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Phenotype of Petal Size in Peach

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Abstract

Classification of peach [*Prunus persica* (L.) Batsch] flowers as large, medium, or small was inconsistent. Petal area and ratio of petal length to width were variable over years and locations. Frequency distribution of petal size in segregating populations was consistent with a quantitatively inherited trait and could not be explained by single gene action. We conclude that flower size should not be used as a descriptive character in peach except in cases where petals are exceptionally large or small. The most accurate description is classification into showy or non-showy forms.

Introduction

Flower and/or petal size has long been used as an identifying characteristic for peach varieties. Hedrick (10), in describing peach varieties, included a measurement of the flower in increments as small as 1/16 inches. The International Board for Plant Genetic Resources includes flower size standards for variety descriptions including five classes ranging from extremely small to extremely large (3).

Early research papers reported that flowers could be classified as large, medium, or small and that flower size was inherited as a single locus with incomplete dominance and small size recessive (1, 7, 8). Considerable doubt was cast on this hypothesis with reports that the medium size class could not be distinguished reliably from the small and that the small form appeared to be dominant (4, 5). Upshall (14) supported the hypothesis that small flower was dominant. He reported on an 'Elberta' sport from the small form to the large form suggesting a mutation to the double recessive from the heterozygote, the most readily observed direction of point mutations. The uncertainty of flower size was clarified when Bailey and French (1942) reported that the small flowered type, termed non-showy, was dominant and that the heterozygote could not be identified visually (2). The dominance of the non-showy form was further confirmed with later reports on the inheritance of flower type (11, 15).

Lammerts (11) also proposed a model on the genetic control of petal size in the showy flower type. He reported that in a segregating F_2 population, a dominant gene conferred large petal size in the showy flower type (shsh) with incomplete dominance (LI) which, if acting independantly of the Sh/sh Locus, would allow for three size classes within the showy flower type. Thus, three petal size classes are presumed in the non-showy flower type making a total of six classes. Blake and Edgerton (6) later expanded this model by incorporating three petal types (round showy, ovate showy, and non-showy) with large, medium, and small size classes for a total of nine petal classes.

The objectives of this study were to clarify the size classification in peach flowers and confirm or reject the model (11) of a major gene controlling petal size.

Materials and Methods

Initially, each clone in the low-chill peach germplasm collection (135 clones) at the University of Florida, Gainesville was classified as large, medium, or small based on field observations. These classifications were used to identify families that segregated for petal size in the F_2 families. The flowers in these families also were

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classified as large, medium, or small and analyzed by Chi Square goodness of fit test (12).

Ten petals from each of the 135 clones were measured for area in the spring and autumn of 1993 (some autumn bloom occurs with premature defoliation and is common at Gainesville) and the spring of 1994, in order to determine if there were identifiable size classes in peach flowers. In addition, spring 1994 bloom samples were collected at the North Florida Research and Education Center, Monticello, at the University of Georgia Research Center, Attapulgus, and at the USDA Southeastern Research Station at Byron, GA. Clones from each location were paired with clones from Gainesville to analyze for differences. Three to five flowers were collected as a sample from each clone at anthesis. Ten petals from each sample were then photocopied for future measurements. The photocopied petals were colored black manually and then transferred to transparency sheets for measuring with a LI-COR LI-3000A portable leaf area meter.

An analysis of variance, ANOVA, was performed on the ten petals from ten clones to analyze within clone differences (12). A paired data t-test was performed to analyze location effects between Gainesville and each of the other three locations. A paired data t-test was also performed between the spring 1993 and spring 1994 data. An ANOVA was performed using the data from all three seasons, spring 1993, autumn 1993, and spring 1994. A mean separation was done on the data from all three seasons using Duncan's multiple range test (9).

Results and Discussion

The 135 clones of the University of Florida low-chill germplasm collection were used to establish large, medium, and small flower classes. This population is considered by the authors to have a wider genetic base than the

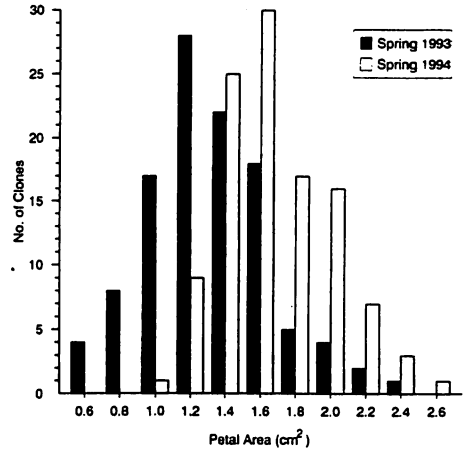

Figure 1. Petal area distribution for 111 showy peach clones in Gainesville in 1993 and 1994.

population studied by Lammerts (11). These classes were used to identify parents and resulting segregating F_2 progenies. The segregation ratios (data not shown) obtained in 6 of 11 F_2 progeny populations did not fit the expectations (Chi squared tests) based on Lammerts (11) model. Five populations fit the model, but 4 of these populations had less than 50 progeny. We concluded that the size classifications of Lammerts (11) were artificial and cannot be used reliably for the identification of segregating size classes of peach flowers. Because of continuous variability among genotypes and scoring ambiguity, further investigations were directed toward petal size.

No within clone effect for petal size was seen over 10 samples of 10 petals each of 10 randomly chosen clones (data not shown). Thus, a 10 petal sample from an individual clone was considered a consistent and accurate sample of petal area and similar samples from multiple clones should portray an accurate array in variation.

Mean measurements of petal area for the 111 showy (Fig. 1) and 24 non-showy (Fig. 2) clones in the Gainesville population for two seasons did not reveal any distinct petal size classes within either the showy or non-showy

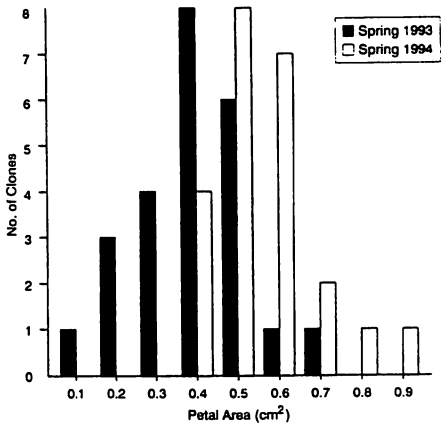

Figure 2. Petal area distribution for 24 non-showy peach clones in Gainesville in 1993 and 1994.

flower types. The petals showed a continuous variation (seen in Fig. 1 and Fig. 2) that was close to normal. The showy type petals had areas from 0.6 to 2.5 cm^2 and from 1.0 to 2.8 cm^2 in spring 1993 and spring 1994, respectively. The non-showy petals had areas of 0.2 to 0.7 cm^2 and from 0.4 to 1.0 cm^2 in spring 1993 and spring 1994, respectively.

An ANOVA of the data from spring 1993, autumn 1993, and spring 1994 of 38 showy clones and 9 non-showy clones revealed petal size differences for the 3 flowering seasons at Gainesville (Table 1). In the showy class mean petal size in spring 1994 was larger than the petal size in the spring 1993 flowers which was larger than the petal size in the autumn 1993 flowers. In the non-showy class, the mean petal area of spring 1994 flowers was larger than the mean area in spring 1993 and autumn 1993 which were not different from each other. Thus, the 3 seasons showed 3 showy and 2 non-showy means that were different and clearly establish significant yearly variability in petal size.

Petal size for showy and non-showy were contrasted for locations that had clones in common (Table 2). No petal size differences in the showy or non-showy flower types between clones in Gainesville and Monticello nor between Gainesville and Attapulgus were seen. Both the showy and non-showy petals from Byron, however, were smaller ($P \leq .05$) than the same clones in Gainesville.

In summary, the differences observed between locations and seasons suggests a substantial environmental effect on size of peach petals as reported for flower size (6). Environmental conditions, especially temperature and rainfall, at the times of flower initiation and development undoubtedly play a major role in the final size of the

Table 1. Mean petal area and range for three successive flowering seasons in showy and non-showy peach flowers.

Flower type	Season	n	Mean (cm^2)	Range (cm^2)	Standard deviation
Showy	Spring 1993	38	1.5 b[x]	0.8-2.0	0.3
	Autumn 1993	38	1.3 a	0.9-2.0	0.2
	Spring 1994	38	1.7 c	1.2-2.6	0.3
Non-showy	Spring 1993	9	0.5 a	0.3-0.7	0.1
	Autumn 1993	9	0.5 a	0.3-0.8	0.1
	Spring 1994	9	0.6 b	0.5-1.0	0.1

[x]Means within showy and non-showy classes followed by the same letter do not differ significantly ($P \leq 0.05$) using Duncan's multiple range test.

Table 2. Peach petal area comparisons between locations for spring 1994.

Flower type	Location	Clones (no.)	Mean area (cm^2)	Range (cm^2)	Standard deviation
Showy	Gainesville	16	1.9 a[1]	1.4-2.6	0.39
	Attapulgus		2.1 a	1.3-3.0	0.55
	Gainesville	3	1.6 c	1.5-1.6	0.06
	Byron		1.2 d	1.2-1.2	0.03
	Gainesville	13	2.0 e	1.3-2.4	0.32
	Monticello		2.1 e	1.2-3.4	0.59
Non-showy	Gainesville	6	0.6 a	0.4-1.0	0.20
	Attapulgus		0.6 a	0.4-0.7	0.10
	Gainesville	4	0.7 c	0.5-1.0	0.20
	Byron		0.6 d	0.4-0.9	0.25
	Gainesville	5	0.7 e	0.5-1.0	0.18
	Monticello		0.7 e	0.5-0.8	0.13

[1]Means with the same letter are not significantly different at $P \leq 0.05$ using paired data t-test.

peach flower. Environmental influences on peach petal size are supported by a report that mean flower size was reduced by NAA application in the autumn (13), suggesting that flower size may be influenced by sink strength during flower bud development. Therefore, accurate classification of flower size may be impossible because of year to year and locational differences in size due to varying environmental conditions. Our conclusion is that flower size is not a reliable descriptive character for peach clones. Only flower characteristics such as showy or non-showy, doubleness, and color should be used.

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