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Breeding Cotton

Cotton (*Gossypium* spp.) has been cultivated in tropical and subtropical climates of the world since prehistoric times and is now cultivated extensively in the temperate climates. In India, cotton has been an important crop for more than 3000 years. Cotton was grown and used for clothing in Brazil, Peru, and Mexico long before the discovery of America. With the colonization of North America, cotton was one of the first crops to be cultivated in the South, and the cotton industry has been inextricably linked with the development of that area ever since.

In the beginning, many kinds of cotton were grown across the area that is now the U.S. Cotton Belt. After unsuccessful attempts to introduce cotton from the Mediterranean area, stocks were imported from Mexico, South America, and the West Indies. The early importations were perennial in their growth habit, or they required a photoperiod different from that found in the latitude of the southern states. They varied in boll size, staple length, fiber strength, plant type, and many other respects. Possessing great genetic plasticity, they were eventually molded into earlier maturing, productive varietal types. This was a major breeding achievement. The early history of cotton improvement in the United States has been described by Ware in the 1936 USDA Yearbook.

There are still many problems with cotton that can be solved best by plant improvement. Diseases and insects continue to take large tolls from the potential cotton production, a loss that could be reduced with multiple-resistance varieties. The potential of hybrid cotton has yet to be utilized. Changes in cultural practices increase the need for new short-season, rapid-maturing varieties.

Cotton is classified in the genus *Gossypium,* which according to Fryxell contains 39 species, of which, 33 are diploid and 6 are tetraploid species. The diploid species ($2n = 2x = 26$) are grouped in seven genomes designated *A, B, C, D, E, F,* and *G* (Table 20.1). The species with the *A, B, E,* or *F* genomes are African or Asian in origin and often are referred to as Old World species; the

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TABLE 20.1
Some Representative Species of *Gossypium* Grouped by Chromosome Number and Geographic Origin[a]

Species	Chromosomes 2n	Chromosomes Size	Genome symbol	Geographic origin	Cultivation
Diploid species from Asia, Africa, and Australia					
G. herbaceum	26	Large	A_1	Africa	Cultivated
G. aboreum	26	Large	A_2	India	Cultivated
G. anomalum	26	Medium	B_1	Africa	Wild
G. sturtianum	26	Large	C_1	Australia	Wild
G. stocksii	26	Large	E_1	Indo-Arabia	Wild
G. longicalyx	26	Large	F_1	Africa	Wild
G. bickii	26	Large	G_1	Australia	Wild
Diploid species from America					
G. thurberi	26	Small	D_1	America	Wild
G. armourianum	26	Small	D_2	America	Wild
Tetraploid species					
G. hirsutum	52	26 large, 26 small	$(AD)_1$	America	Cultivated
G. barbadense	52	26 large, 26 small	$(AD)_2$	America	Cultivated
G. tomentosum	52	26 large, 26 small	$(AD)_3$	Hawaii	Wild
G. caicoense	52	26 large, 26 small	$(AD)_4$	Brazil	Wild

[a]Adapted from Fryxell (1979, 1984), Phillips (1974), and Endrizzi, *et al.* (1984).

species with the *C* or *G* genomes are Australian in origin; the species containing the *D* genome are New World species, having originated in the Americas. The American diploid species grow wild from Arizona to Peru, but mostly they are found in Mexico. The chromosomes of the American diploid species are smaller than the chromosomes of the African and Asian species. Of the six tetraploid species ($2n = 2x = 52$), five are indigenous to the Americas and one to Hawaii. They originated as allotetraploids with the *AADD* genome combination and have 26 small and 26 large chromosomes (Fig. 20.1). The origin was demonstrated experimentally by crossing *G. arboreum* (*A* genome, $2n = 26$) × *G. thurberi* (*D* genome, $2n = 26$) and doubling the chromosomes of the sterile hybrid with colchicine. The resulting amphidiploid (*AADD*, $2n = 52$) could be crossed with American tetraploid cottons, the cross producing fertile hybrids. There is a high degree of chromosome homology among most species with the same chromosome number and from the same geographic area. The fact that homology is not complete indicates a certain degree of differentiation in the chromosome complement.

Four species of *Gossypium* with spinnable seed fibers, called *lint,* have been domesticated and form the cultivated cottons. They include two diploid species, *G. arboreum* L. and *G. herbaceum* L., and two tetraploid species, *G. hirsutum* L. and *G. barbadense* L. *Gossypium herbaceum* originated in the Middle East and may have been the earliest cotton cultivated. It was carried to India, where it became the progenitor of *G. arboreum*. *Gossypium arboreum* is widely