDMV-B and requiring back inoculation to a more sensitive indicator plant.

The collection of 100 grasses studied here is distributed among all six subfamilies of Gramineae, and represents 30% of all grass species occurring in Mississippi. Table 3 shows the taxonomic analysis of Mississippi grasses, the species tested, and the new hosts of MDMV and SCMV. Approximately 50% of all Mississippi grasses belong to the subfamily Panicoideae, and 50% of the grasses tested in this study are members of that subfamily. Although the bulk of the hosts (69.7%) fell in the Paniceae of the subfamily Panicoideae and in the subfamily Eragrostoideae (also referred to as Chlorideae by some authorities), the tribe Andropogoneae of the subfamily Panicoideae contained the greatest proportion of hosts. Most of the differences in the host ranges of MDMV and SCMV were found among species in the subfamily Eragrostoideae (Table 3). More than one third of the species tested in this subfamily and found susceptible to MDMV proved immune to infection by SCMV. Hosts of MDMV and SCMV were located in five of the six subfamilies of Gramineae.

DISCUSSION

The present investigation has attempted to approach the selection of grass species for a host range study of MDMV and SCMV in a more systematic manner than has been done previously. Grasses were collected in the wild in a relatively small, well defined area with an eye to attaining as broad a spectrum of taxa as possible. The grasses selected for this study represent all six subfamilies of Gramineae as presently recognized by Gould (2) and others. To test the whole grass family was considered to be more important than to test species with the greatest representation in Mississippi. On the other hand, susceptibility data were obtained on all Mississippi species of certain genera (viz., *Chloris, Gymnopogon, Leersia, Manisuris*, and *Sporobolus*). The grass species occurring in Mississippi are distributed among 90 genera of which 50 were represented in this study.

Taxonomic analysis of the present infectivity data confirms the conclusions drawn by Watson and Gibbs (12), based on the data of Tosic and Ford (11), namely, that MDMV and SCMV are most adapted to species of the subfamily Panicoideae and are less likely to infect species of the subfamily Festucoideae. In this study, members of the Festucoideae made up only 5.3% of the hosts, but comprised 25.0% of the nonhosts. MacKenzie (7), who studied primarily festucoid grasses for their reaction to MDMV-A and MDMV-B, found 16 of 20 such species to be immune to both strains. The third major grass subfamily in the USA, the Eragrostoideae (Chlorideae), appears to contain an intermediate number of hosts of MDMV and SCMV. At present, there is insufficient information on the reaction to MDMV and SCMV of species in the subfamilies Oryzoideae, Arundinoideae, and Bambusoideae to predict the proportion of hosts in these three taxonomic groups.

In the United States, MDMV-A overwinters largely in *Sorghum halepense* and therefore tends to have a more southern distribution than MDMV-B which does not infect *S. halepense*. Thus, a relation may be sought between the natural occurrence of MDMV-A and MDMV-B and the U.S. regions with maximum species representation and diversity in the major grass subfamilies. Festucoideae have the greatest diversity and species representation in the northern and Pacific states, whereas members of the Panicoideae are best represented in the southeastern and Atlantic states. Eragrostoideae are fairly well distributed over the entire United States. Species in the other three subfamilies (Bambusoideae, Oryzoideae, and Arundinoideae) constitute only 2.5% of all U.S. grasses (2) and 6.0% of the Mississippi grasses.

If the reaction to MDMV and SCMV of the grass species studied here is viewed on the generic level, certain trends may be discerned. For example, the genus *Echinochloa* contains species that are highly susceptible to MDMV and SCMV. In fact, all U.S. species of this genus that have been tested (*E. colonum, E. crusgalli, E. crusgalli* var. *frumentacea, E. crus-pavonis,* and *E. polystachya*) proved to be very susceptible. Conversely, species in the genus *Paspalum* tend to be only slightly susceptible or immune to MDMV and SCMV. The genus *Sporobolus* appears to combine as many host species as nonhost species of MDMV, but most species in this genus are immune to the strains of SCMV.

The susceptibility to MDMV-B of the perennial grasses tested here is of special interest because the mode of overwintering for this virus is not known. Among the 62 species infected by MDMV-B, there were numerous perennial grasses having a wide distribution in all corn-growing areas. Such grasses included *Brachyelytrum erectum, Chasmanthium latifolium* (= *Uniola latifolia*), *Dichanthelium* (*Panicum*) *lindheimeri, Gymnopogon ambiguus, Leersia lenticularis, Leersia virginica, Leptoloma cognatum, Paspalum laeve, Sporobolus asper, Sporobolus cryptandrus,* and *Tridens flavus.* Whereas some of these grasses showed a relatively high level of susceptibility (eg, *Leersia virginica* with 95% infection and both *Sporobolus asper* and *Tridens flavus* with close to 50% infection), others were only occasionally infected and then showed only mild symptoms (viz, *Brachyelytrum erectum* and *Paspalum laeve*), but contained enough virus to infect all or most of the sweet corn test plants upon back inoculation. Among the MDMV-B-susceptible perennial grasses with predominately southern distribution, *Andropogon ternarius* was 100% susceptible and *Bothriochloa saccharoides* and *Sacciolepis striata* over 80% susceptible. Although *Sporobolus poiretii* and *Pennisetum setaceum* produced only an occasional plant with discernible symptoms when inoculated with MDMV-B, recovery attempts showed that the virus multiplied in the symptomless plants.

During the growing season, a number of annual grasses that are highly susceptible to MDMV-B could become infected with this virus and serve as sources of inoculum for secondary spread. Prime suspects among the annual hosts with an extensive range in corn-growing areas would include such common grasses as *Bromus secalinus, Chloris virgata, Digitaria sanguinalis, Echinochloa colonum, Eleusine indica, Eragrostis pilosa,* and *Panicum dichotomiflorum.*

The search for overwintering hosts of MDMV-B in the wild may be complicated by the existence of symptomless carriers among perennial hosts in which the presence of this virus would have to be confirmed by bioassay. Inoculated plants of *Paspalum laeve, Pennisetum setaceum,* and *Sporobolus poiretii* showed mild or no disease symptoms, but MDMV-B was easily recovered, even from the symptomless plants, to sweet corn. In another study, *Elymus villosus* behaved similarly (1).

Of the differential hosts contained in Table 2, the least suitable are the *Paspalum* species. Only a very small proportion of inoculated plants may develop symptoms, as can be seen in Table 1 for *P. floridanum* inoculated with SCMV-B and *P. laeve* inoculated with MDMV-B. Therefore, an expected positive reaction may be missed if insufficient numbers of test plants are used. Unfortunately, *Paspalum* species so far are the only known grasses that show differential reactions to inoculation with certain combinations of these viruses.

The prospect of finding differential host species with which to distinguish among MDMV-A, MDMV-B, and SCMV seems best in the subfamily Eragrostoideae. In the present study, 10 species belonging to this subfamily were susceptible to MDMV but immune to SCMV, and an additional species reacted reversely. Based on the present data and those from other studies (10,11), it appears that the eragrostoid genera *Chloris, Eragrostis, Leptochloa, Sporobolus, Trichloris,* and *Tridens* are most likely to harbor prospective differential host species.

With the addition of the new hosts described here, there are now 251 grass species, representing 79 genera, reported as hosts of MDMV. Inclusive of those reported here, 194 gramineous species, belonging to 72 genera, are known hosts of one or another strain of SCMV. It is recommended that future host range studies of these viruses should include additional species from the subfamilies Eragrostoideae, Arundinoideae, Bambusoideae, and Oryzoideae.

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