Almond High-Density Trial at CSU Fresno: Developing New Orchard Systems with Modified Row, Tree Spacing, Pruning

Project No.:   **17-HORT30A-Brar**

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Objectives:

Evaluate high density almond planting with different row and tree spacing to develop new orchard systems.

Interpretive Summary:

The high density almond trial was planted in February 2018 with two cultivars Nonpareil and Shasta on nemaguard rootstock, planted at 6 different tree X row spacing combinations: 16 x 21 ft, 10 x 21, 10 x 18, 7 x 18, 10 x 15, and 7 x 15 ft. There are 6 replicated blocks for each of the six spacing treatments, randomized within each block of row spacing. There are 5 replicate data trees in each treatment block of a cultivar-spacing combination. All trees except 21 x 16 ft spacing were never unheaded and are trained as central leader trees, while 21 x 16 ft treatment is headed and trained aa per conventional industry-standard practices. Six weeks after planting, tree height and trunk girth of the experimental trees were measured. During summer of 2018, all central leader trees were trimmed on east and west side (towards the row middles) to maintain desired pyramidal shape.

Materials and Methods:

Location: The experimental block is situated in the University Agricultural Laboratory (University Orchards) of the California State University, Fresno. The trees were planted in early February 2018. In a long term-study, the objective is to evaluate Nonpareil and Shasta trees on Nemaguard planted at 6 different Tree X Row spacing:
i)   16 x 21 ft (130 trees per acre)
ii) 10 x 21 ft (207 trees per acre)
iii) 10 x 18 ft (242 trees per acre)
iv) 7 x 18 ft (346 trees per acre)
iv) 10 x 15 ft (290 trees per acre)
v)   7 x 15 ft (415 trees per acre).

The trees planted at 16 x 21 ft spacing were planted as control trees that had been headed back in the nursery and all side shoots trimmed. All remaining trees were planted as "unpruned" central leader trees taken direct from the nursery to be grown with minimal

pruning to produce mature, full height trees up to 16 or 20 ft tall depending on row width. Trees planted 10 ft apart along the rows were trained as narrow palmette style trees in summer by removing any large structural branches growing out into the center of the rows. Trees planted 7 ft apart along the rows will be pruned in both directions to produce a slender pyramid tree shape.

Trees of two commercial varieties 'Nonpareil' and 'Shasta®' were selected at the collaborating nursery. These highly productive varieties were chosen because when grown as central leader trees their architecture naturally tends to produce a strong, narrow tree shape. The trees were on an average 6 ft tall when planted as they have remained unpruned in the nursery apart from removal of side branches below 3 ft to produce a clean trunk for shake harvesting. evaluation in terms of graft compatibility and tolerance to nematodes and difficult soil types.

To replicate commercial conditions, each experimental block includes four rows (two alternating rows per variety) with seven trees per row (28 trees). Data will be collected from the five central trees in the two internal rows per variety. The two external rows and one tree at the end of each row are guard trees. There are six replicated experimental blocks for each of six pruning treatments extending across 28 rows (1,008 trees) in a mainly randomized design except that each group of four rows has the same row width for the complete row. This trial design will ensure that micro-climates expected in a fully commercial high density block are replicated in this trial. This is important to ensure that the trial provides a true indication of the effect of planting density on kernel quality and maturation. The first commercial crop is expected in the 2019 season.

Irrigation system was installed, and three different irrigation zones have been created to have the capability to irrigate different row spacings plots differently in future.

Tree height and trunk girth data were collected in March 2018, approximately 6 weeks after planting. During the spring season, some central leader trees were selectively pruned at the top to select a dominant c\central leader shoot wherever the top shoots were forking or where the terminal bud stopped growing due to weather conditions or mechanical damage.

During June 2018, the trees in 7- and 10-foot tree spacing across all row spacings (practically all unheaded central leader trees, leaving only 21 x16 conventional training) were trimmed along the rows to stimulate growth and to achieve a desired pyramidal shape. Some mortality of the trees was observed in first few weeks after planting and the dead trees were replanted with new potted trees in May. The cause of tree mortality is believed to be the damage by late frost and long term storage of the trees in cold storage.

Results and Discussion:

Measurements on tree height and trunk diameter were taken in March 2018. The data are presented below in both table and graph format (**Tables 1 & 2**; and **Figure 1 & 2**).
In tree height, all central leader trees within each cultivar did not have statistically significant differences between spacing treatments. However, Shasta trees were significantly taller than Nonpareil trees. In terms of trunk girth all trees were similar in trunk girth and no significant differences were found among spacing treatments or cultivars. The headed trees in 21X16

treatment were significantly shorter that their unheaded/central leader counterparts, because they were headed back in the nursery.

<div align="center">***</div>

Table 1. Tree Height

Spacing	Nonpareil		Shasta	
RowXTree	Mean	SEM	Mean	SEM
15x10^{1}	197.77	3.54	217.47	3.06
15x7[1]	198.10	4.04	207.87	3.26
18x10^{1}	198.77	3.58	210.87	4.32
18x7[1]	200.83	3.28	215.90	3.18
21x16[2]	99.50	1.98	102.70	1.34
21x10^{2}	204.00	4.17	211.30	4.36

[1]n=30; [2]n=20

Table 2. Trunk Girth

Spacing	Nonpareil		Shasta	
RowXTree	Mean	SEM	Mean	SEM
15x10^{1}	16.07	0.31	16.42	0.31
15x7[1]	15.80	0.27	15.91	0.28
18x10^{1}	16.12	0.25	16.81	0.33
18x7[1]	15.87	0.32	17.00	0.25
21x16[2]	16.35	0.35	17.39	0.24
21x10^{2}	16.05	0.33	15.90	0.39

[1]n=30; [2]n=20

Tree Height
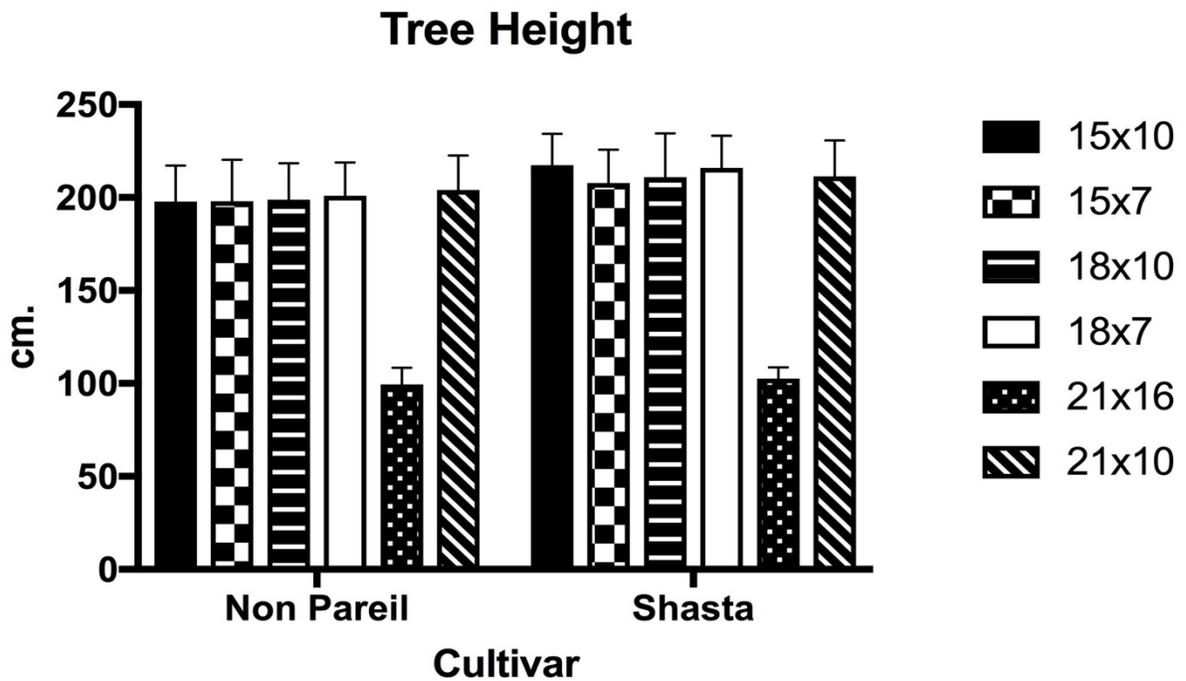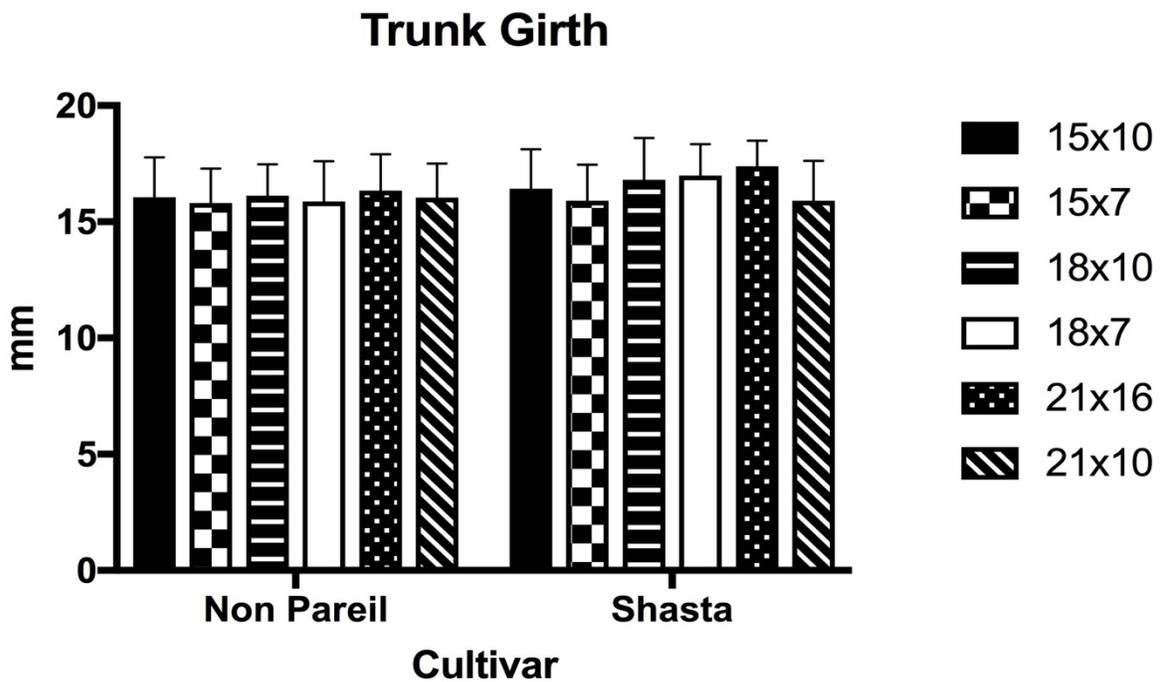

Fig. 1

Trunk Girth

Fig. 2

Figures 1 and 2: Tree height and truck girth data for Nonpareil and Shasta tree planted at high density.

Pictures from the trial at Planting:

Photo 1: Digging the planting holes

Photo 2: Planting the trees

Photo 3: Refilling the holes after planting

Pictures from July 2018, 6 weeks after summer training:

a

b

c

d

Photo 4. a. Nonpareil trees at 15X10 ft spacing; b. Shasta at 15x7 ft, c. Shasta at 18X10 ft and d. Nonpareil at 21X16 ft (Conventional training).