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THE USE OF NEUTRONS AND OTHER IONIZING RADIATIONS

IN THE

BROOKHAVEN MUTATIONS PROGRAM *

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In 1952 Drs. Curtis, Singleton and Sparrow began a program at Brookhaven National Laboratory which gave scientists the opportunity to have plant material treated with various ionizing radiations. This program was started to aid plant scientists in developing crop varieties by using mutation plant breeding.

This laboratory has various radiation facilities available, namely the Brookhaven Graphite Research Reactor (BGRR) which has a thermal column that is relatively free of gamma rays. To produce fast neutrons a uranium-235 fission plate is inserted in the thermal column. A 13 (ca 5.3 hectares) acre gamma field with a 3,500 c cobalt-60 source is used for exposing plant material to acute and chronic gamma treatments. A gamma greenhouse with a 15 c cobalt-60 source is used for irradiating growing plants. The Biology Department also has a 250 kVp x-ray machine. A kilocurie cobalt-60 gamma source is available in the Nuclear Engineering Department that is used for irradiating samples of plant material.

Six cesium-137 gamma sources are located in the new Controlled Environment Research Facility (CERF). Growth chambers and rooms are available in this research area, which enables the investigator to expose growing plants to gamma rays under a controlled environment of temperature, humidity, light intensity and duration. One of the sources has 12,000 c of cesium-137. This particular facility has an internal irradiator in which seeds or small amounts of plant material can be placed and lowered to the source.

At the present time, approximately half of the irradiations in Brookhaven's Mutation Program are done for plant breeders, the remainder are done for geneticists. The total number of irradiations has decreased in the past few years. One reason for the reduction in irradiations at Brookhaven has probably been due to the number of other irradiation facilities that have become available throughout the world.

The Brookhaven Mutations Program has played a role in many applied mutation research projects, i.e., many improved varieties of crops have been developed as a result of mutation breeding programs. The plant material was initially irradiated at Brookhaven or at, e.g., Oak Ridge National Laboratory or some other such facility in the world. The number of varieties being produced by using the mutation breeding technique is becoming quite large. A list of the varieties in the U. S. that were developed by mutation breeding was given by Miksche and Shapiro (1). Another list was given by Brock (2); his list includes varieties from various places in the world. This mutations program has also played a role in many fundamental mutation research projects.

In 1955-1956 the largest number of irradiations were performed in conjunction with the Brookhaven Mutations Program (1). Plant breeding and mutation plant breeding are both long term ventures. Approximately a decade has passed since the largest number of irradiations were performed at Brookhaven and this is approximately the time needed to produce and test a variety. This is one of the reasons that more varieties have not been released to date— assuming that the number of

irradiations done at Brookhaven in 1955-1956 is a guide to the world wide interest in mutation breeding. Probably in the future many more varieties will be released that are products of mutation breeding programs.

Mutation breeding is a relatively new technique and information is very scarce on treatment doses and types of radiation that will produce the maximum yield of beneficial mutations. Some of the information on dosages is obtained from scientists that use this program. Because of the lack of information, on the type of radiation to use, both neutrons, x- and gamma rays are employed in Brookhaven's Mutation Program.

Extensive data are available on the doses of radiation required to produce various levels of response on growing plants (3). There is a relatively small amount of data available on irradiation response with seeds. However, some data are now becoming available, e.g., Osborne and Lunden (4); Gomez-Campo and Delgado (5).

As the science of mutation induction develops more effort will be invested in developing improved varieties by using the mutation breeding technique. Currently, there are many papers being published on mutation breeding [e.g., Gaul (6)].

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