

American Pomological Society U. P. Hedrick award for research paper by a student: (1985 Second Place Award)

Relationship Between Parental Flower Bud Set and Seedling Precociousness in Peach and Nectarine, *Prunus persica* (L.) Batsch

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Abstract

Flower bud set was evaluated in 18-month-old peach and nectarine *Prunus persica* (L.) Batsch seedlings growing in a high density nursery system. Nonsignificant correlations between trunk diameter and flower bud set (-0.3) and between trunk diameter and percent fruiting plants (0.03) were found among 36 families from crosses or open pollination. Crosses with 'EarliGrande' (a light flower bud setter) consistently produced progeny with low bud set, as compared to crosses with Fla. 7-3 (a heavy flower bud setter). The percent of fruiting plants was high in families having Fla. 7-3 as a parent and in families derived from seed parents having a heavy flower bud set. These results indicate that clones with high flower bud set as mature trees tend to produce precocious seedlings. The estimate of narrow sense heritability by midparent-offspring regression for flower bud set in 18-month-old seedlings was 0.55.

Seedlings of most woody plants pass through a juvenile phase during which they cannot be induced to flower. The delay in flowering caused by a long juvenile period may last several years and is one of the major problems limiting genetic advance under selection in most breeding programs (3). The juvenile phase can be shortened considerably in some species by controlling the environment and by various cultural practices (13). Apart from the effect that cultural practices have on the juvenile period, the within and between progeny differences are due to heredity. There appears to be genetic variability for precocity in fruits such as cherries (4), pears (10,

12), pecans (6), and apples (10). Breeding for precocity may not only increase breeding efficiency but may have an additional advantage in commercial production because of the general relationship between short juvenile period, early bearing of grafted trees (9), and high yield (6, 10). The objective of this research was to study the inheritance of flower bud set and its relationship to precociousness in low chilling peach and nectarine germplasm from the University of Florida breeding program.

Materials and Methods

Crosses using 'EarliGrande' (a light flower bud setter) and Fla. 7-3 (a heavy flower bud setter) as pollen parents were made in February and March of 1982. Twelve selections and cultivars with differing degrees of flower bud set were used as seed parents. The 12 open-pollinated families (op) were also included in this study because peaches are highly (95%) self-pollinated. The seedlings were planted in the field in late September of 1982 at 1 m between rows and .2 m within rows. Management of this high density nursery has been described (8).

When the seedlings were 18 months old flower bud set was rated on a scale of 1 to 10; 1 = the lowest or none to 10 = flower bud formation at most of the nodes of terminal branches.

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This research was supported by a grant from the United States-Israel (Binational) Agricultural Research Development Fund (GARD).

Additional Index words. juvenility, breeding, genetics.

Evaluations were made in February during bud swell. Parents which were in an adjacent block and managed as a commercial planting were also scored using the same criteria. Seedling vigor was evaluated as trunk diameter during bloom time, at a height of 0.5 m.

Flower bud set, trunk diameter, and percent of flowering plants were analyzed for correlations. Offspring-midparent values were regressed using a weighted regression procedure to obtain estimates of narrow sense heritability (h^2) for flower bud set (5).

Results and Discussion

Correlation of plant vigor and seedling flower bud set. The possibility that the length of the juvenile phase of a peach or nectarine seedling could be related to its vigor (as measured by trunk diameter) was investigated. The correlations between trunk diameter and flower bud set ($r = 0.29$) and between trunk diameter and percent of fruiting plants ($r = 0.03$) were nonsignificant, indicating that flower bud set has a major genetic component that is unrelated to plant vigor (Table 1). A negative correlation has been found in apple and pear between trunk diameter and length of the juvenile period (11). However, in another report no correlations were found between trunk diameter and the length of the juvenile period in pear progenies (7). Apple triploids

Table 1. Phenotypic correlation matrix among flower bud set, trunk diameter, and fruiting plants in Florida low chilling peach and nectarine seedlings.²

	Trunk diameter	% Fruiting plants
Flower bud set	-0.29 n.s.	0.39 **
Trunk diameter	—	0.03 n.s.

²Correlation between family means $n = 36$. n.s. ** = nonsignificant and significant at $P = 0.01$, respectively.

and tetraploids tend to have longer juvenile periods than diploids even though they may be more vigorous and attain greater size at an earlier age (2). Thus the juvenile period appears to be negatively correlated with tree vigor only within a particular breeding line. Amount of growth and length of the juvenile period in peach appear to be largely independent and selection for short juvenile period cannot be reliably based on trunk diameter.

The average number of fruiting plants per family is correlated with the average rating of flower bud set per family (0.39^{**}). This indicates that seedlings which formed flower buds, had flower buds strong enough to set fruit. This also indicates that flower bud set evaluation can be made in the high density nursery during the first fruiting year.

Inheritance of flower bud set. The narrow sense heritability estimate for degree of flower bud set was 0.55 for the families under study and indicates mainly additive gene action (Fig. 1).

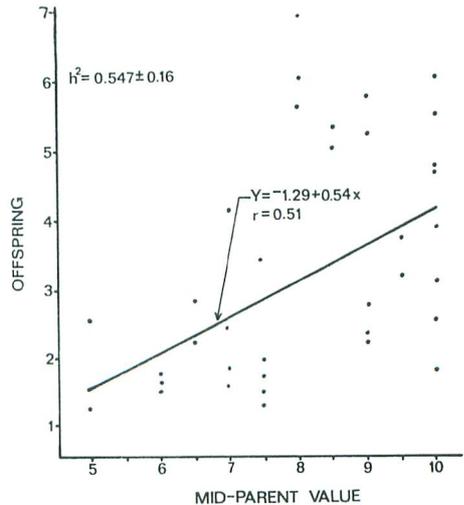


Figure 1. Midparent offspring regression for flower bud set in some Florida low chilling peach and nectarine families (scale used 1 to 10, with 10 being the highest flower bud set).

Table 2. Flower bud set of midparents and their offspring in some Florida low chilling peach and nectarine families.

Cross	Midparent value ^z	N	Progeny mean	SD	Progeny range
Fla. 3-4 OP ^x	10.0	27	5.5	1.8	3-9
Fla. 3-4 X EG ^x	7.5	30	2.0	0.9	1-4
Fla. 3-4 X 7-3	10.0	26	6.1	2.3	1-9
Fla. 5-14 OP	8.0	3	7.0	1.7	5-8
Fla. 5-14 X EG	6.5	16	1.8	1.4	1-6
Fla. 5-14 X 7-3	9.0	7	2.3	2.1	1-7
Fla. 5-15 OP	8.0	26	5.7	2.0	1-9
Fla. 5-15 X EG	6.5	16	2.3	2.7	1-5
Fla. 5-15 X 7-3	9.0	22	5.9	1.2	1-10
Fla. KE15 OP	10.0	19	1.8	0.9	1-3
Fla. KE15 X EG	7.5	16	1.5	0.6	1-3
Fla. KE15 X 7-3	10.0	22	4.8	2.3	1-9
Fla. 5-20 OP	5.0	20	2.6	1.7	1-7
Fla. 5-20 X EG	5.0	8	1.3	0.5	1-2
Fla. 5-20 X 7-3	7.5	28	3.3	1.7	1-7
Fla. 7-11 OP	7.0	22	4.1	2.3	1-7
Fla. 7-11 X EG	6.0	15	1.7	0.9	1-4
Fla. 7-11 X 7-3	8.5	23	5.4	2.4	1-10
Fla. 9-9 OP	10.0	49	2.6	1.6	1-9
Fla. 9-9 X EG	7.5	38	1.7	0.9	1-4
Fla. 9-9 X 7-3	10.0	42	4.7	2.0	1-9
Fla. 9-12 OP	8.0	12	6.1	1.3	4-8
Fla. 9-12 X EG	6.5	12	2.8	1.1	1-5
Fla. 9-12 X 7-3	9.0	18	5.4	2.6	1-9
Fla. 9-16 OP	10.0	29	3.7	2.5	1-9
Fla. 9-16 X EG	7.5	37	1.3	0.6	1-4
Fla. 9-16 X 7-3	10.0	50	3.1	1.7	1-8
Fla. 9-18 OP	9.0	11	2.4	1.7	1-6
Fla. 9-18 X EG	7.0	20	2.4	1.2	1-6
Fla. 9-18 X 7-3	9.5	26	3.2	2.1	1-10
Sunlite OP	7.0	35	1.7	1.1	1-6
Sunlite X EG	6.0	48	1.6	0.9	1-4
Sunlite X 7-3	8.5	31	5.2	2.1	1-10
Sunripe OP	9.0	28	2.7	1.0	1-5
Sunripe X EG	7.0	18	1.6	0.8	1-3
Sunlite X 7-3	9.5	21	3.8	1.8	1-7
EarliGrande	5.0				
Fla. 7-3	10.0				

^zEvaluated in the scale 1 to 10, 10 being the highest bud set

^yBud set evaluated in 18 month-old seedlings

^xEG = 'EarliGrande', OP = open-pollinated

This estimate is reliable for this population, but would be conservative where selection for precociousness has not been practiced. Some selection for precociousness has been done in this breeding population, in that plants not producing fruit either in their

second or third leaf in the fruiting nursery have been discarded since 1975. This is evident in Table 2 which shows that the range of seed parents in relation to flower bud set goes from 5 to 10 in the scale used, while the flower bud set range in the offspring

often ranges beyond one or both parents.

Influence of pollen parent on flower bud set. Crosses with 'EarliGrande' as male parent consistently produced progenies with lower flower bud set ratings (1.8) as compared with crosses involving Fla. 7-3 (4.0) (Table 3). This is expected if h^2 is at least moderately high because 'EarliGrande' is a light flower bud setter and Fla. 7-3 is a heavy bud setter. Furthermore, OP families (mostly self-pollinated) were significantly different from crosses performed with either male parent. These results confirm findings in other species (4, 6, 10, 12), in the sense that some crosses may produce progenies with half or twice the normal juvenile period.

This study suggests that the degree of bud set in mature trees influences the number of precocious seedlings in their offspring. Crosses between normal and dwarf genotypes with short internodes have been shown to produce precocious seedlings (Ralph Scorza, 1984 per. com.). Dwarf peaches have short internodes and are usually heavy bud setters, and short internodes in non-dwarf peaches are reported to be associated with heavy flower bud set (1).

Even through heavy flower bud set may not be critical to obtain adequate yields in mature orchards of peaches and nectarines, commercial yield may be advanced by 1 or 2 years in newly

set orchards. Furthermore, the use of heavy flower bud setters as parents could be advantageous by producing higher percentages of progeny that fruit in 2 years from seed. Discarding seedlings that do not flower in their first year in the fruiting nursery will increase the percent of fruiting seedlings and would allow earlier selection for other characters. The high h^2 value obtained indicates that simple recurrent selection should lead to rapid progress in selecting for precociousness.

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Table 3. Effect of pollen parents on flower bud set of their offspring in a population of low-chilling peach seedlings.

Contrast	Flower bud set rating ^z	F value
'EarliGrande' vs Fla. 7-3	1.8 vs 4.1 ^y	13.88**
Fla. 7-3 vs OP ^x	4.1 vs 3.4	26.39**
'EarliGrande' vs OP	1.8 vs 3.4	14.29**

^zScale 1 to 10, being 10 the highest bud set

^yAverage of 12 families per cross of OP family

^xOP = open-pollinated family

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Fruit Varieties Journal 40(1):12-17 1986

Reviewed Research Paper

***In Vitro* Propagation of Peach: I. Propagation of 'Lovell' and 'Nemaguard' Peach Rootstocks.¹**

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Abstract

An improved tissue culture propagation medium was developed for *in vitro* multiplication of peach (*Prunus persica* L.) rootstocks 'Lovell' and 'Nemaguard'. A 144-fold increase in number of shoots was achieved after 10 weeks with 26.7 μ M (6.0 mg l⁻¹) BA and 0.04 μ M (0.01 mg l⁻¹) IBA. Shoots continued to regenerate with subsequent subcultures. 20% of the shoots rooted in the new medium without growth regulators at one half the recommended concentrations of KNO₃ and (NH₄)₂SO₄ plus 44.3 μ M (9 mg l⁻¹) IBA. Complete plants were transferred to soil, and grown with 100% survival. Explants taken from juvenile and mature plants did not differ significantly in their growth in the new medium.

Introduction

Seedling rootstocks have the potential disadvantage of genetic variation among them due to segregation that may lead to variability in the growth and performance of the scion cultivar. Improvement of rootstocks via incorporation of dominant genes through crossing, progeny testing and clonal rootstock propagation of selected progeny requires only one generation while rootstock propagation via seedling requires additional generations of breeding and selection to fix the genes

and characters. Combinations of genes are also most conveniently maintained via vegetative propagation of clonal rootstocks, since recombination does not occur as would be the case for sexual reproduction. However, seedlings are presently used due to ease and economy of propagation.

Reports of *in vitro* peach propagation are numerous (1, 5, 9, 10, 11, 13, 15, 16). Media used in some studies (10, 12, 13, 15) have been limited to either MS or its close modifications. In addition, these media have not been demonstrated to be adequate for multiplication of more than few cultivars *in vitro*. Our study reports the development of a medium of *in vitro* multiplication of 'Lovell' and 'Nemaguard' and the continued regeneration of shoots without decline for up to 13 weeks. This study also reports the effects of 9 different media used on peach explants.

Materials and Methods

Actively growing shoots from juvenile and 14 year old peach plants

¹ This research was supported by USDA grant #81-CRSR-2-0732. The authors acknowledge Carol Calibro for typing and Carle Staub for media preparation and culture of explants. The use of trade names in this paper does not imply endorsement by the University of California of products named or criticism of similar ones not mentioned.

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