California Citrus Nursery Board
FINAL REPORT FY 2010

"Good Bud, Bad Bud"

Year 2 of 3

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Introduction – Results of three studies conducted at UCR provided evidence of distinct phenotypical differences between floral and vegetative mother branches related to their floral intensity and fruiting potential. Mother branches with many flowers produced daughter branches with many flowers and high fruit set potential, whereas mother branches that were long with long internodes, many thorns and few flowers tended to produce daughter branches with this phenotype and a low fruit set potential. These results strongly suggested that bud wood source could have a significant effect on the productivity of the tree. The goal of our research is to test this possibility so that if proven correct, nurserymen can take advantage of this information in tree propagation and maintenance of nursery bud wood trees.

Objective – Determine whether buds obtained from floral mother branches produce trees that are more productive than those produced from buds obtained from vegetative mother branches.

Summary of activities that are underway to accomplish the objective – Buds from the two types of mother shoots collected from 'Tahiti' lime and 'Washington' navel orange were budded on 'Carrizo' citrange rootstocks in 2006. Ten trees of each cultivar were established in the field at UC-Riverside. The trees were harvested when 3 years old in the winter of 2009-2010. Trees propagated with buds from floral mother shoots produced more fruit per tree compared to trees propagated with buds from vegetative mother shoots. For 'Tahiti' lime compare 153 fruit (33 lb) per tree to 133 fruit (26 lb) per tree, respectively (P = NS). For 'Washington' navel orange compare 67 fruit (37 lb) per tree to 54 fruit (30 lb) per tree, respectively (P = 0.06).

To determine whether the effect of bud source on scion phenotype was still discernable as trees progressed to age 4 years, we randomly selected four branches (24 inches long) in each of the four quadrants of each tree, southwest (SW), northwest (NW), northeast (NE) and southeast (SE) (16 branches/tree) and quantified the number of daughter shoots per tagged branch, average shoot length, average number of nodes per shoot, average number of thorns per shoot, average number of fruit per shoot and the average length and width of the five largest leaves per shoot. Bud source had no significant effect on the characteristics associated with the floral or vegetative phenotypes of the 4-year-old 'Tahiti' lime or 'Washington' navel orange trees, with two interesting exceptions (Tables 1 and 2). First, trees produced from buds collected from floral mother shoots of 'Washington' navel orange had significantly more fruit per tree than trees that were produced from buds originating on vegetative mother shoots. However, for the 'Tahiti' lime, the opposite was true. Whether the greater productivity of 'Tahiti' lime trees produced from buds collected from vegetative mother shoots is due to a loss of the parental phenotype at age 4 years or reflective of alternate bearing, since these trees had the lower yield last year and the trees produced from buds from floral mother shoots had the higher yield last year, must await the results of future harvests. This was a surprising result as the overall appearance of each tree makes it possible, with no *a priori* knowledge, to predict with great accuracy which mother shoot type was the bud source. The second interesting result was both scion and rootstock suckers were more numerous on trees propagated with buds from vegetative mother branches, with significantly more suckers on the scions of 'Tahiti' lime trees produced from buds collected from vegetative mother shoots (Tables 1 and 2).

With every wind event, we have collected all fruit that have abscised from all trees. We recorded the number of fruit that dropped from each tree, the total weight of the fruit that dropped per tree, and determined the transverse diameter of each fruit by tree in order to have a complete picture of the productivity of each type of tree. Harvest for both the 'Tahiti' lime trees and 'Washington' navel orange trees will be in December 2010.

In addition, this year we repeated this experiment in order to further test our hypothesis that the floral and vegetative phenotypes are stable traits. We collected buds and propagated a second set of floral and vegetative 'Tahiti' lime and 'Washington' navel orange trees, being very particular about the trueness to type of the mother branches (bud sources) (Tables 3 and 4). Floral mother branches had significantly more daughter shoots than vegetative mother branches and these daughter shoots were significantly shorter with shorter internodes, fewer thorns (lime only) and smaller leaves (both leaf length and width) and had set more fruit.

Table 1. Effect of bud source on scion phenotype of 4-year-old ‘Tahiti’ lime trees in July 2010

Mother branch (bud source)	Rootstock suckers	Scion suckers	Daughter shoots	Fruit	Summer shoots	Off-season floral shoots (June data)	Nodes	Thorns	Shoot length	Leaf length	Leaf width
	---- no. per tree ----		*------ no. per 16 shoots -------*			*---------- no. per shoot ----------*			*---------- cm ----------*		
Floral	0.75	0.75 b[z]	73.13	67.88 b	19.88	0.90 b	24.42	6.00	24.50	6.35	3.44
Vegetative	2.25	4.13 a	69.50	91.75 a	22.00	1.94 a	25.14	6.86	24.60	6.34	3.52
P-value	0.2849	0.0059	0.5174	0.0155	0.0692	0.0708	0.6579	0.6247	0.9391	0.9573	0.3791

[z] Values in a vertical column followed by different letters are significantly different at P-value specified by Fisher's Protected LSD Test.

Table 2. Effect of bud source on scion phenotype of 4-year-old ‘Washington’ navel orange trees in July 2010

Mother branch (bud source)	Rootstock suckers	Scion suckers	Daughter shoots	Fruit	Summer shoots	Off-season floral shoots (June data)	Nodes	Thorns	Shoot length	Leaf length	Leaf width
	---- no. per tree ----		*------ no. per 16 shoots -------*			*---------- no. per shoot ----------*			*---------- cm ----------*		
Floral	0.00	2.44	110.22	31.00 a[z]	44.78	0.48	20.40	2.79	21.40	6.97	3.28
Vegetative	1.20	3.50	122.50	22.70 b	57.00	0.53	20.21	2.04	21.01	7.00	3.18
P-value	0.1168	0.4088	0.1635	0.0512	0.4405	0.7730	0.8976	0.4352	0.7728	0.7323	0.6974

[z] Values in a vertical column followed by different letters are significantly different at P-value specified by Fisher's Protected LSD Test.

Table 3. Characteristics of 'Tahiti' lime mother branches (bud sources) collected in 2010.

Mother branch (bud source)	Shoot length (cm)	Fruit (no.)	Nodes (no.)	Thorns (no.)	Daughter shoots (no.)	Internode length (cm)	Leaf length (cm)	Leaf width (cm)
	---------- *per mother branch* ----------							
Floral	16.11b[z]	2.43 a	14.43	10.29	2.71 a	1.20 b	6.52 b	3.38 b
Vegetative	27.50 a	0.00 b	14.60	12.00	0.00 b	2.03 a	9.16 a	4.17 a
P-value	0.0002	0.0033	0.8667	0.1711	0.0056	<0.0001	0.0046	0.0217

[z] Values in a vertical column followed by different letters are significantly different at *P*-value specified by Fisher's Protected LSD Test.

Table 4. Characteristics of 'Washington' navel orange mother branches (bud sources) collected in 2010.

Mother branch (bud source)	Shoot length (cm)	Fruit (no.)	Nodes (no.)	Thorns (no.)	Daughter shoots (no.)	Internode length (cm)	Leaf length (cm)	Leaf width (cm)
	---------- *per mother branch* ----------							
Floral	13.35b[z]	2.42 a	10.25	3.00 b	4.92 a	1.45 b	7.12 b	3.73 b
Vegetative	26.98 a	0.00 b	12.00	7.40 a	1.00 b	2.47 a	9.93 a	4.80 a
P-value	<0.0001	<0.0001	0.116	0.0062	0.0074	<0.0001	<0.0001	0.0017

[z] Values in a vertical column followed by different letters are significantly different at *P*-value specified by Fisher's Protected LSD Test.