Update on New Training Systems for Pistachio

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Presented at Statewide Pistachio Day, Jan. 18th, 2023

Trials underway

- Kings and Yolo County trials
  - Kings Site #1 (2016)- Lost Hills on PG1 rootstock (18’ x 16’)
  - Kings Site #2 (2017)- Lost Hills on PG1 rootstock (18’ x 16’)
  - Yolo Site (2018)- Golden Hills on UCB1 sdlg rootstock (19’ x 16’)

- Westside training trials added in 2018
  - Kerman on Platinum (18’ x 11’)
  - Kerman on UCB1 seedling (18’ x 11’)
  - Golden Hills on Platinum (18’ x 11’)
  - Golden Hills on UCB1 seedling (18’ x 11’)

Our objective is to bring pistachios into production more rapidly at lower cost with higher water use efficiency while establishing a strong tree structure

Treatments

Conventional (wooden stakes)

- Following Pistachio Production Manual

Modified central leader (5/16" x 8' metal stakes)

- Trees headed at 62 inches at end of first dormant season
- Dormant pruning only- no in season tipping
- No shoots were removed but all shoots that grew more than 18-24" were tipped
- In addition, the most central shoot was tipped and retrained to a central leader and left longer than all other shoots

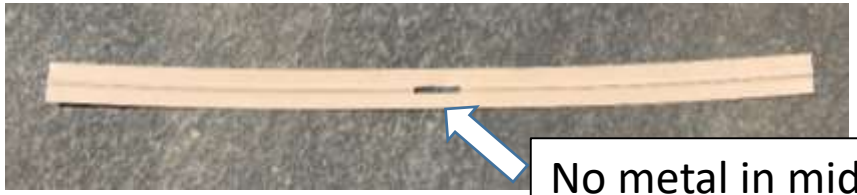
Untrained (3/8" x 10' metal stakes)

- No heading or pruning (only limbs that were too low were removed but this was done on all treatments)

Modified central leader and untrained were attached to metal stakes with flexible ties

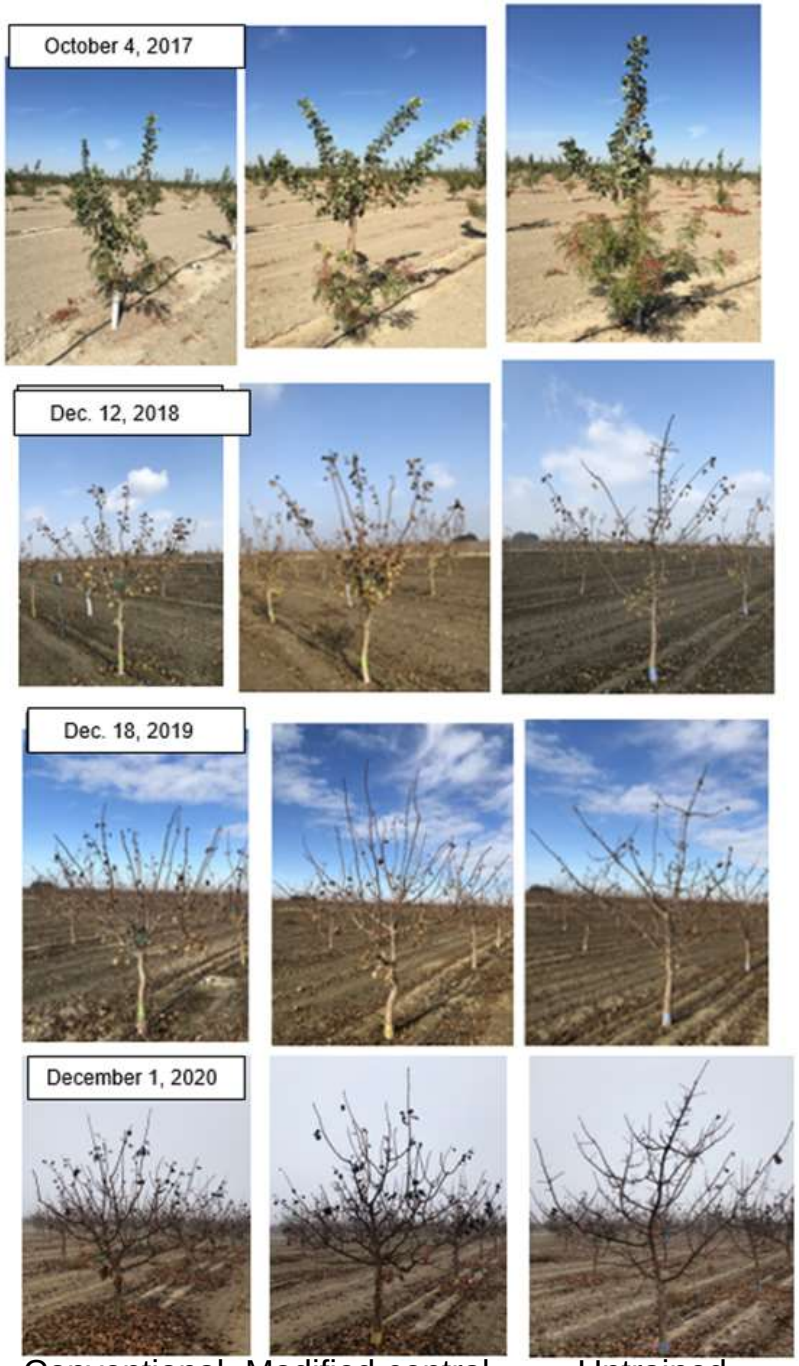
Stretch ties are tied to allow some movement

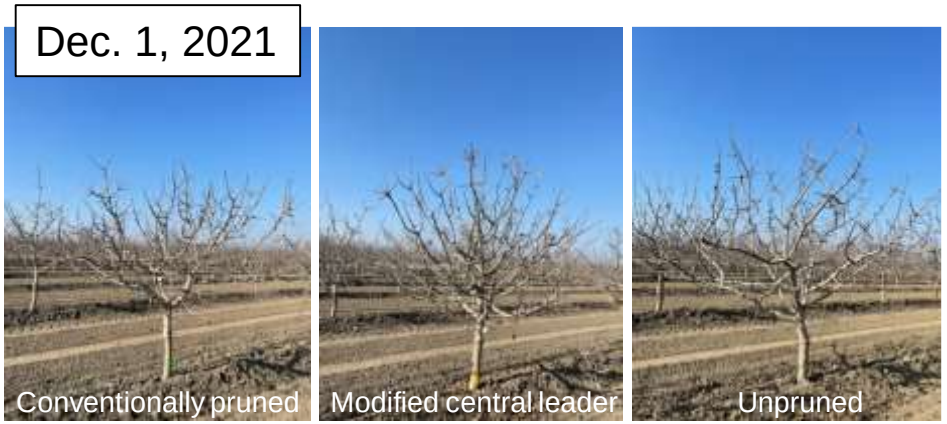
As trunks grow in diameter, stretch ties release themselves



No metal in middle

Kings County Trial #1- Lost Hills on PG1 rootstock





Kings Site #1 before pruning

Jan 17, 2023

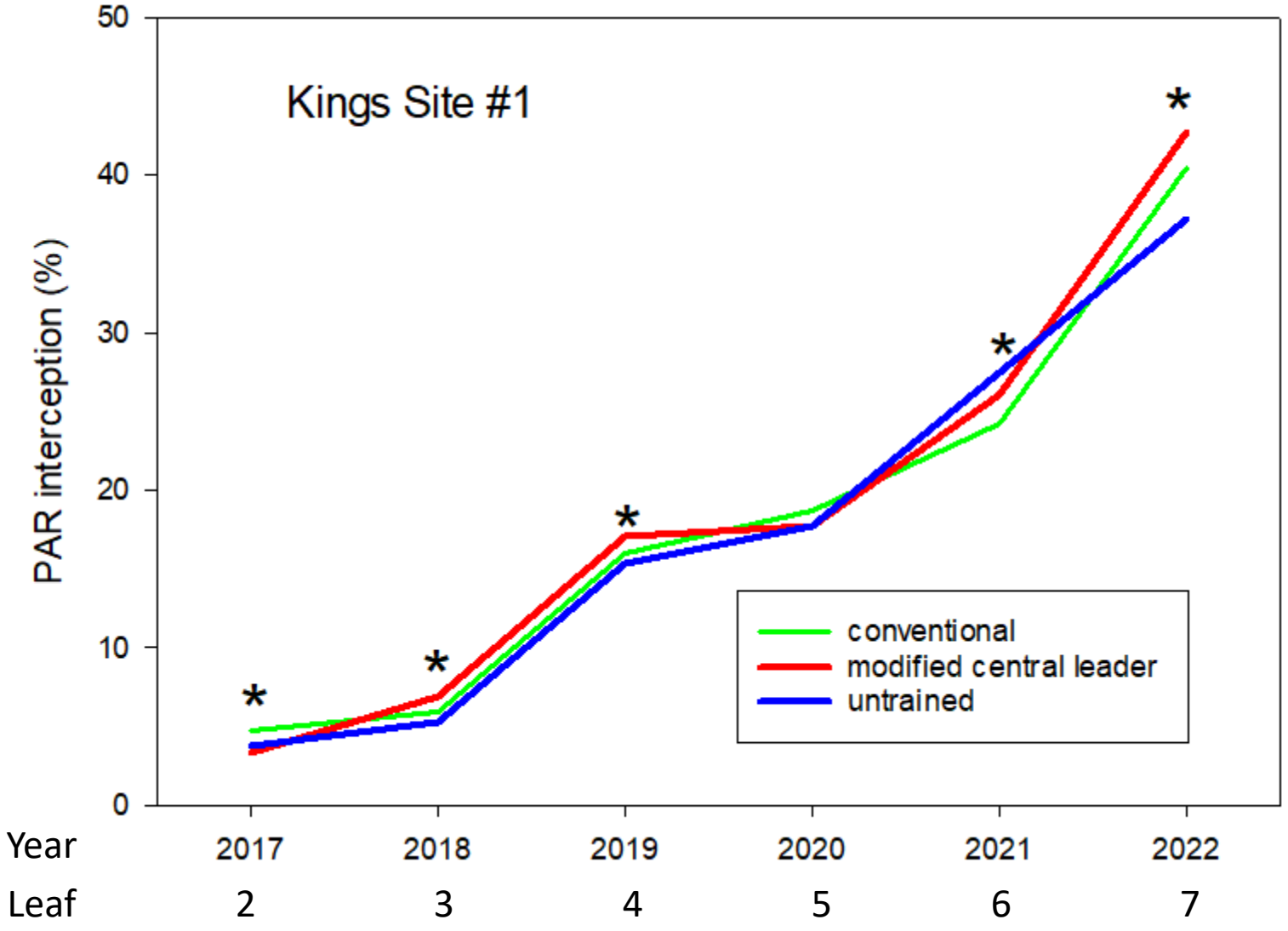
Conventionally pruned

Modified central leader

Untrained

Mobile platform lightbar was used to measure photosynthetically active radiation interception (PAR) each year

Kings Site #1 PAR interception by year and treatment



First harvest in 4th leaf (2019) and second in 5th leaf (2020)

Hand harvest Sept. 2, 2019

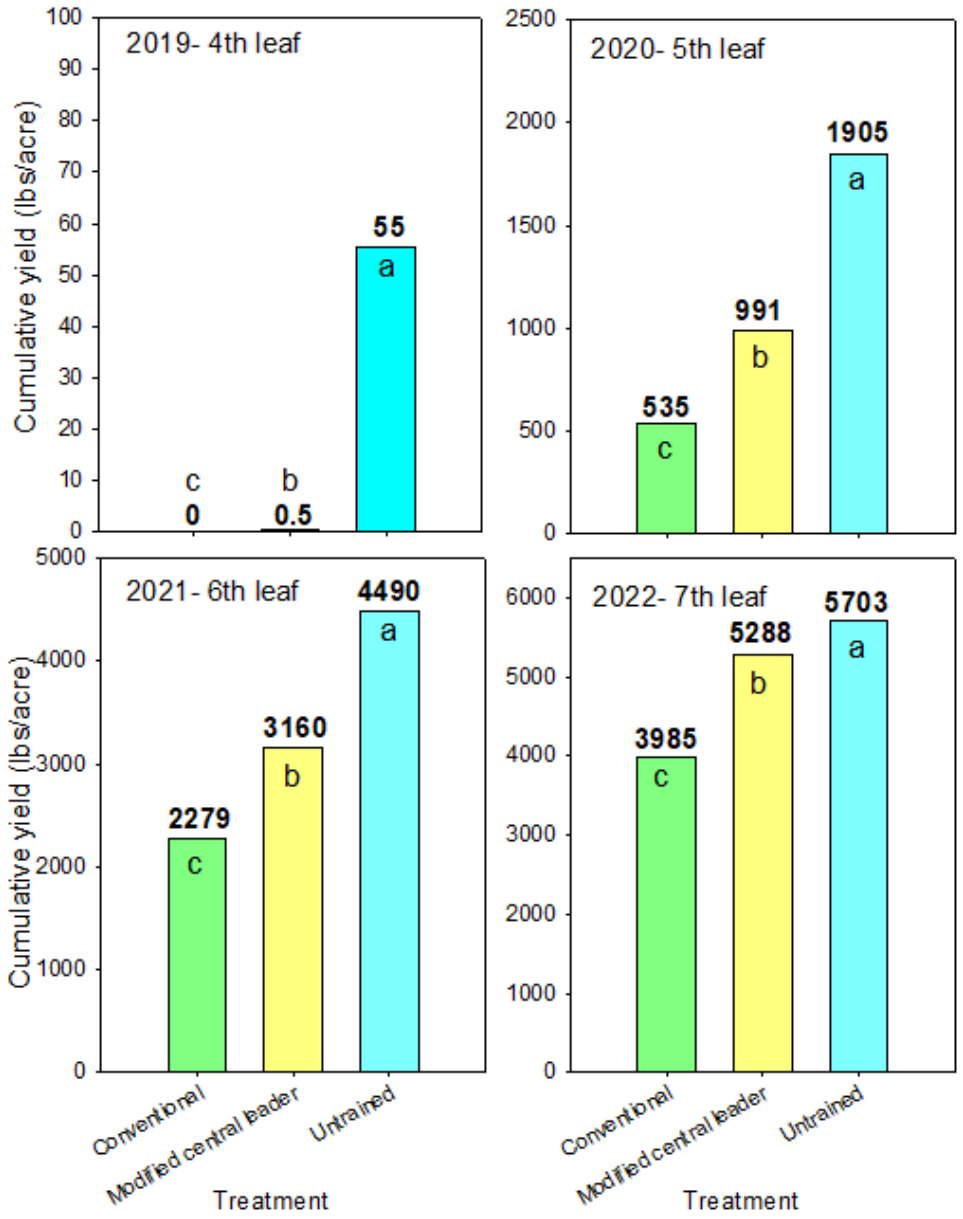
Mechanical harvest 2020 and 2021

Second (hand) both years

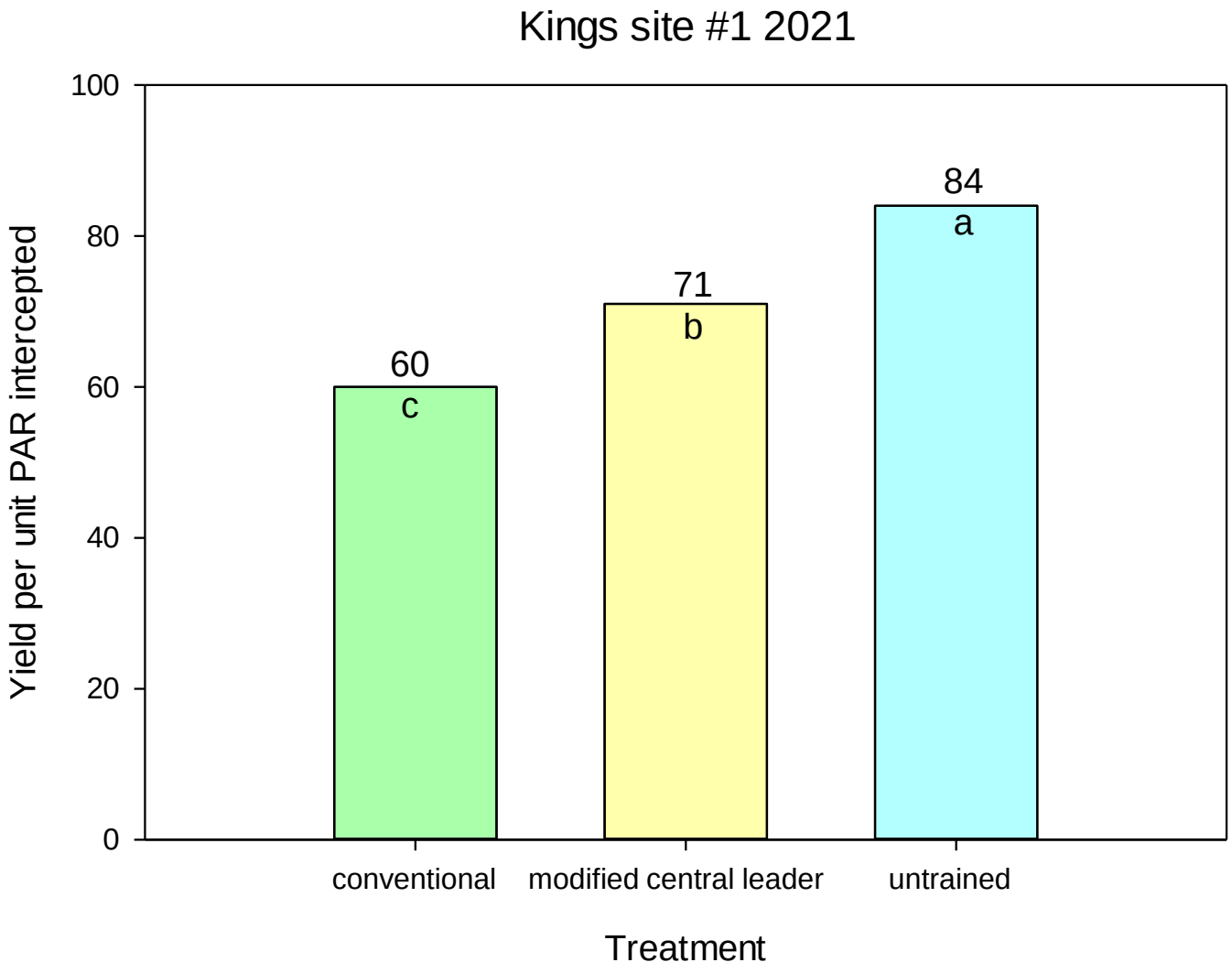
Mechanical harvest Sept. 1, 2022

Kings Site #1

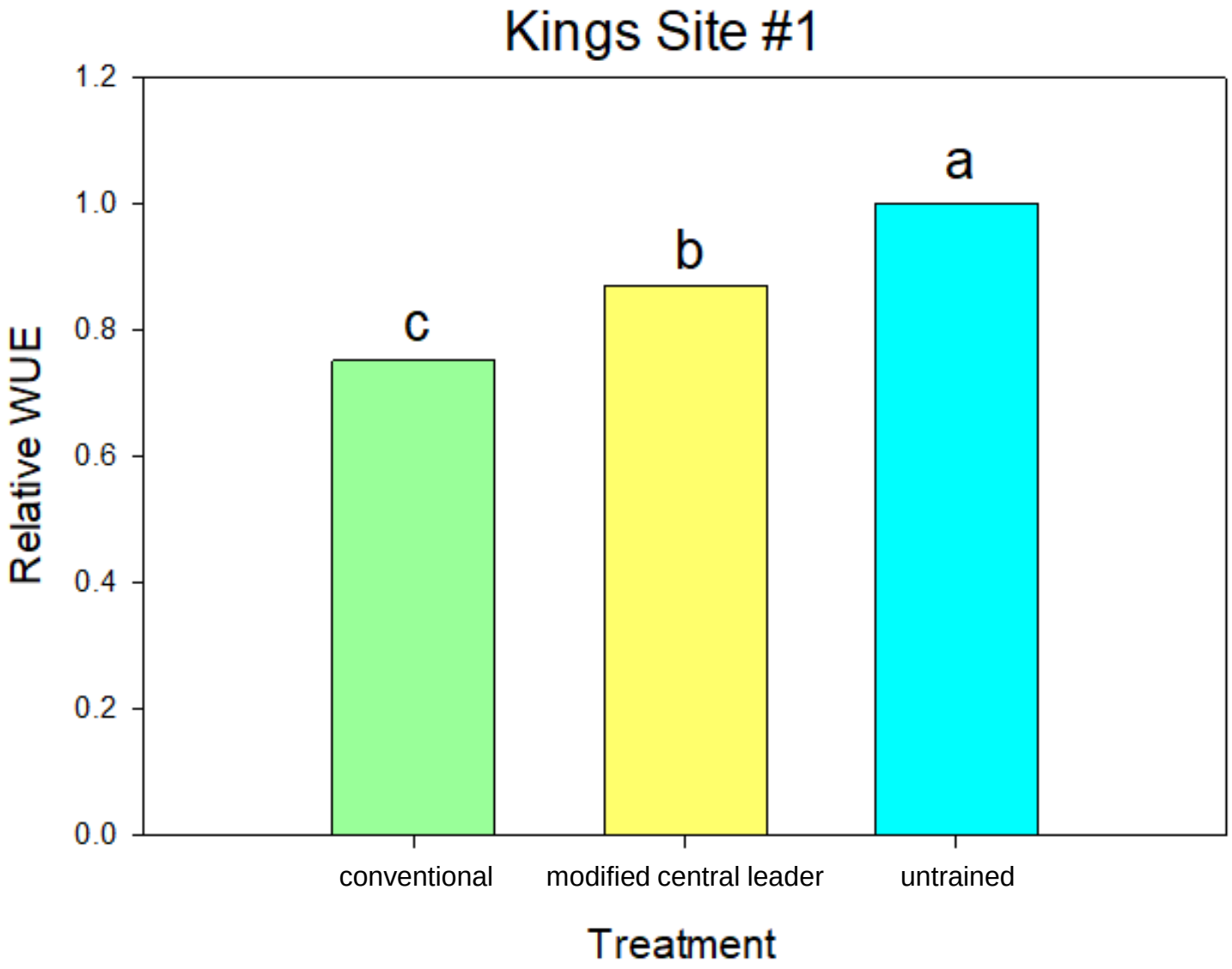
7th leaf



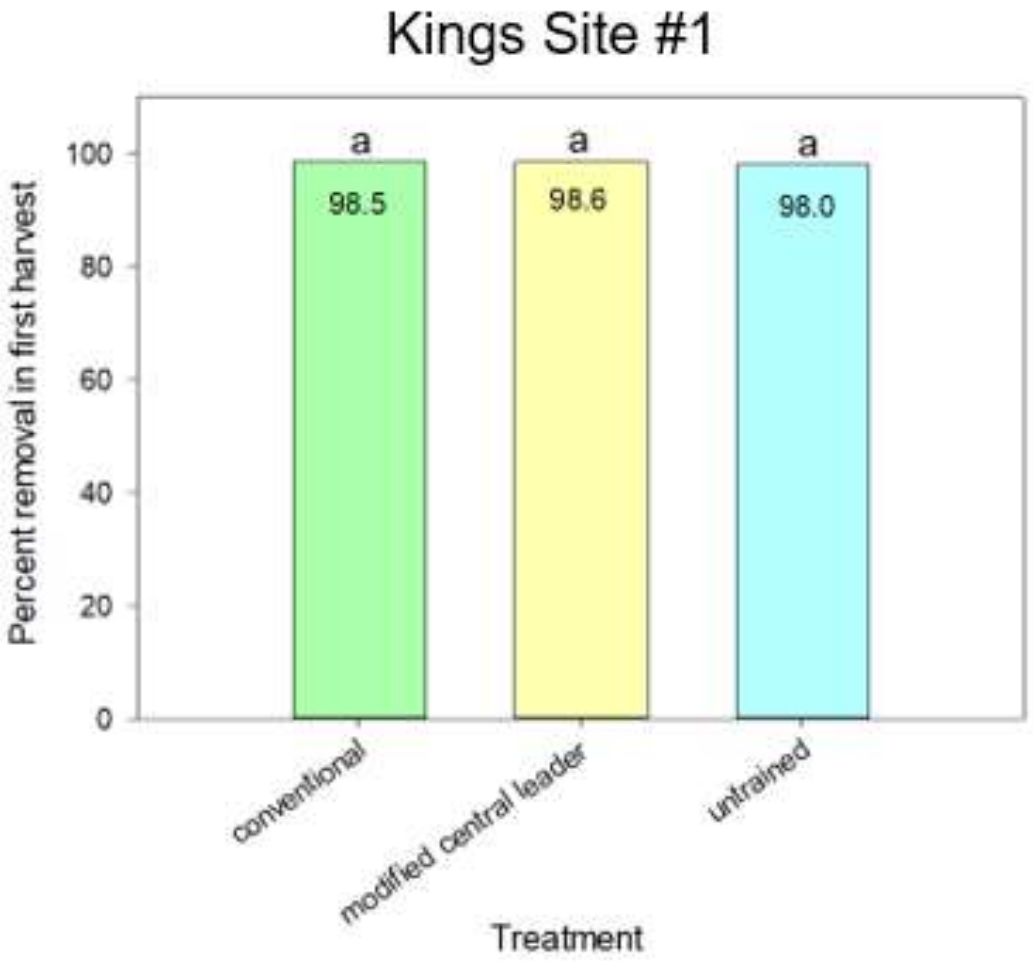
Yield per unit PAR intercepted



Relative water use efficiency



Percent removal on first shake 2022



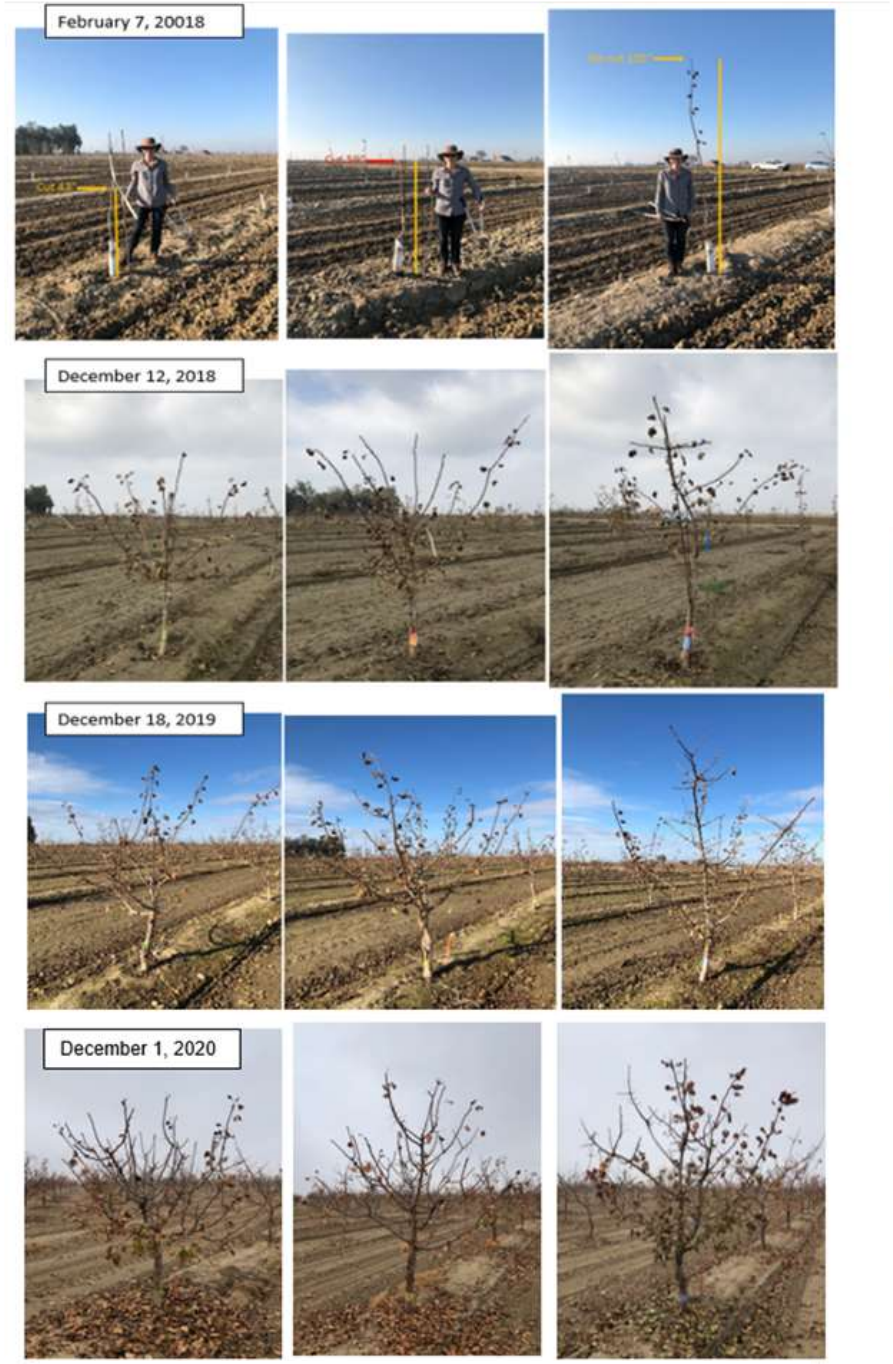
Kings County Trial #2- Lost Hills on PG1 rootstock

First heading cut takes off up to ½ of tree

Conventional

Untrained

Modified central leader



Kings County Trial #2- Lost Hills on PG1 rootstock

Kings Site #2 before pruning

Jan 17, 2023

Conventionally pruned

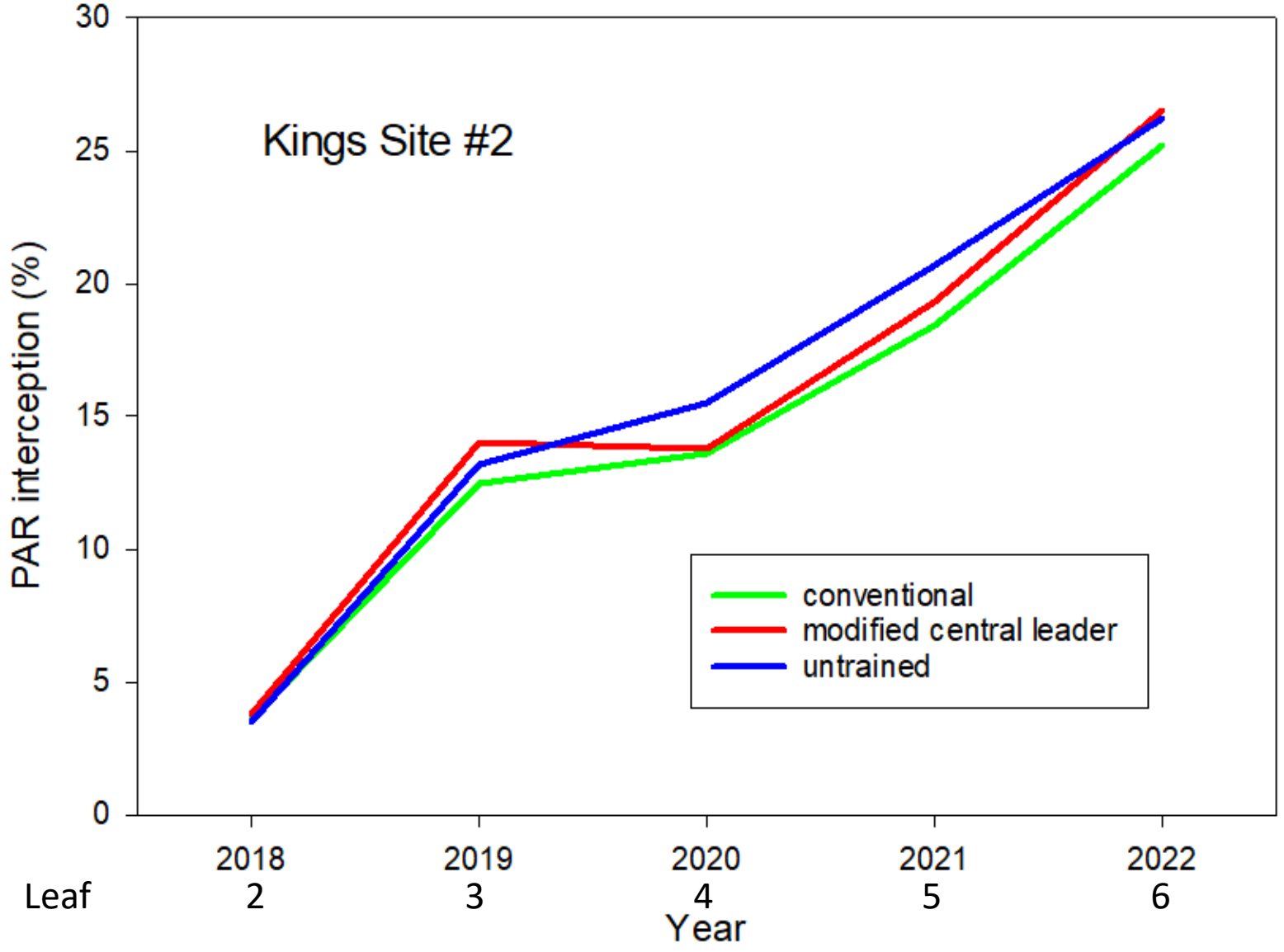
Modified central leader

Untrained

The orchard was flooded twice in 2018, one time each year in 2019 and 2020, three times in 2021 and four times in 2022

August 1, 2018

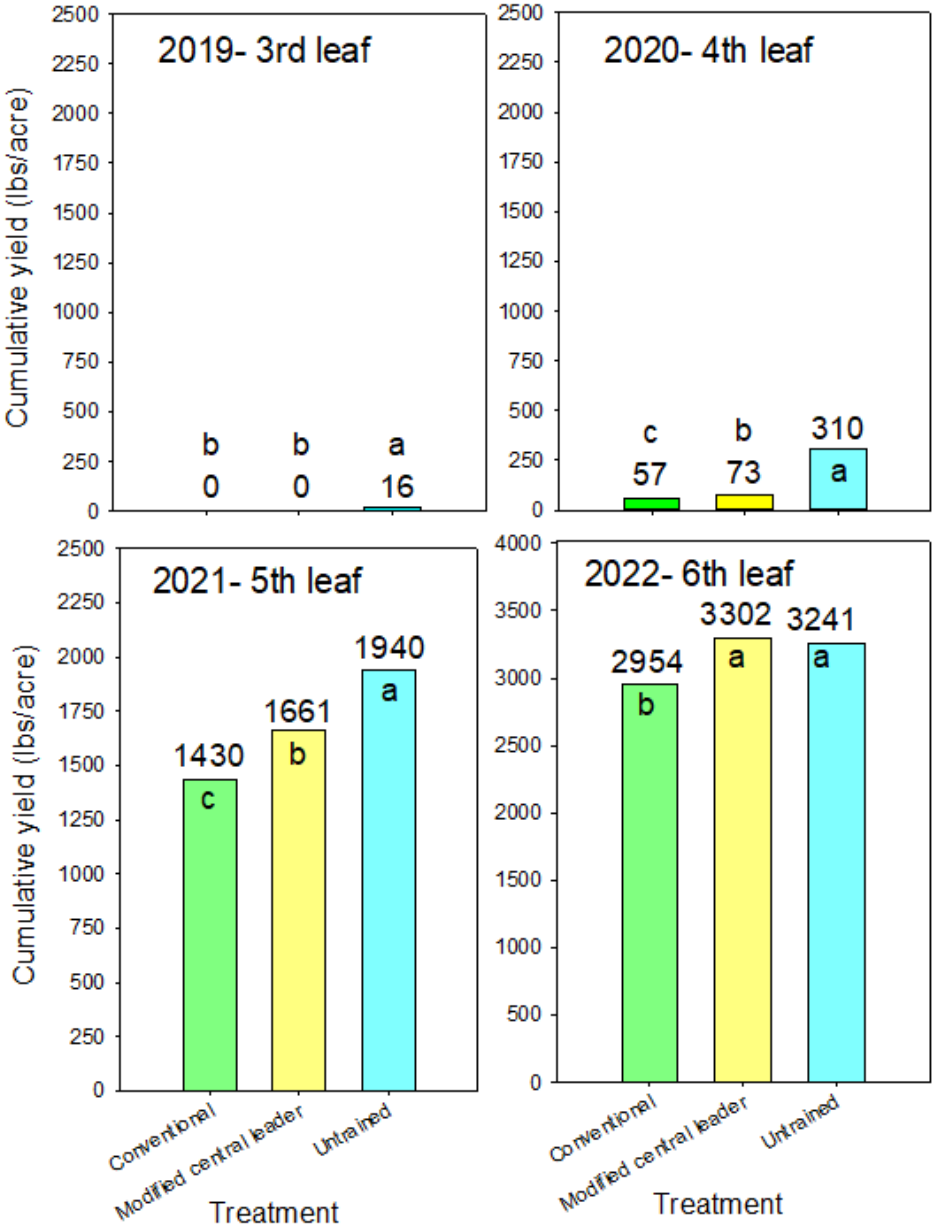
Kings Site #2 PAR interception by year and treatment



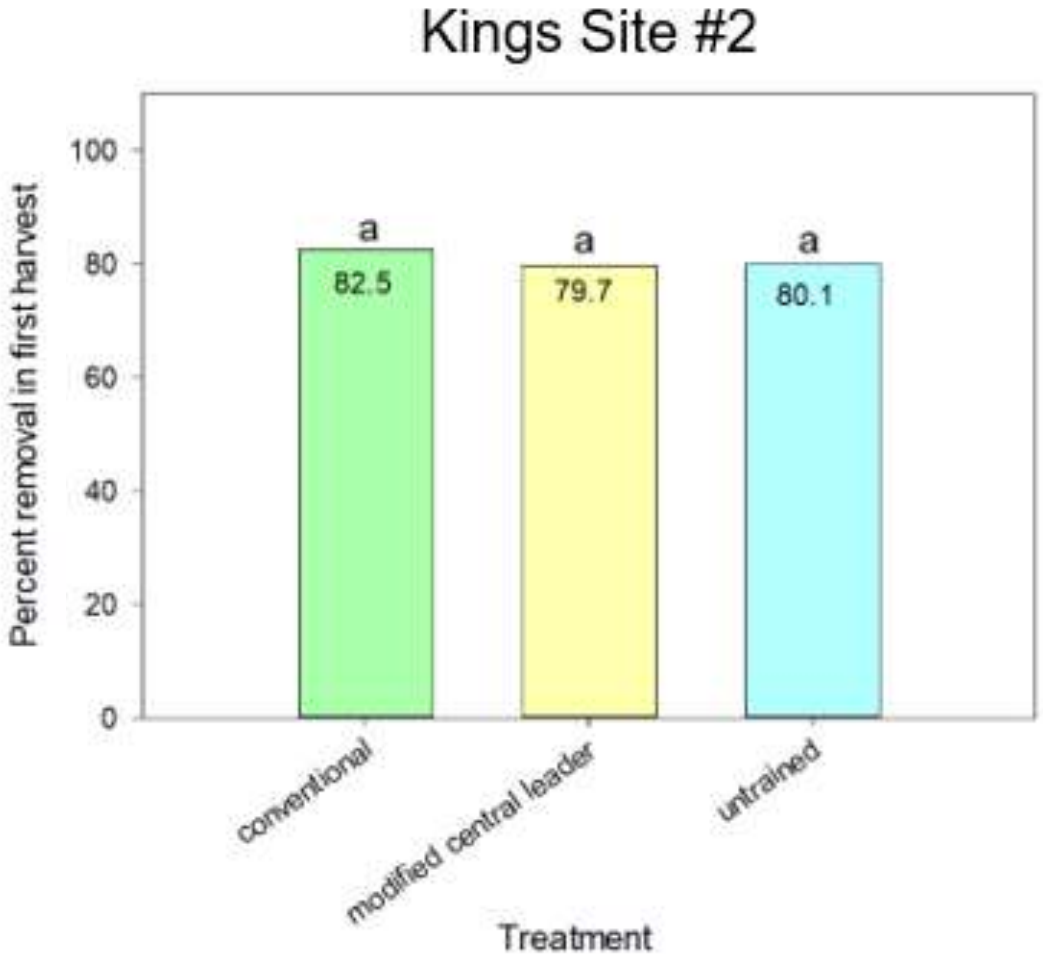
Mechanical harvest- Sept. 1, 2022

6th leaf

Kings Site #2



Percent removal on first shake 2022



Yolo County Trial #3 (planted Feb. 16, 2018)- Golden Hills on UCB1 seedling (trees were nursery grafted and frost damage in the nursery resulted in about 50% of terminal shoots being damaged)

10/21/18

Yolo County Trial #3- Golden Hills on UCB1 seedling
Photos taken Nov. 30, 2021 after pruning

Conventionally pruned

Modified central leader

Untrained

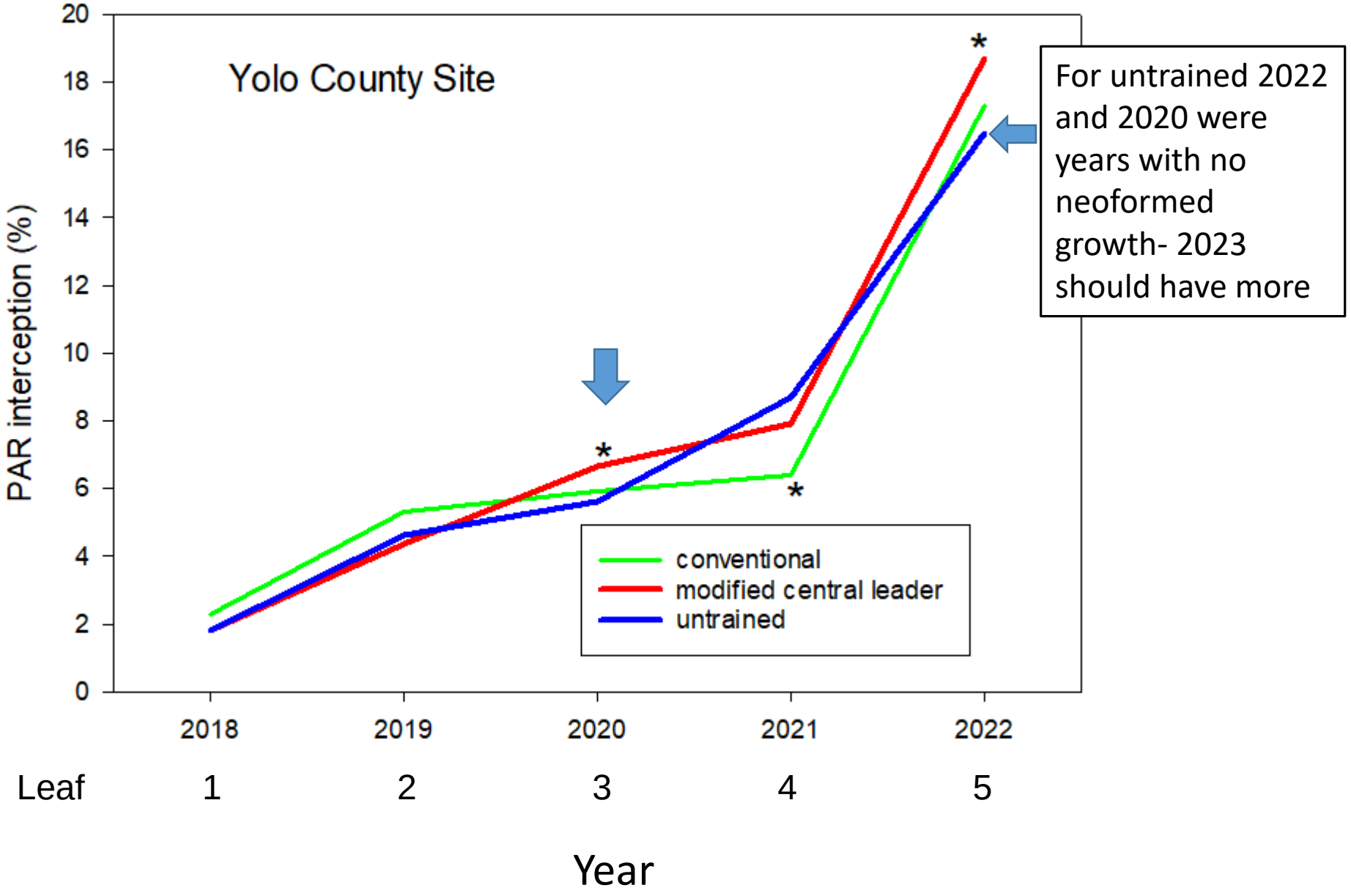
Yolo County Trial #3- Golden Hills on UCB1 seedling
Photos taken Nov. 28, 2022 before pruning

Conventionally pruned

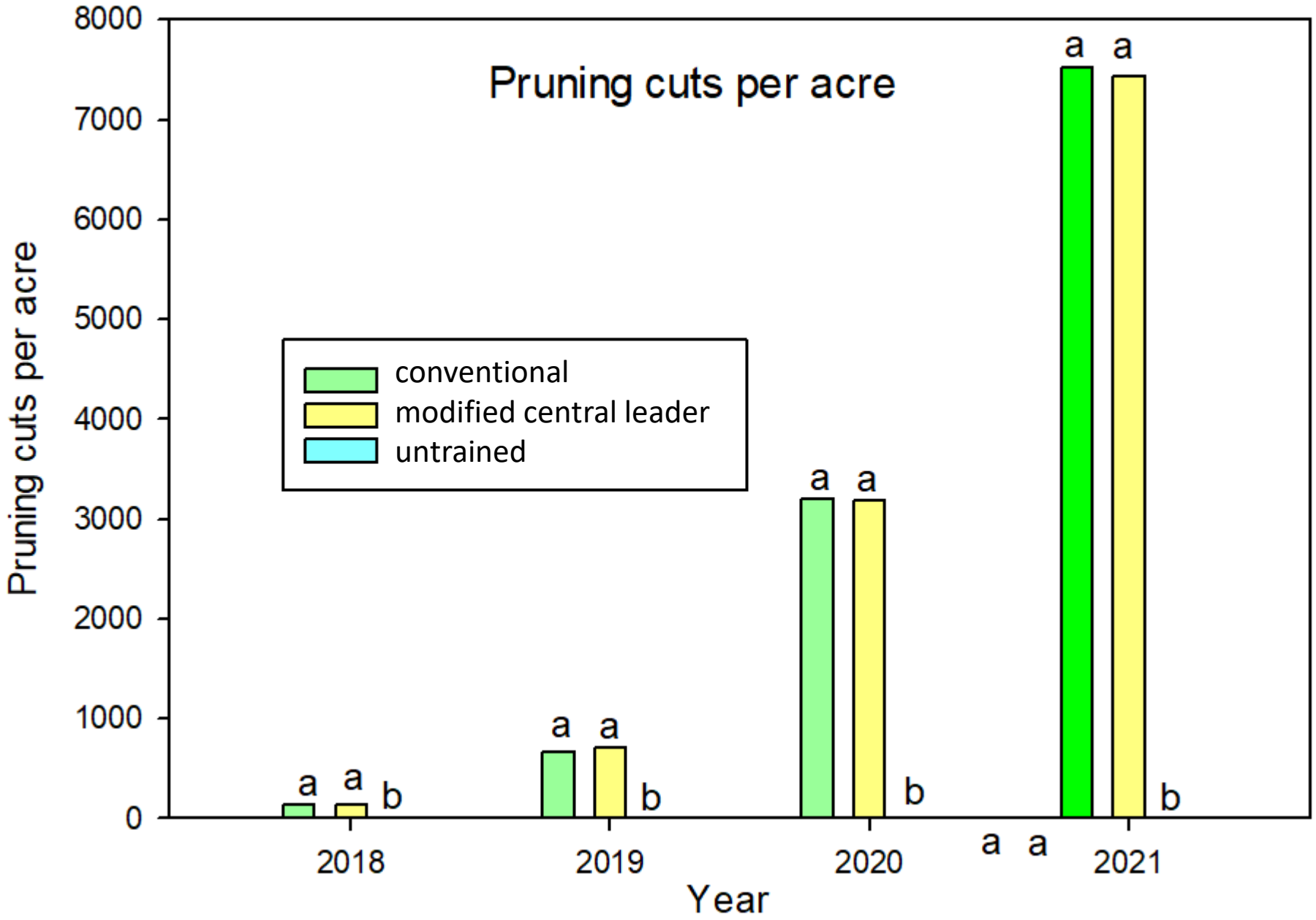
Modified central leader

Untrained

Yolo County Site PAR interception by year and treatment



Over 4 years, for conventional 7,518 cuts per acre or 601,440 cuts on 80 acres



Yolo site- cuts per 80 acres for first 4 years

conventionally pruned

601,440

modified central leader

595,200

untrained

0

This site is growing more vigorously than either of the Kings County sites

Besides the pruning cuts, conventional growers also do lots of tying to keep branches more upright (or propping apart).

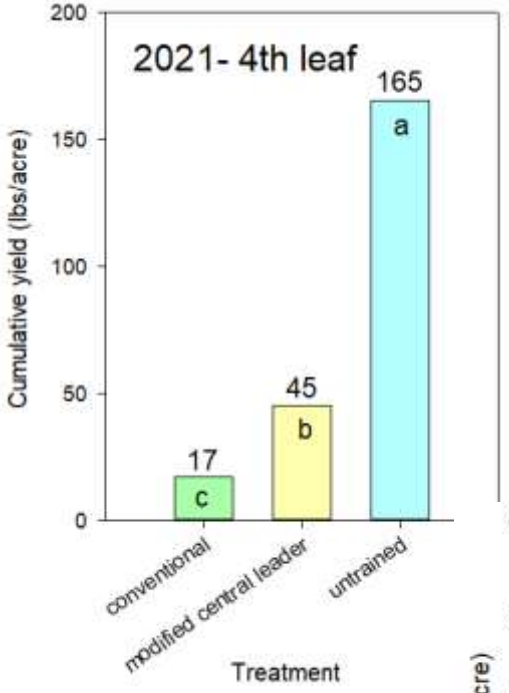
Commercial orchard near our trial in Yolo County





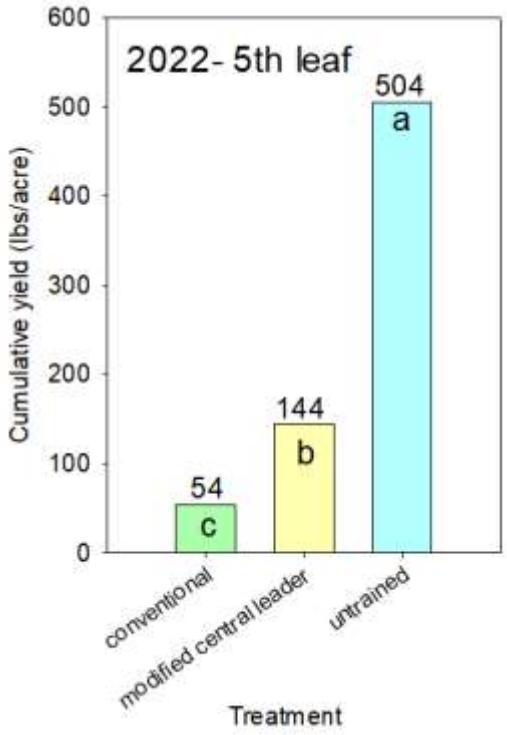
Percentage of unpruned trees requiring ties in the 3rd leaf

Yolo County Trial #3- hand harvest in 2021 (grower did not harvest) and mechanical harvest in 2022 (second hand harvest two weeks later)

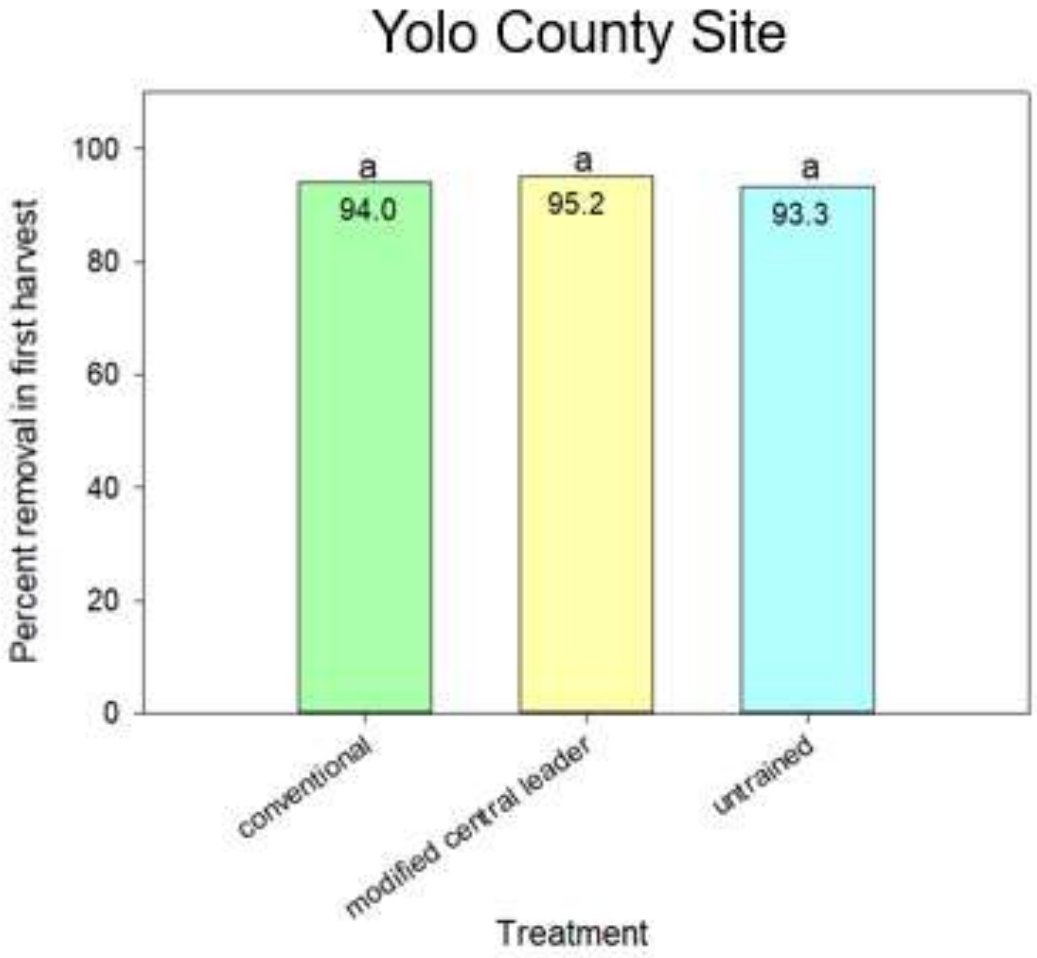


Hand harvest in 2021

Mechanical harvest in 2022

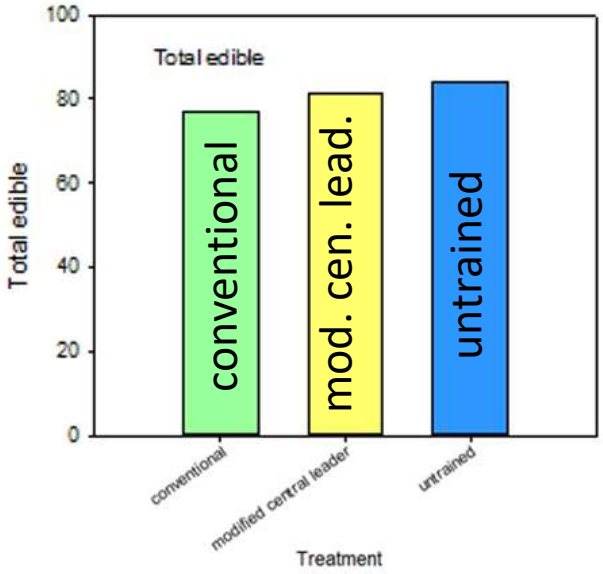


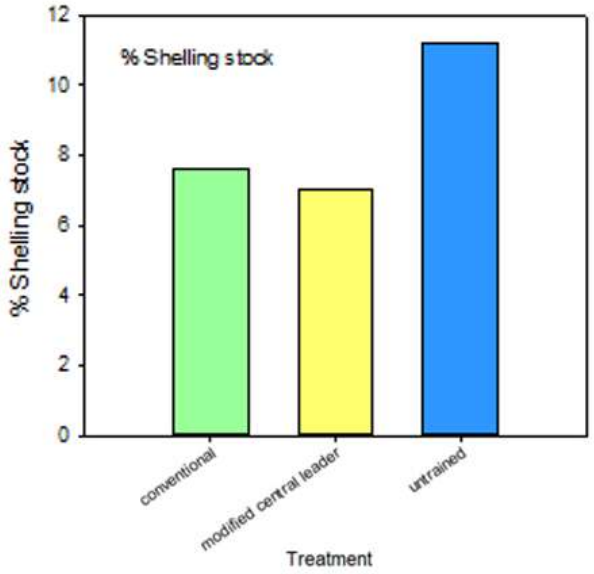
Percent removal on first shake

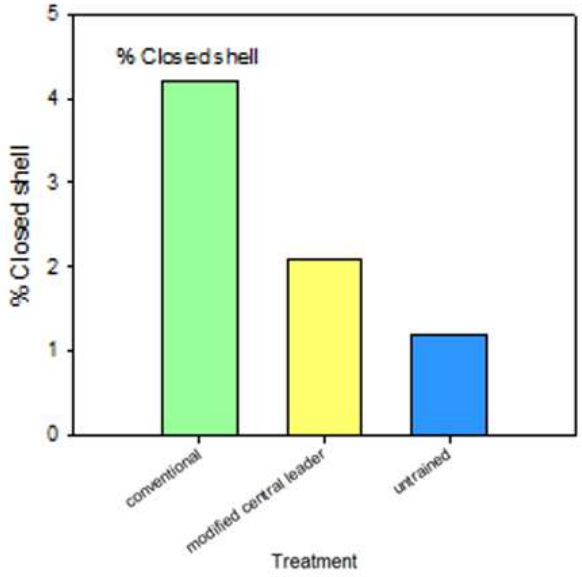


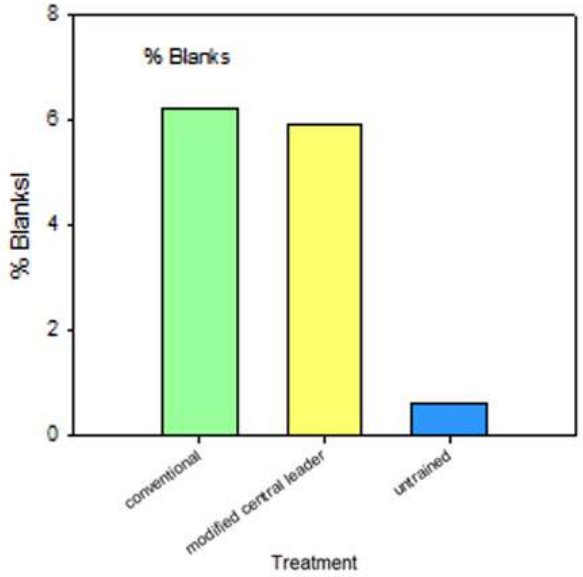
Yolo County Site

Data from commercial processor grading

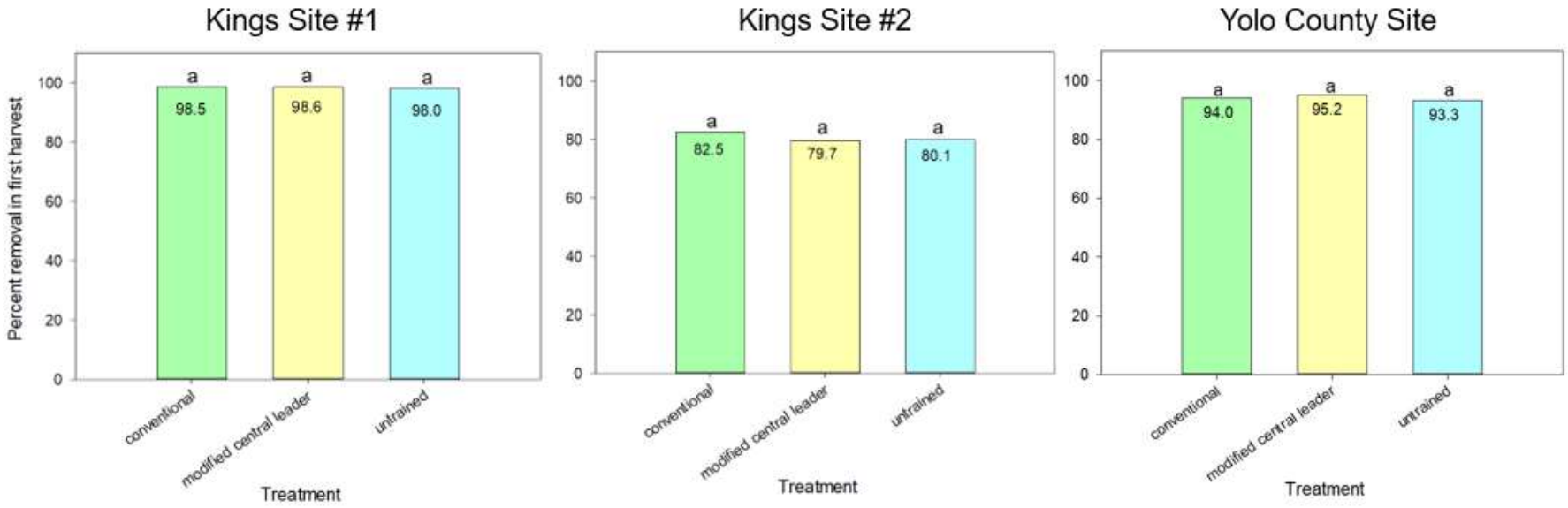




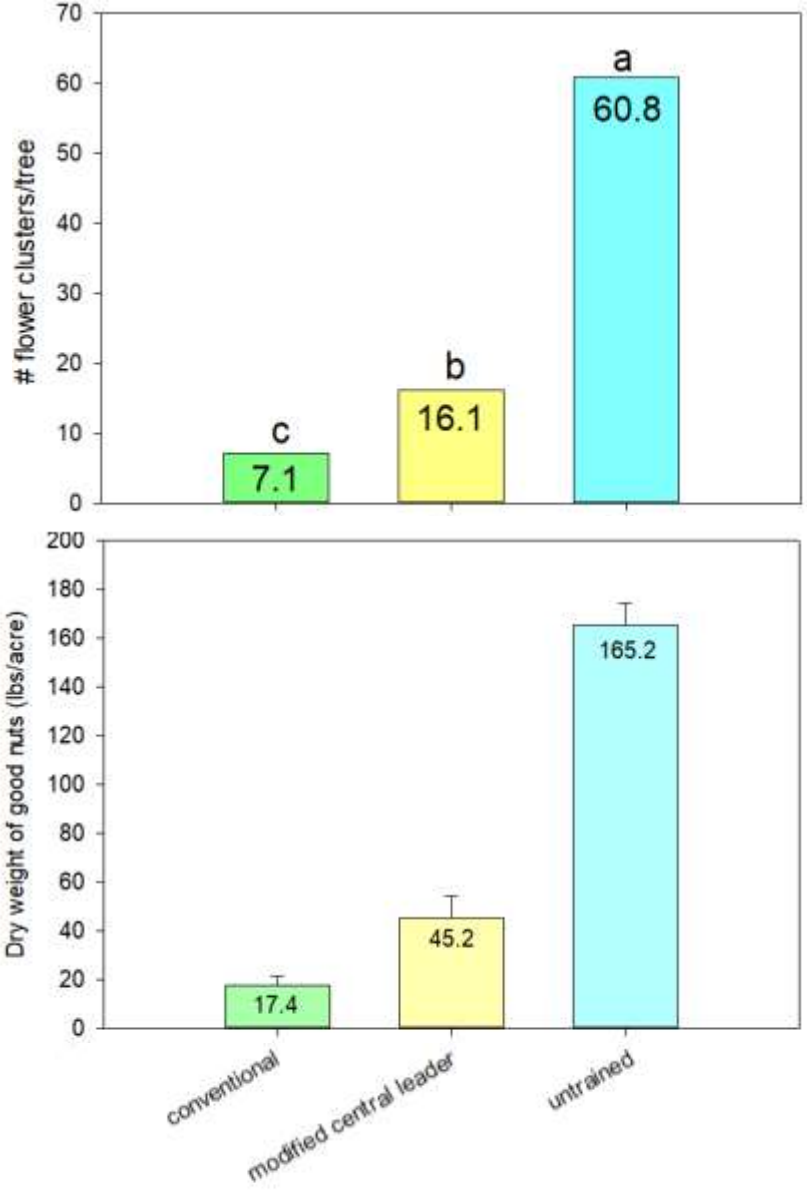




Percent removal on first shake for all three sites in 2022



flower clusters/tree



Yield = (# flower clusters/tree) x (#trees/acre) / (clusters/lb variety adjustment)

Conventionally trained males had 1-5 catkins per tree versus 45-50 on unpruned males

Secondary trials at Yolo County Site #3 and Kings County Site #1

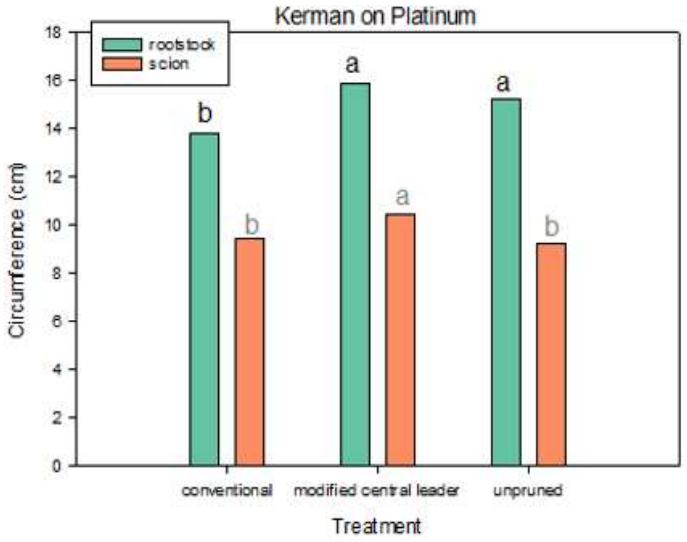
Staking trial at Yolo Site #3

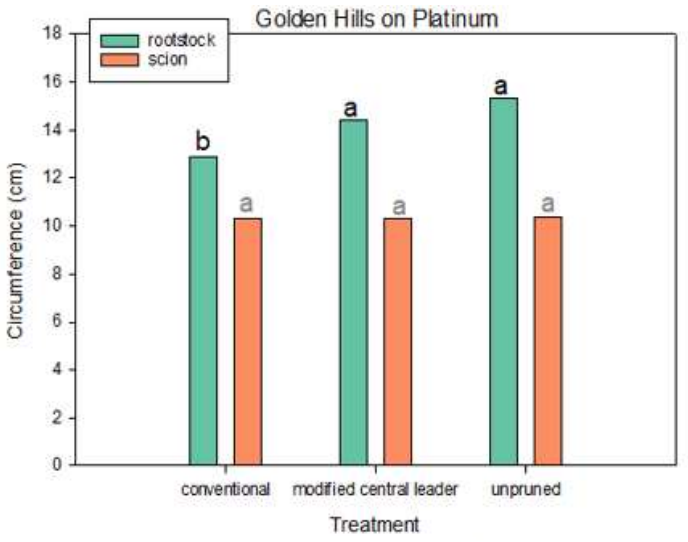
- Wooden stakes tended to lead to smaller rootstock diameter compared to metal stakes

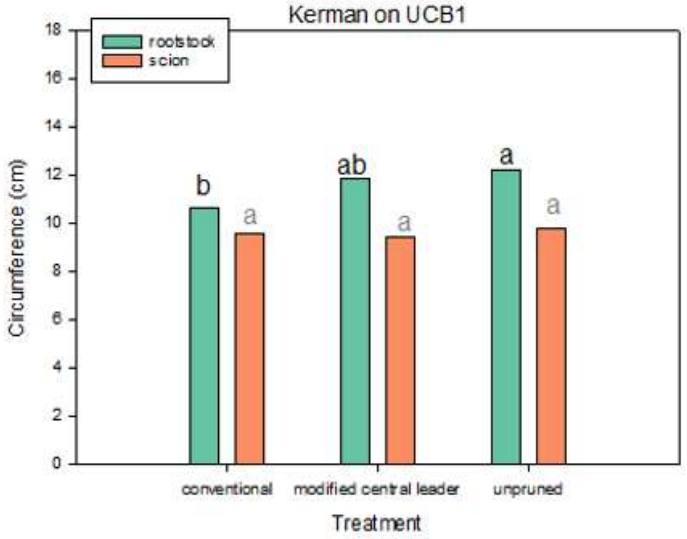
Rootstock sprout trial Kings County Site #1

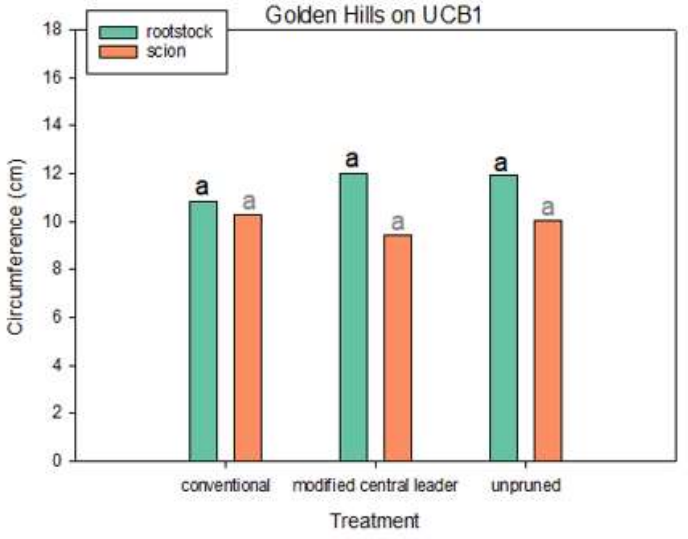
- Leaving rootstock sprouts on tended to result in larger rootstocks and smaller scions

Rootstock and scion circumference for Westside pruning trials







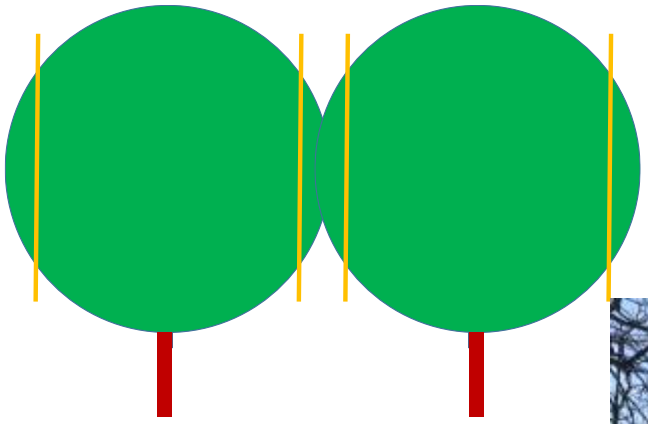


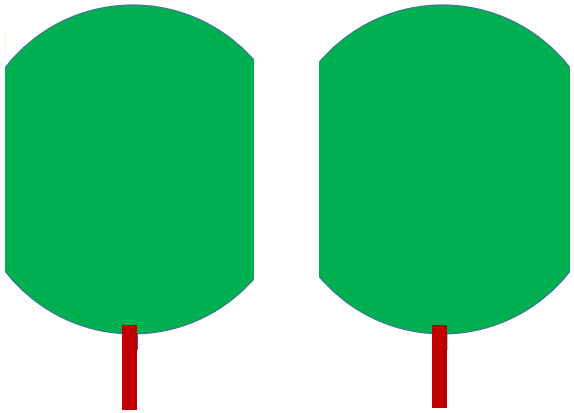
Golden Hills larger than Kerman and Platinum rooted trees larger than UCB1 seedling- first harvest will occur in 2023.

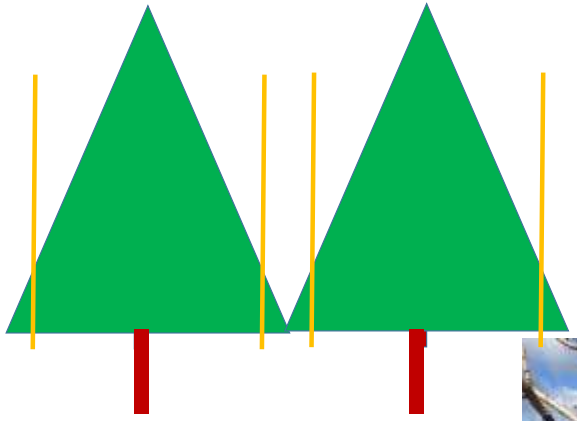
Conventional

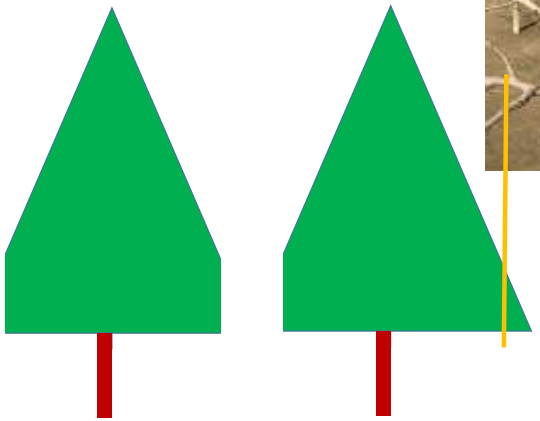
Unpruned

Fig. 15. Conventionally pruned trees (left) have large shoots that grew out in response to dormant heading cuts the previous winter. Unpruned trees have shoots that have multiple ages on a given shoot (right). The two year old shoot has developed a complexity that is lagging one year behind on the conventionally pruned trees.









There appear to be 2 causes of blank zones on pistachio shoots. The first is the response to the frequent heading (and tipping).

The second is yellowing of shoots due to overly wet conditions at the time shoots are elongating in summer

Yellow shoots in current year (due to wet conditions) results in blank zones in the following year, similar to what we have seen in walnut.

8/26/18

5/10/19

Symptoms of overwatering

In season tipping resulted in two shoots half the time and one shoot the majority of the rest of the time

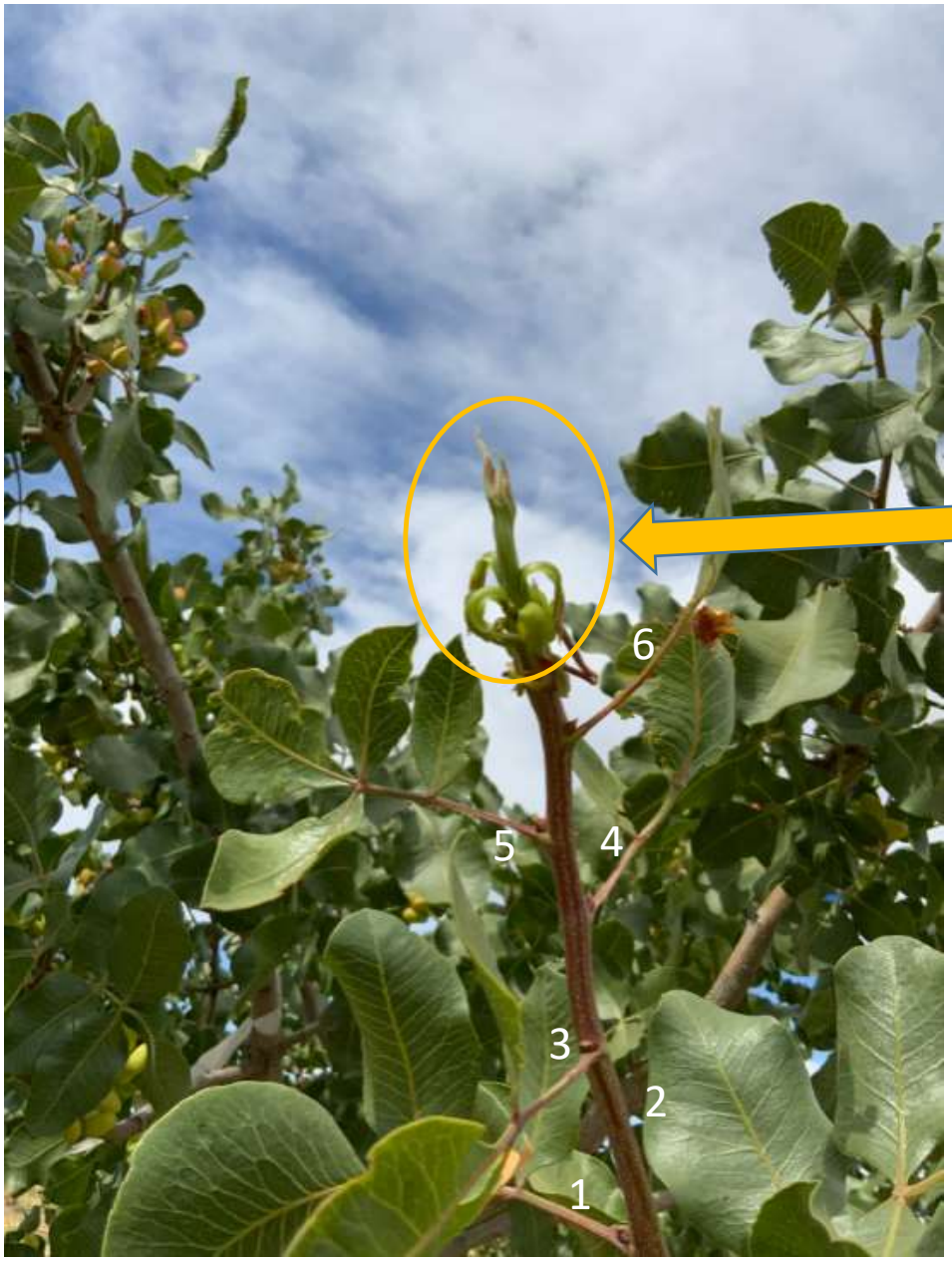
Figure 8. Most limb breakage that occurred following harvest in 2017 occurred at the point where the initial in-season tipping cut occurred in the second year. This is likely because the two buds that pushed out in response to the tipping were very close together and ended up with included bark.

Damage resulting from weak connections due to all scaffolds emerging in narrow space due to low initial heading cut

Broken scaffolds following harvest in conventionally trained pistachio orchard in Kings County in August 2018.

Limb connections are very strong in modified central leader and untrained trees

Unpruned shoots put on neoformed leaves only every other year (similar to walnuts)



Neoformed leaves
start- ~ June 1

Preformed leaves
1-6

May 26, 2021

Conventional

Ongoing grower trials

Lost Hills modified central leader trial Yolo County

Ongoing grower trials

Golden Hills modified central leader trees Kern County

Golden Hills untrained trees Kern County

Ongoing grower trials

Golden Hills untrained rootstock/scion trial Yuba County

Ongoing grower trials

3rd leaf Golden Hills modified central leader trial Kern County

Ongoing grower trials

4th leaf Golden Hills untrained trial Kern County

Ongoing grower trials

5th leaf Golden Hills untrained (minor amount of pruning) trial
Kings County

Ongoing grower trials

Golden Hills 8th leaf modified central leader trial Kings County

Ongoing grower trials

Golden Hills 12th leaf modified central leader trial Kings County

We also get a lot of questions from growers asking if they can convert from conventional training to modified central leader or unpruned.

Conventionally pruned

Conventionally pruned until after second leaf when pruning was stopped

Cessation of pruning trials- trees were pruned to modified central leader until third leaf

Westside Field Station

Golden Hills- Fresno County

Modified central leader pruned

Pruning stopped after third leaf

These are trees where pruning was stopped the previous winter (both had conventional training previously)

These shoots would normally be headed back severely in a conventionally pruned orchard so you would not see this

Cessation of pruning trials- 5th leaf Golden Hills

Golden Hills- Yolo County

Conventionally pruned

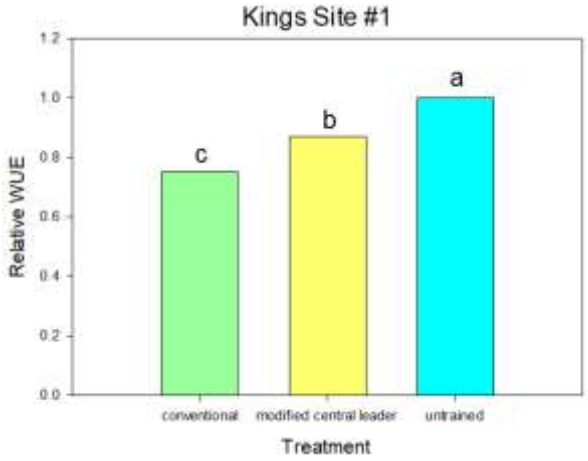
Conventionally pruned until after fourth leaf when pruning was stopped

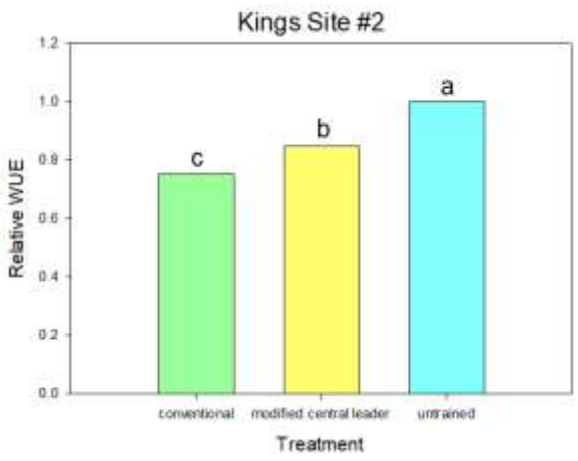
Cessation of pruning trials

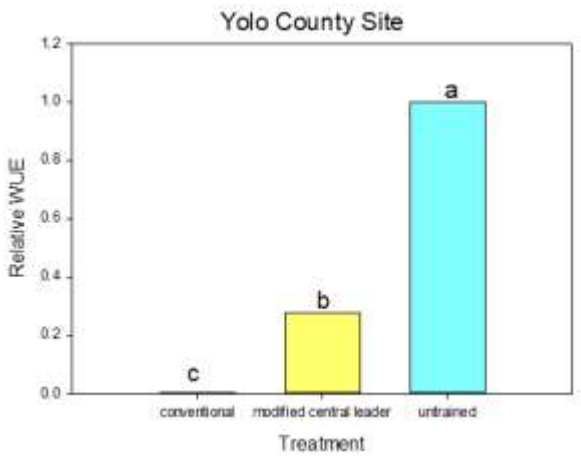
Conventional pruning stopped after third leaf

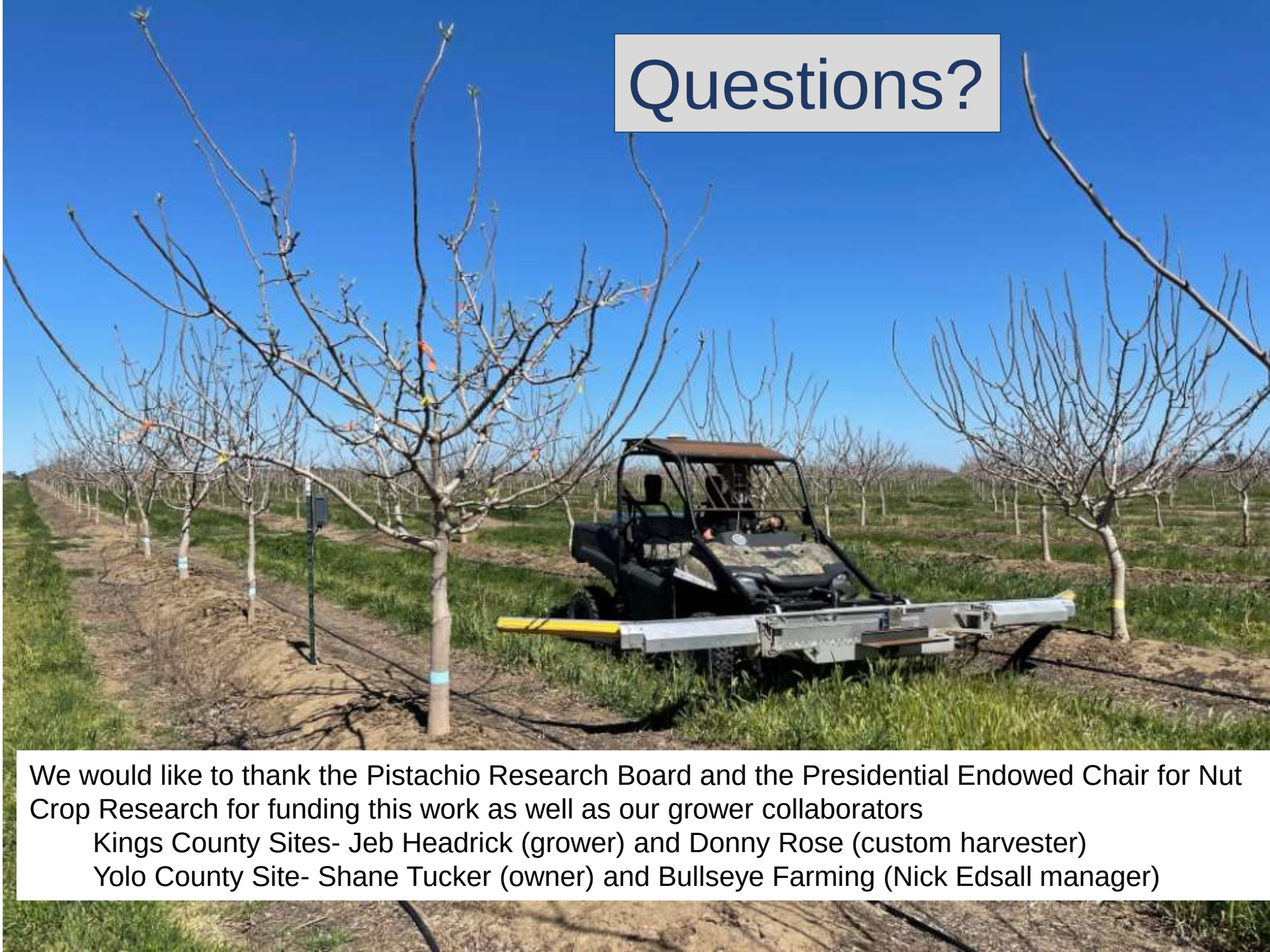
Summary- all sites

- Modified central leader and untrained
  - Larger rootstocks
  - Stronger branch connections
  - Taller trees
  - More early fruiting positions
  - Earlier yield potential
  - Higher water use efficiency
- Untrained- much lower training costs









We would like to thank the Pistachio Research Board and the Presidential Endowed Chair for Nut Crop Research for funding this work as well as our grower collaborators

Kings County Sites- Jeb Headrick (grower) and Donny Rose (custom harvester)

Yolo County Site- Shane Tucker (owner) and Bullseye Farming (Nick Edsall manager)