Tetraploid Caducous Bract Cotton

H. Muramoto, Associate Professor, Department of Plant Sciences

Summary

After many years of hybridization and selection, a caducous bract (bracts which fall before the bolls open) tetraploid cotton was developed. This would mean cleaner cotton that would give an economic benefit to cotton growers, and hopefully, it would alleviate the sufferings from Byssinosis or "Brown-lungs" disease among cotton textile mill workers.

******

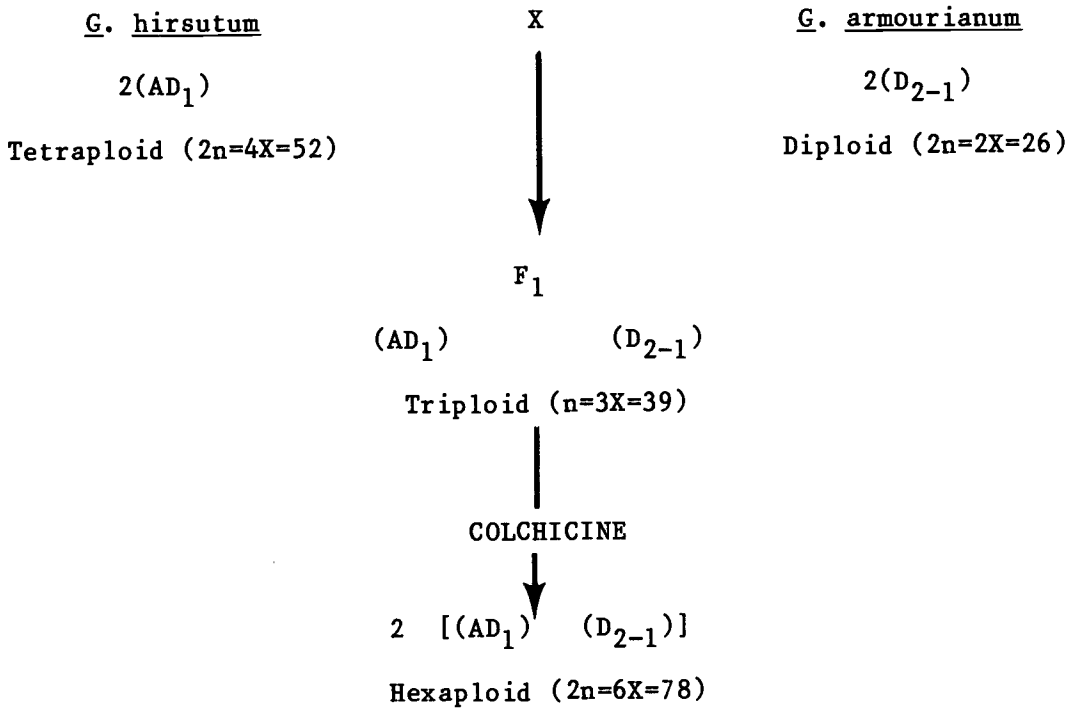
The development of a caducous bract tetraploid cotton would mean cleaner cotton that would grade higher for an economic benefit to cotton farmers; and hopefully, it would alleviate the sufferings from Byssinosis or "Brown lungs" disease among cotton textile mill workers. There are approximately half-million textile mill workers who are potential victims of this disease in the United States, and worldwide, there are between 2-3 million textile mill workers. The exact cause of the disease is still under investigation, and undetermined, but it is known to be caused by cotton dust of organic origin. The chief suspect is the bract. Experiments using water extract of different parts of the cotton plant to challenge human volunteers showed that only the bract extract was active in causing byssinotic symptoms among the volunteers. So, it was suggested that cotton breeders develop a bractless cotton.

All commercial cultivars have persistant bracts which adhere to the seed cotton when the bolls open. In the harvesting operation they shatter and are picked with the cotton. In the ginning operation the bract particles are further pulverized, and become a major component of cotton dust that is baled with the cotton lint. In the processing of cotton into threads, the bales are opened, blended, and carded to get the fibers parallel before spinning. In the carding operation, the pulverized bracts together with other cotton dust are released into the air which the mill workers breath. Prolong exposure to cotton dust by mill workers develop into the illness called Byssinosis or "Brown-lungs."

Our efforts to develop a bractless cotton was initiated over 15 years ago. Since all commercial cultivars had persistant bracts, we had to look elsewhere. A search was made among the relatives of cotton in the genus Gossypium. In searching the literature, two wild lintless diploid species, both endemic to the Gulf of California region in Mexico were found to have a trait worthy of consideration. These two species did not have bractless bolls, but had caducous bracts -- bracts which fall before the bolls open. Since both species were diploids, our task was complicated. We decided to first make an hexaploid cotton to see if the caducous bract trait could be identified in the presence of chromosomes and genes of commercial cotton. Once this was accomplished, a back-cross program was initiated to transfer the caducous bract trait to commercial cultivars. The back-cross program involved transferring the trait from a 78 chromosome cotton to a 52 chromosome cotton.

Caducous bract hexaploid cotton plants (2n=6X=78) were developed by hybridizing an American wild lintless relative of our commercial cotton, G. armourianum (2n=2X=26) with commercial cultivars G. hirsutum (2n=4X=52) and

doubling the chromosome number of the sterile hybrids with colchicine as shown in the following diagram:



Fertility was a problem at first, as is the case with all newly man made cottons, but after several years of selection, fertility was restored and a breeding population of hexaploid cotton was established. After the population was allowed to open pollinate for several years, selection for caducous bract plants was initiated.

Once caducous bract hexaploid cottons were selected, a back-crossing program was initiated. With the aid of a research grant from the National Institute of Occupational Safety and Health (NIOSH), a technician and a graduate student were employed to assist in the expansion of the research involving the growing of two crops a year - one in the field and another in the greenhouse during the winter months. When the grant was terminated three years later, we had transferred the caducous bract trait from a 78 chromosome hexaploid through a pentaploid with 65 chromosomes to three aneuploids with 57, 58, and 60 chromosomes. Many cuttings were made of these plants and rooted, so clones were available for use in the second back-crossing cycle. The caducous bract aneuploids were back-crossed to several commercial cultivars used as the recurrent parents. The second back-cross cycle was made in the greenhouse in 1982. Seed from these crosses were planted in the field in 1982 and allowed to self-pollinate. The progenies from these plants were grown in 1983 and from this population three caducous bract plants were selected. Chromosome counts showed these plants were all trisomics with 53 chromosomes. A few seeds from these plants were grown in the greenhouse for evaluation with the rest of the seeds planted in the field in 1984. Several caducous bract plants were selected from these populations, and chromosome counts showed that these plants have 52 chromosomes. The caducous bract transfer from hexaploid to tetraploid is graphically illustrated in Figure 1. Seeds from these plants are now being grown in the greenhouse and the rest will be planted in the field for further evaluation to check whether the

caducous bract trait is breeding true. If, the progenies all show the caducous bract trait, its mode of inheritance will be studied and plans will be made to release the caducous bract cotton to the public.

Transfer of caducous bract trait from Hexaploid to Tetraploid cotton.