Maize Dwarf Mosaic Virus Transmission by Greenbug Biotypes

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ABSTRACT

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A new biotype (biotype E) of the greenbug, *Schizaphis graminum*, was compared with biotype C as a vector of the A and B strains of maize dwarf mosaic virus (MDMV-A and MDMV-B). Two isolates of MDMV-A and one isolate of MDMV-B were tested. Biotype E was more efficient than biotype C as a vector of one MDMV-A isolate. Biotype E greenbugs were more efficient than biotype C as vectors of MDMV-B.

Additional key words: aphids, sorghum

The greenbug, *Schizaphis graminum* Rond., is a major pest of sorghum and other cereals. In addition to being a toxicogenic insect, the greenbug is an important vector of maize dwarf mosaic virus (MDMV) (4). In 1979, a new biotype of greenbug (designated biotype E) was found infesting varieties of wheat and sorghum that were resistant to the previously prevalent biotype C (3). Biotype E is better adapted than biotype C to cooler temperatures, causes more damage by its toxins on susceptible and resistant plant materials, and is under consideration as a MDMV vector associated with long-distance dispersal of MDMV on the Great Plains (1–3). The objective of this study was to determine the vectoring potential of biotype E with regard to transmission of MDMV.

MATERIALS AND METHODS

Aphids were reared in screen cages in either a growth chamber or a glasshouse at 25 C with 16 hr of supplemented light. Trudan-5 sudangrass, *Sorghum sudanese* (Piper) Stapf (Northrup King), was used as aphid-rearing host, virus-source, and assay host. Biotypes C and E greenbugs were obtained from Glen Moore (Northrup King Corp., Edina, MN) and George Teetes (Texas A&M University, College Station), respectively. A 1980 isolate of biotype C was used in all transmission tests except those conducted at the University of Minnesota, where a 1978 isolate was used.

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Insects were transferred from rearing plants to petri dishes with a camel's hair brush. After 1–3 hr of preacquisition starvation, aphids were given 10-min acquisition-access feeding periods on MDMV-infected source plants. Detached virus-source leaves (the lower third of the third true leaf showing strong disease symptoms) were used. Only late instar apterae or alatae that could be transferred to assay plants (one aphid per plant) within 15 min after the acquisition feeding period were used. Aphids were allowed 24 hr of inoculation feeding before being killed with insecticide (malathion). Whether test insects were inoculative was determined about 2 wk later on the basis of symptom development in assay plants.

A johnsongrass (*Sorghum halepense* L. (Pers.)) strain of MDMV isolated from sweet corn (*Zea mays* L.) in Minnesota in 1977 and designated MDMV-Ap was maintained in johnsongrass before use in transmission experiments. A second johnsongrass isolate was also obtained from sweet corn in Minnesota in 1981 (MDMV-A-11). A non-johnsongrass-infecting strain of MDMV (MDMV-B) was isolated from sweet corn in 1981 and maintained in Trudan-5. Virus isolates that had been maintained through more than three successive transfers via mechanical inoculation were subsequently subjected to at least three successive transfers by aphids before being used in transmission trials in order to ensure maximal aphid transmissibility.

RESULTS AND DISCUSSION

Results indicate that biotype E was generally more efficient in transmitting MDMV than biotype C (Tables 1 and 2). Both alate and apterous forms of biotype E were more efficient vectors of MDMV-A-11 than biotype C. The results were similar for MDMV-B. Biotype C apterae, however, were slightly more efficient than biotype E alatae. Alates of both biotypes were generally less efficient than their respective apterae.

Biotype C and biotype E transmission efficiencies were similar for experiments conducted at Texas A&M University (Table 3) but all were significantly less when compared with results obtained

Table 1. Transmission of maize dwarf mosaic virus strain A-11 by *Schizaphis graminum* biotypes

	Biotype C		Biotype E	
Morphology	Plants infected/ plants exposed	Percent infection	Plants infected/ plants exposed	Percent infection
Alatae	99/407[x]	24.32 ab,[y] 2.13[z]	125/380	32.89 bc, 2.41
Apterae	147/702	20.94 a, 1.54	254/691	36.76 c, 1.83

[x] One test aphid was transferred to each sundangrass assay seedling.
[y] Multiple comparison of proportions X^2 test. Percentages followed by the same letter are not significantly different at $P = 0.05$.
[z] Standard error of the mean percentage of plants infected.

Table 2. Transmission of maize dwarf mosaic virus strain B by *Schizaphis graminum* biotypes

	Biotype C		Biotype E	
Morphology	Plants infected/ plants exposed	Percent infection	Plants infected/ plants exposed	Percent infection
Alatae	39/437[x]	8.92 a,[y] 1.36[z]	36/240	15.00 ab, 2.30
Apterae	112/641	17.47 bc, 1.49	43/617	23.18 c, 1.69

[x] One test aphid was transferred to each sudangrass assay seedling.
[y] Multiple comparison of proportions X^2 test. Percentages followed by the same letter are not significantly different at $P = 0.05$.
[z] Standard error of the mean percentage of plants infected.

Table 3. Transmission of maize dwarf mosaic virus strain Ap by *Schizaphis graminum* biotypes

Morphology	Biotype C		Biotype E	
	Plants infected/ plants exposed	Percent infection	Plants infected/ plants exposed	Percent infection
Alatae	48/575[w]	8.35 a,[x]1.15[y]	51/479	10.65 a, 1.41
Apterae	149/1259	11.83 a, 0.91	78/827	9.43 a, 1.02
Alatae[z]	137/667	20.54 b, 1.56	...	...
Apterae[z]	387/1904	20.32 b, 0.92	...	...

[w] One test aphid was transferred to each sudangrass assay seedling.
[x] Multiple comparison of proportions X^2 test. Percentages followed by the same letter are not significantly different at $P = 0.05$.
[y] Standard error of the mean percentage of plants infected.
[z] Data from experiments conducted at the University of Minnesota using a 1978 clone of biotype C.

earlier at the University of Minnesota (1).

This is apparently the first report of biotype E as a vector of MDMV and in most cases, a more efficient vector than biotype C. The stability of biotype E is not known (3). In addition to its ability to cause feeding damage, its higher MDMV transmission efficiency should be considered when planning control strategies.

The MDMV-Ap transmission data (Table 3) are of dubious comparative value for the following reasons: 1) both clones of biotype C are nearly identical in their ability to transmit a "fresh" isolate of MDMV-A (A-11), suggesting that something had happened to our Ap isolate; 2) the Ap isolate was transferred mechanically for several generations, possibly resulting in loss or change in the helper component (6); 3) there may have been a mutation in the virus or selection of a virus substrain during mechanical maintenance of the Ap isolate, leading to partial loss of aphid transmissibility; and 4) loss or reduction of aphid transmissibility is not an unusual phenomenon in these systems (5).

It is not unusual for the greenbug to be dispersed to the northern Great Plains (1,2,7–9). Increased virus transmission efficiency could result in increased incidence of MDMV in these regions. The lower MDMV-B transmission efficiency, particularly when alates were used, may help explain the lower incidence of this strain in many regions.

LITERATURE CITED

1. Berger, P. H., and Zeyen, R. J. 1981. Extended retention of MDMV: Implications for long-distance virus dispersal. (Abstr.) Phytopathology 71:203.
2. Bruehl, G. W. 1961. Barley yellow dwarf. Monogr. 1. American Phytopathological Society, St. Paul, MN. 52 pp.
3. Daniels, N. E. 1981. Migration of greenbugs in the Texas Panhandle in relation to their biotypes. Texas Agric. Exp. Stn. MP-1487. 4 pp.
4. Daniels, N. E., and Toler, R. W. 1969. Transmission of maize dwarf mosaic by the greenbug, *Schizaphis graminum*. Plant Dis. Rep. 53:59-61.
5. Koike, H. 1979. Loss of aphid transmissibility in an isolate of sugarcane mosaic virus strain H. Plant Dis. Rep. 63:373-375.
6. Sako, N., and Ogata, K. 1981. Different helper factors associated with aphid transmission of some potyviruses. Virology 112:762-765.
7. Wadley, F. M. 1931. Ecology of *Toxoptera graminum*, especially as to factors affecting importance in the northern United States. Ann. Entomol. Soc. Am. 24:325-395.
8. Wallin, J. R., and Loonan, D. V. 1971. Low-level jet winds, aphid vectors, local weather, and barley yellow dwarf virus outbreaks. Phytopathology 61:1068-1070.
9. Wallin, J. R., Peters, D., and Johnson, L. C. 1976. Low-level jet winds, early cereal aphid and barley yellow dwarf detection in Iowa. Plant Dis. Rep. 51:527-530.