Availability

Small amounts of seed are available free of charge to public and private researchers and may be obtained from D.W.D.

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Sugary (su) and *sugary enhancer (se)* Sweet Corn Inbreds with Resistance to Maize Dwarf Mosaic Virus

John A. Juvik[1] and Cleora J. D'Arcy[2]

Agricultural Experiment Station, University of Illinois, Urbana, IL 61801

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Maize dwarf mosaic virus (MDMV), an economically serious viral disease of sweet corn (*Zea mays* L.) in the United States and other countries of the world, is transmitted primarily by aphid vectors. Early infection by the virus in sweet corn can cause stunted growth, delayed maturity, reduced yield, and poor ear quality (11). To provide public and private breeders with germplasm to help alleviate this problem, the Illinois Agricultural Experiment Station announces the release of nine *sugary (su)* sweet corn inbreds with improved resistance to maize dwarf mosaic virus. These newly developed inbreds have been designated IL793a, IL794a, IL795a, IL796a, IL796b, IL797a, IL798a, IL799b, and IL800a.

On the basis of elevated sucrose and maltose content in mature dry kernels, four of these inbreds appear to be homozygous for the *sugary enhancer (se)* gene. The *se* gene is a recessive modifier of *su* (3), and results in increased kernel sugar content, sweetness, and tenderness (4). The *se* gene was derived originally from the three-way cross [IL14a (*su*) x Bolivia 1035] x IL442a. This three-way cross produced the first *su se* inbred, IL677a (5), which has been used as a source of the *se* allele in the Illinois sweet corn breeding program (8, 12). Kernels with the *su se* genotype contain sugar contents (primarily sucrose) 60% to 100% greater than do genotypes homozygous for only *su*. These levels are comparable to those of sweet corn homozygous for the shrunken-2 (sh_2) endosperm mutation, but without a concomitant reduction in phytoglycogen (water-soluble polysaccharides) content (6). The high level of phytoglycogen in *su* and *su se* cultivars contributes to their tender, creamy texture.

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[1]Assistant Professor, Dept. of Horticulture.
[2]Associate Professor, Dept. of Plant Pathology.

Origin

Pa405, an inbred dent corn, was found to be highly resistant to MDMV (9). Genetic analysis of segregating populations created from crosses between Pa405 and several MDMV-susceptible sweet corn inbreds indicated that resistance to the virus was controlled through the action of three genes (9). A breeding program was initiated to introgress the MDMV resistance alleles from Pa405 into elite sweet corn germplasm. All nine inbreds have been selfed eight or nine generations, assuring near-homozygous lines. IL793a resulted from S_9 seed of the cross Pa405 and 59170F_1, where 59710 was derived from the four-way cross of (IL676a x IL677a)S_3 x (IL671a x IL677a)S_4. IL794a resulted from S_8 seed created from the four-way cross of (B5283 x IL677a) x (Pa405 x 'Gold Cup'), where B5282 was an S_4 selection developed from the triple cross (IL14h x IL11a) x Lenha, a "soft" flint accession from Rio Grande de Sul, Brazil. Eight generations of selfing of selections from the four-

Table 1. Disease incidence, emergence, maturity, kernel characteristics, and mature-dry kernel sugar content of the MDMV-resistant inbred releases

Inbred	Generations of selfing	Percent disease incidence[z]	Percent emergence	Days to mid-silk[y]	Kernel rows	Yellow kernel color	Kernel sugar content (% dry wt.)[x]				
							Fructose	Glucose	Sucrose	Maltose	Total
IL793a	9	0	88	62	16–18	Medium	0.08	1.01	2.74	ND	3.83
IL794a	8	0	92	59	14–16	Light	0.04	0.14	3.93	0.02	4.13
IL795a	8	0	84	57	12–14	Light	0.18	0.65	3.41	0.01	4.25
IL796a	8	0	64	62	14–16	Medium	0.21	0.27	5.44	0.69	6.61
IL796b	8	0	80	62	16	Light	0.11	0.47	4.96	0.44	5.98
IL797a	8	0	100	60	16–20	Dark	0.09	0.65	3.48	0.03	4.25
IL798a	8	0	80	63	12	Light	0.03	1.24	5.16	0.23	6.93
IL799b	8	0	72	64	14–16	Light	0.38	1.36	5.54	0.29	7.57
IL800a	8	0	72	59	14–16	Light	0.10	1.36	3.48	0.01	4.95
IL677a[w]	16	100	68	66	14–16	Light	0.23	0.49	4.97	0.42	6.11
Sugary reference[v]	---	---	---	---	---	---	0.12	0.31	3.18	0.03	3.64

[z]Percent disease incidence = number of plants displaying MDMV symptons in the 1986 nursery/total number of plants repeatedly inoculated.
[y]Days to mid-silk = days from seed planting (22 May 1986) to 50% silking.
[x]Values are averages of gas chromatographic analyses of two separate extractions of 50 mature-dry kernel samples of bulked seed from five to nine ears.
[w]This original *su se* inbred was used as a "high sugar" reference sample.
[v]Data from one standard *su* inbred (IL451b) and two commercial *su* hybrids (Commanche and Seneca Sebtry) were averaged for use as a reference sample.

way cross (57962F_1 x IL677a) x ('Gold Cup' x Pa405), where 57962 is the F_1 of IL101-T55 x IL677a, led to the development of the inbred IL795a. Both IL796a and IL796b resulted from S_8 seed from a three-way cross between (IL702a x IL677a) x B6011, where B6011 was an S_3 plant from the same parentage that created IL793a. IL797a is an S_8 selection from the cross of B5707 and B6011, where B5707 was an S_4 selection from the backcross (IL304a x IL677a) x IL677a. Eight generations of selfing with selection from the three-way cross ('Gold Cup' x Pa405)F_1 x IL677a, led to the development of IL798a. IL799b was derived from the cross ('Gold Cup' x Pa405) F_1 x 59829F_1, where 59829 is [('Hawaiian sugary' x IL110g) x IL677a]S_5 x [(IL101-T34 x IL677a)S_5 x (IL677a x IL459a)]S_5. IL800a resulted from S_8 seed of the four-way cross ('Gold Cup' x Pa405)F_1 x {('Gold Cup' x 'Six Shooter White Dent')S_4 x [(IL677a x IL459a)S_5 x IL677a]S_4}F_1. Additional information on the parentage of the older Illinois inbreds used to derive these releases can be provided upon request. IL798a, IL799b, and IL800a were developed from the previously released germplasm—ILM6161a, ILM6222a, and ILM6223a, respectively (10).

Description

All nine inbreds had fair to excellent husk protection, were tender and sweet tasting in the field, and, for inbreds, had relatively large, uniform, and well-filled ears. Of more than 180 inbred lines evaluated in 1986, these nine had superior resistance to MDMV, the highest percent emergence, good lodging resistance, and the best yield of good-quality seed.

Plants of each segregating generation from the original cross to the S_7 or S_8 inbreds were field-inoculated four or five times during the growing season, from the three-leaf stage until silking, with MDMV strains A and B at the Urbana, Ill. breeding nursery. The sweet corn nursery is planted each spring on Drummer silty clay loam soil (fine silty mixed, mesic type haploquolls). Because both MDMV-A and -B are present in Illinois, the inoculum consisted of a mixture of both strains. The original MDMV-A inoculum was from several naturally occurring isolates taken from Illinois Johnsongrass [*Sorghum halepense* (L.) Pers.], whereas strain B came from the ATCC (American Type Culture Collection). Strains A and B were increased separately on susceptible sweet corn in the greenhouse prior to field-inoculation. The purity of the strains was tested by ELISA (2).

Equal amounts of freshly harvested leaf tissue infected with MDMV-A and MDMV-B were added to 0.05 M chilled sodium phosphate buffer (0.2 g·liter^{-1}), pH 7.0, and ground in a Waring blender for 30 sec. The homogenate was expressed through a triple layer of cheesecloth and a single layer of Miracloth. Before inoculation, 22 μm Carborundum at 15 g·liter^{-1} was added to the inoculum. Plants were inoculated using a Wren artist's airbrush (Bink's Manufacturing Co., Franklin Park, Ill.) with air supplied from a compressor operating at 480 kPa.

Selection for resistance was based on the absence of leaf mosaic and ear butt blanking, symptoms of MDMV infection. Plants displaying the leaf mosaic were rogued from the plots during the growing seasons. Lack of leaf mosaic was shown to be an accurate criterion for the selection of resistant genotypes, since ELISA for the presence of MDMV in corn leaf tissue revealed that symptomless plants were virus-free (9). Selfed seed from individual plants without symptoms and with favorable horticultural characteristics were grown ear-to-row the following generation.

Comparative 1986 data for the inbred releases of disease incidence, percent emergence, days from planting to average silking date, kernel row number, color, and sugar content are shown in Table 1. The S_7 and S_8 plants from which the released seed originated were all 100% free of MDMV symptoms in 1986. With this number of generations of selfing with selection for resistance, these inbreds should be nearly homozygous for the alleles conferring resistance to the virus. There is a possibility that the disease-resistant alleles are not completely fixed in the inbreds IL796a and IL798a since, in the 1985 nursery, symptoms were observed on several plants of these genotypes.

Fructose, glucose, sucrose, and maltose content of mature-dry kernels from bulked samples of the inbreds in (Table 1) were determined by gas chromatographic analysis. Fifty kernels of each bulked inbred were ground into powder with a Wiley mill. Two 200-mg samples of each inbred then were extracted and analyzed using the procedures described by Juvik and La Bonte (7). For comparison, mature-dry kernels of the *su se* inbred, IL677a, and three standard *su* genotypes (the inbred IL451b and the commercial F_1 hybrids 'Commanche' and 'Seneca Sentry') also were analyzed. Mature-dry kernel sugar content of *su, se,* and *sh*$_2$ inbred genotypes has been significantly correlated with the higher sugar (primarily sucrose) concentrations found in kernels of the same genotypes at commercial harvest maturity (J.A.J., unpublished data). Kernels from all nine inbred releases were found to contain greater sugar content than the average of the three standard *su* genotypes (Table 1). Genotypes homozygous for *su se* generally display enhanced kernel sucrose and maltose concentrations (1). The elevated sucrose, maltose, and total sugar content of the inbreds IL796a, IL796b, IL798a, and IL799a suggests that these lines are homozygous for *se*. The sugar content of these inbreds is comparable to that of IL677a.

These releases can be used directly for the development of *su* and *su se* F_1 hybrids or as sources of germplasm for the backcrossing of MDMV resistance and *se* into elite inbreds. These inbreds have not been tested for combining ability, so their potential for parents in commercial hybrid production is unknown.

Availability

A limited quantity of seed of the released inbreds (25 kernels per release) is available for distribution upon written request to J.A. Juvik, Dept. of Horticulture, Univ. of Illinois, 1103 West Dorner Drive, Urbana, IL 61801.

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