Atom Helps Breeders Search for Hybrids

From radiation tests with pearl millet, two mutant plants have resulted that present the possibility for a revolution in hybrid seed production.

Pearl millet is a major livestock feed crop in the United States and a human food crop in many parts of Asia, Africa, and Europe. Plant geneticist Wayne W. Hanna and his colleagues at the Coastal Plain Experiment Station, Tifton, Ga. have been testing the response of millet to radiation in hopes of improving the crop as a forage and food source. The Station is part of USDA's Agricultural Research Service.

Several mutations were by products of those tests, but two in particular show special promise. One is a genetic female sterile and the other a facultative apomict. The two have started the scientists down the road toward possibilities that are, at the very least, fascinating. Here is that story.

In general, grasses may cross with any other plant of its species or with itself. The goal in breeding work is to cross specific plant with only certain ones serving as the male and female parents, therefore these plants need to be pollinated by hand or isolated to assure the desired cross.

In some crops, such as millet, plant breeders have been able to develop male steriles which serve as female parents to produce hybrid seed when pollinated with the intended male parent plants. The male parent can still self pollinate and produce seeds, therefore, the male and female parents must be separated in the seed production field so the seeds do not get mixed.

Now a female sterile gene has been isolated in pearl millet. With proper genetic manipulation of the female sterile gene, it would be possible to combine seed of the male parent (female sterile) and female parent (cytoplasmic male sterile) and plant the two parents together in the seed producing field. All plants would be harvested. The very small percentage of self-pollinated seed produced would not affect yield of pearl millet.

This much alone holds promise for simplifying seed production and conserving and area. But that is just the beginning.

Pearl millet is one of several plants known to exhibit facultative apomixis, that is, it produces seeds in two ways: sexually, through fertilization of an egg from the female by the sperm from the male, or apomictically, whereby the embryo develops from vegetative cells without fertilization of an egg.

Plants from these latter seeds are genetically identical to the parent. If a high quality hybrid were produced that was apomictic, seeds from the first generation could be saved to produce a second generation that was identical to the parent - with no loss in hybrid vigor. The same would be true for the future generations.

Usually, sexually produced hybrids have to be produced each year since advantages of hybridization decrease with each succeeding generation.

In the ARS investigations, Dr. Hanna reports that only 25 percent of the seeds of a pearl millet mutant were produced by apomixis. To get the full advantage in hybrid production, obligate (100 percent) apomixis would be desired. Here the female sterile trait enters the picture.

With appropriate crosses, the female sterile is being used to eliminate the sexual tissue in facultative apomictic plants. Hopefully, this will encourage the vegetative cells to produce an embryo, thus enhancing apomixis. Appropriate genetic manipulation would bring this to the obligate point.

Apomixis is probably present in most species or at least in a related or wild species. Special efforts should be made to discover this valuable plant breeding tool, Dr. Hanna said.

Being able to grow "perpetual hybrids" like this would have great potential, especially for the developing nations of the world which desperately need the additional yield that high quality hybrids could provide. At present the cost of buying new hybrid seed each year may be prohibitive or simply unacceptable. Using apomictic hybrids, farmers could save seed from each crop to plant the next season without losing hybrid vigor.

Similar advantages are also possible for the seed industry. Each year, seed - producers must being with the original parents lines and produce the hybrids for a new seed crop. Eliminating this step would save money on seed production which could be passed on to farmers and consumers, with the additional potential of increasing total food supplies at the same time. Apomixis would lessen the need for highly trained production people and would increase the opportunity for breeders to use superior gene combination in hybrids.