Sixth Year Evaluation of 14 Almond Rootstocks in a Sandy Location Irrigated with Well Water

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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. Soil was sampled for nematodes and found non-detectable levels of Ring, lesion, and Rootknot nematode.

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 potential for plant parasitic nematodes, 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). Leaf tissue was sampled in Mid-July from non-fruiting spurs. Hull Boron was collected from 2015 harvested hulls.

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Results:

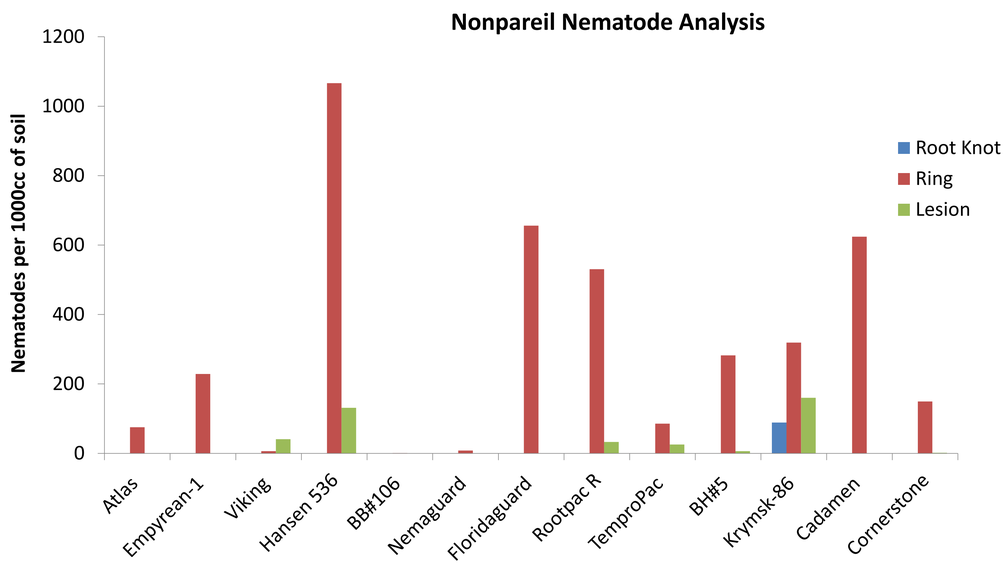

Figure 1:Nematode counts for 'Nonpareil' scion grafted to 13 different rootstocks taken after four years of growth. Sampling performed in October of 2015.

Leaf Nutrient Analysis

Rootstock	%N	%P	%K	S (ppm)	B (ppm)	%Ca	%Mg	Zn (ppm)	Mn (ppm)	Fe (ppm)	Cu (ppm)
Atlas	2.24 ABC	0.12 AB	1.98 A	1546 ABC	45.78 A	4.46 CDE	0.89 CDE	17.66 A	86.28 CD	722.6 A	8.84 A
BB106	2.23 ABC	0.11 B	1.72 A	1592 ABC	42.12 A	5.10 B	0.88 CDE	16.56 A	83.56 CD	605.4 A	11.38 A
BH5	2.11 ABC	0.11 B	1.83 A	1522 BC	39.6 A	5.06 B	0.85 CDE	18.34 A	82.42 CD	615.2 A	10.7 A
Cadaman	2.26 ABC	0.12 B	1.81 A	1536 ABC	40.98 A	4.79 BC	0.96 ABCD	16.6 A	108.02 ABCD	585.2 A	7.28 A
Cornerstone	2.18 ABC	0.12 B	2.08 A	1600 ABC	46 A	4.57 BCD	0.95 BCD	17.46 A	96 ABCD	786.6 A	7.96 A
Empyrean-1	2.23 ABC	0.12 B	1.62 A	1582 BC	43.58 A	4.76 BCD	1.16 A	17.5 A	113.84 ABC	586 A	7.58 A
FlorX	2.09 ABC	0.12 B	1.85 A	1460 BC	45.76 A	4.90 BC	0.96 BCD	21.94 A	104.88 ABCD	830.8 A	9.6 A
Hansen	2.07 BC	0.11 B	1.53 A	1656 AB	44.04 A	6.04 A	1.13 AB	18.08 A	140.08 A	643.6 A	10.62 A
Krymsk	2.35 A	0.12 B	1.87 A	1790 A	49.2 A	3.63 F	0.82 DE	21.52 A	92.68 BCD	848.4 A	13.2 A
Nemaguard	2.17 ABC	0.12 B	2.09 A	1430 BC	45.4 A	4.20 DEF	0.84 DE	17.6 A	74.66 D	739.8 A	8.24 A
RootPacR	2.28 AB	0.13 A	2.15 A	1602 ABC	41.56 A	3.90 EF	0.78 E	18.44 A	132.68 AB	715.4 A	8.42 A
Tempro	2.00 C	0.11 B	1.85 A	1408 BC	45.58 A	5.09 B	1.03 ABC	21.02 A	116.08 ABC	721.4 A	8.34 A
Viking	2.12 ABC	0.12 B	1.98 A	1376 C	45.52 A	4.95 BC	0.76 E	18.2 A	100.24 ABCD	786.8 A	12.5 A

Table 1: Leaf nutrient analysis of 'Nonpareil' scion grafted to 13 different rootstocks taken after four years of growth. Values are reported in total percent (%) or parts per million (ppm). Different letters indicate statistically significant differences (one-way ANOVA, Tukey-Kramer HSD, p<0.05).

Hull Boron Nutrient Analysis

Rootstock	Hull Boron (ppm)
Atlas	80.4 AB
BB106	71.4 ABC
BH5	69.8 ABC
Cadamen	78.6 AB
Cornerstone	63 BC
Empyrean-1	71 ABC
FloridaguardxAlnem	70.4 ABC
Hanson 536	76.2 ABC
Krymsk-86	71.2 ABC
Nemaguard	84 A
RootPacR	56 C
TemproPac	77.6 AB
Viking	68.4 ABC

Table 2: 'Nonpareil' hull boron nutrient analysis of among 14 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.

Discussion:

- Nematode counts varied across rootstocks (Figure 1). Sampling prior to planting (2010) found non-detectable populations of plant parasitic nematodes, suggesting that the populations present are feeding and reproducing on the rootstocks.

- Rootknot nematodes (*Meloidogyn*e spp.) were found only in Krymsk-86 . Lesion nematode (*Pratylenchus vulnus*) were found on Cornerstone, Kryms-86, BH#5, TemproPac, RootPacR, Hansen 536, and Viking. Ring populations have been increasing, with the exception of BB106, Nemaguard, and Viking. Differences were not statistically significant, but the nature of nematode sampling results in high variability, obscuring results.

- Hull data suggests that there are different boron nutrient uptake rates among rootstocks (Table 2). We found deficient hull boron in all rootstocks except 'Nemaguard' (Table 2); this may have had an impact on yield. Interestingly, 'Nemaguard' historically has been one of the lowest yielding rootstocks, suggesting that the higher boron values may be due to increased soil availability from lower rates of crop extraction.

- Leaf nutrient analyses varied depending on the nutrient. There were no differences in potassium, boron, zinc, iron, or copper concentration amongst rootstocks (Table 1). Calcium differences appear to be tied to tree size (data not shown) with lower calcium content in the smaller trees. Magnesium, manganese, and iron are higher in the larger trees.