

UC CE Third Year Performance of 14 Almond Rootstocks in a Sandy Location Irrigated with Well Water

David Doll UC CE Farm Advisor, Merced Co. Cooperating personnel: Matt Jones, Andrew Ray, and Larry Burrow, UCCE Merced Co.; Glen Arnold, Arnold Farms

Introduction: This replicated trial was established on a site in Winton, CA in Atwater Sand in January 2011. The trial compares the performance of 'Nonpareil' on 14 rootstocks, and the performance of 'Fritz' and 'Monterey' on seven rootstocks. Each rootstock and variety combination has 6 trees within a block, with six replicate blocks. Many of the rootstocks are peach/almond hybrids (P/A-Hybrids), a type of rootstock the grower developed an interest in after participating in a previous UCCE rootstock trial. Prior to planting, the site was cover cropped with Merced Rye, tree sites were back-hoed, and the row-strips were fumigated with Telone®-II (1,3-dichloropropene) at 33 gallons per acre. Trees are spaced 22'x18' and are irrigated using double-line drip.

Rootstocks in this trial include:

Rootstocks planted on Nonpareil, Fritz, and Monterey	Rootstocks planted on Nonpareil only
Nemaguard	Rootpac(R)-R
Hansen	TemproPac
BH#5	Krymsk-86
Viking	Cornerstone*
Atlas	Cadamen*
Empyrean-1	BB#106
Red Titan III*	Floridaguard x Alnem (USDA)

* Trees were planted in late January 2011 with the exception of Cadamen and Cornerstone. These potted trees were planted in April 2011 and are only for tissue comparative and nematode studies. Red Titan III were excluded from analyses due to tree loss issues

Objectives: Rootstocks were compared based growth, yield, nematode counts, leaf tissue, and irrigation water nutrient analysis, on a site characterized by low exchange capacity soil (with areas of shallow soils and hardpans), the presence of ring, rootknot, and lesion nematode, and sodium and nitrate content in irrigation water. Efforts will also be made to observe various phenological differences among rootstocks, such as bloom and harvest timing and prevalence of various diseases.

Methods: Soil mapping was done using Veris Electrical Conductivity Mapping (Strategic Farming). Zones of soil differences were identified, analyzed, and used to help block the trial. Initial and end-of-season trunk growth measurements were taken. Stem water potential (SWP) was collected from 3 trees in blocks 1-3 using standard procedure. The same trees within each block were measured 4 times, for a total of 12 days of SWP measurements. Water samples were collected to determine water quality. Approximately 100 leaves were taken from three trees in each rootstock/block combination. Nematode samples were collected in annually in October.

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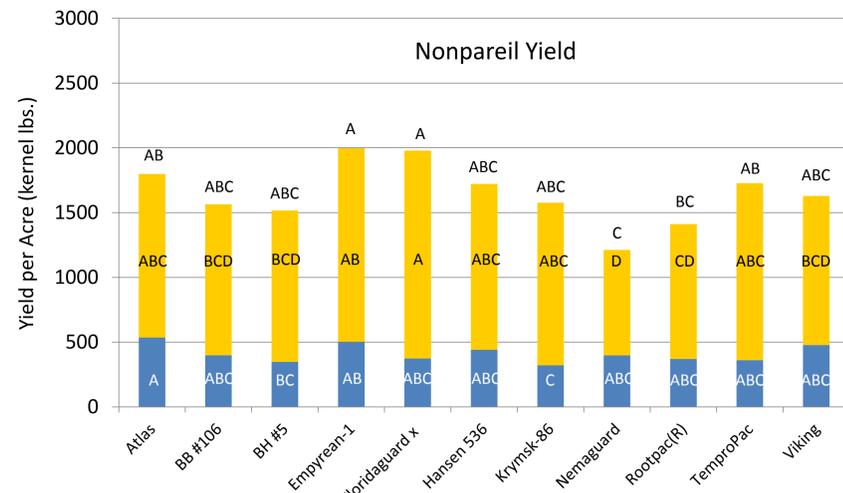


Figure 1: 2014 and 2013 yields for 'Nonpareil' scion grafted to 11 different rootstocks. Cadamen and Cornerstone rootstocks (potted trees planted in mid-April) were excluded from the analysis. Different letters indicate statistically significant differences (log10 normalized one-way ANOVA, Tukey-Kramer HSD, p <0.05).

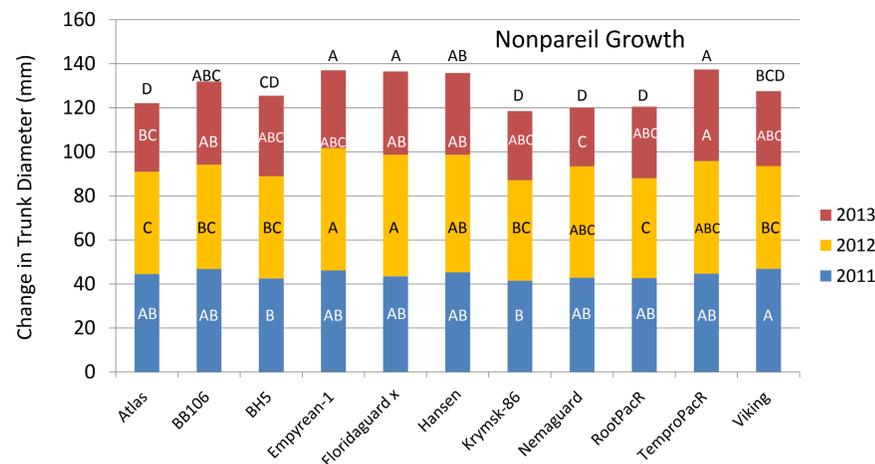


Figure 4: 2011-2013 change in caliper of 'Nonpareil' scion grafted to 11 different rootstocks. Cadamen and Cornerstone rootstocks (potted trees planted in mid-April) were excluded from the analysis. Different letters indicate statistically significant differences (log10 normalized one-way ANOVA, Tukey-Kramer HSD, p <0.05).

Table 2: Water analyses (2011-2014) from well supplying water for the trial. Blue indicates values are below normal, red indicates values are above normal.

Sampling Period	pH	EC dS/m	SAR	Ca meq/L	Mg meq/L	Na meq/L	Cl meq/L	B mg/L	HCO ₃ meq/L	NO ₃ -N mg/L	N lbs/acre in.
2014 Late season	7.6	0.31	0.90	1.47	1.05	1.00	0.30	0.05	1.80	10.3	2.3
2013 Mid-season	7.2	0.43	0.90	1.82	1.36	1.10	0.50	0.10	1.50	18.5	4.2
2012 Late season	7.4	0.48	1.30	1.69	1.20	1.50	0.80	0.10	1.60	13.9	3.2
2011 Late season	7.9	0.52	0.8	2.44	1.47	1.18	0.42	0.03	2.1	17.2	3.9
2011 Mid-season	7.9	0.52	0.9	2.50	1.50	1.23	0.42	0.03	2.1	19.6	4.5

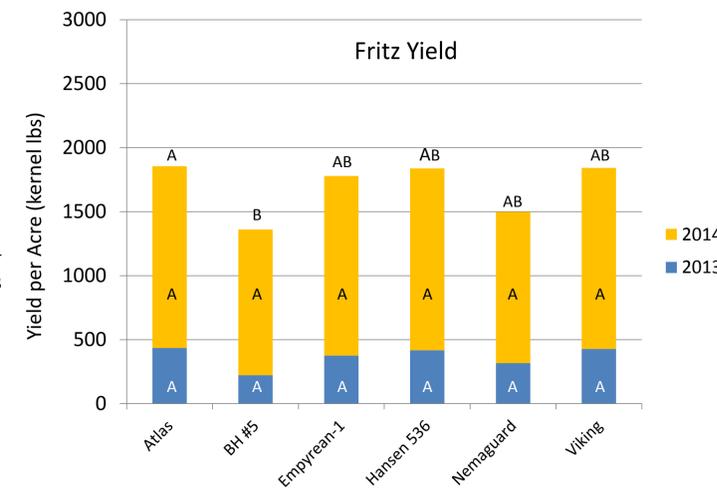


Figure 2: 2014 and 2013 yield for 'Fritz' scion grafted to 6 different rootstocks. Different letters indicate statistically significant differences (log10 normalized one-way ANOVA, Tukey-Kramer HSD, p <0.05).

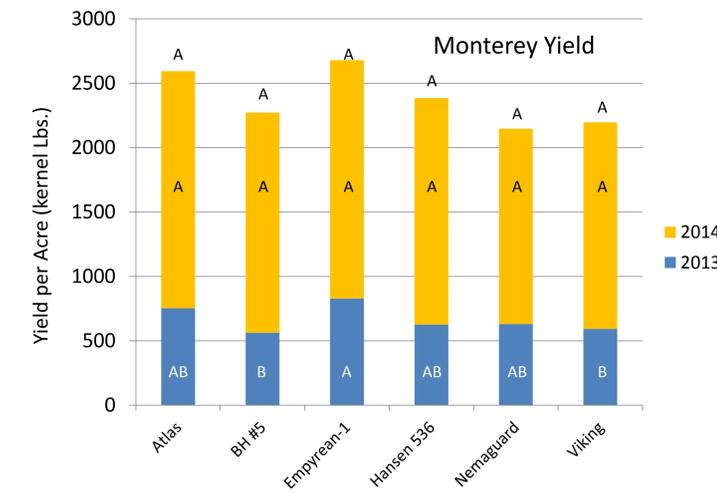


Figure 3: 2014 and 2013 yield for 'Monterey' scion grafted to 7 different rootstocks. Different letters indicate statistically significant differences (log10 normalized one-way ANOVA, Tukey-Kramer HSD, p <0.05).

Table 1: 'Nonpareil' leaf nutrient analysis of among 13 rootstocks. Different letters indicate statistically significant differences (log10 normalized one-way ANOVA, Tukey-Kramer HSD or Steel-Dwass All pairs, p <0.05). Blue indicates nutrient concentrations are deficient, red indicates nutrient concentrations are excessive.

Rootstock	N %	P %	K %	Zn mg/kg	Mn mg/kg	Na %	B mg/kg	Ca %	Mg %	Fe mg/kg	Cu mg/kg	Cl %
Atlas	2.18 A	0.104 A	1.69 ABC	18.0 A	96.4 A	<0.01 A	42.4 A	5.52 A	0.95 A	303 A	5.4 A	0.20
BB#106	2.08 A	0.096 A	1.55 BC	16.4 A	95.8 A	<0.01 A	39.4 AB	6.29 AB	0.93 BC	261 A	5.0 A	<0.1
BH#5	2.18 A	0.100 A	1.55 BC	16.4 A	93.8 A	<0.01 A	37.6 ABC	5.93 ABC	0.88 BCD	263 A	5.4 A	<0.1
Cadamen	2.39 A	0.106 A	1.66 ABC	18.2 A	112 A	<0.01 A	41.8 AB	5.07 AB	0.97 BCD	279 A	5.2 A	0.18
Cornerstone	2.19 A	0.104 A	1.53 BC	13.8 A	91.4 A	<0.01 A	35.2 C	5.37 BC	0.95 BC	270 A	3.8 A	<0.1
Empyrean-1	2.11 A	0.100 A	1.31 C	15.0 A	116 A	<0.01 A	38.8 AB	5.66 ABC	1.18 BC	230 A	4.4 A	0.08
Floridaguard xAl	2.17 A	0.104 A	1.52 BC	13.8 A	108 A	<0.01 A	40.4 AB	6.13 ABC	1.04 AB	266 A	5.2 A	<0.1
Hansen	1.99 A	0.094 A	1.33 C	15.6 A	138 A	<0.01 A	39.8 ABC	6.32 AB	1.04 AB	242 A	4.6 A	0.02
Krymsk-86	2.27 A	0.104 A	1.60 ABC	14.0 A	100 A	<0.01 A	38.2 ABC	4.61 C	0.87 BCD	277 A	5.0 A	0.12
Nemaguard	2.19 A	0.100 A	1.68 ABC	11.8 A	78.0 A	<0.01 A	39.2 ABC	5.09 BC	0.86 BCD	280 A	4.2 A	0.20
Rootpac(R)	2.24 A	0.114 A	2.04 A	13.8 A	118 A	<0.01 A	37.2 BC	4.46 C	0.77 CD	288 A	4.6 A	0.04
TemproPac	2.12 A	0.104 A	1.48 BC	17.0 A	119 A	<0.01 A	39.4 ABC	5.57 ABC	1.02 AB	289 A	4.8 A	0.02
Viking	2.13 A	0.100 A	1.84 AB	15.2 A	100 A	<0.01 A	37.2 BC	5.67 ABC	0.73 D	272 A	4.6 A	<0.1

Results:

- 'Nonpareil' grown on 'Empyrean-1' and 'Floridaguard x Alnem' produced significantly greater cumulative yields than 'Nonpareil' grown on 'Nemaguard' and 'RootPacR' (Fig. 1). RootPacR is a smaller tree than the hybrids (data not shown).
- 'Fritz' grown on 'Atlas' produced significantly higher cumulative yields than 'Fritz' grown on 'BH #5' (Fig. 2).
- 'Monterey' produced the highest yields in 2014, but yield differences among rootstocks were not significant (Fig 3).
- Among rootstocks on 'Nonpareil', 'Empyrean-1', 'TemproPac' and 'Floridaguard x Alnem' exhibited the most growth since planting, and along with 'Hansen' and 'BB#106,' grew significantly more than 'Atlas', 'Krymsk-86', 'Nemaguard' and 'RootPacR' (Fig. 4).
- High 'Nonpareil' leaf Ca concentrations were observed in all rootstocks except 'Krymsk-86' and 'Rootpac(R)', and high Mg concentrations except in 'Rootpac(R)' and 'Viking,' which may suggest differential nutrient allocation in these rootstocks (Table 1).
- High NO₃ concentrations in irrigation water has persisted since 2011 and is likely contributing to high tree vigor (Table 2).
- 2013 showed the first appreciable presence (post-fumigation) of root-lesion nematodes in soils around 'Krymsk-86' and 'Cornerstone' rootstocks (data not shown). Nematode counts will be monitored closely in coming years.
- 'Fritz' showed delayed blooming compared to 'Nonpareil' and 'Monterey' in 2014, which was not observed in 2012.