No new hybrids have yet been introduced, but some of the hybrids tested have many good qualities.

Characteristics evaluated include plant vigor, ear length, husk cover, kernel sweetness and tenderness, and tolerance to ozone air pollution.

High-sugar sweet corn hybrids in southern California

James W. Cameron

Sweet corn hybrids grown in the United States usually carry the recessive gene, sugary-1 (su_1), which is responsible for the accumulation of sugars and water-soluble polysaccharides, but only a little starch in the kernels at fresh-market stage. Field corn, in contrast, which is grown for feed and industrial uses, carries the dominant form of this gene, and its kernels contain principally starch from fresh-market stage onward.

A number of other recessive genes that affect the carbohydrate balance in corn kernels have long been known. They include waxy, sugary-2, brittle-1 and brittle-2, dull, and amylose extender. Their effects have been extensively studied by corn geneticists, but they have been little used in commercial hybrids, even though most of them increase sugars and reduce starch, to some degree, by the eating stage.

An additional recessive gene, which has shown much promise, is shrunken-2. Its effects on kernel carbohydrates were described in 1953 by J. R. Laughnan, of the University of Illinois. Shrunken-2 allows the accumulation of high levels of sucrose, which is more slowly converted into starch than in sugary-1 types, and it thus results in sweeter kernels that remain sweet longer. Shrunken-2 kernels contain very little of the water-soluble polysaccharide fraction, and they sometimes taste more "watery" than do sugary-1 varieties.

The first commercial shrunken-2 hybrid—Illini Xtra-Sweet—was released some years ago by Illinois Foundation Seeds, Inc., and has since been grown to a limited extent in some areas of the United States. Later, the foundation introduced an earlier-maturing hybrid, called Illini Early Xtra-Sweet. Florida plant breeders recently released another shrunken-2 hybrid—Florida-Sweet—which is well adapted to that area. Its parental inbreds are related to sugary-1 lines developed earlier in Iowa. In the Florida studies, Florida-Sweet at optimum maturity contained about three times the amount of sugars and half the starch present in common sweet corn. After 10 days storage at 44° F, these relative proportions were still maintained.

Studies have been under way at the University of California, Riverside, for several years to develop shrunken-2 inbreds and hybrids that might be useful in California. Florida-Sweet, Illini Xtra-Sweet, and many experimental hybrids have been grown for comparison of characteristics including plant vigor, ear length, husk cover, sweetness and tenderness of kernels, and tolerance to ozone air pollution. No new hybrids have yet been introduced, but considerable information has been obtained.

The table shows some of the important characters of hybrids planted at Riverside on about May 7, 1975 and 1976. Florida-Sweet is more vigorous and more uniform than Illini Xtra-Sweet. Its sweetness and seed-coat tenderness are similar to those of Xtra-Sweet under

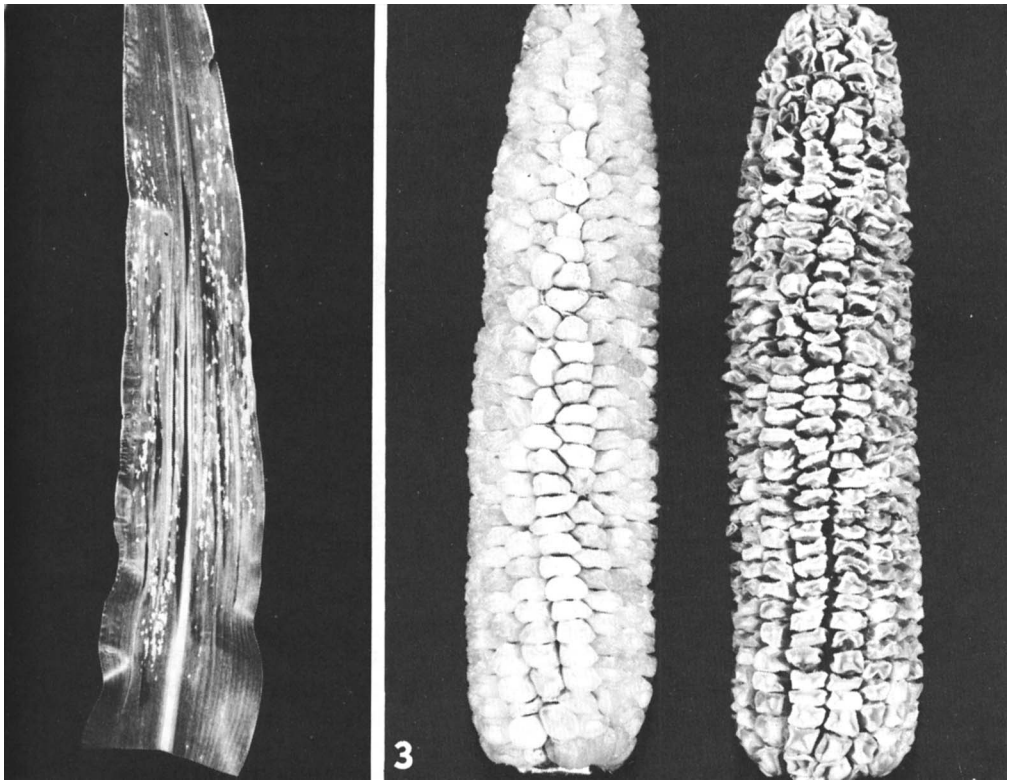

Fig. 1. Ears of three high-sugar sweet corn hybrids. Left to right: Illini Xtra-Sweet, Florida-Sweet, and Experimental 263.

Fig. 2. Acute ozone injury on Illini Xtra-Sweet leaf (right), contrasted with no acute injury on Florida-Sweet leaf (left).

Fig. 3. Dry seed ears showing thinner kernels of shrunken-2 (right), in contrast to those of sugary-1 sweet corn (left).

Riverside summer conditions, although Florida-Sweet passes through its optimum harvest period a little faster. It has from 0 to 1 tillers, somewhat fewer than those of Xtra-Sweet. In all, Florida-Sweet has many superior plant characters besides its high sugar.

The three experimental hybrids listed in the table also have many good qualities. Experimental 130 is a cross of a California inbred with a line related to a parent of Florida-Sweet. This hybrid has the favorable husk extension and tightness of Florida-Sweet and has the shrunken-2 and sweetness characteristic. It is more uniform in ear development and maturity than Xtra-Sweet.

Experimental 92 and 263 are crosses of California inbreds with a University of Illinois line. Their kernels are outstandingly sweet and tender, and they maintain these qualities during many days of storage at 50° F. Ears of 263 are unusually long, but they often lack adequate husk cover at the tips. Figure 1 shows ears of Illini Xtra-Sweet, Florida-Sweet, and Experimental 263 at approximately optimum market maturity.

In the Los Angeles Basin, some sugary-1 sweet corn varieties have been susceptible to acute air pollution injury due to ozone (*California Agriculture*, May 1971). Illini Xtra-Sweet has also been seriously susceptible. Florida-Sweet and the experimental hybrids in the table, however, are quite resistant. Figure 2 shows the contrast in leaf injury in the Florida and Illinois hybrids, grown side by side. When high ozone and high temperatures occur repeatedly during the growth of susceptible varieties, plant vigor and ear quality can be seriously impaired.

The greatest problems associated with shrunken-2 varieties are the low vigor of the mature seeds and their susceptibility to molds. The high sugar and low starch levels result in a lighter-weight, more shrunken seed than with sugary-1 (fig. 3). Such seeds have a lower germination percentage and are more subject to rot than sugary-1, especially at cool soil temperatures. However, established seedlings grow as vigorously as other types. Workers in Florida have found that fungicidal seed treatments can reduce losses at germination.

Varieties containing the shrunken-2 gene should be isolated by space or by planting time from other sweet corn varieties that do not contain shrunken-2. Cross-pollination of either type by the other causes nearly complete loss of sweetness of each type. Each type carries a dominant gene, which, after cross-fertilization, cancels out the genetic effect of the sugar gene carried by the other.

At the University of Hawaii, J. L. Brewbaker has recently developed several high-sugar varieties. Some carry the shrunken-2 gene, and others have brittle-1 or brittle-2, which can impart a somewhat different flavor to the kernels. In Hawaii, many pests and diseases of corn are more severe than in California; varieties adapted to Hawaii thus have somewhat harsher and tougher plant and ear tissues than do most "Mainland" hybrids. Also, they are usually taller and later maturing. Some have been tested at Riverside, but they do not appear suitable for our requirements.

Several commercial seed companies have been studying high-sugar genotypes, and new varieties may soon be put on the market. At present, a few growers with roadside stands are the main source of this type of fresh-market corn.

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CHARACTERS OF HIGH-SUGAR (SHRUNKEN-2) SWEET CORN HYBRIDS AT RIVERSIDE, CALIFORNIA, IN 1975 AND 1976

Hybrid	Husk: Extension (inches)	Husk: Tightness at tip	Husk: Leaves	Ear length (inches)	Rows of kernels per ear (number)	Sweetness	Seed-coat tenderness	Days to maturity*	Leaf susceptibility to acute ozone injury
Illini Xtra-Sweet	0 to 2	Loose	Short	7½ to 9	16 to 18	Sweet	Tender	83 to 85	Susceptible
Florida-Sweet	1½ to 2	Tight	Medium to long	8 to 8½	14 to 16	Sweet	Moderately tender	87	Resistant
Experimental 92	1	Medium	Medium	8	14	Very sweet	Very tender	83	Resistant
Experimental 130	1½	Tight	Short	8½	14 to 16	Sweet	Moderately tender	83	Resistant
Experimental 263	½ to 1	Medium	Medium	9	14 to 16	Very sweet	Very tender	86	Resistant

* Days from May 7 planting to optimum fresh market maturity.