Effects of eight almond rootstocks on Nonpareil tree growth grown on marginal soil high in boron

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Background:
As the almond industry expands in the Sacramento Valley, growers are increasingly planting new orchards on marginal soil using lower quality irrigation water. Almonds are generally more drought tolerant and tolerate more shallow soils than other tree crops, but, in the Sacramento Valley , marginal soils are often fine textured (more clay, slower drainage). These heavier soils can be problematic with water logging and restrictive clay layers inhibiting root growth. In addition, in Yolo County, the soils and water are high in boron (B). These soil limitations are not unique to Yolo County. Heavy soils are found throughout the northern Sacramento Valley and in the southern west side of the San Joaquin Valley B levels are so high in some areas that they prohibit agriculture. The plot chosen for this trial will test both of these soil limitations in the evaluation of eight almond rootstocks.

Previous research and observational data showed seven rootstocks that may tolerate B better than the commonly grown – in the Sacramento Valley -- Lovell peach. They are Hansen, Nickels, Floraguard x alnem hybrid (FXA), Krymsk 86, Brights-5, Rootpac-R, and Viking. This trial is an opportunity to evaluate potential differences in B tolerance between rootstocks and their performance on heavier, marginal soils. An additional rootstock, Titan SG1, was added after the initial planting. Data collected from this rootstock will be included in the report but considered observational.

Objectives:
Evaluate plant growth, nut yield, and boron uptake of the Nonpareil almond variety on eight different rootstocks in the Sacramento Valley growing in a silty clay loam (Class 2) soil high in boron.

Methods
The trial is located in Yolo County north of Cache Creek . Nonpareil almond nursery grafted trees on eight different rootstocks (Lovell, Hansen, Nickels, Floraguard x alnem hybrid (FXA), Krymsk 86, Brights-5, Rootpac-R, and Viking) were planted on February 9, 2011. All trees were bareroot except Brights-5 which was potted. The soil is classified as Marvin silty clay loam with a Storie Index (CA) of 2.

The trial is a randomized complete block design with 6 replicates of each rootstock, 5 trees per replicate. This totals to 30 trees per rootstock with 240 trees in the trial. 20 trees of Titan SG1 (potted) were planted on April 22, 2011 with in the same orchard but not in the replicated trial. The orchard is planted 22' x 18'

In 2013, leaf nutrient analysis was done in July by collecting and bulking the leaves from the 5 trees in each plot. Samples were analyzed by UC Lab. Yield per 5 tree replicate was measured at harvest and presented on a kernel pounds per acre basis.

Non-pariel trees on Nickels peach/almond hybrid rootstock. Summer, 2013

Suckers on Rootpac-R rootstock, 2012

Results
Significant differences in median nut yield per acre existed between rootstocks (Figure 1). Median yield of Brights 5, Nickels, and Rootpac-R were significantly greater than Viking, Lovell, and Krymsk 86, with FXA and Hansen falling in the middle. Visual differences in tree size did not entirely explain these yield differences. These results should be considered carefully, as they are from 3rd leaf trees that were not uniformly pruned the prior winter.

Irrigation water (canal source) contained 1.3-2.25 ppm B this summer and fall. The sodium, SAR, chloride and salt levels in the water at that time should not restrict plant growth [Western Fertilizer Handbook (9th ed, page 40)].

Figure 1. Average and median kernel yield per acre for 3rd leaf Non-pareil trees growing on nine different rootstocks on a silty clay loam soil. Yolo County. 2013. Letters show significant differences in median yield (5% level) between the rootstocks . Titan SG1 is not in the replicated trial and the measurements are included as an observation.

Rootstock	Ave kernel yield/acre	Median kernel yield/acre
Brights 5	298	286 a
Nickels	280	283 ab
Rootpac-R	210	208 ab
FXA	202	181 abc
Titan SG1	196	
Hansen	181	173 bc
Viking	177	176 c
Lovell	137	146 c
Krymsk 86	76	85 d

Results:
Tissue sample results differed based on the tissue source. Average hull B at harvest (Table 2) ranged from approximately 500 – 675 ppm B with Viking the lowest mean B levels (511 ppm) and Lovell the highest (673 ppm B). In contrast, mean July leaf B levels varied by no more than 5 ppm B across all rootstocks-- with no significant differences (Table 2).

No significant linear relationship existed (p=0.1144) between harvest hull B levels and yield per tree or per acre , using data from each of the 50 experimental units (reps) in the trial.

Table 2. Average Boron (ppm) leaf and hull content of Nonpareil almond grafted on 8 different rootstocks. Letters show significant difference between the rootstocks analyzed by the Duncan's Multiple Range test. *Titan was not in replicated trial

Rootstock	Hull B	Leaf B
Viking	511 a	61 a
Nickels	519 a	62 a
Krymsk 86	544 ab	63 a
FXA	558 ab	62 a
Rootpac-R	570 ab	64 a
Brights 5	590 abc	64 a
Titan SG1	609	66
Hansens	624 bc	65 a
Lovell	673 c	63 a

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