Almond Variety Development: 2013

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

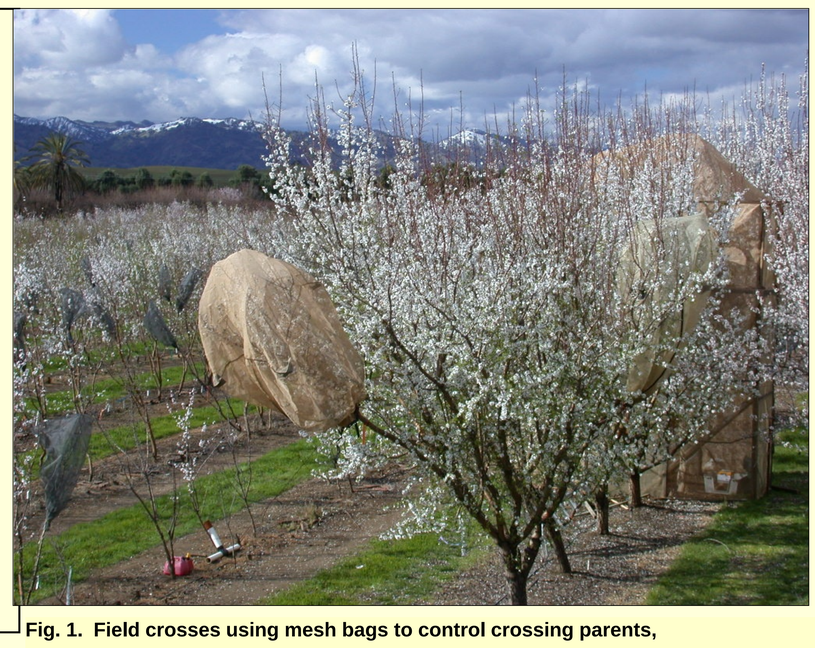
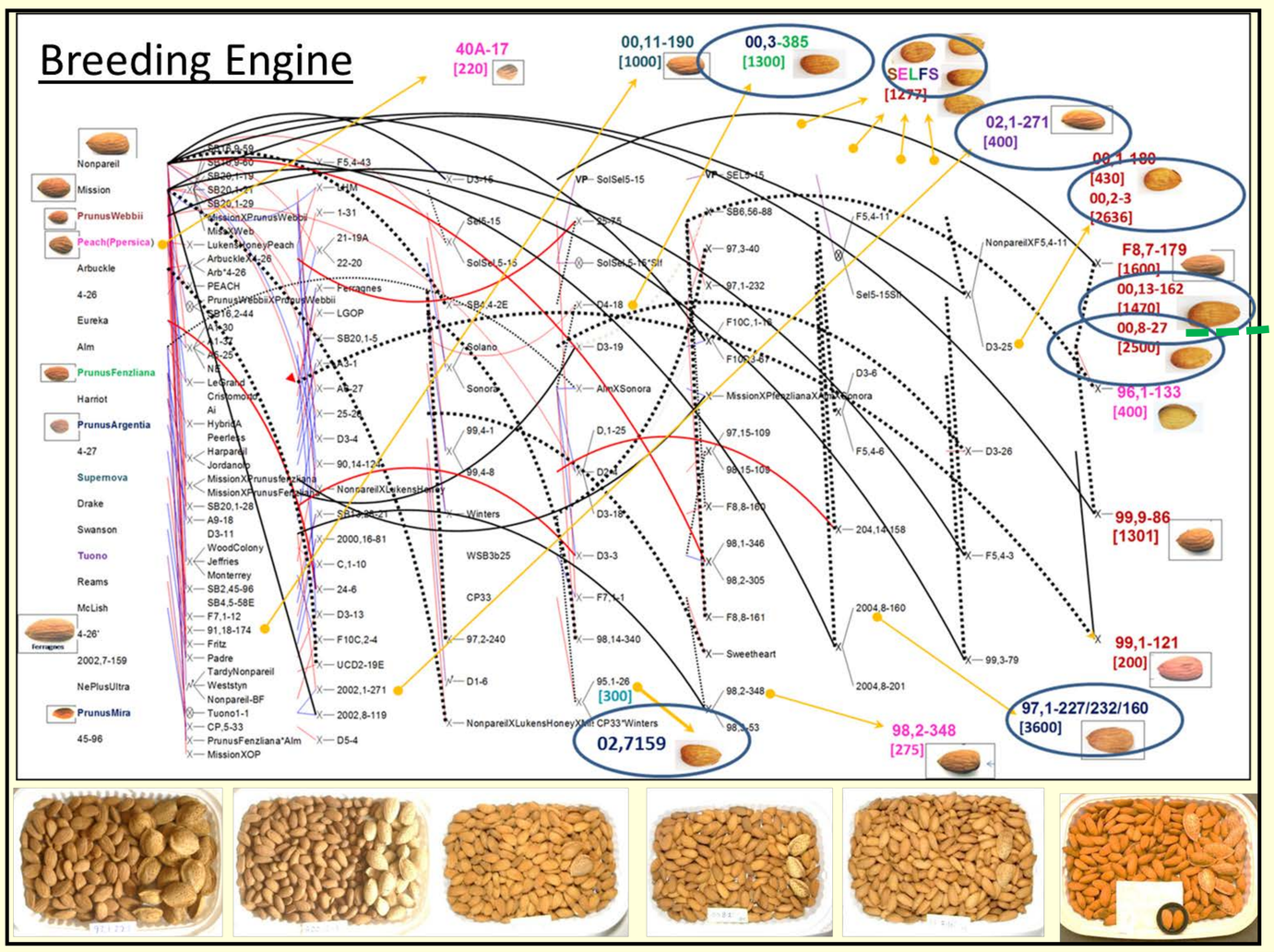
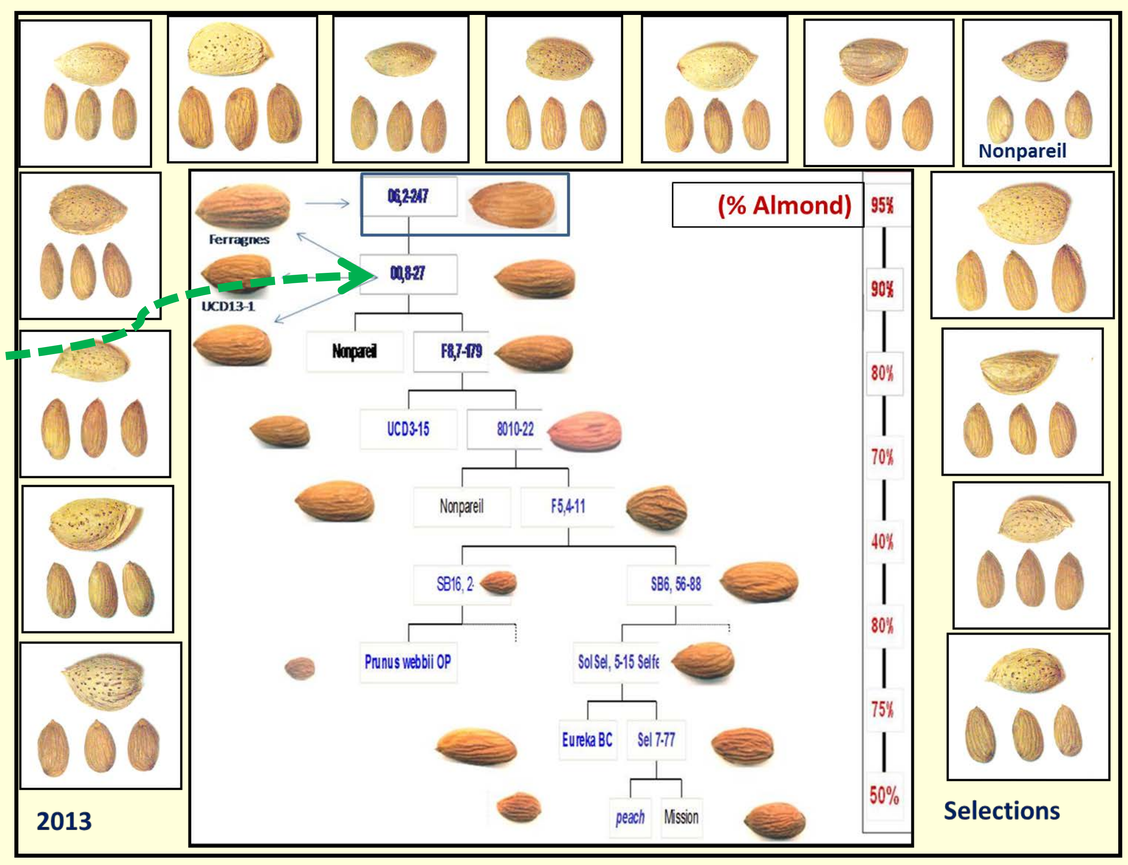


Fig. 1. Field crosses using mesh bags to control crossing parents,

The California almond industry is in a historic period of transformation driven by increasing Central Valley acreage along with increasing environmental and market requirements, reductions in resources such as water, agrochemicals, and natural pollinators, as well as the uncertainties of a changing climate. While almond represents a diverse and highly adaptable species, commercial production in California is dependent almost entirely on the variety Nonpareil and a relatively few pollenizers, most of which have Nonpareil and Mission as direct parents. A long-term emphasis of the UCD almond breeding program has been the identification and incorporation of new and diverse germplasm. Genetic solutions to emerging production challenges are now becoming available from this new germplasm, including regionally-adapted selections expressing high levels of self-compatibility, and increased insect, disease and environmental stress resistance. Improved breeding lines also offer opportunities to expand market demand by optimizing phytonutrients in new varieties while minimizing potential health and marketing risks including aflatoxins, salmonella and allergens.

Over 6,200 progeny trees from the ~14,000 seedlings from 2012 crosses are currently being prepared for pre-screenings for vigor and disease resistance. Weather in 2013 was again favorable and over 30,000 crosses were made with moderate to good seed sets. Over 100 of the most promising selections have been tested for self-compatibility under controlled (bagged limbs) conditions (Fig. 1) with almost half of the genotypes showing promising levels of self-compatibility, validating our strategy of marker assisted-breeding. Over 30,000 bearing trees from diverse genetic sources (summarized in Fig. 2) were evaluated in 2013 for productivity, kernel quality and disease resistance with the most promising selections to be further evaluated for self-compatibility and cropping potential in 2014. Twelve advanced selections are being propagated for regional grower trials. Release of selection 2-19E as a productive Nonpareil late-flower pollinizer is planned for early 2014.

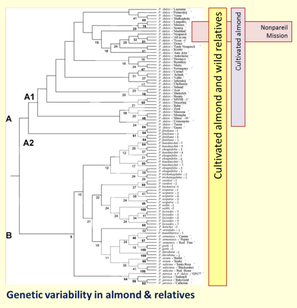




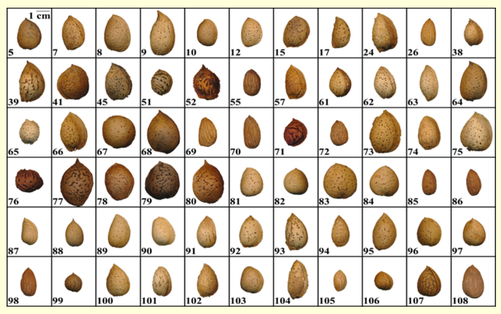
Breeding lineage of self-compatible selection 00,8-27 (TOP) surrounded by kernel and shell samples of 2013 breeding selections advanced to self-fertility testing. LEFT: advanced selections being promoted to regional grower variety trials -also circled in blue in lineage chart.

Fig. 2. Crossing diagram showing major breeding lineages and their often exotic species origin. Source germplasm ranges from cultivated (peach) and wild related species, European and Asian varieties to heirloom California varieties and breeding lines. {Numbers in brackets denote the total number of progeny trees from different advanced lineages evaluated in 2012-13 while text-colors identify species origin. Solid lines denote seed parent while dotted lines denote pollen parent}. For each major breeding lineage, sample kernels are displayed.. Only major 2012 lineages with over 200 progeny under evaluation are plotted. Smaller breeding lineages which are typically developed to explore general breeding potential as well as new breeding objectives encompass approximately 25% of total program efforts. LOWER LEFT: Shelled samples of selections moving into RVT in 2014. TOP RIGHT: Sample selections advanced to self-fertility testing in 2013.

New germplasm = new traits



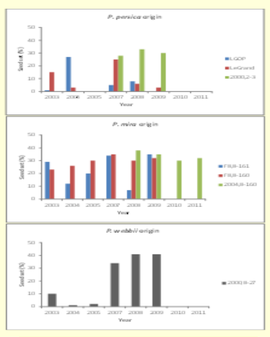
Traditional California germplasm (pink) vs. cultivated almond (blue) vs. much extended germplasm in closely related species (yellow)



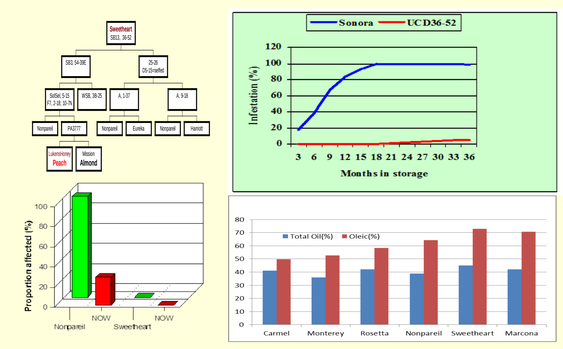
Range in nut types and sizes for the more extended germplasm studied at left using molecular analysis.

Selection	Bloom timing	Harvest timing	Origin
UCD3-40	-5	11	*P.fenzliana*
UCD-Marcona	-2	28	Heirloom-Spanish
UCD18-20	1	20	*P. persica* (peach)
UCD1-16	3	12	*P.fenzliana*
UCD8-27	4	12	*P. webbii*
UCD8-160	4	15	*P. mira*
UCD97,1-232	5	13	*P. mira*
UCD1-271	5	14	Tuono
UCD7-159	5	16	*P. webbii*
UCD2-19E	6	10	TardyNonpareil * Arbuckle
UCD8-201	7	18	*P. mira*

Diverse origins of advanced UCD selections currently going into 2014 Regional Variety Trials ([Lineages and kernel samples shown in chart above].

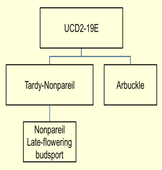


Observed differences in field levels of self-compatibility for different breeding sources used.



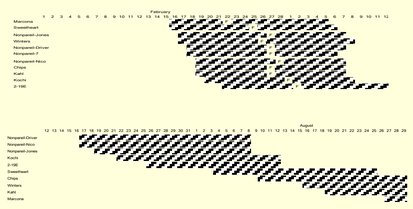
Recent UCD release 'Sweetheart' almond as an example of new traits. Lineage (top-left). Improved resistance to NOW and hull-rot vs. Nonpareil (bottom-left). Post-harvest resistance to worm damage (top-middle). Very high kernel oil and oleic-acid content (bottom=middle). [Right: Sweetheart traits chronicled in cover article of recent HortScience]

New variety release

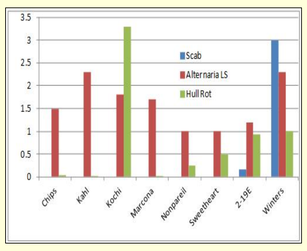


Parentage of UCD 2-19E

Shelled kernels of UCD 2-19E

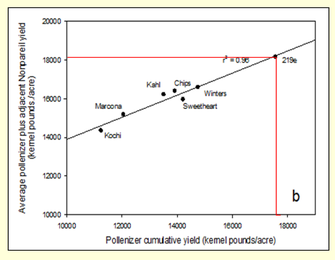


Bloom and harvest periods



Relative field levels of regional diseases (5 year average)

Prolific bloom and nut set characteristic of of UCD 2-19E



Average 5-yr production of 2-19E is comparable to Nonpareil despite tree being ~10% smaller.

2009 Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	Kernel pounds per Tree	Kernel pounds per Acre	Cumulative kernel yield (lbs/acre)
2-19e	14706 a	0.84 f	65.6 f	27.1 c	3285 c	11080 a
Nonpareil-70	13756 ab	1.04 bcd	74.6 ab	31.4 ab	3798 ab	10905 abc
Nonpareil-J	12803 abc	1.04 bcd	71.6 bcd	29.0 bc	3513 bc	9955 cd
Kahl	11035 cde	0.87 ef	59.1 g	21.1 de	2559 de	8513 ef
Chips	9771 ef	0.93 def	58.6 g	20.0 e	2422 e	8144 ef
Kochi	7252 g	1.17 a	68.9 de	18.7 e	2259 e	6955 h

2010 Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	Kernel pounds per Tree	Kernel pounds per Acre	Cumulative kernel yield (lbs/acre)
Nonpareil-70	8823 bcd	1.28 abcd	72.3 ab	24.9 a	3011 a	13916 ab
2-19e	6833 efg	1.10 bcdef	56.1 e	16.7 bc	2020 bc	13100 bc
Nonpareil-Jones	8315 cde	1.23 abcdef	70.9 ab	22.6 a	2737 a	12691 c
Chips	9089 abc	1.15 bcdef	65.9 abc	23.0 a	2789 a	10933 d
Kahl	7587 cde	1.01 f	56.5 de	16.9 b	2046 c	10561 d
Kochi	3902 h	1.40 a	64.4 bcd	12.1 bc	1466 bc	8421 e

2011 Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	Kernel pounds per Tree	Kernel pounds per Acre	Cumulative kernel yield (lbs/acre)
Nonpareil-70	17744 abc	1.05 bc	70.7 a	41.0 a	4962 a	18878 ab
2-19e	18253 ab	0.91 bcde	64.8 abcd	36.8 a	4460 a	17560 cd
Nonpareil-Jones	16992 abcd	0.96 bcde	70.0 ab	36.0 a	4360 a	17051 d
Chips	11901 f	0.94 bcde	60.3 de	24.7 bcd	2985 bcd	13918 e
Kahl	12420 f	0.89 cde	53.5 f	24.4 bcd	2953 bcd	13514 e
Kochi	8701 g	1.22 a	63.5 cde	23.3 d	2825 d	11247 f

2012 Variety	No. of nuts/tree	Average kernel wt (g)	Shelling percentage	Kernel pounds per Tree	Kernel pounds per Acre	Cumulative kernel yield (lbs/acre)
Nonpareil-70	8530 b	1.2 bc	70.9 bc	22.6 ab	2733 ab	21611 ab
2-19e	7617 bc	1.19 bcd	69.4 bcd	20.1 abc	2432 abc	20270 bc
Nonpareil-Jones	8855 b	1.18 bcd	67.7 bcd	23.0 ab	2783 ab	19833 c
Chips	9008 b	0.92 h	75.3 ab	18.2 bc	2201 bc	16416 d
Kahl	8830 b	1.05 fg	55.0 d	20.4 abc	2465 abc	15979 d
Kochi	2025 d	1.41 a	26.0 e	6.3 d	763 d	12816 e

Advanced UCD breeding selection 2-19E has been developed as a late Nonpareil-bloom pollinizer. Low susceptibility to the important almond diseases hull rot, Alternaria leafspot, and scab have been documented in 2009-12 Kern County grower trials, along with high productivity and kernel and shell characteristics similar to Nonpareil (data chart at right). High yields have been consistently achieved despite a smaller tree size (which contributes to greater yields for the adjacent Nonpareil rows). UCD2-19E is currently being finalized for patenting and release to California growers by early 2014.