Almond Variety Development: 2017

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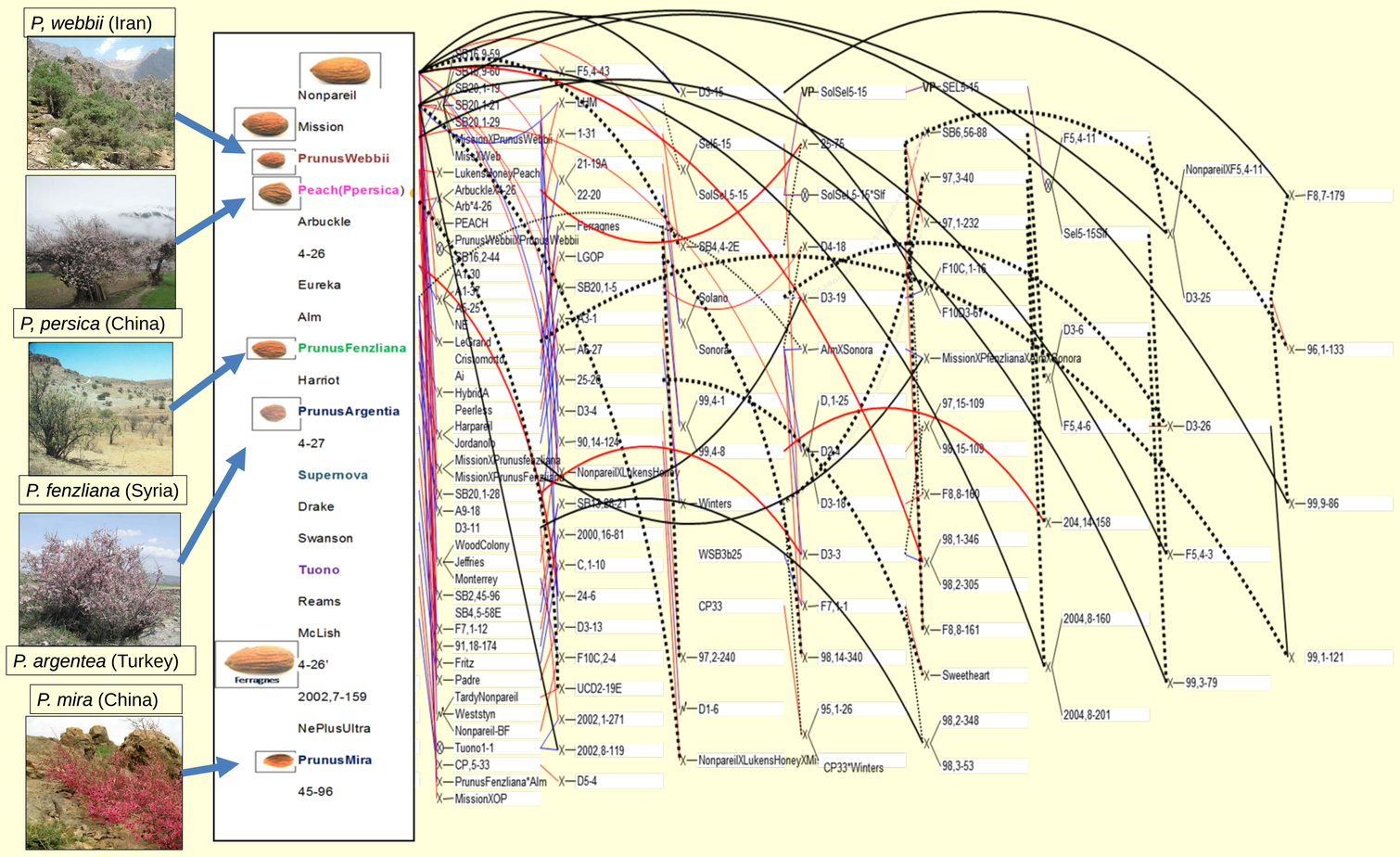
Field crosses using mesh bags to exclude bees an so control crossing parents.

Introduction

The California almond industry is in a historic period of transformation driven by increased 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 closely-related 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 improved germplasm, including regionally-adapted selections expressing high productivity, self-fruitfulness, and increased insect, disease and environmental stress resistance. Improved breeding lines also offer opportunities to expand market demand by optimizing phytonutrients in new cultivars, such as the high heart-friendly oleic acid content in the Sweetheart variety, while minimizing potential health and marketing risks including aflatoxins, allergens and salmonella. The recently established Regional Variety Trials (RVT) includes a large number of UCD selections derived from genetically diverse pedigrees. The diversity has been introduced to allow the capture of the greatest genetic contributions to orchard yield, kernel quality and disease/pest/stress resistance in future California orchards. Ongoing studies in the newly established as well as previous RVT's are demonstrating significant opportunities for improving disease and stress resistance, kernel quality and tree and orchard productivity.



Genotype	Origin	Kernel Mass (g)	Kernel Thickness (mm)	Soluble protein (g/10g)	Allergenicity (vs. Nonpareil)
Peach	Peach	0.11	3.35	2.37	0.51
F10D,2-18	P.webbii	0.8	8.47	2.24	0.76
SB,36-54	P.mira	0.98	8.84	2.55	1.73
F10D,3-13	P.webbii	0.83	8.03	1.71	0.47
F5,4-10	P.webbii	0.78	7.22	2.21	0.53
F10D,3-2	P.webbii	0.77	6.99	1.78	0.66
F10C,12-28	Peach	1.08	9.02	1.93	1.76
A7-25	P.webbii	0.82	7.26	1.91	0.51
F10D,3-7	P.webbii	0.69	6.74	1.54	0.42
2005,20-192	Peach	0.99	7.37	2.39	0.63
F10D,1-2	P.webbii	0.84	7.15	2.04	0.68
F10D,2-5	P.webbii	0.76	8.07	1.80	0.47
F5,10-9	P.fenzliana	0.82	7.04	1.81	0.61
F5,20-42	P.webbii	1	8.18	1.67	0.65
F8N,6-68	P.webbii	0.96	7.19	2.35	0.88
F10D,1-22	P.webbii	0.97	7.72	2.11	1.78
F5,6-13	P.fenzliana	0.84	6.71	2.56	0.95
F8N,7-4	P.webbii	0.76	6.21	1.95	0.65
F5,6-1	P.fenzliana	1.33	7.38	2.59	0.92
SB13,25-75	P.webbii	1.17	7.76	2.22	1.78
F10D,3-3	P.argentea	0.96	7.01	1.75	0.26
97,1-232	P.mira	1.29	8.16	2.06	2.06
F5,13-54	P.fenzliana	1.05	8.31	1.63	0.7
97,2-240	P.webbii	1.28	9.45	2.22	0.4
F5,16-60	P.argentea	0.87	7.34	2.41	0.44
Ha5-36	Peach	1.12	7.46	2.11	0.66
A1-31	Peach	1.53	8.75	1.38	0.75
F10D,3-15	P.webbii	0.96	7.18	1.86	0.33
F10D,3-26	P.webbii	0.93	7.45	2.12	1.06
2000,8-27	P.webbii	1.2	8.62	2.39	0.55
2004,9-1	P.mira	1.24	7.54	1.45	1.89
F10C,20-51	Peach	1.1	7.31	2.39	0.56
2004,18-20	Peach	1.54	8.7	1.87	0.68
F1-01	P.webbii	1.58	8.22	1.71	0.32
F6-21	Peach	1.48	8.29	1.94	1.56
F10D,3-50	P.fenzliana	1.59	8.75	1.54	2.18
Ha2-68	Peach	1.44	7.34	1.24	1.57
2004,8-160	P.mira	1.77	8.64	1.98	2
95,1-26	Peach	1.98	9.47	2.09	1.1
97,3-40	P.webbii	2.08	8.7	2.58	0.9
				0.00	
Nonpareil	Almond	1.31	7.86	2.31	1.02

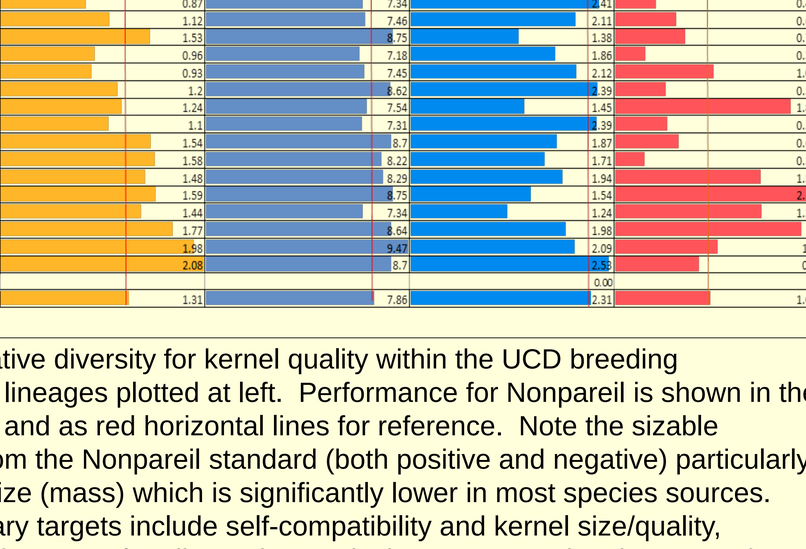
Representation of UCD almond breeding lineages transferring self-incompatibility and other desirable traits from related species and land races. (Solid lines identify the seed parent all dotted lines identify the pollen parent). Because traits associated with wild species (thorniness, bitterness, etc.) are often undesirable for commercial production, the challenge is to select for desirable genes while simultaneously roguing-out undesirable traits. A concurrent challenge is to maintain a large genetic diversity to provide genetic options for current and emerging production challenges brought about by losses in agrochemicals, land and water quality, and changing climates.

Representative diversity for kernel quality within the UCD breeding germplasm lineages plotted at left. Performance for Nonpareil is shown in the bottom row and as red horizontal lines for reference. Note the sizable variation from the Nonpareil standard (both positive and negative) particularly for kernel size (mass) which is significantly lower in most species sources. While primary targets include self-compatibility and kernel size/quality, breeding efforts are also directed towards the capture and maintenance in advanced breeding lineages of all accessible desirable traits including resistance to important diseases, pests and environmental stresses.

Nuts samples from the 2017 Chico Regional Variety Trial showing successful recovery of good kernel and shell quality despite a parentage that includes 1 to 3 wild species as sources of desirable traits.[Nonpareil kernels and shell shown at lower right for reference]

Item	Kernel Crack-Out	Kernel mass (g)	Heat Tolerance
UCD 1-271	0.59	1.39	9.20
UCD 7-159	0.74	1.54	10.20
UCD 8-201	0.55	0.98	8.60
UCD 18-20	0.55	1.18	10.10
UCD 1-16	0.64	1.08	9.50
UCD 1-232	0.47	1.16	10.10
UCD 3-40	0.48	1.48	9.40
UCD 8-160	0.59	1.42	11.00
UCD 8-27	0.60	1.08	7.90
Nonpareil	0.67	1.05	9.30

Representative trait recovery for Regional Variety Trial samples shown at left. The performance of advanced UCD selections demonstrating high levels of self-incompatibility/self-pollination is comparable to the Nonpareil standard (shown on the bottom row and as red vertical lines for reference) despite their wild species origins. In several cases, advanced selection performance exceeds Nonpareil standard values, though additional multiyear, multi-site testing will be required to fully verify these findings.



The recently released UCD variety ***Kester*** combining high productivity with kernel and shell characteristics similar to *Nonpareil*. A prerequisite of all UCD variety releases is the long term (12+ years) assessment (usually in small grower test plots followed by large-scale Regional Variety Trials) in all regions of potential plantings prior to patenting and release. Because almond typically takes this long to come into mature orchard production, such long-term testing is required to identify any major problems (market type, disease susceptibility, rootstock incompatibility, Bud-failure expression, lower limb die-back, etc.) prior to large-scale grower planting.