

# Yield Loss in Sweet Corn Correlated with Time of Inoculation with Maize Dwarf Mosaic Virus

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## ABSTRACT

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The effect on sweet corn yield of inoculation with maize dwarf mosaic virus strains A and B at the three-leaf stage, eight-leaf stage, or just before silking was tested at Urbana and Dixon Springs, IL. Early infection delayed maturity and reduced kernel fill at the basal portion of the ear, ear length, ear diameter, ear weight, number of second ears, and plant height. Little difference was found between plants inoculated last and the uninoculated control.

Reductions have been reported in the yield of dent corn (*Zea mays* L.) infected by maize dwarf mosaic (2,3,5,6,8). Experimentally, dent corn yields have been significantly reduced by early inoculations with maize dwarf mosaic virus (MDMV) when compared with late inoculations (5,6,8). In sweet corn, time of infection with MDMV could have an extremely important effect on yield because of the common practice of staggering plantings in the production of canning and fresh market sweet corn. MDMV typically becomes widespread in middle to late summer when aphid vectors are present in high numbers. At this time, later plantings are at a younger growth stage than earlier plantings, which are nearing maturity (7). If plants infected with MDMV at younger growth stages experience greater yield losses than those infected at later growth stages, later plantings can be expected to have greater losses.

In fresh market sweet corn, ear quality is important in addition to ear weight. Ear quality can be expressed as ear diameter, ear length, and kernel fill at the basal portion of the ear (butt fill). During a preliminary experiment with the sweet corn cultivar Gold Cup in 1978, early infection with MDMV damaged ear quality more than later infections did. In the study of sweet corn yield reported here, we tested the effect of infection with

MDMV strains A and B at the three-leaf stage, eight-leaf stage, or just before silking.

## MATERIALS AND METHODS

In 1980, we planted sweet corn cultivars at Urbana and Dixon Springs, IL, on 28 May and 27 May, respectively. The cultivars tested were Gold Cup, Golden Gleam, and BVX 819 at Urbana and Gold Cup and Golden Gleam at Dixon Springs. Gold Cup and Golden Gleam were chosen because of their susceptibility and tolerance, respectively, to MDMV (4). BVX 819 is a proprietary experimental hybrid in which one parent carries MDMV resistance obtained from field corn. Field spacing was 97 cm between and 33 cm within rows of 25 plants at Urbana and 76 cm between and 33 cm within rows of 25 plants at Dixon Springs.

The experimental design was a split plot with cultivars as main plots and treatments as subplots; main plots were replicated three times. Subplots consisted of four rows at Urbana and three rows at Dixon Springs, bordered on either side by one row of the same cultivar. The four treatments were inoculation at the three-leaf stage, at the eight-leaf stage, about 1 wk before silking, and no inoculation. Because MDMV-A and -B are both present in Illinois, the inoculum consisted of both strains. Equal amounts of freshly harvested tissue infected with MDMV-A and MDMV-B were added to 0.05 M chilled sodium phosphate buffer (1 g/5 ml), pH 7.0, and ground in a Waring Blender for 30 sec. The homogenate was expressed through a triple layer of cheesecloth and through a layer of Miracloth. Before inoculation, 22- $\mu$ m Carborundum at 15 g/L was added to the inoculum. Plants were inoculated using a Wren artist's airbrush (Binks Manufacturing Company, Franklin Park, IL) with air supplied from an air compressor

operating at 4.9 kg/cm<sup>2</sup>.

Heights of 20 plants per subplot at Urbana and 12 plants per subplot at Dixon Springs were measured immediately after anthesis as the distance from the ground to the lowest branch on the tassel. Twenty-eight plants per subplot at Urbana and 15 plants per subplot at Dixon Springs were assayed at fresh market maturity for each of the following dependent variables: days to the mid silk stage, butt fill, ear length, ear diameter, weight of first ears, and number of marketable second ears (first ear being the top and largest ear on the plant, second ear being smaller than and below the first ear). Days to mid silk was the time from planting until emerging silk was observed in half of the plants within the subplot. To determine butt fill, we counted the missing kernels on the basal one-third of the ear. We observed every plant weekly; those in inoculated treatments not showing symptoms and those in uninoculated treatments showing symptoms were tagged and not sampled.

The data were analyzed as a split plot with comparisons made within cultivars at each location with a Fisher's least significant difference test at the 5% level of confidence.

None of the plants at Urbana was irrigated; however, all plots at Dixon Springs were irrigated on 17 July when Gold Cup had begun pollen dehiscence but before dehiscence in Golden Gleam.

## RESULTS

From visual observations, inoculation resulted in 90-100% infection with MDMV for all inoculations and all cultivars except BVX 819 in the third inoculation, which was about 70% infected. Uninoculated plants of all cultivars were about 30% infected at Urbana and 40% at Dixon Springs.

Disease development was similar at both locations. Inoculation at the two earlier times adversely affected the dependent variables, but there was little or no difference between the last inoculation and the control (Table 1).

Maturity, expressed as days from planting to mid silk, was always delayed with MDMV infection and was delayed most with the earlier inoculations. Plant height was most reduced with the earliest inoculation and progressively less with

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**Table 1.** Yield and ear characteristics of sweet corn cultivars inoculated at various times with maize dwarf mosaic virus strains A and B

Cultivar	Treatment*	Days to midsilk	Plant height (cm)	Ear characteristics				Second ears (no.)
				Missing kernels (mean no.)	Length (mm)	Diameter (mm)	Weight (g)	
				<b>Urbana<sup>x</sup></b>				
Gold Cup	1	57.0 a <sup>y</sup>	83 a	19.5 a	164 b	44.2 ab	165 ab	0.7 a
	2	53.3 b	95 b	12.4 b	158 a	42.4 a	159 a	8.7 b
	3	53.0 b	121 c	4.4 c	170 c	44.7 b	172 bc	17.7 c
	4	53.0 b	124 c	2.2 c	171 c	45.9 b	179 c	15.7 c
Golden Gleam	1	64.3 a	105 a	33.7 a	184 a	42.9 a	228 a	0.0 a
	2	62.7 b	126 b	26.7 b	185 a	43.1 a	229 a	1.0 a
	3	62.0 b	144 c	21.6 bc	199 b	45.2 b	260 b	2.3 ab
	4	62.3 b	156 d	17.2 c	202 b	45.4 b	269 b	6.0 b
BVX 819	1	58.7 a	114 a	18.8 a	204 a	45.3 a	254 a	0.0 a
	2	58.0 ab	122 ab	12.2 b	215 b	46.6 ab	278 b	0.0 a
	3	57.0 c	126 b	4.7 c	227 c	48.4 b	305 c	0.3 a
	4	57.3 bc	130 b	4.7 c	230 c	48.3 b	300 c	0.3 a
FLSD (0.05)		0.9	11	5.3	5	1.8	12	4.0
				<b>Dixon Springs<sup>z</sup></b>				
Gold Cup	1	53.3 ab	99 a	40.8 a	151 a	42.0 a	149 a	1.0 a
	2	55.3 b	96 a	29.3 a	161 b	42.6 ab	159 a	2.0 ab
	3	52.0 a	138 b	35.8 a	161 b	43.5 b	163 a	4.0 bc
	4	52.0 a	137 b	40.2 a	155 ab	43.6 b	154 a	5.3 c
Golden Gleam	1	60.0 a	104 a	59.6 a	180 a	41.9 a	172 a	0.0 a
	2	58.7 ab	105 a	32.8 bc	180 a	42.4 a	188 bc	1.3 a
	3	57.7 ab	131 b	37.9 b	185 ab	42.8 a	178 ab	2.3 a
	4	57.3 b	141 c	21.9 c	191 b	44.9 b	202 c	1.3 a
FLSD (0.05)		2.6	9	15.3	7	1.0	14	2.3

\*1 = inoculated at three-leaf stage; 2, at eight-leaf stage; 3, just before silking; and 4, uninoculated control.

<sup>x</sup>Data are means of 60 plants (20 per subplot) for plant height and 84 ears (28 per subplot) for other characteristics. Experiment was a split plot with cultivars as main plots and treatments as subplots, with three replications of each plot.

<sup>y</sup>Values in columns within cultivars having no common letter are significantly different ( $P=0.05$ ) according to Fisher's least significant difference test.

<sup>z</sup>Data are means of 36 plants (12 per subplot) for plant height and 45 ears (15 per subplot) for other characteristics. Experiment was a split plot with cultivars as main plots and treatments as subplots, with three replications of each plot.

later inoculations; the last inoculation and the control were generally not different. Butt fill was always the most reduced (ie, the most missing kernels) with the earliest inoculation. In all cases, butt fill in the third inoculation and the control were not significantly different. Ear length followed the same trend as butt fill. Ear diameter and length were reduced more in the first inoculation than in the second except for Gold Cup at Urbana, which was the reverse. Ear diameter and length did not differ significantly between the last inoculation and the control except for Golden Gleam at Dixon Springs. Production of second ears in Gold Cup, the only cultivar that was a good producer of second ears, followed the general pattern seen for other variables.

## DISCUSSION

Dixon Springs is 300 km south of Urbana and has a warmer climate. At Dixon Springs, the mean temperature in June, July, and August was 26.6 C, or 1.1 C more than any recorded mean during the same period at Urbana (1). We were thus able to test cultivar response to different times of MDMV inoculation in two environments.

At Dixon Springs, irrigation was necessary to prevent total crop loss from

high temperatures and light rainfall (21.6 vs. 26.2 cm at Urbana) (1). Unfortunately, the irrigation was applied while Gold Cup, an earlier maturing cultivar, was pollinating but before Golden Gleam, a later cultivar, had begun pollen dehiscence. There was little difference between infected and uninfected Gold Cup plants, apparently because of moisture stress. Plant height and number of second ears were determined before pollination, and some differences were noted; however, ear fill, diameter, weight, and length were generally reduced in both virus-infected and uninfected plants.

Our data followed the same trend we observed in the preliminary test with Gold Cup in 1978. In 1980, all cultivars at both locations showed consistent yield reductions from the first two inoculations and little or no yield reductions from the last inoculation. Increased yield loss from early inoculations with MDMV has been found in dent corn (5,6,8). Plant height was reduced much more in sweet corn inoculated early than reported in field corn. The height of BVX 819 plants was affected less than that of the other hybrids, although BVX 819 did not appear to have any greater resistance to MDMV than the other hybrids in other characteristics measured.

In general, the earlier the MDMV

infection the more severe the losses, as measured by several dependent variables. Later planting dates would result in MDMV infection at younger growth stages, hence greater yield loss. The risk of yield loss with later planting dates should be considered in areas where maize dwarf mosaic has been observed in previous growing seasons.

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