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AS11 Sweet Corn Population

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A *sugary-1* breeding population of maize (*Zea mays* L.), AS11, has hypersensitive resistance (Rp_1^d gene) to common leaf rust (CLR) (*Puccinia sorghi* Schw.) and is resistant to maize dwarf mosaic virus (MDMV) strains A and B. It is released for its potential value in sweet corn improvement.

Origin

AS11 derives CLR resistance from Ill. 125b-739-77, obtained from A.M. Rhodes, Univ. of Illinois, and resistance to strains A and B of MDMV from PA405. In 1978, the Illinois line was hybridized with an F_5 *sugary-1* derivative of I453 x B52 selected for second brood European corn borer (*Ostrinia nubilalis* Hübner) resistance. PA405 was hybridized with the same I453 x B52 derivative and, in 1979, the two hybrids were intercrossed.

In 1980, individual plants resistant to both pathogens were self-pollinated and evaluated the following year as progeny rows. Subsequently, from 1981 through 1984, from 5% to 10% of the plants were selected for both resistances and for horticultural traits following either self- or half-sib-pollination across the progeny series. In addition to disease resistance, there also was selection for early flowering, lodging resistance, European corn borer resistance, kernel and cob color, and various other ear traits. In 1985, 190 early flowering, MDMV and CLR resistant plants were selfed. These lines were progeny-tested in 1986 in a replicated trial to determine homozygosity for resistance, and plants in 20 of the most vigorous and earliest flowering lines of the 41 progenies found to be homozygous resistant for both diseases were bulk sib-pollinated (across the 20 lines) to constitute AS11. Population size was ≈4000 plants each year.

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In selection for MDMV resistance, strains A and B were isolated from Minnesota, Iowa, and Texas sources. A and B strains were purified and strain-specific rabbit antisera produced (6). Serological testing of isolates used in resistance screening was done yearly to ensure that strains were not mixed during maintenance. From 1978 to 1986, six isolates of MDMV-A were used in resistance screening (one from Texas, one from Iowa, and four from Minnesota), as were four isolates of MDMV-B (one from Iowa and three from Minnesota). Isolates were selected for maximum symptom expression in sweet corn and were changed periodically, ensuring that virulence was maintained.

MDMV isolates and strains were maintained separately in sudangrass hybrids (1), and plants of 'Jubilee' sweet corn were used as inoculum-increase hosts. Inoculum of strains A and B was prepared separately in 0.05 M phosphate buffer, pH 7.0, for field inoculation purposes and tested separately each year for infectivity by inoculation of susceptible field-grown sweet corn. For resistance screening, chilled (6°C) A and B strain inoculum was mixed 1:1 (v/v) at the field site, and the strain mixture applied to plants in the fifth leaf stage by manual, mechanical inoculation using 500-mesh carborundum as an abrasive. About 10 days after inoculation, elimination of segregating-susceptible plants, as determined by visual symptoms, began and continued throughout the growing season. Thus, plants expressing both early and late-breaking symptoms were eliminated systematically from the population. From our evaluations in 1986 and 1987, we conclude that AS11 is homozygous for resistance to the MDMV strains that we have used. AS11 was also sent to the Dept. of Plant Pathology, Texas A&M Univ., for evaluation by R. Toler, where it was screened by mechanical inoculation of A and B strains and by natural aphid-borne inoculum. AS11 was judged homozygous resistant in the Texas screenings (R. Toler, personal communication) and also in Minnesota tests.

To facilitate selection for corn leaf rust resistance, the field nursery was established yearly as described by Randle et al (5). Spreader rows of susceptible maize material were inoculated artificially and the disease spread naturally into test material. A mixture of rust-susceptible hybrids was used in spreader rows to discourage the possibility of strain selection in the buildup of the rust fungus. This nursery also was used for the MDMV screening. Uredospores of the rust fungus taken from fields the previous year and maintained in storage at −80°C provided the inoculum source. Susceptible plants in the test population were eliminated throughout the season. As with selection for resistance to MDMV, the susceptible segregants could be eliminated prior to flowering.

European corn borer screening of the population occurred in three of the years during the development of AS11. Freshly hatched larvae (two egg mass equivalent, i.e., ≈40 larvae), obtained from the Dept. of Entomology, Univ. of Minnesota, were placed on the ear tips at silking to simulate second-brood infestation. Damage was evaluated on a 0 to 9 basis, with 0 defined as no damage and 9 as 10% or more of the ear consumed by larvae.

Description

AS11 has a high degree of resistance to mainland U.S. populations of leaf rust and to several isolates of maize dwarf mosaic virus strains A and B.

AS11 is late-maturing, with silking date averaging 1 week later than that of 'Jubilee' in the Minnesota environment (lat. 45°N). Kernel color is yellow and cob color white. The population has not been improved for culinary traits. Resistance to ear and kernel damage from European corn borer is present at only a low to moderate level, ≈5 to 6 on the 0 to 9 scale, which is similar to 'Jubilee', a hybrid that, although considered to be susceptible, consistently has ranked in the more resistant half of the many hybrids evaluated for corn borer resistance in our program.

The rust resistance of AS11 is conditioned by the dominant allele Rp_1^d, one of a series at the Rp_1 locus (3). Resistance to strains A and B of maize dwarf mosaic virus also is conditioned primarily by three qualitative or major genes in PA405 (4). Both diseases have at times caused significant loss to the sweet corn industry (2, 6).

Potential Use

The use of AS11 as a source of inbreds for direct commercial use will require at least one hybridization with germplasm already well-adapted to the rigid quality and agronomic standards of the sweet corn industry. Thereafter, selection and recombination, or backcrossing, would be logical procedures. In genetic studies, AS11, because it has dual resistance, provides opportunity for investigation of the effects of the two diseases, singly and in combination on the host, as well as the impact of one disease on symptom expression by the second.

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

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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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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.