

SUGARCANE MOSAIC VIRUS

TOLERANCE IN SWEET CORN

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SUGARCANE MOSAIC VIRUS (SCMV) was first identified in California sweet corn plantings nearly ten years ago, and since that time growers have sustained some severe losses due to the disease. Plants infected with the virus show a mosaic pattern in the leaves consisting of broken linear stripes between the veins. Affected plants also show some degree of stunting often so severe that the crop may be abandoned. Some varieties develop leaf scorching or ear blanking. Plants infected early in their development are more severely affected than later infections. Some growers have been able to reduce their losses by controlling Johnson-grass (the major perennial host plant of the virus) in ditches or along fence lines around their property, but this has not always been effective since aphids can carry the virus from adjacent or even distant properties.

At the time of the discovery of the disease in California, all of the varieties in commercial use were found to be susceptible, and no resistant varieties were known. Beginning in 1966, seed companies supplied a large number of experimental hybrids which were tested in field plots. Sufficient SCMV infection occurred in two of the early plantings to reveal that some of the hybrids remained symptomless while others were severely diseased. Those which failed to develop symptoms were judged to be tolerant to the virus, and two tolerant hybrids were subsequently released by a seed company for grower use under the names "Bonanza" and "Valley Market". Both are being used by growers in some areas where the disease exists.

Although field resistance is a useful means of selecting varieties for commercial use, it cannot be used to determine the actual effects of the disease on

individual hybrids, since all plants are assumed to be infected to some degree. In order to measure the effects of the virus on the plants, an experiment was established in 1971 at West Side Field Station (Five Points) in which virus-infected and noninfected plants of each variety were compared.

On April 23, 18 hybrids were seeded in paired rows 40 ft long and were replicated three times. On June 1, when the plants were 14 to 18 inches tall, one row of each variety was inoculated using a mixture of several western SCMV isolates extracted in a phosphate buffer. Three or four leaves of each plant were stripped twice between cheese-cloth-wrapped thumb and forefinger which was wet with the freshly prepared inoculum, to which an abrasive had been added. The adja-

cent row of the same hybrid was left uninoculated to act as a control.

Within two weeks, characteristic symptoms of SCMV infection occurred on the inoculated plants in the form of small interveinal chlorotic spots later forming a typical mosaic pattern. The virus infection caused a reduction in growth rate in all of the hybrids, and in addition some hybrids exhibited necrosis of leaf margins and some interveinal bleaching. No symptoms occurred in the control plants. Plant height measurements, made at the time of early tasseling (June 18) and a few days before harvest (July 13), are shown in table 1.

At market maturity for each hybrid, all mature ears were harvested from each plot and were rated or measured for several plant and ear characters. The most

The corn hybrid Merit was severely affected by kernel blanking and reduction of ear length (photo below) as a result of sugarcane mosaic virus infection. Photo right shows leaf symptoms of the infection including broken linear stripes between veins.

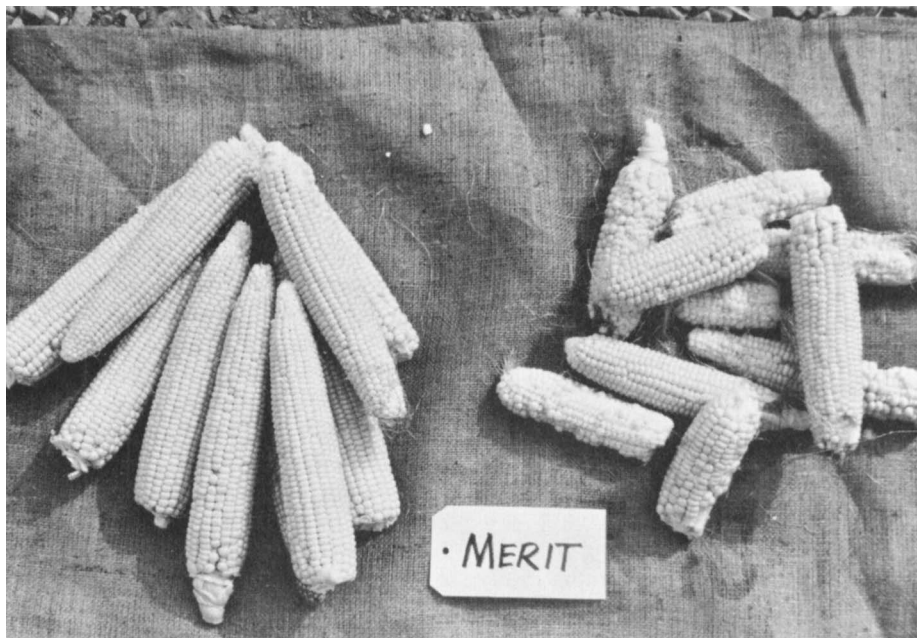


TABLE 1. AVERAGE PLANT HEIGHT* OF SCMV-INOCULATED AND HEALTHY SWEET CORN HYBRIDS - 1971

Hybrid	June 18†		July 13‡	
	Healthy	SCMV	Healthy	SCMV
	inches			
NCX 2000	45.3	41.3	66.0	58.0
70-2109	40.5	38.0	68.0	57.5
Sunshine State	41.3	36.3	71.7	60.7
Goldie	46.0	39.5	70.0	55.5
XP 299	39.7	35.3	65.0	54.3
NK 75	46.0	39.7	79.7	60.3
Jubilee	43.7	39.3	73.3	64.0
Bonanza	36.3	30.3	73.3	57.0
Sweet Tennessee	41.3	35.3	76.7	59.3
NK 51036	45.0	37.7	77.3	62.0
58-1804C	40.7	32.7	69.7	59.3
Exp. 667	42.0	37.0	81.6	70.0
NCX 238	42.3	37.0	73.7	65.7
Merit	47.3	40.3	86.3	72.7
Exp. 668	45.7	37.7	74.7	66.3
Continental	44.7	39.3	83.7	73.3
Stylepak	40.7	34.7	64.0	51.3
FM Cross	46.0	43.0	79.3	69.0

* From bed top to center of tassel.

† June 18: Tassels emerging on most varieties.

‡ July 13: Earliest varieties mature.

These experimental results show not only that sugarcane mosaic virus (SCMV) tolerance exists in sweet corn, but also that it is variably expressed in plant and ear characteristics. Virus infection can apparently be expressed independently or collectively in the form of leaf symptoms, in an inability to produce ears of marketable size, and in defects in kernel development on the ears. Some of the hybrids tested showed collectively less defects than others, and should be considered for trial in areas where SCMV infection is prevalent. These are: NCX 200 (Niagara), 70-2109 (Rogers Bros.), Sunshine State (Keystone), and Goldie (Northrup-King). On the basis of very high table quality, past performance, and fairly good tolerance in this experiment, the hybrids Bonanza and Jubilee should also be included in grower trials.

paring over-all disease effects, the individual character rankings were totaled. Significant effects of SCMV infection are shown in table 2. Average measurements are shown for the healthy and diseased plants. To simplify comparison, the hybrids were ranked for disease effects on each character, and as a means of com-

While these rank totals provide a simple evaluation summary, careful consideration should be given to the individual character ranks because of their relative importance. While the rank total for Sunshine State places it near the top in disease tolerance, it ranked poorly in yield, suffering a 49% reduction in mature ears per plot. Similarly, Goldie had a yield reduction of 34% in the inoculated plots, although it had the highest control plot yield, while in overall ranking it was one of the most tolerant.

The most striking response to virus infection was the reduction in ear length and weight, and in the severe kernel blanking (see photographs). Merit, an

important variety in some areas, and two experimental hybrids, 668 and NCX 238, were particularly susceptible to these defects. Goldie, 58-1804C, and Jubilee were essentially free of kernel blanking and showed only slight reductions in ear weight and length. Stylepak, FM Cross, XP 299, and Merit had severe reductions in ear length and many short, sparse ears were produced. The effect on ear length and blanking is of major importance to the grower.

The results of this experiment provide evidence of a wide range of sugarcane mosaic virus susceptibility among this group of sweet corn hybrids. The intensity of effects for individual characters

Close-up photo of corn ears below shows typical kernel blanking resulting from sugarcane mosaic virus infection.

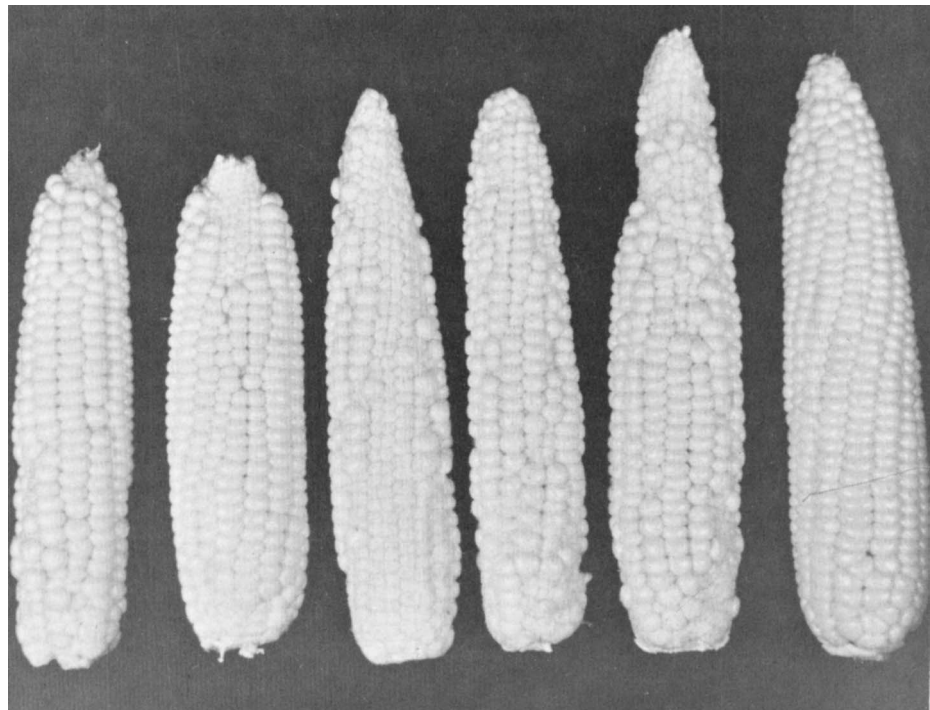


TABLE 2. EFFECTS OF SUGARCANE MOSAIC VIRUS INFECTION ON SWEET CORN HYBRIDS - 1971

HYBRIDS	Days to Maturity	Mature ears per plot			Unhusked ear diam.			Husked ear length			Husked ear weight			Mature plant height			SCMV Rank	Rank Totals	
		H*	D*	Rank†	H	D	Rank	H	D	Rank	H	D	Rank	H	D	Rank			
		no.			inches			inches			g			inches					
NCX 2000	82	48.3	45.0	(2)	2.07	2.03	(2)	8.5	8.0	(5)	242	224	(5)	79	69	(5)	7.3	(2)	(21)
70-2109	82	47.0	36.0	(8)	2.00	2.00	(1)	8.5	8.5	(1)	231	233	(1)	82	70	(7)	5.0	(7)	(25)
Sunshine State	82	42.0	21.3	(14)	2.10	2.03	(3)	8.7	8.3	(1)	204	203	(2)	74	66	(2)	6.0	(5)	(27)
Goldie	81	57.3	37.7	(10)	1.97	1.97	(1)	8.5	8.2	(3)	241	227	(2)	72	61	(8)	6.7	(4)	(28)
XP 299	88	40.0	38.0	(1)	2.00	1.97	(4)	9.3	7.3§	(12)	197	163	(10)	84	73	(4)	7.0	(3)	(34)
NK 75	77	38.7	31.3	(4)	1.90	1.73	(8)	7.8	7.0	(8)	206	162	(11)	66	58	(3)	7.0	(3)	(37)
Jubilee	81	53.7	35.0	(11)	2.07	1.93	(6)	8.2	8.3	(4)	232	216	(3)	70	59	(6)	4.7	(8)	(38)
Bonanza	83	38.3	31.0	(5)	2.10	1.90	(11)	9.3	8.3	(9)	221	184	(9)	73	64	(6)	7.7	(1)	(41)
Sweet Tennessee	83	24.7	19.7	(6)	2.20	1.93	(13)	8.5	8.0	(5)	199	185	(4)	86	73	(10)	6.7	(4)	(42)
NK 51036	78	31.3	15.3	(15)	2.00	1.67	(15)	8.0	7.8	(2)	200	172	(8)	68	57	(9)	7.0	(3)	(52)
58-1804 C	80	57.3	23.7	(17)	1.97	1.87	(4)	7.8	7.3	(6)	208	190	(6)	77	62	(12)	5.0	(7)	(52)
Exp. 667	82	40.3	30.3	(9)	2.30	2.03	(12)	9.3	8.7	(7)	255	224	(7)	70	56	(13)	5.3	(6)	(54)
NCX 238	80	29.3	26.3	(3)	2.10	1.97	(5)	9.2	7.5	(10)	232	181	(12)	64	51	(14)	2.7	(11)	(55)
Merit	82	49.0	26.0	(13)	2.20	2.00	(9)	9.3	6.2§	(15)	263	172	(15)	75	66	(1)	6.7	(4)	(57)
Exp. 668	82	23.0	18.0	(7)	2.03	1.87	(7)	8.7	7.0	(11)	190	139	(13)	65	54	(11)	3.3	(9)	(58)
Continental	79	27.3	15.7	(12)	2.17	1.97	(10)	8.7	6.5	(13)	237	161	(14)	80	60	(17)	3.0	(10)	(76)
Stylepak	86	32.3	14.3	(16)	2.07	1.80	(14)	9.0	6.2§	(14)	260	154	(16)	73	57	(15)	3.0	(10)	(85)
FM Cross	82	39.3	12.3	(18)	2.23	1.77	(16)	8.5	4.7§	(16)	238	123	(17)	77	59	(16)	3.0	(10)	(93)

* H = Healthy; D = Diseased

† Ranked for per cent reduction in size in diseased plants; 1 = lowest per cent reduction

‡ Leaf symptoms rated July 13 on a 1-9 scale; 9 = no symptoms; 1 = severe

§ Nubbin ears prevalent on diseased plants

varies also among the hybrids, so that there was not a consistent tendency for high or low ranking for all characters. Thus, relatively high ear defects were coupled with the least reduction in number of ears produced (XP 299), and low ear production was coupled with ears which had few defects (Sunshine State). Stylepak and FM Cross, however, were consistent in defectiveness for all char-

acters, while NCX 2000 and 70-2109 were the most consistent in being relatively free of defects.

Leaf symptoms were not always well correlated with ear quality and the number of ears produced. Note that NK 75, Bonanza, and XP 299 had good ratings for leaf symptoms, yet all were at least moderately affected in ear quality. On the other hand, 70-2109 expressed obvious

leaf symptoms, but produced ears that were free of defects.

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WATER USE BY CROPS AS AFFECTED BY CLIMATE AND PLANT FACTORS

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THE WEATHER LARGELY DETERMINES the use of water, or evapotranspiration (ET), by most crops during times when the plants are healthy and fully shade the ground. Even under full-cover conditions, however, the evapotranspiration of various crops can vary significantly with differences in stomatal or surface resistance, reflectance, and aerodynamic roughness. However, during early stages of crop growth, transpiration is very limited, and the controlling factor in water use is basically the moisture status of the soil surface. How frequently the

surface receives water from rain or irrigation—along with the weather conditions—largely determines evapotranspiration rates.

Early studies of water use by crops as well as studies in the past decade by the University and by the State Department of Water Resources have been particularly valuable in sorting out some of these factors. In the first place, the year-around seasonal pattern of loss by a standardized surface (short grass or pasture) has been determined for a number of locations in the state ranging from coastal

to Central Valley to mountain valley locations. Secondly, in many of these locations, water use has been determined for a number of other crops at various stages of growth and maturity.

This report examines the variation of water use by grass at Davis, month-by-month over a 12½-year period, to indicate seasonal patterns and the variability between months. Then it presents the variation of seasonal patterns of water use by grass for four locations in California. Finally, specific results of Davis studies illustrate general relationships