HYBRID CORN: MAN'S GLORY AND LIMITATION

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Hybridization and heterosis are discussed in relation to development of hybrid corn. Brief consideration is given to early investigations of Shull and East; then tests by the author are described whereby he was able to demonstrate to students some of the aspects of hybridization of corn. After considering relationship of his subject to "evolution," the author concludes, "If corn had developed from some 'simple' plant, such as an alga, it would necessarily have been by the introduction of many new and improved genes. Instead of introducing new genes, the remarkable process of making **Zea mays** *more useful to man involves experts rejecting undesired genes and collecting other genes into more desirable groups."*

Introduction

Maize or corn, *Zea mays,* was found growing in the American continents by Christopher Columbus; and, the appearance of the corn plant has changed but little since its discovery.[1] Vases found in tombs in western South America, antedating the white man, are decorated with likeness of modern dent corn.

American Indians cultivated all the main types now grown, including dent, flint, sweet, and pop corn. The Mandan Indians of Dakota developed a variety which was grown by white people also, as the best variety for that region, up until about 1935.

Now, however, 95 percent of the corn crop in the United States is hybrid, because hybrid corn yields 15 to 20 more bushels per acre than ordinary, open pollinated corn. Research establishing this improvement was a triumph for biologists, but they cannot use the results to support their general evolutionary ideas.

Nature of Hybrids

Hybridization means the same as crossing of varieties or breeds of plants and animals, and should not be confused with *crossing over,* which is defined as the exchanging of portions of chromosomes. Crossing usually is practiced between varieties or breeds within a species.

When practiced between genera it usually yields no progeny, or else progeny which are sterile: e.g. the mule.[2] Crossing of corn and sugar cane resulted in normal fertilization of the embryo nucleus, but growth stopped because of disharmony of the female cells with the nuclei of the pollen grain.[3]

Hybrids are of two types, according to the benefits to man. The first type has two desirable traits which have been found growing in different varieties or species.

For instance, a certain grass, *Agopyron,* is immune to wheat rust. When crossed with wheat, *Triticum,* some of the progeny have this immunity along with profitable grain production.[4] This crossing brings together the undesired traits in some of the progeny as well as the improved combination in others, necessitating strict selection and rejection for several years.

Hybrid corn is of the second type of hybrid, in which the selection precedes the crossing, and the benefits are realized from the elimination of defects, and also from the added vigor which the plants have following the crossing. This hybrid vigor, called *heterosis* by G. H. Shull who will be mentioned again below, arises from the condition that diverse genes are brought together in the same cell.

Heterosis is more pronounced in corn than in genera which normally are self-pollinated, such as beans and wheat. This fact is noted, but to explain the proposed reasons would make this paper too long.

Of course, both types of hybrid are brought about by making new combinations of genes. Neither type of hybrid involves a change in a gene. Thus hybrid corn does not illustrate, nor can it be used to help someone believe in natural or lasting development of kinds of plants.

Early Investigation

Self pollination or any type of inbreeding or mating of close relatives results in a reduction of vigor in many species of living things. This has been known for a long time. Such loss of vigor is very easily noted in corn. Once an instructor at a college near the author thought that inbreeding would finally cause corn to revert to its wild ancestor, whatever that unknown type might be. That he was mistaken in his estimate was shown by two geneticists who continued their experiments on inbreeding until there was no further reduction in size or vigor.

G. H. Shull (1874-1954) worked on corn at Cold Spring Harbor, Long Island from 1905 to 1916. E. M. East (1879-1938) did similar research, first at the Illinois Agriculture Station, then at Connecticut Agricultural Experiment Station, from 1905 to 1914.

In corn the staminate, or male flowers, are found on the "tassel" at the top of the stalk, while the pistillate, or female flowers, are on the shoot which develops into the "ear." The styles, one from each grain of corn and called "silk," are

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very long and protrude from the end of the ear.

Pollen from the tassel falls by gravity or wind from the tassel to the silk; then, from the pollen a tube elongates into the developing grain of corn. Nuclei traverse this tube and unite with other nuclei in the corn grain. New growth begins. Of course the nuclei carry a complement of genes from the male part of the plant.

Hybridization in Corn

The standard technique of hybridization of corn is to place a bag over the tassel to catch the pollen produced there and to exclude other pollen. At the same time the workers place a bag over the silk to exclude pollen.

When the silk is mature, the bagged tassel is cut off, pollen is shaken over the silk of the same plant, then the silk is covered again while the development of the self-pollinated seeds proceeds. At the proper time of the season these seeds are planted, and the process is repeated.

Many inferior plants appear, and seeds from such plants are not used to continue the experiment. Some plants do not produce seeds. Along with the defects there is a distinct reduction in vigor in each generation.

After six generations, however, no further reduction in vigor, nor any more defective stalks were found, but rather a uniform strain of corn was established. In an inbred strain of this kind, each plant has genes of the same kind as those of the other plants in that strain unless a mutation occurs, and this takes place very rarely.[5]

Next in order is the planting of rows of corn side by side, alternating two inbred strains. When the plants are mature, all the tassels of one strain are removed, causing plants of that strain to be pollinated by the other strain, thus making hybrid seed corn.

When this hybrid corn is planted the next season, all the vigor of the original open pollinated corn is restored and even more because of heterosis. Another advantage is that latent defects have been brought out and discarded during the years of inbreeding.

However, the increase of vigor is not the same for each cross; line A x B may not be so good as line C x D. Also commercial breeders consider their methods as trade secrets and may use tests of their own rather than following the above routine for six generations.

Tests by the Author

In instruction, in addition to printed pages and pictures, there is well-known value in demonstration. Accordingly I developed inbred strains and hybrids of Golden Bantam sweet corn to demonstrate the method to my students. Two generations were grown in a year, one in winter in the greenhouse, the other in summer outside.

During the inbreeding generations, the same loss of vigor was noted as was discovered by Shull and East. An added loss of size and vigor was typical of the greenhouse generations, and the ears averaged about two inches in length; yet the grains were of normal size.

After four generations of inbreeding and strict selection I planted seeds from several ears in a garden, an ear to a row. Plants in each row were marked by some peculiarity: row D plants were fairly tall and the stalks were of normal diameter but they did not grow erect; row F plants had so many branches (suckers) near the base that it looked like bunches of grass and produced but few ears; row C plants grew erect but the stalks were slender and the ears were small.

Just as expected, crossing two of the better strains produced seeds which were not superior in any apparent manner, but when planted they grew into uniform, vigorous corn plants.

After some years I planted the second filial generation of a popular sweet corn hybrid. The first filial generation is the one which usually is planted commercially, and it had been vigorous and uniform; but the second generation was otherwise. Both the stalks and ears lacked uniformity in length and vigor, and although the grains were supposed to be yellow, some were white. Lack of vigor was apparent also in the abundance of smut.

Farmers buy fresh hybrid seed each year to avoid such losses. Once the planning of intelligent beings is stopped, corn reverts and becomes inferior. This is the rule in nature, and this species illustrates the principle fully.

Relationship to "Evolution"

Quite evident from the above observations is the fact that hybrid corn is the product of human intelligence; the methods employed do not describe the working of unaided natural event. The idea that plants have developed from so-called simple beginnings by natural means, and struggle among themselves, is not elucidated in the least degree by the glorious success of man with production of hybrid corn.

Indeed, production of hybrid corn illustrates even the limitation of man. To make further improvement, breeders do not take the best inbred strains and attempt to make them better. Instead, they go back to open pollinated corn and employ the same slow, careful hybridization process to make new inbred strains, which may contain a better collection of genes for some soil or climate.

James F. Kidwell mentioned the following possibilities of change in an inbred strain: "1) reverse mutation, 2) linkage, 3) interactions among loci (epistasis), 4) genotype-environment interaction, 5) changing selective value for any reason."[6]

Then he stated that all of these possibilities are so slight that they will make no difference in the mathematical formulas used by geneticists.

Of course all geneticists know that environmental influence, otherwise known as "acquired characters," are not inherited. As for the other changes, practical corn breeders know that such changes would not be an improvement and would be discarded on the conveyor belt when seed corn is harvested.

If corn had developed from some "simple" plant, such as an alga, it would necessarily have been by the introduction of many new and improved genes. Instead of introducing new genes, the remarkable process of making *Zea mays* more useful to man involves experts rejecting undesired genes and collecting other genes into more desirable groups.

Charles Darwin assumed that the improvement accomplished by man was a true sample of the working of natural events.[7] Clearly that assumption was a mistake with regard to hybridization of corn.

Notes and References

[1]Jenkins, Merle T. *Corn Improvement.* U.S.D.A. Yearbook 1936, p. 460.

[2]The few fertile mules which have been observed are explained thus:

> Curiously enough there is no evidence that viable eggs produced by mules ever contain any of the chromosomes which the mule received from the jack. Thus, if a fertile mare mule is bred to a stallion, the colt is a typical horse colt, with no evidence of its donkey ancestry. Conversely, when a fertile mare mule is bred to a jack, the colt is a perfect mule. Obviously the eggs contain only horse chromosomes in these instances. (L. H. Snyder and P. R. David, *Principles of Heredity.* Fifth Edition. Heath, p. 242.)

[3]Vigendre Das, L. D. *Journal of Heredity,* Vol. 61, p. 290.

[4]Snyder, L. H. and P. R. David, *Op. cit.,* p. 232ff. Appearance of viable offspring when a cross between genera occurs is very exceptional. However, since classification is based on morphology, while crossing depends upon similar cytology, the two genera may not be so different physiologically and genetically as they appear outwardly.

[5]As one researcher stated:

> The studies just discussed lead to the conclusion that there is a long-time stability in the genetic basis of particular characters but such a stability has often been questioned. The author then adds that some say genes must have changed if evolution be true. (A. H. Sturtevant, *A History of Genetics.* Harper & Row, 1965, p. 115.)

[6]Kidwell, J. F. Effect of mutation and selection, *Journal of Heredity,* Vol. 62, p. 210.

[7]Found repeatedly in *Origin of Species* by Charles Darwin.

LET THE OCEANS SPEAK

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Drawing from recent studies of the oceans, the author shows that there is much evidence for a young Earth. The amounts of various minerals dissolved in sea water, for instance, would have taken only a tiny fraction of the age of the Earth to accumulate, even according to the position of uniformitarian concepts. A similar statement may be made about the sediment at the bottom of the ocean.

Introduction

Creationists are certain that the Bible is accurate, authoritative, and trustworthy in every field of knowledge whether that be theological, historical, scientific, or any other. The Bible contains a very definite and precise chronological timetable that begins with the creation of this world and the first man, Adam, and covers the great historical events of the first 11,000 years of history.[1]

Actually evidence in the secular record is not at all in disagreement with the sacred record, and the sacred record can be used to place the secular record in proper perspective. Because the Bible is true and accurate in its accounts of people, places, and time, men can use it to distinguish between what is true and false about the secular viewpoints.

Data from the observable universe concerning the earth's past history is becoming increasingly available as men search out the secrets of the universe. But is the world far older than 13,000 years as deduced from biblical evidence? Can creationists really expect to find correlation between the Biblical and secular records, if they insist on the literal interpretation of the creation story and the flood account? Isn't the evidence for a world that is billions of years old so conclusive that it is hardly worthwhile even to expect complete reconciliation between the Bible and true science?

A point must be emphasized. Because this world is under the bondage of decay with much of the record confused and obliterated by storms, floods, decay, fire, pestilence, and so forth, modern man cannot expect to reconstruct the history

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