GENETICS

1,000 Mutations of Corn

Over 1,000 radiation-induced mutations of corn found in special study. Some of these freaks of the plant world are descendants of A-bomb irradiated seeds.

➤ MORE THAN 1,000 radiation-induced mutations of corn have been found by California Institute of Technology biologists in a special study at their Biology Experimental Farm in Arcadia.

Some of these freaks of the plant world, among them dwarf, twisted, frail and blue-fluorescent varieties, were grown from descendants of A-bomb irradiated seeds. Others sprang from seeds subjected to large doses of X-rays and other types of radiation.

The mutations are being used to study heredity and transmitted traits. The plants also provide a direct method of determining radiation effects on food crops and other flora and perhaps indirectly on human beings. Measuring the biological effects offers an indirect method of determining the amount of radiant energy involved in an A-bomb explosion.

Correlations have been established between biological effects and the measurements made with such instruments as the Geiger and scintillation counters, permitting one method to be used as a check on the other in some cases.

The Caltech work in radiation genetics is supported by the Atomic Energy Commission through the Office of Naval Research. Dr. Ernest G. Anderson, professor of genetics, is in charge of the farm. His colleagues in the program include Drs. Albert E. Longley, E. E. Dale and Howard J. Teas.

Hundreds of mutations were found by the scientists in progeny of seeds exposed in the Bikini "Able" bomb test in 1946 and more than a thousand in descendants of seeds irradiated in the Eniwetok test of 1948, Dr. Anderson reports. So many were discovered that only the more interesting variations are being studied intensively, he said.

The seeds exposed at Bikini, however, were commercial varieties in which many mutants might have occurred naturally. Careful analysis and selection reduced the number of mutations positively identified as radiation-induced in the Bikini "crop" to 60.

This sifting was not necessary in the Eniwetok "crop," for all the seeds exposed there were supplied by Dr. Anderson from stocks at the Farm known to be free of mutations and to have constant characteristics throughout.

The principal effect in the mutants as a group, in 46 of the 60 positively identified Bikini mutations, for example, was noted on chlorophyll, the green coloring matter of the plant which uses sunlight to convert air and water into food. Many of these mutants showed a mottling or mosaic of normal green with abnormally pale green, yellow or colorless areas. Some were albinos.

The remainder, Dr. Anderson states, run the gamut of known mutations and added many more. "Virtually everything described previously as a mutation has been picked up in the bomb-exposed material," he said.

Variants included dwarfed and grasslike corn, plants with elongated stems, plants without silks or kernels, others with twisted and contorted leaves and no ears, delicate plants which wither in the noonday sun and still others differing from normal only in that they glow an eerie blue under ultraviolet light.

In one rather extreme type the seeds germinate prematurely on the ears. Ordinarily, a seed forms on an ear, matures, dries and germinates when it is planted in soil. But in some mutants one in four seeds is abnormal, germinates on the ear and 100 or more little corn plants may grow directly from the ear.

The variants are produced by the mixture of many types of radiations, gamma, neutron, alpha-particle, etc., from atomic explosions which damaged or changed the trait-carrying elements of the corn's reproductive system.

Heredity is carried out in sexually reproducing plants and animals by the chromosomes. These fine threads of nucleoprotein can be seen with a microscope in the nuclei of dividing cells. They are made up of many thousands of submicroscopic units called genes, whose action controls the development of inherited characteristics.

Each cell of a plant or animal contains both chromosomes and genes in pairs. They come from the parent plant or animal—one of the pair coming through the sperm and the other through the egg. Such a changed characteristic is inherited when mutation occurs.

One Bikini sample, he said, showed an effect about equal to that produced by 15,000 r-units (roentgen units, a measure of dosage) of X-radiation. (According to the AEC publication, *The Effects of Atomic Weapons:* ". . . Published estimates of the dose that might be expected to double the (normal) gene mutation rate in man range from as low as 3 r to as high as 300 r and it is conceivable that the true value lies outside these limits.")

Later tests involving Eniwetok bomb radiation, gamma rays and X-rays have given data in fair agreement with the Bikini test, according to Dr. Anderson.

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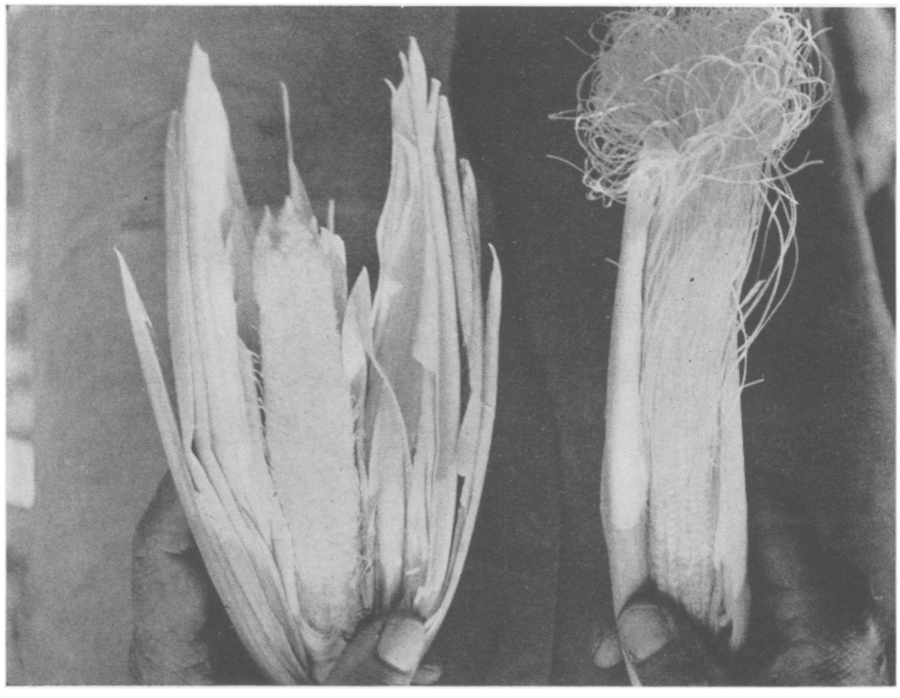

MUTATED CORN—The normal ear of the corn on the left contrasts sharply with an Eniwetok mutant which produces no kernels or silk shown on the right. This freak plant is a descendant of corn exposed to unspecified amounts of radiation during the Pacific A-bomb tests.