

## **2017 FIELD EVALUATION OF PRUNE ROOTSTOCKS**

Luke Milliron, Richard Buchner, Joseph Connell, Franz Niederholzer, Katherine Jarvis-Shean, Carolyn DeBuse, Cyndi Gilles, Ted DeJong, Sarah Castro, Chuck Fleck, Mark Gilles and Allan Fulton

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### **PROBLEM AND ITS SIGNIFICANCE**

The California Prune Industry has historically utilized five rootstocks, Myrobalan seedling, Myrobalan 29C, Marianna 2624, Lovell peach and M40. The last statewide organized prune rootstock effort was the “M” series rootstock plots planted in 1987 (Vina Monastery 3/20/87). Since the conclusion of that experiment many more potential rootstocks for prune have been identified. HBOK 50, Krymsk1, Krymsk 86, Citation, Rootpac-R, Viking, Atlas and others.

Three rootstock experiments have been planted in Northern California. One at Wolfskill, planted 1/19/11, a second in Yuba County planted 6/3/11 and a third in Butte County planted 4/28/11. All trees were nursery grafted to the ‘Improved French’ variety. Test rootstocks are listed in figure 1.

### **OBJECTIVES**

- 1) Evaluate 29 rootstocks potential for use in California Prune production.
- 2) Evaluate trunk cross sectional area (TCSA), fruit load and dry weight per tree, dry ratio, dry fruit size, bloom date and bloom conditions.

### **PLANS AND PROCEDURES**

#### **Butte County Location**

The Butte County location was planted 4/28/11. The wet winter delayed soil preparation resulting in the late planting date. The Butte County soil survey lists the soil as Farwell clay adobe alternating with a lighter textured soil described as Nord loam. Nord loam is noted for its higher pH, low nutrient status and a greater association with replant disease. Test trees followed almonds on Lovell peach rootstock with no soil treatments prior to planting. Lesion nematodes were isolated from soil samples. The layout is a randomized complete block design with 14 treatments and 5 replicates. There are 6 trees per plot in the original design. Trees were headed at 40 inches on 5/10/2011 and the test planting is drip irrigated. The HBOK 50 rootstock came as potted trees and were delivered 5/4/11 and planted by 5/10/11. Instructions were to remove trees from the pots, do not disturb the root ball, cover with 2 inches of soil and irrigate carefully to keep the small root ball moist. The HBOK 50 rootstock produced small bush like trees and did not have sufficient

trunk growth to head the first year and were left alone. Viking and Atlas were not available in 2011 and were added to the experiment in 2012 and are consequently one year younger. Viking and Atlas were propagated by Dave Wilson nursery, HBOK 50 from Duarte nursery and the remaining trees were propagated by Fowler nursery. Tree mortality was high during the 2011 season. Missing tree locations were site fumigated with 0.5 pound of chloropicrin on 11/15/11 and replanted 2/10/12. Viking and Atlas were also planted 2/10/12. Many of the Rootpac-R trees did not survive the initial planting and replacement trees were not available. On 2/10/12 the few remaining Rootpac-R were extracted at Butte and replanted in the Yuba plot. The goal was to have one complete set of Rootpac-R at one location. Both the Butte and Yuba locations have mixed tree ages because of the high initial tree mortality. Fumigated replant trees grew well and growth caught up with trees planted the first year.

Trunk measurements (11/7/16) include scion circumference measured 12 inches above the graft union. Trunk circumference is used to calculate trunk cross sectional area in  $\text{cm}^2$ .

Bloom dates and flower development were visually rated seven times (2 to 3 day intervals) starting March 10 and finishing March 24. Both 2016 and 2017 data are included for comparison.

2017 was the first whole plot mechanical harvest for the Butte location. Load cells were installed on the harvester forks so entire green weight per plot could be measured. As green fruit entered the bin, a 5 to 6 pound random subsample was collected using a small bucket. Harvest subsamples were field weighed and transported to Sunsweet for commercial drying. Subsample weights and fruit counts were used to calculate dry ratio, number of fruit per tree, dry yield per tree and fruit size distribution using an A, B, C, D and “under” stainless steel screen sorter. The original experimental design featured 6 trees per individual rootstock. Tree death per plot often resulted in less than the original 6 trees per plot. Consequently, whole plot yield is divided by the number of surviving trees per plot and reported as fruit load or yield per tree. Butte trees were not fruit thinned to manage crop load and the experiment was harvested 8/29/17.

#### Yuba County Location

The Yuba County location was planted 6/3/11. This was a replant site, with prune following prune. Telone® fumigation occurred in the early spring. The wet winter and late fumigation delayed soil preparation and subsequently delayed planting. Similar to Butte, the plot is a randomized complete block design with 14 treatments and 5 replicates. There are 6 trees per plot in the original design. Rootstocks are the same as the Butte plot with the exception of Rootpac-R which was transplanted from Butte to Yuba and Empyrean 2 which did not survive in the Yuba location. Tree mortality was high during the first growing season. The soil is described as Kilga clay loam. In 2012, Atlas and Viking rooted trees were planted, and missing trees were replanted. In March 2014, French on Fortuna, WRM2 or AP45 trees were planted as replicated observations in the spaces designated for Empyrean 2 in the experimental design. The Yuba experiment is complete and trees are growing well with the exception of canker disease (bacterial and *cytospora*) in some of the varieties (Figure 5). Test trees are micro sprinkler irrigated.

#### Wolfskill Experimental Orchard

A satellite experiment of prune rootstocks was planted at the UC Wolfskill experimental orchard in Winters, California. The plot contains 15 experimental rootstocks and 3 standard rootstocks (Marianna 2624, Lovell, and Myrobalan 29C) nursery budded to 'Improved French.' This experiment provides an initial evaluation of possible rootstocks that have previously not been tried with prune or have had very little field testing.

The experiment is planted with at least 5 trees of each rootstock and is non-replicated, which limits statistical analysis. The goal was to get a first look at how these rootstocks performed with 'Improved French' scions and identify any defects before commercial planting. 'Improved French' on its own root differs from the others in that trees were grown in the nursery for two years. Own rooted trees do have a graft union because 'Improved French' was budded on top. Wolfskill rootstock entries are listed in figure 17. Trees were planted 17 feet across the row and 14 feet down the row, which results in approximately 183 trees per acre.

The Wolfskill site was previously planted to peaches that were removed in 2008. The field was planted annually for 3 years to winter wheat. The Yolo County soil survey describes the soil as Yolo loam. Nematode samples were taken at four locations within the field at approximately an 18-inch depth and combined for nematode evaluation (8/29/11). One liter of soil contained, 50 Lesion (*Pratylenchus sp.*), 50 Pin (*Pratylenchus sp.*), and 30 Dagger (*Xiphinema americanum*) nematodes. There were not enough nematodes to identify the species of either Lesion or Pin nematodes.

The majority of the trees were planted on January 19, 2011. Bare-root trees were planted directly after transportation from the nursery's sawdust box. HBOK 32 and HBOK 10 were planted on April 25, 2011 as potted trees. At the time of planting, trees were headed at 36 inches. Trees that had not reached heading height were left alone and allowed to grow through 2011 then headed at 36 inches in the following dormant season.

## RESULTS AND DISCUSSION

### Butte County Location

2016 and 2017 bloom conditions and bloom dates for the Butte County rootstock experiment are shown in Figures 2 and 3, respectively. For 2016 (Figure 2) full bloom for the controls occurred about March 10 indicated as "0" with Krymsk 86, Marianna 58, Krymsk 1 and HBOK 50 being the last to full bloom, "+4" days after the control rootstocks. Early bloom conditions and bee activity were less than ideal in 2016 resulting in poor cropping on the early bloom and relatively good fruit set on the rootstocks that imparted later bloom. For 2017 (Figure 3), full bloom for the controls occurred about March 19 as the "0" date. Different from 2016 was the spread on the late blooming group: Krymsk 86 "+3" days after control, Marianna 58 "+2" days after control, Krymsk 1 "+1" day after control and HBOK 50 same as control rootstocks ("0"). Bloom conditions in 2017 were very good and all rootstocks set a good crop. Additional years of evaluation are necessary to reliably characterize mature tree bloom.

Tree size (trunk cross sectional area cm<sup>2</sup>), fruit per tree, dry ratio, dry yield (lbs./tree) and percent A screen fruit are shown in Figure 4. Values represent treatment means for the 5 replicates.

Rootstocks that impart smaller canopy size (Krymsk 1, HBOK 50, Marianna 58 and Empyrean 2) had less fruit per tree, lower dry ratios, less dry pounds per tree and larger fruit size. Rootstocks that impart large canopy size (Lovell, Viking, Atlas and Myro 29C) had more fruit per tree, higher dry ratios, more dry pounds per tree and smaller fruit size. Measurements in 2018 will categorize canopy size and attempt to project per acre yields by adjusting the number of trees per acre favoring optimum tree spacing by rootstock. Individual growers will have to consider the pros and cons of smaller trees at a higher density compared to larger trees planted farther apart.

#### Yuba County Location

Yuba County rootstock trial harvest and trunk cross sectional area (TCA) data for 2017 season are found in Figure 6. With dry away ratios between 2.3-2.6 for all rootstocks, fruit size was large for all rootstocks (data not presented). Percent A and B sized fruit were between 70-100% by weight for test samples (10 individual rootstock replicates comprising 13% of total samples). As in the Butte County location, larger trees (bigger TCA) generally produced more fruit. However, the relationship between TCA and yield/tree was not as close in Yuba as in Butte County in 2017. In the Yuba Co planting, TCA explains 54% of the differences in yield between the rootstocks, while in in Butte Co, TCA explains 92% of the differences. We suspect that differences in soil between the Yuba and Butte sites explain the differences in tree size and yield in 2017, particularly the potential for saturated soils in Yuba County at bloom, which has been linked to poor set in different locations around the Sutter/Yuba region.

Rootstock	Pedigree (scientific)	Pedigree (Common)	Other names	Trial	Interest to CA
Atlas	P. persica (Nemaguard) x (Prunus dulcis x Prunus blierianna)	Nemagaurd x(almond x apricot x plum))		Grower	Bac canker resistant?
Viking	P.persica x (P. amygdalus x P. blireiana (P.cerasifera x P.Mume)	Nemagaurd x(almond x apricot x plum))		Grower	Bac canker resistant?
Citation	Prunus salicina x Prunus persica	Red Beaut plum x peach	4-G-816	Grower	
Empyrean 2	Prunus domestica	European prune (OP seedling of 'Imperial Epineuse')	Penta	Grower	small tree
HBOK 50	Prunus persica	Harrow Blood X Okinawa		Grower	nematode resistant?
Krymsk 1	Prunus tomentosa x Prunus cerasifera	Plum x plum	VVA1	Grower	grown in Europe
Krymsk 86	Prunus cerasifera x Prunus persica	Plum/peach hybrid	Kuban 86	Grower	anchorage
M30	Prunus cerasifera x Prunus munsoniana	Plum x wild plum		Grower	
M40	Prunus cerasifera x Prunus munsoniana	Plum x wild plum		Grower	Less suckering
M58	Prunus cerasifera x Prunus munsoniana	Plum x wild plum		Grower	smaller tree?
Myrobalan seedling	Prunus cerasifera	Myrobalan seedlings		Grower	control
Rootpack R	Prunus cerasifera x prunus dulcis	Plum/almond hybrid	Replantpac	Grower	
Lovell	Prunus persica	peach seedling		Grower/Wolfskill	control
M2624	Prunus cerasifera x Prunus munsoniana	Plum x wild plum	Marianna 2624	Grower/Wolfskill	control
Myro 29C	Prunus cerasifera	Myrobalan clone		Grower/Wolfskill	control
Controller 7	Prunus persica	Harrow Blood X Okinawa	HBOCK 32	Wolfskill	
Controller 8	Prunus persica	Harrow Blood X Okinawa	HBOCK 10	Wolfskill	
Controller 9	Prunus salicina X Prunus persica	Plum/peach hybrid	P30-135	Wolfskill	
Empyrean 1	Prunus persica x P. davidana	Peach x Chinese wild peach. Venice, Italy	Barrier	Wolfskill	
Empyrean 3	Prunus domestica	European prune (seedling of Regina Claudia Verde)	Tetra	Wolfskill	sensitive to ORF
Fortuna	Prunus cerasifera x Prunus persica	Plum/peach hybrid		Wolfskill	
HBOCK 27	Prunus persica	Harrow Blood X Okinawa		Wolfskill	
Imperial California	Prunus domestica	plum R/S Italian Origin		Wolfskill	
Ishtara	(P. cerasifera x P.salicina)X (P. cerasifera x P. persica)	peach/plum hybrid (complex hybrid selected by INRA)	Ferciana	Wolfskill	
Krymsk 2	Prunus incana x Prunus tomentosa	wild cherry x Manchu cherry	VSV 1	Wolfskill	
Krymsk 99	P. besseyi x P. salicina	Plum/Plum hybrid (Sand cherry x Japanese plum)		Wolfskill	
Own rooted French	Prunus domestica	European prune		Wolfskill	
Puente	Prunus cerasifera	Plum (from Spain)	Adara	Wolfskill	
Sharpe	Prunus angustifolia x unknown plum	Plum x plum		Wolfskill	
Speaker	No idea scientific name	Plum/peach hybrid	Spicer	Wolfskill	
WRM #2	Prunus cerasifera	Red leaf myrobalan type (found growing in water)		Wolfskill	

Figure 1. Scientific and common pedigree for test plantings at the Butte, Yuba and Wolfskill prune rootstock experiments. Rootstocks at the Butte and Yuba locations are referred to as “Grower Trial.”

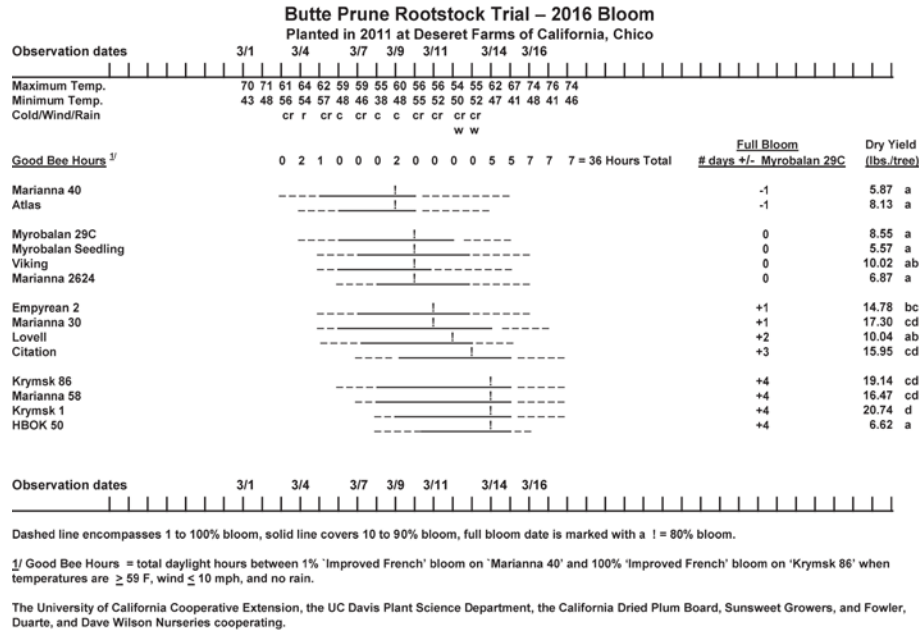


Figure 2. 2016 bloom conditions and timing for the prune rootstocks at the Butte County location.

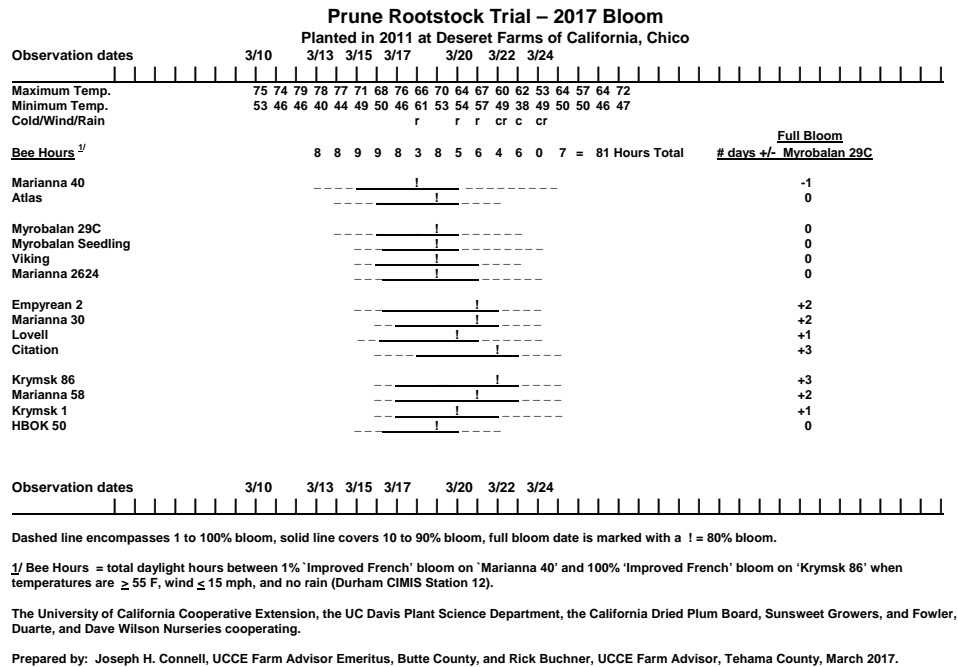


Figure 3. 2017 bloom conditions and timing for the prune rootstocks at the Butte County location.

### 2017 Butte Rootstock Experiment Harvest Comparisons

Rootstock	2016 TCSA (cm <sup>2</sup> )	Fruit Per Tree	Dry Ratio	Dry Yield (lbs./tree)	% A Screen
<b>K1</b>	46.01 a	875 a	3.17 ab	17.5 a	75.8 g
<b>HBOK50</b>	56.07 ab	1998 bcd	3.35 bcd	27.5 ab	41.1 cd
<b>M58</b>	56.34 ab	1387 ab	3.22 abcd	23.7 ab	68.5 fg
<b>EMP2</b>	58.92 abc	1219 ab	3.31 bcd	20.6 a	66.9 fg
<b>Cit</b>	66.52 bcd	1793 abc	3.4 de	27.9 ab	56.0 ef
<b>K86</b>	73.19 cde	2445 cb	3.31 bcd	36.1 bc	48.0 de
<b>Myro</b>	73.37 cde	2186 bcd	3.19 abc	35.9 bc	59.8 ef
<b>M2624</b>	75.22 def	2870 def	3.33 bcd	41.4 cd	41.2 cd
<b>M40</b>	84.69 efg	2644 cde	3.10 a	40.5 cd	39.9 bdc
<b>Lov</b>	89.17 fgh	3440 efg	3.56 ef	41.4 cd	20.3 a
<b>M30</b>	92.45 gh	2925 def	3.38 cde	40.7 cd	33.7 abcd
<b>Vik</b>	97.39 ghi	3652 fg	3.40 de	49.4 de	29.2 abc
<b>Atl</b>	101.38 hi	3963 g	3.61 f	48.9 d	26.2 ab
<b>29C</b>	111.55 i	4418 g	3.27 abcd	61.6 e	31.4 abc

Figure 4. 2017 trunk size (trunk cross sectional area in cm<sup>2</sup>) and yield characteristics for the Butte Co. rootstock experiment harvested 8/29/17. Values = treatment means for the five replicates. Statgraphics multiple range tests. Values followed by the same letters are not significantly different at 95% LSD.

Rootstock	Number of trees lost	Percentage of trees lost
Fortuna	9	100
WRM.2	5	55
M30	12	40
M29C	7	23
Myro seedling	5	17
Rootpac-R	2	7
M2624	1	3
M40	1	3
M58	1	3
Lovell	0	0
Atlas	0	0
Viking	0	0
Citation	0	0
Krymsk 86	0	0
Krymsk 1	0	0
HBOK 50	0	0



Figure 5. Number and percentage of trees by rootstock, lost since spring, 2012 in the Yuba Co rootstock trial. Each rootstock started 2012 with 30 healthy trees in the ground, except Fortuna and WRM.2 rooted trees, planted in March, 2013 (9 trees on each rootstock).

### 2017 Yuba Rootstock Experiment Harvest Comparisons

Rootstock	Dec. 2016 TCSA (cm <sup>2</sup> )	Dry Yield (lbs./tree)	Dry Away Ratio (dry wt:fresh wt)
<b>Krymsk 1</b>	39.03 a	5.13 ab	2.26 a
<b>M58</b>	39.91 a	4.74 a	2.61 d
<b>Citation</b>	46.94 ab	8.22 ab	2.43 abcd
<b>Myro seedling</b>	48.37 abc	3.78 a	2.35 ab
<b>M2624</b>	47.97 abc	4.93 ab	2.37 abc
<b>M40</b>	53.77 bcd	6.17 ab	2.39 abc
<b>M29C</b>	58.44 bcd	9.16 b	2.30 a
<b>Krymsk 86</b>	60.23 bcd	9.95 b	2.58 cd
<b>Lovell</b>	60.62 bcd	8.52 ab	2.55 bcd
<b>Rootpac-R</b>	61.84 cd	8.26 ab	2.33 a
<b>HBOK50</b>	63.09 cd	10.46 b	2.60 bcd
<b>M30</b>	63.53 d	5.90 ab	2.43 abcd
<b>Atlas</b>	65.87 d	9.03 ab	2.43 abcd
<b>Viking</b>	66.85 d	9.51 ab	2.45 abcd

Figure 6. 2017 trunk size (trunk cross sectional area in cm<sup>2</sup>) and yield characteristics for the Yuba Rootstock experiment harvested 9/1/17. Values = treatment means for the five replicates. Values followed by the same letters are not significantly different at 95% using Tukey's HSD.