ABSTRACT

This project supports applied and site-specific adaptive research statewide. The mobile platform lightbar was used in approximately 20 walnut trials in 2019. This included projects from farm advisors, other specialists and faculty members statewide.

New walnut cultivars and advanced selections are being field evaluated at two sites with cooperating farm advisors. Walnut rootstocks (*Juglans* species, Field testing of putatively disease and nematode resistant rootstocks is also being conducted. Clonal rootstocks are being tested in Lake, Solano, Glenn and Tulare counties. Own rooted is being compared to seedling Paradox rooted Chandler in Contra Costa County.

Four trials are being conducted in Yolo, Sutter, Lake and Tulare counties with different heading heights at the time of planting.

Three walnut irrigation projects are being conducting in Lake County looking at growth of Chandler walnuts in orchard sites impacted by irrigation management issues. Another project is looking at growth and productivity responses of a mature Howard walnut planting to unpruned versus mechanical skirted versus mechanically hedged treatments. We recently completed and are summarizing results from a project looking at different hedging strategies in a hedgerow planted Chandler orchard at Nickels Soil Lab as well as a trial looking at whisking back every other tree to improve light penetration. Both this and the previous hedgerow trial are sites for a Botryosphaeria trial. In addition, there are new pruned versus unpruned trials being conducted in Glenn and Kings counties as well a walnut heading trial in Tulare County.

OBJECTIVE

The general objective of this project is to support applied and site-specific adaptive research conducted by C.E. Farm Advisors and specialists, including field testing of cultivars and rootstocks. Much of this research activity, by its very nature, is long term. As such, this overall report is largely a compilation of progress/status reports of many field trials located throughout the walnut growing areas of the state. Where sufficient data is available a separate, specific research report is included with detailed procedures and results for the past year.

This project also includes support for statewide extension support for the walnut research effort including maintenance and calibration of pressure chambers and harvest equipment. The processing of samples for quality evaluation at Diamond is also coordinated through this project.
Finally starting in 2017, the mobile platform light bar and iPAR iPhone app development projects were integrated under this umbrella project. This includes maintenance and upgrades to the mobile platform lightbar in 2018 also included creating a PC based version of the iPAR app for image analysis.

**PROCEDURES**

The following is a list of specific research activities planned to be supported in 2019 as part of this overall project. This includes some projects where field work has been completed but data analysis and writing are still underway:

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**RESULTS AND CONCLUSIONS**

Field evaluations of walnut cultivars and promising selections are being conducted at two sites. Walnut rootstocks (Northern California Black, *Juglans* species, Paradox, English walnut seed sources and clones) are being tested in six cooperative field trials. Field testing of putatively disease and nematode resistant rootstocks are also being conducted. Several projects related to walnut tree decline due to irrigation management problems are being conducted as part of this project. Three trials in Lake County are looking into how best to manage water in walnut orchards that have historically had irrigation problems. Work in Yolo County on effects of environmental impacts on irregular leafing around one year old walnut trees is being conducted. Comparisons of headed versus unheaded walnuts at the time of planting are also being conducted in Yolo, Sutter and Lake Counties. A study in Sutter County is looking at the performance of unheaded June budded Chandler on VX211, Vlach and RX1. Trials in Glenn and Kings County are looking at pruned versus unpruned treatment impacts on canopy development in Solano and Livermore varieties respectively.

Over the past decade or so, a total of 14 trials have been completed comparing pruning versus non-headed treatments during the canopy development phase in walnut. These have include 5 trials on Chandler, 3 on Howard, 2 on Forde, 2 on Solano, 1 on Livermore and 1 on Tulare. None of these trials have shown a benefit to pruning during the canopy development phase. This work has had a large impact on walnut training practices in California and worldwide.

Several trials are ongoing looking at how to manage dense plantings at maturity. This includes two mechanical hedging trials and one whisking trial. One of the hedging trials and the whisking trial
are being used to investigate the role of pruning/hedging cuts on *Botryosphaeria* in walnut. The hedging and whisking trials were completed at the end of 2018 but data analysis will be finalized in 2019.

In 2015, there were severe problems with irregular leafing in walnut statewide. This problem was worse in unheaded trees but occurred in headed orchards as well. Trials were set up in Merced and Stanislaus counties to attempt to remedy this problem. An ongoing rootstock trial on campus was also used to investigate the role of paint on irregular leafing. The on campus trial has been completed and is in the data analysis phase but data collection is continuing at the Chico State trials on Chandler and Solano.

Data collected from these trials have been used to describe new cultivars for release or potential release, provide data for rootstock recommendations, provide information to improve water management and to provide useful information for statewide walnut educational programs and for individual growers to make better informed decisions in replanting or establishing and managing new walnut orchards. In addition, work on the role of preformed and neoformed growth in tree establishment has been developed as part of this project.

This project also includes support for statewide extension support for the walnut research effort including maintenance and calibration of pressure chambers, harvest equipment. Finally starting in 2017, the mobile platform light bar and iPAR iPhone app development projects were integrated under this umbrella project.

Several of the trials listed below are reported separately in this volume.

**TABLE 1. WALNUT FIELD STUDIES**

1. **Walnut Clonal Rootstock Trial Solano County**  
   Principal Investigators: Katherine Pope, Bruce Lampinen, Chuck Leslie, Dave Ramos, Sam Metcalf and Wes Hackett  
   Design: Four clonal rootstocks (Vlach, RX1, VX211, and Burbank are being compared to Paradox seedling rootstock. Rootstocks were planted at an 18.5 x 24 foot spacing in an offset design in spring 2009. Each plot contains 10 trees two rows wide and there are 6 replications of each rootstock. Rootstocks were field budded to Tulare in August 2009.

2. **Using a Pressure Chamber to Aid in Irrigation Scheduling for a Drip Irrigated Hillside Chandler Orchard in Lake County**  
   Principal Investigator: Rachel Elkins and Bruce Lampinen  
   Cooperators: Dan Desmond  
   Trial started: 2006  
   Description: Working with grower to improve irrigation management in hillside Chandler orchard in Lake County

3. **Water management studies in four young Lake County Chandler walnut orchards**  
   Principal Investigator: Rachel Elkins and Bruce Lampinen   
   Cooperator: Steve Jones
Trial started: Spring 2009
Description: Project consists of working with grower on young Chandler plantings that have had irregular growth across orchard

4. Comparison of No Hedging, Mechanical Skirting and Mechanical Hedging to Manage a Hedgerow Howard Orchard at Maturity
   Principal Investigators: Bruce Lampinen, Samuel Metcalf, Bill Stewart, Loreto Contador, John Edstrom and Franz Neiderholzer
   Cooperators: Nickels Soil Laboratory
   Trial started: 2011
   Description: Trial designed to look at effect of different canopy management strategies for a mature Howard hedgerow planting

5. Chandler walnut hedgerow pruning and whisking trial
   Principal Investigators: Janine Hasey and Bruce Lampinen
   Description: This trial has replaced the Chandler pruned versus unpruned trial. Because of the tight spacing of this trial, overcrowding has become a major issue. A mechanical hedging trial has been overlaid on the western most rows of the trial with 6 replications of 3 different years of hedging. On the eastern 4 rows, a whisking trial was imposed with 4 replications of every other tree being whisked back to allow better light penetration and reduce shading related issues. The option to remove every other tree which was whisked will be evaluated after several years.

6. Chandler pruned versus unpruned trial in Merced County
   Principal Investigators: Kari Arnold and Bruce Lampinen
   Description: Trial designed to compare minimal pruning versus non-pruning in Chandler walnut. Treatments are replicated six times in double row plots. This trial is winding down but observations will still be continued.

7. Chandler pruned versus unpruned trial near Kelseyville in Lake County.
   Principal Investigators: Rachel Elkins and Bruce Lampinen
   Description: Trial designed to compare minimal pruning versus non-pruning in Chandler walnut in Lake County. Treatments are replicated 5 times in 5 tree double row plots.

8. Comparison of headed versus unheaded two year old nursery grafted trees in Yolo County.
   Principal Investigators: Bruce Lampinen, Loreto Contador and Tran Nguyen
   Description: Nursery grafted trees were either headed to 3, 6, 9 buds or left full height from the nursery (approximately 12 buds) at the time of planting. Established in 2013.

9. Comparison of headed versus unheaded two year old nursery grafted trees in Sutter County.
   Principal Investigators: Janine Hasey and Bruce Lampinen
   Description: Alternate rows of nursery grafted trees Chandler on Paradox were either headed to 3-5 buds or left unheaded at the time of planting. Established in 2014.
10. Comparison of headed versus unheaded Chandler on Vlach in Lake County.  
   Principal Investigators: Rachel Elkins and Bruce Lampinen  
   Description: Chandler on clonal Vlach rootstock were either left unheaded from the nursery or headed to 3-5 buds. Established in 2014

11. Chandler time of cutoff of fall irrigation trial in Colusa County (Grimes, California)  
   Principal Investigators: Janine Hasey and Bruce Lampinen  
   Description: 1st leaf Chandler walnuts had irrigation withheld starting at 4 different dates at weekly intervals in the fall of 2016 to look at impacts on winter cold damage.

12. Heading versus unpruned/unheaded trial on Solano variety in Glenn County  
   Principal Investigators: Dani Lightle, Luke Milliron, Chuck Leslie and Bruce Lampinen  
   Description: At the end of the dormant season, Solano walnut were either singulated to one leader and otherwise left unheaded/unpruned, headed at approximately 7 feet, or everything was left on trees including in-season branching points.

13. Heading versus unpruned/headed trial on Livermore variety in Kings County  
   Principal Investigators: Bruce Lampinen and Mae Culumber  
   Description: At the end of the dormant season, Livermore walnut were either singulated to one leader and otherwise left unheaded/unpruned or headed at approximately 7 feet.

14. Evaluating within tree walnut quality as related to tree water status, location in tree and leaf area in Howard and Chandler walnuts- currently writing up results for publication  
   Principal Investigators: Bruce Lampinen, Carlos Crisosto, Loreto Contador and Sam Metcalf  
   Description: Walnuts were sampled from trees that had midday stem water monitored over the entire season approximately every 10 days during the season. Walnuts were removed just before harvest and spurs leaves were assessed for number of leaves, number of leaflets and length of longest leaf and these factors are being compared to nut pellicle color and quality as these factors related to tree water status at different times during the season. This work is currently being written up for publication with Carlos Crisosto