Yield Response of Sweet Corn to Maize Dwarf Mosaic Virus

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ABSTRACT

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The effect of maize dwarf mosaic virus strain B on yield of 20 sweet corn cultivars was examined. In 14 cultivars, plants infected with the virus required significantly longer to reach the midsilk stage than plants not infected. Infection caused reductions in kernel fill at the basal portion of the ear in 11 cultivars, ear length in 3 cultivars, ear diameter in 10 cultivars, first ear weight in 9 cultivars, ear marketability in 8 cultivars, and plant height in 7 cultivars. When overall means of all 20 cultivars were compared by treatment, plants infected with maize dwarf mosaic virus strain B took significantly longer to reach midsilk and had significantly reduced butt fill, ear length, ear diameter, first ear weight, ear marketability, and plant height. Variability of different sweet corn cultivars in these characteristics allowed us to classify Cherokee, Golden Gleam, Silver Queen, Sundance, and Wintergreen as tolerant to infection by the virus.

Maize dwarf mosaic (MDM), a major disease of sweet corn (*Zea mays* L.) in midwestern and northeastern areas of the United States, reduces yield and ear quality. Reduced ear quality is expressed as smaller ear diameter, shorter length, lighter weight, and reduced marketability and kernel fill. It is important to quantify the yield reduction in sweet corn caused by maize dwarf mosaic virus (MDMV) and to identify possible sources of tolerance or resistance. Yield reduction in MDMV-infected dent corn is attributed to reduced ear weight (2,4,5), but there is little information on yield loss in sweet corn caused by MDMV (1). Although most sweet corn cultivars are susceptible, we know that some cultivars show tolerance to MDM. In sweet corn, yield must be expressed in terms of ear quality as well as ear weight. Factors that relate to ear quality have not been studied. This study was made to quantify these factors and to identify possible sources of tolerance or resistance.

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MATERIALS AND METHODS

Twenty sweet corn cultivars were planted on 26 May 1978 at the Agriculture Experiment Station, Vegetable Crops Farm, University of Illinois. The experimental design was a split plot with cultivars as main plots and treatments as subplots. Each plot had three replicates. Subplots were paired rows with one row inoculated with maize dwarf mosaic virus strain B (MDMV-B) and the other row not inoculated. Subplots were bordered on each side by one row of the same cultivar. Rows 97 cm apart were each planted with 15 plants spaced 33 cm apart.

Plants were inoculated with MDMV-B at the four- to five-leaf stage on June 9. Inoculum was prepared by adding infected corn tissue to 0.05 M chilled sodium phosphate buffer (1 g/4 ml), pH 7.0, and grinding it for 1 min in a Waring Blendor. The homogenate was filtered through cheesecloth and Miracloth, and 22-μm Carborundum at 15 g/L was added. Plants were mechanically inoculated using an artist's airbrush (Binks Manufacturing Company, Franklin Park, IL) at an air pressure of 4.9 kg/cm^2. Plants within the rows inoculated with MDMV-B not showing symptoms were reinoculated on June 19. The plots were observed once per week; plants in inoculated treatments not showing symptoms and plants in uninoculated treatments showing symptoms were marked to avoid sampling later.

We harvested the cultivars at fresh market maturity. The characteristics measured on five plants per replicate in each treatment were plant height, days to the midsilk stage, kernel fill at the basal portion of the ear (referred to as butt fill), ear length, ear diameter, weight of first ear, and ear marketability. Plant height, measured immediately after anthesis, was the distance from the ground to the lowest branch on the tassel. Days to midsilk was the time from planting until emerging silk was observed in half of the plants within the treatment. Butt fill was measured as the percentage of the basal end of the ear not showing missing kernels. Ear marketability was rated as 1 for marketable ears, 2 for marginal ears, and 3 for unmarketable ears.

We compared treatment means of each cultivar for each dependent variable with Fisher's least significant difference test at the 5% level of confidence (7). The overall means of all 20 sweet corn cultivars were compared by treatment for each dependent variable, also at the 5% level of confidence (7).

RESULTS

Plants inoculated with MDMV were all infected with the disease after two

Table 1. Yield response of 20 sweet corn cultivars to maize dwarf mosaic virus strain B infection

Cultivar	Treatment[a]	Plant height (cm)	Days to midsilk	Ear characteristics[b] Butt fill[c]	Length (mm)	Diameter (mm)	Weight of first ear (g)	Ear marketability[d]
Aztec	C	166	45.7	100	206	46.7	266	1.0
	V	166	46.0	60*[e]	193*	45.0*	226*	2.3*
Banner	C	177	58.0	100	210	49.3	308	1.0
	V	156*	59.0*	13*	183*	45.0*	198*	3.0*
Bellringer	C	172	55.0	100	195	48.3	266	1.0
	V	163*	56.0*	67*	195	45.7*	240*	1.3
Bonanza	C	183	55.7	100	233	45.3	284	1.3
	V	183	57.0*	53*	227	44.3	260	2.0*
Capitan	C	190	58.7	100	235	43.7	270	1.0
	V	190	59.7*	53*	232	43.7	264	1.0
Cherokee	C	200	55.0	100	213	43.3	246	1.0
	V	196	56.0*	93	218	43.0	244	1.0
Enterprise	C	192	57.0	100	222	48.7	296	1.0
	V	188	58.0*	53*	215	48.0	274	1.0
Florida Staysweet	C	170	57.3	100	200	48.0	274	1.0
	V	165	59.0*	53*	200	47.3	284	1.0
Gold Cup	C	185	53.7	100	183	46.0	238	1.0
	V	174*	54.7*	20*	185	45.0	214	2.7*
Golden Gleam	C	202	59.7	100	223	47.3	292	1.0
	V	197	60.3	100	218	47.0	288	1.0
H 12166	C	156	54.7	100	203	48.7	266	2.0
	V	156	56.0*	100	195	46.7*	240*	2.3
H 12266	C	173	53.0	100	217	49.3	314	1.3
	V	166	54.7*	60*	208*	47.0*	262*	2.0*
Lancer	C	185	55.3	100	215	45.7	258	1.7
	V	177*	57.0*	0*	212	42.0*	212*	3.0*
Resister	C	200	54.7	100	230	52.7	370	1.0
	V	200	54.7	80	230	49.7*	318*	1.3
Seneca Scout	C	197	55.0	100	193	44.7	218	1.3
	V	188*	56.7*	53*	188	41.7*	202	2.0*
Silver Queen	C	194	62.3	100	212	48.7	312	1.0
	V	185*	62.7	93	207	47.3	310	1.0
Sugar Loaf	C	187	55.3	100	205	47.7	280	1.0
	V	185	58.0*	87	202	46.0*	248*	1.3
Sundance	C	132	47.0	100	199	47.0	270	1.0
	V	130	47.3	80	194	47.0	254	1.3
Wintergreen	C	183	54.3	100	218	45.0	262	1.7
	V	172*	54.3	80	218	44.3	258	1.7
XP 370	C	177	55.0	100	223	48.0	298	1.0
	V	172	56.3*	80	223	44.7*	264*	1.7*
FLSD (0.05)		7	0.9	20	8	1.5	24	0.5
Overall mean	C	181	55.1	100	212	47.2	280	1.2
	V	175*	56.2*	64*	207*	45.5*	252*	1.7*
FLSD (0.05)		2	0.2	4	2	0.3	6	0.1

[a] C = control, V = inoculated and infected with MDMV.
[b] Data are means of five ears per plot. First ear is the top ear on a plant.
[c] Percentage of ears with no sterility at butt end.
[d] 1 = marketable, 2 = marginal, 3 = not marketable.
[e] * = Significantly different ($P = 0.05$) from corresponding control according to Fisher's least significant difference (FLSD) test.

inoculations. At midsilk, 32% of the plants in the uninoculated control were infected with MDMV. The disease reduced plant height significantly in seven cultivars (Table 1). Fourteen of the 20 cultivars required significantly more time to reach the midsilk stage when infected with the virus.

Infected plants had butt fill percentages of from 0 to 100, whereas healthy controls had 100% butt fill. Butt fill differed significantly between control and MDMV treatments in 11 cultivars. Plants infected with MDMV had significantly shorter ears in three cultivars and significantly narrower ears in 10 cultivars than healthy plants. First ears weighed significantly less from MDMV-infected plants than from healthy plants in nine cultivars. Quality of ears from healthy controls was significantly better (lower rating) than ears from infected plants in eight cultivars.

When overall means of the 20 cultivars were compared by treatment, infected and healthy control plants were significantly different for each dependent variable. Plants infected with MDMV took longer to reach midsilk and had reduced butt fill, ear length, ear diameter, first ear weight, marketable ears, and plant height.

DISCUSSION

The adverse effect of MDM on each variable showed that it was a serious disease of sweet corn. The results reported here represent one season and may vary quantitatively in different environments. When the overall means for all cultivars were calculated and compared by treatment, it became evident that infection with MDMV affected all of the dependent variables in a significantly adverse way. No sweet corn cultivar tested was resistant to the disease, because all showed typical mosaic symptoms 4–6 days after inoculation. Yield, based on ear characteristics, was not reduced significantly in the cultivars Cherokee, Golden Gleam, Silver Queen, Sundance, and Wintergreen; thus we consider them tolerant to MDMV-B. Arny et al (1) also classified Cherokee and Golden Gleam as tolerant to MDMV, based on ear kernel fill and symptoms.

Our data showed that butt fill was the most important characteristic of quality in selecting for tolerance to MDMV in sweet corn; ear diameter and weight were important characteristics for evaluating total yield. Using these characteristics, selecting for tolerance would be more reliable than screening by symptom severity.

For the most effective and economical control of MDMV, genetic resistance should be incorporated into sweet corn lines. Because ample sources of genetic resistance are available in dent corn (3,6), a pool of resistant genes already exists. Until genetic resistance is incorporated into sweet corn, it is likely that MDM will continue to be a major problem in that industry.

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