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Allelism for the White-Flowered Phenotype in Sixteen Diverse Peach Clones

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Abstract

Controlled crosses were made to test 16 diverse peach [*Prunus persica* (L.) Batsch] clones for allelism of the white-flowered (anthocyanin deficient) phenotype. Most of the F 1 progeny were anthocyanin deficient, but an occasional anthocyanin positive seedling occurred, presumably due to outcrossing in the field. The results showed that all sixteen white-flowered peach clones tested are allelic for the anthocyanin deficient phenotype.

Additional index words. *Prunus persica, flowers, anthocyanin, tree fruits, genetics.*

Introduction

The petals of wild-type peach flowers are pink. Peach fruit and leaves are reported to produce more than one type of anthocyanin (7, 13), but cyanidin-3-glucoside is the predominant anthocyanin in peach petals (1). Peach trees with red, white, or variegated flowers also exist. Lammerts (8) demonstrated that the white flowered phenotype is controlled by the *W* (white-flowered) locus. Individuals that are homozygous recessive *ww* are white flowered and are anthocyanin deficient in all plant parts. The *W* locus exerts recessive epistatic control over the pink/red flower locus (*R*) and the red/green leaf locus (*Gr*), (1). White-flowered peach trees have been in existence for hundreds and possibly thousands of years. Downing and Downing (2) described two white-flowered clones; 'Snow' and 'White-Blossomed Incomparable.' Hedrick (4)

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described the white-flowered clones 'Summer Snow,' 'Snow,' and White-Blossomed Incomparable.' Hesse (6) listed two white-flowered clones; 'La Niege' and 'Summer Snow.' Werner et al. (11) described the white-flowered clone 'White Glory.' Numerous white-flowered peach clones of diverse genetic backgrounds exist. The white-flowered phenotypes of *Petunia hybrids* Hort. have been shown to be controlled by mutations at more than one locus (12). Chaparro et al. (1) showed that the three white-flowered peach clones 'Pillar' (variegated pink and white), 'White Glory,' and 'White English' are allelic for the white-flowered phenotype. The purpose of this study was to cross white-flowered peach clones from several diverse germplasm collections to determine if more than one locus controls this phenotype.

Materials and Methods

Pollen from diverse white-flowered peach clones was obtained from several germplasm collections (Table 1). Controlled pollinations were made using several white-flowered trees in our peach germplasm collection. All female (seed) parents were white-flowered F2 descendants from 'White Glory.' Crosses were made in the field, and in the Horticultural Science greenhouses in 1993 and 1994, respectively. Seed was harvested from the crosses at fruit maturity and stratified at 4C until the chilling requirements were satisfied. Seeds were planted in a greenhouse in early spring. Seedling trees were evaluated for the presence of anthocyanin about 60-90 days after germination. White-flowered trees are deficient for anthocyanin, but wild-type trees will produce anthocyanin in sun exposed stem tissue.

Table 1. Peach pollen parents used in the white-flowered allelism study, and their origin.

Clone	Source
Albaplena #80114-1	Arkansas, USA
Albo 64-0	France
B8-20-171	New Jersey, USA
Boliviano	Mexico
BY82P6221	Georgia, USA
BY84N1820	Georgia, USA
Juseitou	Japan
Mirica	Italy
Nakateshiro	Japan
Okinawa[z]	France
P-40-85	California, USA
Peruvanq	Mexico
Shiroshidare	Japan
TSU-5	Georgia, USA
WV #47-211	West Virginia, USA

[z]Original 'Okinawa' introduced into the U.S. had pink flowers (W. Sherman, personal communication). The 'Okinawa' clone provided by Dr. Monet has white flowers, suggesting a mutation to the white-flowered phenotype, or misidentification.

Results

Pollen from sixteen diverse white-flowered peach clones crossed to white-flowered testers in the North Carolina State University germplasm collection yielded F1 progeny that were predominantly anthocyanin deficient (Table 2). In 1993, crosses made in the field produced an occasional F1 seedling that produced anthocyanin (Table 2). The F1 progeny that produced anthocyanin were presumably due to accidental outcrossing in the field. Many crosses conducted in the field in 1993 were repeated in the greenhouse in 1994. No seedlings that produced anthocyanin were recovered from the crosses made in the greenhouse (Table 2). Because all female testers used carried the white-flowered gene derived from 'White Glory' only the name of the male (pollen) parent is listed in Table 2.

Discussion

Seven enzymes are require to produce cyanidin-3-glucoside using malonyl-CoA and p-coumaryl CoA as substrates (5, 10). Different white-flowered mutants of morning glory [*Ipomoea purpurea* (L.) Roth.] (3), petunia [*Petunia x hybrida* Vilm.)] (12) and snapdragon [*Antirrhinum majus*

Table 2. Phenotypic segregation for anthocyanin production in F1 progeny of peach derived from crosses between different white-flowered clones.

White-flowered male parent[z]	Anthocyanin segregation data
1993 Crosses	**Acy-:Acy+[y]**
Albaplena #80114-1	5:4
Albo 64-0	4:2
Boliviano	14:1
BY82P6221	14:1
BY84N1820	10:0
Mirica	3:0
Okinawa	17:0
Peruvanq	14:1
TSU-5	9:0
WV #47-21 1	8:0
1994 Crosses	**Acy-:Acy+**
Albo 64-0	59:0
B8-20-171	47:0
Boliviano	1:0
Juseitou	2:0
Nakateshiro	3:0
Okinawa	19:0
P-40-85	20:0
Peruvanq	15:0
Shiroshidare	13:0

[z]Female parents used in all crosses were white-flowered F2 progeny derived from 'White Glory.'
[y]Acy+ = Individuals producing anthocyanin, Acy- = Individuals lacking anthocyanin.

(L.)] (9) are reported to have mutants at different steps in the anthocyanin pathway. Our results show that peach has a mutation at only one step in the anthocyanin pathway. Over evolutionary history, mutations in the anthocyanin pathway should have yielded non-allelic white-flowered mutants in peach, but no non-allelic clones exist to our knowledge. Chaparro et al. (1) found that the white-flowered phenotype in peach results from a mutation late in the anthocyanin pathway. This suggests that a mutation at any other place in the anthocyanin pathway may be deleterious in peach. In conclusion, our results show that all 16 peach clones tested in this study were allelic for the white-flowered phenotype.

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