Fourth Year Performance of 14 Almond Rootstocks in a Sandy Location Irrigated with Well Water

David Doll UC CE Farm Advisor, Merced Co. Cooperating personnel: Vivian Lopez, Matt Jones, and Andrew Ray, UCCE Merced Co.; Arnold Farms, Atwater, CA

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, root knot, 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. Nematode samples were collected in annually in October and sent in for analysis by Nematodes, Inc (Selma, CA). Observations of bloom percentage as influenced by variety and rootstock were taken on February 24, 2012, March 4th, 2013, February 14, 2014, and February 17, 2015.

Acknowledgements: Thanks to Bright's Nursery, Burchell Nursery, Dave Wilson Nursery, and The Nursery Company for donation of trees. Thanks to Strategic Farming, Inc. for soil electrical conductivity mapping, and Dellavalle Laboratory, Inc for leaf tissue and water sample analyses, and Nematodes, Inc for nematode analysis.

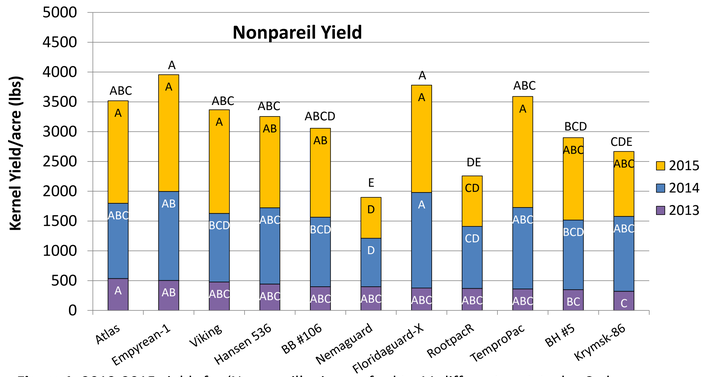

Figure 1: 2013-2015 yields for 'Nonpareil' scion grafted to 11 different rootstocks. Cadamen and Cornerstone rootstocks (potted trees planted in mid-April) were excluded from the analysis. Different letters indicate statistically significant differences (One way ANOVA, Tukey-Kramer HSD, p <0.05).

Rootstock, cv 'Nonpareil'	2012	2013	2014	2015
Atlas	43% DEF	100%	34% ABC	74% BC
BB #106	63% BCD	100%	25% C	88% A
BH #5	43% DEFG	100%	32% ABC	88% A
Cadaman	22% GHI	100%	29% ABC	82% AB
Cornerstone	11% I	100%	30% ABC	80% ABC
Empyrean-1	76% A	100%	53% AB	84% AB
Floridaguard X	38% DEFGH	100%	35% ABC	86% A
Hansen 536	63% ABC	100%	56% A	86% A
Krymsk-86	7% I	100%	33% ABC	83% AB
Nemaguard	54% CDE	100%	23% C	83% AB
Red Titan	28% FGHI	100%	28% ABC	83% AB
RootPac(R)	23% HI	100%	28% BC	89% A
TemproPac	35% EFGH	100%	31% BC	83% AB
Viking	74% AB	100%	28% ABC	71% C

Table 1 Mean estimated percent bloom for four seasons among rootstocks grafted to 'Nonpareil'. Bloom period in 2013 was too compact to reliably determine % bloom differences among rootstocks. Measurements with different letters indicate statistically significant differences at p<0.05 (ANOVA and Tukey-Kramer HSD of arcsin transformed bloom percentages).

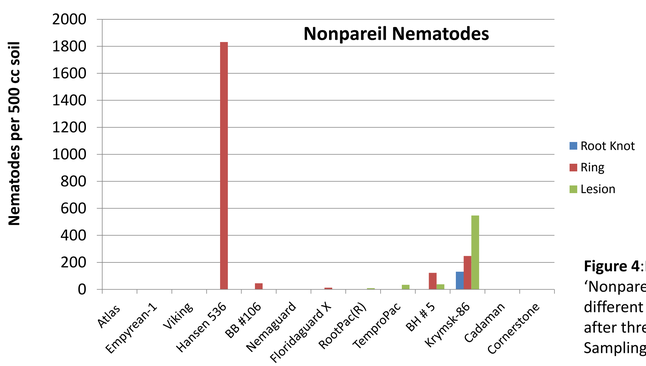

Figure 4:Nematode counts for 'Nonpareil' scion grafted to 13 different rootstocks taken after three years of growth. Sampling performed in 2014.

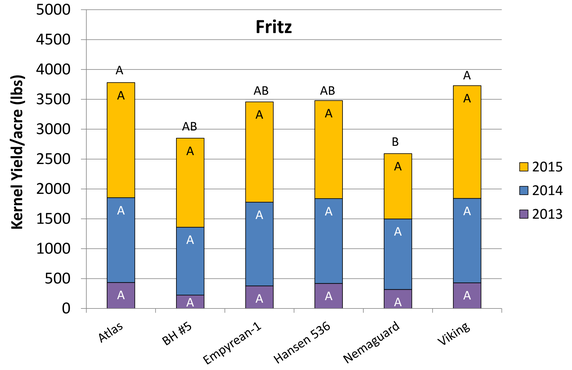

Figure 2: 2013-2015 yield for 'Fritz' scion grafted to 6 different rootstocks. Different letters indicate statistically significant differences (One-way ANOVA, Tukey-Kramer HSD, p <0.05).

Rootstock, cv 'Fritz'	2012	2013	2014	2015
Atlas	31% B	100%	6% A	94% A
BH5	12% C	100%	5% A	92% A
Empyrean-1	66% A	100%	11% A	92% A
Hansen 536	55% A	100%	12% A	91% A
Nemaguard	28% BC	100%	3% A	94% A
Red Titan III	26% BC	100%	5% A	90% A
Viking	36% B	100%	4% A	92% A

Table 2 Mean estimated percent bloom for four seasons among rootstocks grafted to 'Fritz'. Bloom period in 2013 was too compact to reliably determine % bloom differences among rootstocks. Measurements with different letters indicate statistically significant differences at p<0.05 (ANOVA and Tukey-Kramer HSD of arcsin transformed bloom percentages).

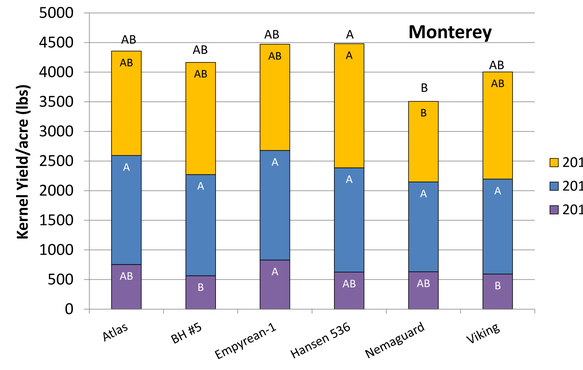

Figure 3: 2013-2015 yield for 'Monterey' scion grafted to 6 different rootstocks. Different letters indicate statistically significant differences (log10 normalized one-way ANOVA,Tukey-Kramer HSD, p <0.05).

Rootstock, cv 'Monterey'	2012	2013	2014	2015
Atlas	42% BC	100%	36% AB	93% AB
BH5	21% D	100%	28% AB	89% B
Empyrean-1	71% A	100%	48% A	94% A
Hansen 536	64% AB	100%	53% A	91% B
Nemaguard	27% D	100%	18% B	89% B
Red Titan III	33% CD	100%	31% AB	94% A
Viking	53% AB	100%	27% AB	90% B

Table 3 Mean estimated percent bloom for four seasons among rootstocks grafted to 'Monterey'. Bloom period in 2013 was too compact to reliably determine % bloom differences among rootstocks. Measurements with different letters indicate statistically significant differences at p<0.05 (ANOVA and Tukey-Kramer HSD of arcsin transformed bloom percentages).

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' and 'Viking' produced significantly higher cumulative yields than 'Fritz' grown on 'Nemaguard' (**Fig. 2**).
- 'Monterey' produced the highest yields in 2015, for the second consecutive year. 'Hansen' rootstock was significantly greater than 'Nemaguard' for both the year 2015 and cumulative yield across all years recorded. (**Fig 3**).
- Nematode counts varied among rootstocks but were not statistically significant (**Fig. 4**). Rootknot nematodes were found in Krymsk-86; Ring nematodes were found on 'Hansen 536', 'BH #5', and 'BB #106', 'Floridaguard X', and 'Krymsk-86.'; Lesion nematodes were found in 'BH #5', 'Krymsk-86', 'RootPac(R)', 'TemproPac', and 'Viking'.
- 'Nonpareil' flowers had similar bloom periods across rootstock, though all bloomed earlier than 'Viking' rootstock flowers (**Table 1**).
- 'Fritz' blooms were identical across rootstocks (**Table 2**).
- 'Monterey' flowers bloomed slightly earlier on 'Empryean-1' and 'Red Titan III' relative to other rootstocks (**Table 3**).
- 'Frtiz' and 'Monterey' showed more complete bloom than 'Nonpareil', which may be the result of inadequate chilling hours or uneven chilling within the canopy.