IMPROVEMENT OF SWEET CORN

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The only genetic difference between the composition of a sweet corn kernel and that of field corn is due to a single recessive gene out of the hundreds or thousands of genes in corn. This gene makes the sugary condition of the kernel persist in sweet corn; or, in other words, prevents the conversion of some of the sugar into starch.

The first recorded observation of sweet corn by white men appeared in 1779, when Lt. Richard Bagnall, of Sullivan’s Indian Expedition, returned from an Indian campaign to the west of the Susquehanna with several sugary kerneled ears procured from the natives. We know today that the Iroquois Indians cultivated at least two sweet varieties, one white and one black—similar to Black Mexican—and that the Indians of the upper Missouri included four sweet corns among the 104 corn varieties they cultivated (45).¹

In 1828 Thorburn’s seed catalog listed a single sweet corn variety, and by 1881 the number of advertised varieties in all seed catalogs had increased to 16. Today, by reason of an increased interest in the production of hybrid sweet corn, it would be difficult to estimate with any accuracy the number of sweet corn varieties and stocks on sale, but it must run into many hundreds.

Considering its popularity, it may be surprising to some that the region of sweet corn cultivation is confined practically to southern Canada and the northern half of the United States. There are three reasons for this restricted distribution. (1) The period during which sweet corn kernels remain sweet after picking is of very short duration, and at the higher temperatures farther south the sugars are rapidly converted to starch. (2) The corn earworm, Heliothis obsoleta Fabr., is less injurious or is absent only in latitudes with winter temperatures low enough to prevent winter pupation of the larvae. Earworm injury in the Southern States is so great that the main dependence for roasting ears is the naturally more resistant field corn, including such varieties as Trucker’s Favorite, Mexican June, and Tuxpan. These varieties, together with practically all the field corns of the South, have become relatively resistant to the corn earworm through natural selection extending over a long period. This fact is being used to good advantage (38) in converting some of the leading southern dents into highly resistant sweet corns by appropriate crosses. The third reason is much like the second, but in this case the condition is bacterial wilt instead of an insect. This disease is especially severe in the South,

¹ Italic numbers in parentheses refer to Literature Cited, p. 392.
and sweet corn varieties are much more susceptible in general than the southern field corns.

Prior to 1900, when the rediscovery by three European botanists of Mendel's paper on hybridization in garden peas aroused greater plant breeding activity than had hitherto been known, the literature of sweet corn breeding was confined to descriptions of variety tests. An examination of the experiment station bulletins around 1889, especially in Illinois, Indiana, and Nebraska, shows the names of some 75 sweet corn varieties classified according to earliness or lateness of maturity, color of kernels, and suitability for cultivation in those States. Some attempts were then made to standardize names and show which were synonymous. Early station bulletins from North Carolina and Louisiana mentioned that field corns were productive under local conditions, but sweet corn could not be successfully cultivated because of the damage inflicted by the corn earworm.

With few exceptions the men then practicing plant breeding failed to conceive of the possibility of hybridizing different stocks of corn with a view to producing new types for special purposes. Mendel's paper, however, by clearly stating certain definite laws of inheritance operating when character contrasts are introduced in a cross, showed that breeding for special purposes could be done systematically and with comparative ease. After 1900 the character of experiment station publications changed from lists of varieties to reports of crosses made with definite objectives, such as production of extra early maturing stocks, and of better canning varieties with deeper and more tender kernels, increasing the uniformity of all characteristics in canning varieties, and increasing yield and resistance to disease or insect attack.

WE CAN hardly overstress the importance to the canned-corn industry of the all-embracing uniformity of characters resulting from the production of crosses and top crosses of inbred lines of sweet corn. The uniformity in texture and consistency of grains and in shape and size of ears has practically revolutionized the machinery and methods of handling in the cannery; and furthermore, in the field the even placing of the ears on the stalks and the uniformity with which an entire field reaches maturity have brought economies never before possible. These advantages are also evident in more recent cannery practices, such as putting up corn in frozen packs, and an increase in the whole-grain method of removing kernels from the cobs. It is estimated that about 80 percent of the yellow sweet corn grown for canning in 1937 will be from hybrid seed, and half of this, or 40 percent of all yellow cannery sweet corn, will be Golden Cross Bantam.
Among the first sweet corn breeders to work for specific ends without knowledge of Mendel's laws was a Maryland physician, Stabler (44). In 1879 he planted alternate rows of Burr Mammoth and Stowell Evergreen and removed the tassels from the latter, thereby obtaining hybrid seed from which he selected an improved canning variety called Roslyn Hybrid Sweet. The new variety had large ears, straight rows, deep kernels, small cobs, and a higher yield than either parent. Stabler later produced an earlier maturing evergreen variety, called Early Stabler, by selecting seed from the first ears to set. He recognized that even though the ears were open pollinated, so that the pollen parent was unknown, it had to be early maturing to pollinate an early silking plant, and consequently the ensuing selections would be earlier than the original stock.

The interest aroused in genetics and plant breeding after 1900 was promptly applied to sweet corn, first by Halsted, Kelsey, and their colleagues in New Jersey, and later by East in Connecticut, Pearl, Surface, and Sax in Maine, and Huelsen and Gillis in Illinois. These workers established inbred lines through artificial self-pollination to produce true breeding stocks and to eliminate defective characters. With improved inbred lines they expected to analyze the factors of inheritance and produce newly constructed varieties from specifications found in both parent stocks. At about the time of the Maine work, Collins and Kempton (7), of the United States Department of Agriculture, made the first deliberate attempt to breed a sweet corn resistant to the corn earworm by crossing resistant dent varieties with susceptible sweet corn varieties.

**SWEET CORN BREEDING**

Sweet corn is chiefly used as a canning vegetable almost throughout the world and as a green garden vegetable in regions favoring its cultivation. The activities of sweet corn breeders are predetermined by these uses somewhat along the following lines:

1. For the canning industry, the production of high-yielding uniform hybrid stocks with good quality, by crossing inbred lines among themselves or top crossing inbred lines as pollen parents on commercial varieties as seed parents. Both practices insure greater uniformity in time of maturity, as well as in other characters, and increased yield.

2. Extension of the geographic range of the crop farther southward through the development of improved earworm-resistant varieties of sweet types by hybridization of susceptible varieties of good quality with naturally resistant field corns; and the extension of the range northward by selecting extra early maturing stocks.

Shortly before the timely rediscovery of Mendel's paper, Halsted and his coworkers (13, 14, 15, 16, 17, 18, 19, 20, 21) of New Jersey in 1898 began breeding sweet corn with the object of combining in one variety the best features of Black Mexican and Egyptian (Washington Market), which had white kernels. They observed that crossed seed in this case could easily be identified on ears of Egyptian plants, since corn has the advantage of exhibiting xenia.² For example, black aleurone color is dominant to clear in this cross, and any kernels on a plant with white ears that chance to be pollinated by pollen grains

² See the article on Fundamentals of Heredity for Breeders, in this Yearbook.
from a black parent will develop into black instead of white kernels. Black Mexican and white Egyptian occupied adjoining rows and the breeders commenced their work merely by choosing black seeds from Egyptian ears. Faster progress was made by raising a winter generation in the greenhouse, and in their earlier work Halsted and Kelsey selected breeding stock from open pollinated ears. It was not until 1900 that they practiced artificial pollination and not until 1905 that their reports began to include Mendelian terms. Notwithstanding their primitive methods at the beginning, the new variety Voorhees Red Sweet was fairly well fixed when it was released to the public in 1903. The variety combined features from the two parents and in addition exhibited red kernels, a character not expressed in either parent.

Immediately upon adoption of controlled pollination and Mendelian conceptions, Halsted began an extensive hybridization program with sweet corns with the specific object of improving stocks for earliness, higher percentages of two- and three-eared stalks, and recombination of the best features of diverse parents. At first Black Mexican was used as pollen parent with Malakov, an extra-early variety recently introduced from Russia, and with Garwood, Country Gentleman, Striped Evergreen, Banana, and Golden Bantam. Many other varieties were included later, and Black Mexican was omitted when pollination from bagged tassels made xenia no longer important as a device in this work to identify a cross. The problem of adequately testing the new stocks was overcome by enlisting the aid of cooperating farmers. In 1906, seed of six new varieties was widely distributed for trial and the year following four more were added to the number, two of which were given names abbreviated from the two parents, Malamo (Malakov × Premo) and Malakosby (Malakov × Crosby).

At this time Halsted began crossing sweet corns with Iowa Silvermine (white) and Pride of Nishna (yellow), dent corns, further to increase the yield of seed and stover. From the former he derived Silver Sweet by crossing with Stowell Evergreen and Jersey Sweet by crossing with Country Gentleman.

The order of importance of the elements that contribute to quality in sweet corn depends on whether we are considering market varieties or canning varieties. The market gardener places sweetness first, followed by tenderness of the pericarp, or outer covering of the kernel, then consistency or texture of the kernel contents. But since the canner may add extra sugar to the brine, his specifications for the breeder (9) place tenderness of the pericarp first and sweetness last, with consistency of kernel as the requirement second in importance.

**Sweet Corn for the Cannery**

The chief factors in the selection of varieties for use in the canning industry are deep kernels, yellow or white, according to local preferences; uniformity in all characteristics of the plant and ear; satisfactory yields; high quality; and, in regions afflicted with insects or disease, resistance to or escapement from injury. Previous to 1924, the date when practical interest was first aroused in the production of hybrid stocks from crossing inbred sweet corn lines, canned sweet corn was
obtained almost entirely from the four major varieties described in table 1.

**Table 1.—Sweet corns used for canning**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Year introduced</th>
<th>Color</th>
<th>Maturity date</th>
<th>Height</th>
<th>Cut corn at 20 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crosby</td>
<td>1860</td>
<td>White</td>
<td>Early</td>
<td>Feet</td>
<td>Percent</td>
</tr>
<tr>
<td>Stowell Evergreen</td>
<td>1860</td>
<td>do</td>
<td>Intermediate</td>
<td>5-6</td>
<td>37.2</td>
</tr>
<tr>
<td>Country Gentleman</td>
<td>1882</td>
<td>do</td>
<td>Late</td>
<td>7-8</td>
<td>45.9</td>
</tr>
<tr>
<td>Golden Bantam</td>
<td>1900</td>
<td>Yellow</td>
<td>Early</td>
<td>7</td>
<td>46.1</td>
</tr>
</tbody>
</table>

The data shown as percentage of cut corn at 20 days after the appearance of the silks, as given by Culpepper and Magoon (8), are included in order to indicate the efficiency of a variety in producing the deep kernels best suited for canning. This figure is computed by dividing the weight of cut kernels by the total weight before cutting.

A serious drawback of all commercial varieties for canning purposes, however, is the great variability in characters, and especially in the time when individual plants reach maturity. This means that at any given time a large percentage of underripe and overripe ears must be taken, along with those in prime condition. A breeding practice that would increase the uniformity in reaching maturity, shape of ears, or texture of grains, as well as giving increased yield or greater depth of kernels, would be desirable. The increase in uniformity alone would be a great boon to the canning industry because this results in a relatively much larger pack from a given yield in the field. It was shown by G. H. Shull in 1908 that increased yield and a high degree of uniformity in all characteristics would result from crosses between inbred lines. Many years before this, about 1880, W. J. Beal, of the Michigan Agricultural College, observed that hybrid vigor and somewhat greater uniformity resulted from the crossing of commercial varieties in the field. At that time he proposed planting alternate rows of two field varieties, detasseling one and using ears from the detasselled variety to obtain hybrid seed.

**MORE RECENT BREEDERS**

In the summer of 1907 Pearl and Surface (39) in Maine commenced investigations on sweet corn for the specific purpose of producing seed adapted to Maine rather than to Connecticut and Massachusetts—the chief sources of seed. For the production of improved canning varieties their immediate objectives were greater earliness, higher yield, and improved ear shape. They produced inbred lines by in-breeding for several generations and discarded the poorer lines while retaining the better ones. Their contribution to sweet corn breeding practice was the selection of breeding stock on the basis of the performance of the progeny and not upon the appearance of the ear and plant, which had been the practice until that time. In their own words, "the objects of selection must be to discover and separate the desirable genotypes from the poor ones." After 3 years of such work Maine farmers had better locally grown seed than could be purchased elsewhere.
Figure 1.—Method of producing double-cross hybrid seed corn and representative ears of the crop produced from hybrid seed.
In Illinois, which, according to the latest statistics, is usually slightly ahead of Iowa as the leading sweet corn State, both in acreage and in total pack, breeding operations were begun about 1926 by Huelsen and Gillis, as reported by Keilholz (32). Their methods were much the same as those already in use elsewhere, but they emphasized the improvement of quality by use of the puncture test to identify the most tender lines for use in breeding. The test shows the pressure in grams per square centimeter required to penetrate the pericarp of the corn kernel. Huelsen and Gillis learned that high degrees of tenderness are exhibited in dent corns as well as in sweet corns.

In Connecticut the production on a commercial scale of cross-bred seed from inbred lines in field corn was first practiced in 1921 by George S. Carter, of Clinton (30). Shortly thereafter, in 1924, the Connecticut Agricultural Experiment Station introduced an F₁ or first-generation hybrid sweet corn called Redgreen, produced from two inbred lines, one being Stowell Evergreen and the other from a variety of unknown parentage. This hybrid stock was soon grown and canned by the W. N. Clark Canning Co., of Rochester, N. Y., and its superior characters in adaptation to locality, productivity, uniformity of maturing, and quality were immediately recognized.

Redgreen was not as successful elsewhere as in New England, central New York, and certain sections of the Northwest. Today practically every experiment station has several or many such cross-bred stocks, many of which are sold by the leading vegetable seedsmen. The lead in such activities was taken by the Connecticut station (30, 31), the Minnesota station (28), and the Purdue University station in cooperation with the United States Department of Agriculture. Figures 1 and 2 illustrate the methods and results obtained in producing single- and double-crossed corn.

The most popular and most widely adapted of these hybrid stocks is Golden Cross Bantam, produced about 1927 by Smith (43), of the Department, in cooperation with the Purdue University station by crossing Purdue 39 (Purdue Bantam) and Purdue 51, both inbred lines of Golden Bantam. Purdue 39 has attained some degree of commercial importance in its own right by reason of its resistance to bacterial wilt or Stewart's disease \((Aplanobacter stewarti)\) (E. F. Smith) McC.), high quality, and yield.

The great popularity of Golden Cross Bantam is chiefly due to its yield, canning qualities, uniformity, and resistance to bacterial wilt (figs. 3 and 4). This disease is most serious in latitudes close to 40° north and is of importance mainly in sweet corns, sometimes destroying almost the entire crop. The earlier maturing varieties are most susceptible. A recent study of Stewart's disease (26) recognizes two distinct genetic types of resistance: (a) Vigor-correlated, inferred from the fact that vigorous hybrids between some low-resistant inbred strains are more resistant than either parent; and (b) true resistance, shown by the fact that hybrids from low-resistant inbreds are less resistant than hybrids from high-resistant inbreds. Golden Cross Bantam may owe its high degree of resistance to both these causes, since it has hybrid vigor and one of its parents, Purdue 39, is also highly resistant.
Figure 2.—Diagram of method of crossing inbred plants and the resulting single crosses to produce double-cross hybrid seed.

The tremendous importance of these hybrid sweet corns, and particularly Golden Cross Bantam, is indicated by the fact that it is estimated that about 80 percent of the yellow sweet corn which will
be grown for canning in 1937 will be grown from hybrid seed. It is estimated that half of this, or 40 percent of all yellow cannery sweet corn, will be Golden Cross Bantam.

Figure 3.—Golden Cross Bantam, a variety resistant to bacterial wilt or Stewart’s disease. It remains healthy on wilt-infected soil and makes a normal crop.

**Top-Crossed Sweet Corn**

The use of inbred lines as pollen parents crossed on commercial varieties as seed parents—called the top cross—for producing uniformly maturing and high yielding corn stocks was begun at the Connecticut Agricultural Experiment Station in 1917 with field corn. The practice was soon used on sweet corn with excellent results, and
in 1935 the station recommended to the trade two early stocks, Spaneross C-2 and Mareross C-6, and two midseason stocks, Whiperross C-6.2 and Whiperross C-7.2. In addition to these they recommended for the 1936 trade the following new top crosses: Mareross C-13.2, Burcross C-2, Seneross C-7, Dalecross C-2, Orcross C-2, Coineross C-2, and Staneross C-2. The 1935 seed catalog of one of the vegetable seedsmen listed four top crosses, all of which were produced by its own breeding staff. In recommending the top-cross method, Jones and Singleton (31) say:

From the standpoint of ease of producing seed and the adaptability of this seed, as compared to that of single crosses (between two inbred lines), there is much to be said in favor of variety-inbred crosses (top crosses).

The importance to the canned-corn industry of the all-embracing uniformity of character resulting from the production of crosses and top crosses of inbred lines can hardly be overstressed. The uniformity in texture and consistency of grains and in shape and size of ears has practically revolutionized the machinery and methods of handling in the cannery; and furthermore, in the field the even placing of the ears on the stalks and the uniformity with which an entire field reaches maturity have brought economies never before possible. These advantages are also evident in more recent cannery practices, like putting up corn in frozen packs and the whole-grain method of removing kernels from the cobs. In each instance the uniform texture of grain in single-cross and top-cross stocks of sweet corn makes them superior to the open-pollinated corn varieties.
Market Sweet Corn Breeding

Many of the varieties bred for the canning industry also are suited to market growing. In addition, there is need for extremely early strains for the extreme northern areas of the territory. In the South the question of earworm resistance is of major importance, and, if resistant strains are developed, sweet corn culture may increase in importance in this region.

About 1913 Collins and Kempton (7), of the Department, began a study on earworm resistance in dent and sweet corn. They obtained two highly resistant dent varieties, which were crossed with three susceptible sweet varieties, Stowell Evergreen, Early Evergreen, and Cory. The hybrid progenies proved more resistant than the commercial varieties. Prolongation of the husks beyond the tip of the ear and thickness of the husks were found to be associated to some extent with low damage. The evidence indicated that increased resistance of the hybrids also was due to other characters not measured but probably correlated with husk prolongation. The presence of some volatile substances distasteful alike to the moth and larva, but too elusive for measurement, was suggested.

Mangelsdorf, of Texas, crossed the highly earworm-resistant dent varieties, Mexican June and Surcropper, with the sweet variety Country Gentleman, and continued backcrossing to the dent parent for several generations. Eventually he obtained two varieties of sweet corn, Honey June and Surcropper Sugar, which to outward appearances were practically identical in plant characters with their dent parents and were highly resistant to the earworm, but which in addition were sweet. In numerous tests of the adaptation of these two sweet corns to conditions in Texas (23, 24) and in California (40, 41, 42), the degree of earworm resistance has been demonstrated to be superior to that shown in any other sweet corn varieties with the possible exception of Papago, a commercially unpromising sweet corn produced by Freeman (12) at the Arizona station, and of Aunt Mary's Sweet.

Papago was produced from a few sweet grains found in the summer of 1910 on ears of squaw (flour) corn grown by the Papago Indians. Aunt Mary's Sweet is a recently introduced sweet corn from Ohio, which has been carefully nursed from year to year for perhaps a century on a single farm near Darby Plains. Such antiquity suggests Indian origin, and this is the expressed belief of the introducer, L. R. Bonnewitz, of Van Wert, Ohio. The point of Indian origin might well be stressed for Papago and Aunt Mary's Sweet, since it is to be expected that the inherent earworm resistance of maize varieties in possession of the Indians was due to a fixation by natural selection of resistance to earworm attack.

Florida 191 and Suwanee Sugar, recently produced by the Florida station, have given much promise as earworm resistant converted dent-sweet corns when tried in the diverse environments of the Southeast and the far West. More recently, Georgia 439 and Georgia 428 from the Georgia Experiment Station have indicated promise equal to that of the best strains of Honey June (23).

In the last 4 or 5 years a number of investigators in widely distant States have independently conducted tests of rather extensive lists of
varieties of sweet corn to determine their earworm resistance and value for market or breeding purposes. In tests at Davis, Calif. (40, 41), Winter Haven, Tex. (23, 24), and Charleston, S. C., certain varieties were consistently outstanding in earworm resistance, namely, Honey June, Surcropper Sugar, Papago, Aunt Mary's Sweet, Florida 191, and Oregon Evergreen. The relative resistance of these sorts varied among the several tests, but they were of the same general degree of resistance.

Even with the high degrees of resistance thus far uncovered, progress in breeding earworm resistant sweet corns is still far from satisfactory. Other hybrids have recently been made by Mangelsdorf in Texas (see the table of introductions in the appendix) and by Poole in California, using southern dent corns like Tuxpan and Davis Prolific that are even more resistant than the first dent parents used in producing Honey June and Surcropper.

Evidence obtained during 2 years of study by the California station has demonstrated, in statistically significant tests, that high earworm resistance is altogether independent of length or thickness of husks.

Other possible factors not correlated with resistance are length of ear, weight of ear, height of plant, and length of time required for maturity (42). Promising lines of investigation as yet untried include the search for factors determining volatile compounds that repel laying moths, suggested by Collins and Kempton, measurement of the tightness of the husk covering, and determination of the quality of husk covering. These lines of investigation will require collaboration with specialists outside the field of genetics, or the development of a special technique, before quantitative measurements can be taken.

Although it is still too early to estimate the extent to which these new sweet corns will extend the geographic range of sweet corn cultivation, there is no question regarding the interest of truck and home gardeners in present efforts. Honey June in particular has aroused enthusiasm among Texas and California growers, and one railroad company in Texas has planted large acreages for shipment of green sweet corn to northern points.

**GENETICS**

The genetics of sweet corn is the same as the genetics of corn in general, except for the particular genes responsible for the sugary condition of the endosperm. Corn genetics has been so adequately treated in the 1936 Yearbook of Agriculture (27) that no further reference is necessary except for considerations peculiar to sweet corn.

As has been said, the only genetic distinction to be drawn between starchy endosperm and sweet endosperm is the fact that the normal gene $S_u$ (starchy) at locus 71 on chromosome IV (10) in field corn has mutated to $s_u$ (sugary) in sweet corn. There is another allelomorph of this gene at the same locus, and in addition two nonallelicomorph sugary genes on two other chromosomes than number IV, which will be discussed below. The sugary mutations result not only in a higher total sugar content but also in a persistence of the sugary condition of the endosperm to maturity. All other characteristics of the sweet corn are determined by other genes.

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3 This section is written primarily for students or others professionally interested in genetics or breeding.
corn varieties, such as short stature, early maturity, loose husks, etc., are shared in common with field corn.

The investigator who seeks to effect certain combinations between sugary or sweet corns and nonsugary corns may encounter aberrant monohybrid ratios involving the sugary character. These aberrant ratios are due in some cases to the action of genes linked with sug, but also may be due to other causes (2, 3, 4, 5, 6, 33, 34, 35).

Mangelsdorf (37) investigated the respective rates of growth of pollen tubes carrying Sug and sug and finds that Sug pollen tubes have an accelerated growth rate at the start and that sug pollen tubes grow as fast as Sug when the initial handicap is overcome.

In most other cases reported in the literature it appears that when both Sug and sug appear together in one organism, the F2 segregates in entirely normal monohybrid ratios. The first exception was noted in 1920 by Harper (22), who reported that when two sugary races were crossed the resultant F1 was starchy, indicating two nonallelomorphic sugars. Subsequent investigations have shown that there are indeed two previously unknown nonallellomorphic sugary genes, su2 on chromosome VI (11) and sug on chromosome IX (Eyster, unpublished, 10). Furthermore, there is some evidence that at the sug locus on chromosome IV there is a third member of the series, sug, producing a sugary kernel not as sweet as sug, and which apparently is associated with the presence of the gene du, dull endosperm, on chromosome X (unpublished communication from Mangelsdorf, also mentioned in 10).

A condition called "pseudostarchy" has been analyzed by Jones (29) and is thought to be caused by the complex interaction of three dominant genes with the sug gene. One gene is necessary for the full expression of pseudostarchy, a second inhibits the shrinkage of sugary kernels, whereas the third dominant gene produces an opaque appearance of the dried kernels.

In an investigation of the chemical composition of known endosperm genotypes from crosses of dent X sugary, Lindstrom and Gerhardt (36) showed (table 2) an increase of sugars and a decrease of starches for each additional sug gene (expressed as s in table 2) obtained in the recombinations resulting from reciprocal F1 matings and backcrosses, or in an F2 generation.

<table>
<thead>
<tr>
<th>Cross type 1</th>
<th>Endosperm genotype</th>
<th>Samples</th>
<th>Total sugar</th>
<th>Dextrin</th>
<th>Starch</th>
<th>Carbohydrate index 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>White dent</td>
<td>SSS</td>
<td>3</td>
<td>2.3</td>
<td>1.9</td>
<td>95.6</td>
<td>0.07</td>
</tr>
<tr>
<td>Evergreen</td>
<td>sss</td>
<td>3</td>
<td>4.9</td>
<td>24.5</td>
<td>27.9</td>
<td>1.05</td>
</tr>
<tr>
<td>F1 (HF X E)</td>
<td>SSS</td>
<td>4</td>
<td>2.7</td>
<td>2.1</td>
<td>53.6</td>
<td>0.99</td>
</tr>
<tr>
<td>F1 (E X HF)</td>
<td>SSS</td>
<td>1</td>
<td>5.6</td>
<td>1.7</td>
<td>56.1</td>
<td>0.09</td>
</tr>
<tr>
<td>F1 X E</td>
<td>sss</td>
<td>4</td>
<td>1.8</td>
<td>1.6</td>
<td>57.5</td>
<td>0.06</td>
</tr>
<tr>
<td>E X F1</td>
<td>ssS</td>
<td>3</td>
<td>5.3</td>
<td>25.7</td>
<td>23.1</td>
<td>1.34</td>
</tr>
<tr>
<td>F2</td>
<td>sss</td>
<td>2</td>
<td>2.2</td>
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<td>0.08</td>
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<tr>
<td></td>
<td>sss</td>
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<td>4.5</td>
<td>25.9</td>
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<td>1.12</td>
</tr>
<tr>
<td></td>
<td>sss</td>
<td>4</td>
<td>2.3</td>
<td>2.7</td>
<td>57.5</td>
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</tr>
<tr>
<td></td>
<td>sss</td>
<td>3</td>
<td>5.3</td>
<td>29.1</td>
<td>21.6</td>
<td>1.59</td>
</tr>
</tbody>
</table>

1 HF = High fat strain; E = evergreen parent.  
2 Ratio of total sugar plus dextrin to starch.
In another analysis of chemical composition of known endosperm genotypes involving the sugary gene, Abegg (1) demonstrated a cumulative relationship for percentage of crude fat relative to the genes sugary and waxy in the following series:

<table>
<thead>
<tr>
<th>Genotypes:</th>
<th>Percent of crude fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Su su su Wx wx wx</td>
<td>1.0</td>
</tr>
<tr>
<td>Su su su wx wx wx</td>
<td>1.4</td>
</tr>
</tbody>
</table>

The typical ear of corn possesses rows of kernels in even numbers because the female florets of the ear are arranged in pairs, each member of which has two ovules. The rows are straight because only one ovule on each floret develops, and the relatively uncrowded ear displays its kernels in an evenly rowed condition. The sweet corn variety Country Gentleman, however, is unique in the fact that the second ovule of each floret also develops and produces a crowded zigzag or "shoe-peg" condition. Huelsen and Gillis (25) investigated the inheritance of the apparently unrowed condition in Country Gentleman by carrying to the F3 generation a cross between Country Gentleman and Narrow Grain Evergreen, the latter with typical straight rows. Intermediate degrees of zigzagging were sometimes difficult to classify, but on the whole the data conformed quite well to the working hypothesis that the unrowed condition of Country Gentleman was due to the operation of two pairs of recessive genes, p1 p1 and p2 p2, the chromosomal locations of which have not yet been identified. According to hypothesis the history of this cross is symbolically represented as Narrow Grain Evergreen, rowed (P1P1P2P2) × Country Gentleman, unrowed (P1P1P2p2).

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SWEET CORN

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