Almond Variety Development: 2011

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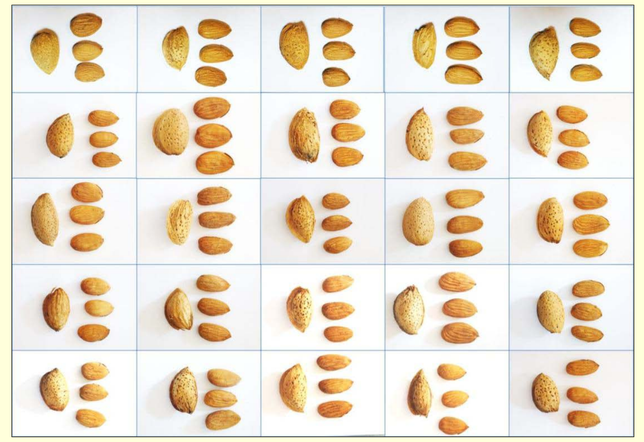
Location: Dept. of Plant Sciences, Univ. of California/ Davis



2011 Breeding selections for advanced selfing and resistance testing.

Improved Almond Varieties: Objectives

1. Improved early pollinizers for *Nonpareil*, and ultimately,
2. Varieties that possess self-fertility and improved market value and disease/insect resistance.

Targeted Traits

- -Self-compatibility
- -Self-pollinating
- -Tree architecture
- -NOW resistance
- -Hull Rot resistance
- -phytonutrients

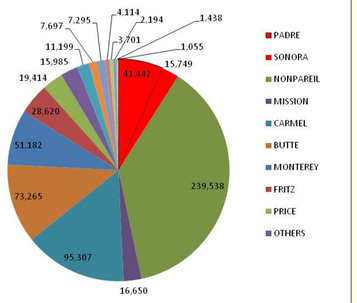
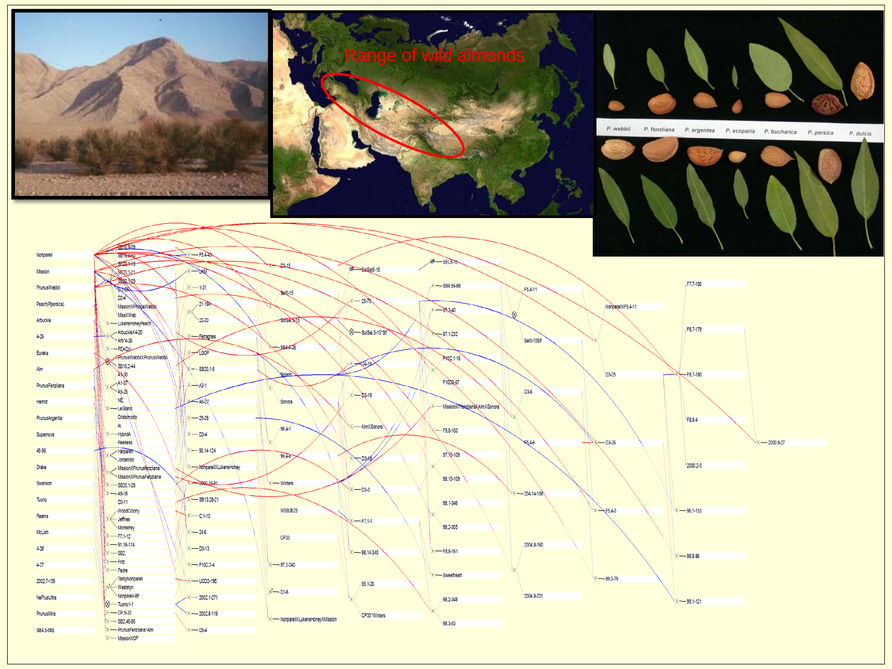
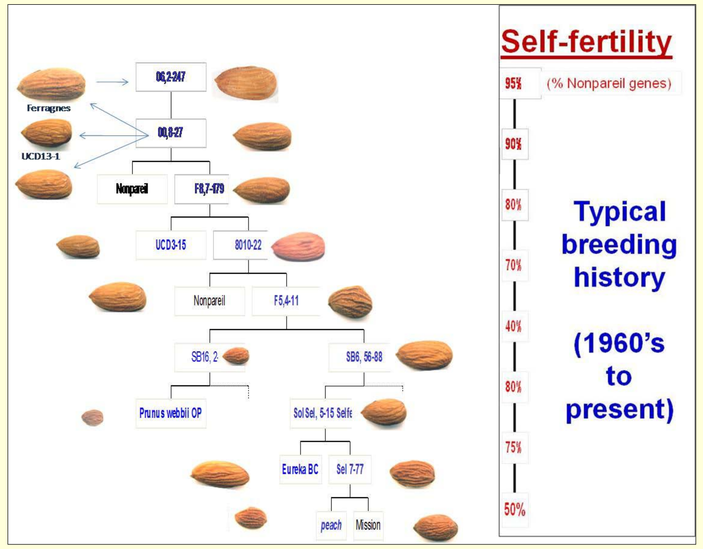


Fig. 1. Current California acreage is dominated by 'Nonpareil'. Remaining varieties with the exception of UCD bred 'Padre' and 'Sonora' are progeny of 'Nonpareil' by 'Mission' and so lack needed new genes.

To breed new traits such as self-fruitfulness and disease/pest resistance into California almond varieties, the required genes must first be transferred from other sources. Since it is often not possible to know how effective a source (for example self-fertility from either cultivated peach or the wild almond species *Prunus webbii*) is until it is backcrossed into cultivated almond, many independent sources are initially evaluated. 'Improved' germplasm is then made available to public and private California breeders.



New traits have been transferred from a wide diversity of sources ranging from *P. scoparia* growing in harsh desserts of Iran (top-left) to peach growing in sub-tropical China. Shell and leaf characteristics of species parents (top row at right) and their initial hybrids with almond (bottom row) demonstrate the diversity of this material. Flow chart shows recent progress in transferring new traits to cultivated almond (red line=seed parent; blue=pollen). Breeding line traits summarized in chart at bottom-right.

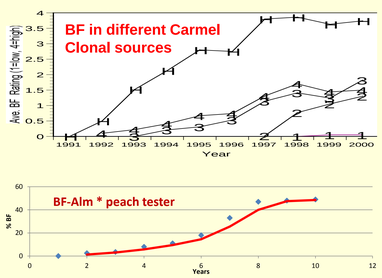


Self-fertility

Breeding lineage (seed parent-left; pollen parent-right)of one of approx. 20 distinct breeding lines used in the transfer of self-fruitfulness to cultivated almond. Good kernel and tree quality is rare in early generations but much more frequent with continued backcrossing to cultivated almond. Over 4,000 seed was recovered from approx. 200 controlled crosses in 2011; sample of new selections from earlier crosses are shown above (top-right).

Noninfectious Bud-failure (BF) control

BF results when terminal shoot-buds fail to go dormant and die in the Fall (above left vs. healthy at right) resulting in terminal die-back with growth of sub-terminal buds. Recurring cycles of die-back/basal bud growth results in the non-productive 'crazy-top' type trees. Cultivated almond has a strong tendency for summer-dormancy to survive the hot, dry environments of its central Asian origin. This summer-dormancy, which appears to trigger BF, is not present in certain almond relatives and so is a means of BF identification through molecular markers and BF control through resistance transfer.



2011 Data (Proportion of trees of different clonal sources showing BF)	DELTA	KERN	FPMS
CARMEL#1			
3-56-1-90	7%	26%	-
NONPAREIL			
3-8-2-70		9%	-
3-8-6-72		7%	-
3-8-5-72	-		
3-8-8-72	-		-
3-8-16-90			-
3-8-12-72			-
3-8-18-92			

BF levels within a cultivar will vary depending upon age and stress-levels for different propagation sources (data for Carmel shown top-left). Thus BF-expressing cultivars can be 'rehabilitated' to some degree by selecting the lowest expressing source for future propagations, as has been done successfully for Nonpareil and with partial success with Carmel. Even these elite sources will erode with increasing age, however, as shown in the Table of 2011 BF data at right. In crosses of BF almond by peach and certain other wild almonds, BF eventually develops in only ~50% of the progeny with ~50% resistant, presumably because the peach does not contribute a summer-dormancy/BF factor. We are currently attempting to find molecular markers which segregate with this resistance to breed BF-free almonds.

Variety	DELTA	KERN	FPMS	Grower
Aldrich	-	-	-	
Butte	-	-	-	
Chip's	-	?		
Donna	-	-		
Fritz	-	-	-	
Jenette	-	X		
Jiml	-	-		
Johlyn	-	?		
Kahl	-	?		
Kaperiel	-	?	-	
Livingston	-	-		
Milow	-	-	-	
Mission	-	-	-	
Monterey	-	-	-	
Morley	?	-		
NPU	-	-	-	
Padre	-	-	-	
Peerless	-	-	-	
Plateau	-	-		
Price	-	-	-	
Rosetta	-	-	-	
Ruby	-	-	-	
Sano	?	-		
Savana	?	-		
Sonora	-	-	-	
Wood Colony	-	-		
Yokut	?	X		
Winters	-	-		X
2-19E	-	-	-	

Selection	Bloom vs. Nonp.	Kernel (g)	Shell-out (%)	Doubles (%)	Origin	Length (mm)	Width (mm)	Thick (mm)	Self-set (%)
UCD2-19E	5	0.95	0.62	1	California almond	21	11.4	8.1	6
Sweetheart	0	0.95	0.51	0	Peach (P. persica)	19.6	13.2	8.7	12
LG-05	8	1.08	0.62	8	Peach	21.8	11.9	9.4	59
F8,8-4	1	1.36	0.60	9	Prunus webbii	25.7	12.9	9	76
F8,8-161	5	1.16	0.50	14	Prunus fenzliana	25.3	12	8.3	79
F8,8-160	5	1.29	0.62	0	Prunus mira	27.1	11.9	8.3	88
F8,7-180	2	1.27	0.60	0	Prunus webbii	29.3	12.8	7.5	11
F8,7-179	2	1.08	0.62	3	Peach	27	12.2	8.5	73
F7,1-1	0	0.68	0.71	0	Peach	17.4	10.2	8.2	98
F10C,2-4	2	1.18	0.44	15	California almond	25.7	13.2	7.8	4
F10C,1-16	4	1.16	0.68	3	California almond	26.2	11.4	8.5	7
D3-26	5	1.22	0.63	1	Prunus webbii	25.3	12.9	8.5	12
D,1-6	2	1.45	0.73	18	California almond	26.1	13.5	8.2	8
D,1-25	5	0.74	0.40	1	Prunus mira	24.4	11.6	6.9	79
C,1-10	3	1.22	0.69	2	California almond	27.1	14.3	7.5	5
99,9-86	0	1.33	0.51	0	Prunus webbii	25.6	13.8	8.9	81
99,4-8	6	1.51	0.27	0	Peach	26.2	16.8	8.5	4
99,3-79	4	1.30	0.42	12	Prunus webbii	21.3	13.3	10.5	7
98,3-53	-1	1.72	0.75	0	Peach	29.6	15	8.7	65
98,2-305	5	1.06	0.52	0	Prunus argentia	24.9	13.3	7.5	4
97,3-40	-5	1.77	0.45	1	Prunus fenzliana	32.3	14.5	9.3	7
97,2-240	3	1.19	0.65	3	Prunus webbii	22.6	13.1	9.4	3
97,15-109	3	1.22	0.66	3	Prunus argentia	27.2	13	8	67
95,1-26	1	1.80	0.56	2	European almond	29.1	14.2	9.6	63
2000,2-3	1	1.17	0.57	3	Peach	24.4	12	9.1	90
2000,16-81	3	0.93	0.52	4	Irradiated almond	21.5	11.7	9.8	82
2000,8-27	3	1.07	0.51	10	Prunus webbii	24.1	11.7	8.4	92
2004,14-158	0	1.48	0.39	0	Prunus fenzliana	25.9	14.2	8.8	62
2002, 7-159	4	1.14	64	3	Tuono almond	26.7	11.5	8.8	67
2004,8-160	3	1.85	0.65	0	Prunus mira	30.4	15.4	8.5	96

Regional trials are used to monitor BF-expression (Summary Table at left) as well as breeding selection performance (5-year Summary Table at right; 2011 data analysis not yet complete). Data is collected from trials in Sacramento and San Joaquin valley sites. Breeding selections shown are 'boxed' in the Breeding Flow-chart (center) to demonstrate successful trait transfer. These breeding lines remain BF-free, except for those lineages resulting from crosses to Nonpareil or Carmel.