

# Hybrid Corn

*This is the ninth article in a series of brief progress reports on the application of the science of genetics to commercial agriculture.*

## resistant to ear rot and adapted to California conditions possible through science of genetics

Francis L. Smith

**Increased crop production** often results from the application to farming of fundamental scientific knowledge.

The case of hybrid corn is an outstanding example. In other crops the improvements of the plant breeders are new varieties which gradually replace their predecessors. The farmer obtains the seed of the new variety and continues to produce his own seed. But the modern corn grower has abandoned his time-honored custom of saving his seed for planting. In order to take advantage of the marked increase in yields he willingly revolutionizes his practices and ideals of good seed corn. Now he depends upon someone in the business of producing and distributing hybrid corn seed for his supply each year.

During the past 40 years, scientists have assembled more information on the genetics of corn than any other plant species. Corn breeders used the principles worked out by the scientists to produce hybrid corn.

Farmers were quick to take advantage of the improvement in production. In 1933 less than 0.1% of the United States corn acreage was hybrid corn. By 1947 there was 71% of the acreage in hybrids. The average yield of corn in the United States for the 63-year period 1870-1938 was 26 bushels per acre. In the nine-year period 1939-1947 the average yield was 33.4 bushels. The 28% gain in yield is largely due to the use of hybrid corn. In California 41% of the corn acreage was hybrid corn in 1947. The hybrid seed used in the state is produced in the corn belt.

The modern technique of producing hybrid corn is an expansion of fundamental genetic research. In order to study inheritance, great care is taken to assure genetic purity. This is obtained by applying pollen of a plant to the silks of the same plant—self-fertilization. As this procedure continues generation after generation the plants become more and more uniform—the plants in a given inbred line approach genetic purity. Genetic analysis is made by studying offspring from crosses. In the case of corn the cross is made by dusting the pollen from one inbred line onto the protected silks of another. It was found that the hybrid plants, resulting from these crosses, were very vigorous and yields were greatly in-

creased—to the point that they actually exceeded the best open pollinated varieties. These results pointed the way to increasing corn yields.

The vigor of the corn hybrids gives its greatest expression in the first generation. Opinions of scientists differ on the details of the causes of the hybrid vigor or heterosis, but all agree that the genes derived from the different parents combine to produce the maximum effect in the first generation. Second generation plants lose part of this effect because there is a reassortment of the genetic material of the hybrids in the formation of the pollen and egg cells which make the next generation. Therefore new hybrid seed must be obtained every crop year.

### Custom Made Varieties

The purpose of inbreeding corn is to make a line which is genetically pure, in which all the germ cells are as near alike as possible. The corn breeders recognize that the genetic factors contained by the inbred lines are all important. To be useful in breeding, a corn line must have a large number of good characteristics. In the preliminary inbreeding work, most of the lines are discarded because they lack some important genes and gene combinations, the breeder's standards of value becoming more exacting. After inbreeding for a number of generations, the best lines are tested in hybrid combinations to find out their good qualities. The hybrids can be no better than the combination of inbred lines used as parents. Many of the features of the corn plant have been traced to definite genetic factors. Among the valuable characters that are largely determined by genetic factors are insect and disease resistance and date of maturity. The maturity date can be controlled with such precision that hybrids are made to order for the growing season of the different areas of the corn belt. Thus the width of the corn belt has been materially increased by using early maturing hybrids for the north and late maturing ones for the south. Tests of a large number of corn belt hybrids indicate that those with midseason maturity fit the great valleys of California conditions better than the very early or the very late ones.

The first hybrid corn was experimental

material from hand pollinated ears. The seed was produced on the relatively poor yielding inbred lines. Before hybrid corn could be developed into its present proportions, cheaper methods of seed production had to be devised. The hand pollinations were eliminated by planting the two inbred lines in alternating two-row and six-row strips in the seed field. Hybrids were assured by detasseling all the plants in the six-row strips so that all the grain produced on these strips must have received the pollen from the two rows. But even this method made the price of the hybrid corn so high that it was prohibitive to the average farmer. Another improvement in technique solved this problem. This is what is known as the Double Cross method. In this method the single crosses are made as already indicated. Then seed from two single crosses are interplanted in two-row and six-row strips and the plants in the six-row strips are detasseled. The resulting seed is the Double Cross seed and has four instead of two inbred lines in its ancestry. For practical purposes the Double Cross seed is as productive as the single cross seed and can be produced cheaply enough to be used by all corn growers.

### Corn Hybrids for California

In California there is a growing interest in the use of hybrid corn. For a number of years 25 to 50 commercial hybrids from the corn belt are tested in yield plots each year. It has been possible to make some recommendations to growers on the basis of their performance in these tests. Some hybrids from the northern corn belt states are too early for efficient production. These early types may find a place in a double cropping system when the corn is used for ensilage, and in the higher altitudes where the growing season is short. On the other hand, hybrids adapted to the southern states seem to be too late for promise.

In testing commercial hybrids it has been found that all of them are susceptible to varying degrees of the pink ear rot caused by one of the *Fusarium* fungi. Since there is a variation in the degree of damage, it is possible to recommend that some highly susceptible hybrids should not be planted in the state. This

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# Excel Onion

early maturing and of high quality,  
new variety proven good producer

H. A. Jones, Bruce A. Perry and Glen N. Davis

**Producing 35% more onions** of high quality 10 to 14 days earlier than conventional Yellow Bermudas, with fewer bolters, doubles and splits, off-colors and other undesirables, is the record of Yellow Bermuda 986.

Extensive tests by commercial growers and seed producers in southern California and south Texas have proved its merits.

The 986 was derived from a single plant and developed cooperatively by the United States Department of Agriculture, the Texas Agricultural Experiment Station, and the California Agricultural Experiment Station. It showed such early promise that it was released to selected growers of the seed trade.

## Trials in 1946

Seed grown in the Imperial Valley was sent through various State agencies to onion growers for extensive commercial trials in 1946.

Near El Centro, 12 acres of 986 were seeded directly on raised beds on October 25, 1945. Harvested April 3rd to 17th, they yielded 6,043 50-pound bags of onions, or an average of 503 bags per acre. Bolters were 25% to 30% but as the market was strong, these were topped and sold.

On an adjoining field a second planting of 30 acres was made November 2, 1945. Harvested April 17th to 24th, it produced 16,627 50-pound bags, or 554 bags per acre. In this second planting, less than 2% were bolters.

On the basis of a one-year test, November 1st seems to be about the right time to plant 986 in the Imperial Valley to produce bulbs without transplanting.

For the first time, the growers in the Imperial Valley could market onions on the West Coast about the same time as the Texas growers.

Where accurate comparisons could be made, 986 had a lower percentage of bolters and was practically free from splits, doubles, pink flesh, and other off-colors. It was uniform in size, shape, color of bulbs, and time of maturity, and ripened 10 to 15 days ahead of other strains.

One peculiar trait of 986 observed in all locations was the ability of bolters to become good-sized, well-shaped onions.

Though not a storage variety, 986 keeps better in storage than other yellow Bermudas tested—an advantage in holding bulbs for seed purposes. Yellow Bermuda 986 is especially crisp and mild in flavor, making it a very desirable salad onion.

An important feature of 986 is its early maturity. To maintain this early maturing habit it is important that the onion bulbs for the production of stock seed be selected in the South. The place of seed production is not important, but the place where onion bulbs are selected for the production of stock seed is extremely so.

Preliminary tests indicate that 986 is not a good transplant crop for the North, since its extreme earliness causes it to mature while the bulbs are still small.

## Test Results

The following results obtained by growers in California indicate what may be expected of Yellow Bermuda 986.

On trial grounds at El Centro, 986 was seeded directly on October 26, 1945; 5% bolted, and there were no doubles or off-colors. The adjoining row of Yellow Bermuda, planted at the same time, was about 10 days later and had 30% bolters and 50% splits and doubles.

## DAIRY

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0.6 cents. Average prices in Los Angeles have ranged from 0.6¢ above to 0.7¢ below the San Francisco price, but over a period of years the difference has amounted to only 0.1¢ a pound.

Cheese prices, while more difficult to compare because of differences in qualities and grades for which quotations are made in the major markets, move very closely together.

Evaporated milk prices are reported on a regional rather than a market basis, but again the prices in the various parts of the country move up and down together almost perfectly.

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The relation between dairy product prices and prices paid farmers for milk will be discussed in the January issue.

Yellow Bermuda 986 planted in four large field test plots near Bakersfield matured 10 to 14 days ahead of the early variety generally grown there, but yield was only about 60% of that produced by this check variety. The percentage of bolters was low, but a high percentage of doubles appeared near Shafter. Despite its early maturity, 986 was not early enough to compete for the early market.

In the Coachella Valley, near Indio, Yellow Bermuda 986 was compared in several locations with Texas Grano and Crystal Wax.

It matured about two weeks before either of these two varieties, with no doubles or bolters apparent.

Average yields per acre in 50-pound sacks were: Texas Grano, 750; Yellow Bermuda 986, 528; and Crystal Wax, 480.

Six selected 986 bulbs weighed 2.5 pounds, whereas six of Texas Grano weighed 3.5 pounds.

Yellow Bermuda 986 attained excellent size and quality, and can be recommended for planting in the Coachella Valley.

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observation led to further inquiry. If the hybrids showed varying degrees of susceptibility, the inbred lines which are used as parents should also vary in their reaction to this disease. Over 70 inbred lines obtained from corn belt experiment stations have been tested over a period of two years, grown under conditions best suited to the Fusarium fungus. In order to get a severe test of susceptibility, spore suspensions of the fungus were sprayed on the silks of the corn. At harvest time the effect of the disease was noted. These tests indicated that there are differences in the susceptibility of inbred lines. A large proportion of the lines tested, that were obtained from the California variety King Philip Hybrid, were in the more resistant class. The work has progressed one step further. Crosses of inbred lines with varying degrees of susceptibility have been made in all possible combinations. From this type of study it is hoped that a hybrid corn combination will be found which will have the necessary qualities for profitable yields with Fusarium resistance added, a tailor-made hybrid combination, particularly adapted to California.

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