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Preliminary Evidence that a Single, Dominant Gene Determines Hairiness on Leaves and Twigs of Chinese Chestnut

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The leaves and twigs of American chestnut trees are relatively hairless cornpared to Chinese chestnut. This difference may be useful in backcrossing the blight resistance of the Chinese chestnut tree into American chestnut. Blight resistance is the only desired characteristic from the Chinese parent. Selecting blight-resistant progeny for American chestnut characteristics may accelerate the elimination of undesirable characteristics from Chinese chestnut, such as poor forest competitive ness. This would be possible if hairiness is not tightly linked with blight resistance. If it is linked with blight resistance, then it might facilitate selection of blight-resistant progeny.

Leaf and twig hairiness would be most useful in selecting for American chestnut characteristics if it were inherited from Chinese chestnut as a single dominant gene, because the trait would be possessed by about one-half of the progeny from backcrosses to the American chestnut. This study was undertaken to examine the inheritance of leaf and twig hairiness in first hybrids of Chinese and American chestnut and in progeny of backcrosses to both parents.

Material and Methods

Leaves growing in full sunlight were collected from 22 progeny of crosses between Chinese and American chestnut trees (Fl first hybrids), and 41 progeny of backcrosses of Chinese x American first hybrids to American chestnut (B1). In the case of seedlings in their first year of growth, leaves were collected in October from the youngest growth on the plant. In the field, I examined leaves and twigs of 183 progeny of a backcross of a Chinese x American first hybrid to a Chinese chestnut (Chinese B1). During the year in which leaves were collected or examined, all plants had only been growing in the field.

The collected leaves were examined at lOx magnification for the presence of hairs (simple and stellate non-glabrous trichomes) on interveinal portions of the larnina. American chestnut leaves do have simple hairs on their mid ribs and secondary veins, but very few simple or stellate hairs on interveinal portions of the lamina. Leaves were considered hairy if some interveinal portions had more than 10 hairs per square centimeter. When it was difficult to distinguish simple and stellate hairs, the leaves were examined at up to loOx magnification.

Twigs of American chestnut possess simple hairs, but they are sparse and short and not visible to the naked eye. Twigs of Chinese chestnut are hirsute. Twigs were examined for the presence of hairs at the time of leaf collection, without the aid of magnification.

Results and Discussion

Six out of nine Chinese chestnut trees only had first-hybrid progeny with hairy leaves (Table 1). Furthermore, hairy leaves occurred on all 183 progeny of a backcross of one of these first-hybrids to Chinese chestnut. These data indicate that the hairiness trait in those six Chinese parents is dominant. One Chinese chestnut parent (cv Nanking, Table 1) had both hairy and hairless progeny, and two parents (PI 7273 and LF, Table 1) had only hairless progeny. The hairless progeny were either in their first year of growth (cv Nanking and PI 7273) or were less than 30 cm tall (LF), suggesting that leaf hairiness is not always expressed in juvenile leaves when plants are heterozygous for the trait.

All of the older hybrids had both simple and stellate leaf hairs. Some of the hairy 0-year-old progeny had only simple leaf hairs whereas others had both simple and stellate leaf hairs. Juvenile leaves of Chinese chestnut also may possess only simple hairs, although all leaves of Chinese chestnut seedlings growing in full sunlight are hairy. This indicates that juvenile leaves develop simple hairs more readily than stellate hairs.

All Fl progeny with hairy twigs also had hairy leaves, but some 0-year-old progeny with hairy leaves had hairless twigs. Chinese chestnut seedlings always have hairy twigs, as did all 183 first back-crosses to Chinese chestnut. This suggests that juvenile leaves of heterozygous plants develop hairs more readily than juvenile twigs, but that additional, epistatic factors modify expression of hairiness in juvenile twigs. The expression of simple leaf

hairs, stellate leaf hairs, and twig hairs appears to be controlled by a common mechanism. It will be interesting to follow the development of leaf and twig hairs on the 0-year-old progeny in coming years.

Hairs occurred on the leaves of some backcross progeny from all four Chinese chestnut grandparents (Table 2). About one half of the backcross progeny had hairless leaves, while one half had hairy leaves. The ratio of hairy-leaved to hair-less-leaved progeny fit the 1:1 ratio expected if one dominant gene in Chinese chestnut controls the hairiness trait ($p > .5$). The 3:1 ratio expected if two genes control the trait did not fit ($p < .005$). However, there is evidence of heterogeneity in expression of the trait among the progeny of different Chinese chestnut grand parents (Table 2). We also do not know whether any hairless 0-year-old progeny will become hairy in subsequent years. More time and more progeny will confirm whether leaf and twig hairiness in Chinese chestnut is indeed controlled by a single dominant gene, as these results suggest.