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AGENDA

California Ripe Olive

Research Subcommittee Meeting

ZOOM/Conference Call

July 20th, 2021

9:00 AM

Join Zoom Meeting:
https://us02web.zoom.us/j/84344030133
Meeting ID: 843 4403 0133

Dial-in:
+1669-900-6833
Meeting ID: 843 4403 0133

I. **Call To Order**
   a. Roll Call - pg. 2
   b. Research Subcommittee Chairman's comments
   c. Approval of 1-22-2021 Research Subcommittee Minutes (action item) pg. 3

II. **Review of 2020 Research Final Reports** - pg. 6

III. **Update on CA Specialty Crop Block Grant Program Applications** - pg. 21

IV. **Discussion and Approval of 2022 Research Priorities** - pg. 22 (action item)

V. **Other Business**

VI. **Adjournment**

2021-2023 Research Subcommittee

Producer Members:

Carolina Burreson
Michael Silveira
Chris Henderson
Andy Weinrich
Ed Curiel
Vito DeLeonardis
Giulio Zavolta
Pat Ricchiuti
Galen Pfeiffer
Mark Heuer

Handler Members:

Dennis Burreson-Chairman
Matt Miller
John Pieretti
Tomas Masanes Autard
Julia Tinsley
Jacob Peters
Sergio Mendez

California Olive Committee
Research Subcommittee Meeting Minutes
Zoom/Conference Call
January 22, 2021
9:00 am

I. CALL TO ORDER

A meeting of the Research Subcommittee Meeting was called to order by Dennis Burreson at 9:00 am. and the following members were present:

Members	**Affiliation:**
Carolina Burreson	PRODUCER
Michael Silveira	PRODUCER
Chris Henderson	PRODUCER
Vito DeLeonardis	PRODUCER
Giulio Zavolta	PRODUCER
Galen Pfeiffer	PRODUCER
Dennis Burreson	HANDLER
Matt Miller	HANDLER
Julia Tinsley	HANDLER
John Pierretti	HANDLER
Jacob Peters	HANDLER
Janet Edwards	HANDLER

Others Present:	
Todd Sanders	COC
Elise Oliver	COC
Janette Ramos	COC
Kathie Notoro	USDA
Dr. Reza Ehsani	Researcher

With the appropriate number of members from producers and handlers in, a quorum was established.

- MOVED by Galen PFEIFFER, duly seconded by Giulio ZAVOLTA, and carried THAT the minutes for November 5, 2020, be approved as presented. **(MOTION 1-22-21 #1)**

II. Review of 2021 Research Projects

The Full Committee approved the following 2021 Research Projects and Budget at the meeting on December 8, 2020.

Chart Entered Here --------

III. Presentation of 2021 Research Proposals

a. Dr Ehsani to present second 2021 Proposal

At the December 8th Full Committee Meeting, the Full Committee decided they would like to see a second proposal from researcher Dr. Reza Ehsani in regards to a project focused on the design of a shaker better suited for mature trees. Dr Ehsani presented on the second proposal at today's meeting, the proposal was also included in the packet.

IV. Approval of 2021 Research Project (Action Item)

a. Closed Session

At the December 8th Full Committee meeting, the Committee approved a 2021 Research Budget at $244,534.62 with a contingency fund of $89,997. The Committee also delegated the authority to the Research Subcommittee to make the final decision on whether or not to fund Dr. Ehsani's 2021 project.

1. Combining trunk shaking and canopy shaking for a highly efficient, low-cost olive harvester- Part 2 Mature Trees
   FISCAL MPACT: $69,997

   - MOVED by Mike SILVEIRA, duly seconded by Vito DeLEONARDIS, and carried THAT, the Research Subcommittee approve a second project. **(MOTION 1-22-21 #2)**

V. Other Business

NONE

VI. Adjournment

Chairman Dennis BURRESON adjourned the Research Subcommittee meeting at 10:11 a.m.

Date: January 22, 2021 Elise Oliver, California Olive Committee

Summary of Motions for January 22, 2021

Motion 1-22-2021 #1 **APPROVED**

MOVED by Galen PFEIFFER, duly seconded by Giulio ZAVOLTA, and carried THAT the minutes for November 5, 2020, be approved as presented.

Motion 1-22-2021 #2 **APPROVED**

MOVED by Mike SILVEIRA, duly seconded by Vito DeLEONARDIS, and carried THAT, the Research Subcommittee approve a second project.

****INFORMATION ONLY****

FROM: RESEARCH SUBCOMMITTEE

SUBJECT: FINAL 2020 RESEARCH REPORTS

BACKGROUND:

2020 RESEARCH PROJECTS FOR THE CALIFORNIA OLIVE COMMITTEE

- Projects in red had No Cost Extensions and are now complete. Final Reports can be found in the following pages of the packet and also on the COC website under the 'Industry' tab.

Researcher	Project	Amount
Reza Ehsani Louise Ferguson	Combining trunk shaking and canopy shaking for a highly efficient, low cost olive harvester.	$92,699
Debra Keenan	Evaluation of new chemistries to control Olive Fruit Fly	$25,000
Carol Lovatt Elizabeth Fitchtner	Managing Alternate Bearing in Olive with PGRs and Pruning	$23,232
Frank Zalom Joanna Fisher	Control of overwintering olive fruit fly using insect pathogenic fungi	$17,196
J. E. Adaskaveg	Epidemiology and management of olive knot caused by Pseudomonas savastanoi pv.savastanoi	$16,650
J. E. Adaskaveg	Management of foliar diseases of olive (peacock spot)	$10,000
Jim Stewart	Southern San Joaquin Valley Olive Fruit Fly Monitoring Project	$6,400
Ernie Simpson	Sacramento Valley Olive Fruit Monitoring Project	$6,500
	Total	**$ 197,677.00**

Final Report for 2020
California Olive Committee
Submitted June 30, 2021

Project Title: Control of overwintering olive fruit fly using insect pathogenic fungi (Year 2)

Project leaders: Frank Zalom and Joanna Fisher   Location: UC Davis

Cooperating Personnel: Emily Symmes (former Area IPM Advisor) UC Cooperative Extension, Cindy Kron (Area IPM Advisor) UC Cooperative Extension

Requested Funding for 2020: $17,196

Objectives:

(1) Evaluate efficacy of using commercially available insect pathogenic fungi to control overwintering olive fruit fly, Bacterocera oleae, *populations.*

(2) *Evaluate the capacity of insect pathogenic fungi to persist in olive orchards under California field conditions.*

(3) Determine when olive fruit fly larvae drop out of infested fruit in the fall*.*

Background:

Olive fruit fly, *Bactrocera oleae,* is the most important insect pest of California table olives. Olive fruit fly (OLF) is primarily managed with a single product, GF-120 spinosad bait, for which resistance is well documented. Continued use of GF-120 bait could lead to more widespread and higher levels of resistance, resulting in the total loss of olive fruit fly control by this insecticide in many CA olive growing regions. The pyrethroid insecticide fenpropathrin (Danitol) has been registered more recently for olive fruit fly control. However, pyrethroids are well known to disrupt scale and mite biological control in other systems where they are used, leading to secondary pest outbreaks. It is imperative that additional control strategies be developed. Particularly useful would be those strategies that target the overwintering generation, which survive as pupae in the soil. This proposal is intended to test the efficacy of using fungal insect pathogens to control overwintering olive fruit fly populations that are already registered commercial products.

We proposed testing the use of registered insect pathogenic fungi to control overwintering OLF larvae and pupae in fall as well as emerging adults in spring through lab and field trials. The fungi would be applied to the soil prior to larval drop in the fall and a second time prior to adult emergence in the spring. In year 1 (fall 2019 – spring 2020), we evaluated Met52, a *Metarhizium brunneum* based product*,* and two *Beauveria bassiana* based products, BioCeres and Mycotrol, that contain different strains of the fungus. In year 1, it was found that larvae and pupae have low susceptibility to all three products even at high application rates. However, year 1 laboratory results suggested that adult OLF are susceptible to Mycotrol and acquire a lethal infection when emerging from fungal treated soil. Additional lab bioassays conducted in year 2 (fall 2020 – spring 2021) confirmed these results, suggesting that it is likely that only a single spray of an insect pathogenic fungi (IPF) timed to infect adults from the soil in spring could suppress the overwintering OLF generation. To test this hypothesis, we applied Mycotrol sprays to the soil of field cages at two sites and at two open-field study sites in spring 2021 targeting emerging adults. In year 1, we found that *B. bassiana* can persist in California orchard soil, and repeated this work in year 2 which proved to be a much drier winter than in year 1. Finally, we enlisted interested individuals from different olive-growing sites in a citizen science study to determine the timing when olive fruit fly larvae drop out of infested fruit in the fall to pupate in the soil.

Progress:

Objective 1: In year 2, we proposed to evaluate efficacy of using commercially available insect pathogenic fungi to control overwintering olive fruit fly populations in the field by applying the fungal product identified from year 1 (Mycotrol) at two field sites. When we submitted out proposal, we planned on spraying twice, once in fall 2020 to target the overwintering larvae and a second time in spring 2021 to target emerging adults. However, additional lab bioassays confirming that emerging adults were more susceptible to the fungi compared to larvae and pupae suggested that the fall soil treatment would likely not significantly reduce emerging adults in the spring so we concentrated our efforts on a single spray applied in spring to target adults emerging from soil. Adult emergence from our year 2 cage studies has just concluded and we have yet to analyze all of the data at this time, but our raw data to date indicates that 60% of adult OLF died within 28 days after emerging from soil treated with a rate of 3 quarts/acre of Mycotrol when considering survival by adult OLF emerging from the untreated control soil. We are continuing to sample OLF adults and olive infestation at the two open field sites through tat least he end of July 2021, so data on this study are not yet available.

Field cage study:

In year 2 (fall 2020 – spring 2021), the efficacy of a spring application of Mycotrol for controlling emerging adults in the spring was tested in addition to determining the impact of a fall copper fungicide spray (Champ WG) on the efficacy of Mycotrol. Pots were either treated with water (control), Mycotrol in the spring, a copper fungicide spray in the fall or both a copper fungicide spray in the fall in addition to a Mycotrol spray in the spring. A total of 240 pots (60 pots per treatment) were buried in soil at two sites. The field sites were furrowed between rows of pots to increase soil drainage and prevent water from pooling. Pots were infested the week of November 16, 2020, a month earlier than in year 1 (fall 2019 – spring 2020), with twice as many OLF larvae (20 larvae/pot) than in year 1. The copper fungicide spray was applied at a rate of 7 lb/acre at a rate of 50 gallons/acre on November 9, 2020 to simulate the approximate time of when growers would typically apply a fall fungicide application. The Mycotrol spray was applied at a rate of 1.5 quarts/acre mixed in 50 gallons of water/acre on February 22, 2021. Insect emergence was lower than anticipated due to warmer and drier spring weather conditions that caused insects to begin emerging prior to the application of Mycotrol. However, the remaining year 2 insects were collected daily from field cages and brought back into the lab where they were maintained with food and water and monitored for mortality. Eighty percent of emerging adults from pots treated with Mycotrol died by nine days after their emergence. Untreated control flies had lower mortality, and 38% of control flies were dead nine days after emergence. These findings suggest that under field conditions Mycotrol could reduce the lifespan of emerging olive fruit flies, thereby restricting their reproductive lifespan.

Field study:
Two different field sites were used for our field studies in year 2, one located in Hopland and the other in Healdsburg CA. These sites were chosen due to their proximity to new UC Cooperative Extension Area IPM Advisor Dr. Cindy Kron, and because they were known to have resident olive fruit fly populations. Cindy became our UCCE collaborator in 2021 following the resignation of Dr. Emily Symmes in 2020. Each Hopland site plot was approximately 0.39 acre in size and a total of 8 plots (4 plots/treatment) were treated with either Mycotrol or left untreated (control) on April 2, 2021.

Each Healdsburg site experiment plot was 0.59 acre in size and a total of 8 plots (4 plots/treatment) were treated with either Mycotrol or left untreated on March 12, 2021. The sites were sprayed shortly after the first OLF were detected in orchard plots so spray timing would coincide with the onset of insect emergence from soil. The OLF population the plots at both sites is being quantified using McPhail traps baited with Torula yeast lures with a total of 3 traps/experimental plot (24 traps/site). The traps are being checked weekly from March 1 through July 26, 2021 and the number of OLF flies in each trap are being counted to monitor the adult OLF populations. Fruit infestation levels (OLF stings on fruit) will be counted at the end of July or whenever OLF stings start to be observed at field sites. Because this work is ungoing, we have no data to report at this time.

Objective 2: We proposed evaluating the capacity of insect pathogenic fungi to persist in the soil in olive orchards in California. In year 1 (fall 2019 – spring 2020), we tested the persistence of Mycotrol and Met 52 when applied to field sites in the fall, collecting and processing over 300 soil samples. We found that *Beauveria* (the active ingredient in Mycotrol) can persist in soil for at least two months after application and found both *Metarhizium* (the active ingredient in Met52) and *Beauveria* were still present in both field plots at the end of the study in March.

In year 2 (fall 2020 – spring 2021) we continued this objective and measured the persistence of Mycotrol applied to the two field sites in the spring of 2021 using the same methods as described in Objective 1. We took soil samples from these sites every two weeks for three months starting on March 12, 2021 and ending on June 10, 2021. Soil samples were collected from all four fungal treated plots at each site. A total of 112 soil samples were collected and are currently being processed. We anticipate that all soil samples will be evaluated for presence of the entomopathogenic fungi by the end of August 2021.

Objective 3: We proposed to determine when olive fruit fly larvae would drop out of infested fruit in the fall. Originally, we planned to use metal baking sheets that would be placed under trees to catch larvae falling from infested fruit but in year 1 (fall 2019) we found that predators would sometimes eat the larvae before they could be counted. Instead, in fall 2020 we used large mesh sleeve bags that are placed over infested olive branches and which can be easily opened by participants to check for dropped larvae. We distributed a total of 12 traps to 5 participants located in the Orland/Corning area and Napa/Sonoma region. Our participants included Cindy Kron (UC Area IPM Advisor), a PCA, an olive grower and other stakeholders. We also set-up 8 traps on olive trees located on the UC Davis campus. The larvae began dropping out of fruit on October 13 in Corning, on November 14 south of Hamilton city, on October 16 in Davis and on November 12 in Santa Rosa. Larvae continued dropping out of fruit at the Davis, Corning and Santa Rosa sites until the end of November when monitoring efforts were ended. Monitoring at the site located south of Hamilton city was terminated after the first larvae were recorded on November 14. This research suggests that larval drop in the fall occurs over a relatively long period of time and can begin as early as mid-October. Additional studies are needed to understand how temperature, olive variety and other environmental factors impact larval drop in the fall, but this information would be essential to precisely time treatments or cultural controls for OLF before they drop to the soil or alternatively when they have fully dropped from the fruit in trees and are concentrated in the soil.

Dissemination of research results

Due to Covid-19, we were unable to present at this fall's CAPCA conference as we had planned since the organizers finalized meeting schedules earlier this year than in past years. We had also planned to present our results at UC Cooperative Extension winter olive meetings this past year, however our two original UCCE collaborators, Dani Lightie and Emily Symmes resigned in fall 2019 and winter 2020, respectively, so grower meetings that they would normally have organized did not occur this year. We plan to prepare an olive newsletter article this summer for the 'Topics in

Subtropics' Cooperative Extension newsletter, and plan to summarize our results and present them in this way.

Contains confidential information for the COC. Please do not post online.

Department of Botany and Plant Sciences
Relevant AES/CE Project No.: 4556

University of California
Division of Agricultural Sciences

FINAL REPORT
(Year 1 Final Report January 1, 2020 - June 30, 2021)

Project Year: 2020 (Year 1)

Anticipated Duration of Project: This was year 1 of a 3-year project. Due to back-to-back ON-crop years in 2018 and 2019, the 2020 yield data were necessary to resolve whether it is best to do flower/fruit thinning on one side of the tree and then the other side annually vs. every other year so the best strategy could be selected and combined with PGR treatments (shown to be effective in earlier research) to increase annual yield and 2-year cumulative yield in an AB orchard to greater than the sum of a 2-year ON/OFF cycle.

Project Leaders:

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Project Title: Managing Alternate Bearing in Olive with Plant Growth Regulators (PGRs) and Pruning

Cooperators: Lindcove REC - 'Manzanillo' table olive orchard; Kurt Schmidt, Lindcove Research and Extension Center, 22963 Carson Avenue, Exeter, CA 93221; Phone: 559-592-2408, ext. 153; Email: krschmidt@ucanr.edu

Objectives for 2020 (Year 1). ***Background.*** Alternate bearing (AB) is the production of a heavy, high-yield "on-crop" followed by a light, low-yield "off-crop". The alternating high and low yields result in a significant economic problem. In ON-crop years, trees produce a large number of small size fruit with reduced commercial value. In OFF-years, trees produce large fruit, in some cases too large, and too few fruit to provide growers with a good income. It is important to note that the lack of fruit in the OFF-crop year, if more or less industry-wide, has a negative economic impact on every step in the production chain from farm to consumer, including orchard management, harvesting, packinghouse operation, manufacture of value-added products, marketing, and consumer prices, which jeopardizes the stability and sustainability of the olive industry. Climate is the major factor initiating AB. Abnormally high or low temperatures, water-deficit stress or excessive winter rain causing soil hypoxia etc., which significantly reduce yield, result in an OFF crop that is followed in one to two years, depending on the length of time the trees need to recover, in an ON crop. Conversely, optimal climate conditions during flowering and fruit set, such that natural fruit thinning fails to occur result in an ON crop that is followed by an OFF crop. Climate events repeat in a random manner. Thus, there is a reoccurring need for a management strategy to mitigate the negative economic impact of AB on table olive growers and the industry when it occurs.

The current research project is based on our discovery of the four mechanisms by which the ON-crop of olive fruit reduces return bloom the following year and perpetuates alternate bearing (AB) in 'Manzanillo' olive trees:

(1) inhibition of summer vegetative shoot growth (Sibbett, 2000);
(2) abscission of floral buds during the summer after pit hardening;
(3) inhibition of floral development at the level of gene transcription; and
(4) inhibition of spring bud break.

Keep in mind that all four effects are more severe on bearing shoots of ON-crop trees, the majority of shoots, than they are on non-bearing shoots of ON-crop trees due to the combined effects of the fruit set on the shoot and crop load (the total number of fruit per ON-crop tree). Also note that the OFF crop has the opposite effect for each mechanism. Taken together, the four negative effects of the ON-crop on return bloom, especially the abscission of more than 70% of the floral buds for next year's bloom and the inhibition of floral gene transcription caused by the ON crop of fruit, make it abundantly clear that early fruit thinning (before pit hardening) with the goal of increasing the number of nonbearing shoots is necessary to mitigate alternate bearing in 'Manzanillo' olive. Moreover, fruit thinning, which increases the number of non-bearing shoots, will improve the efficacy of PGR treatments that increase summer vegetative shoot growth, improve retention of floral buds, and stimulate spring bud break to increase floral intensity following the production of the ON crop (Fichtner and Lovatt, 2016; Fichtner et al., 2017).

The overall goal of our research is to develop a management strategy that maximizes total yield and yield of commercially valuable size fruit annually such that the sum of two annual yields is greater than the sum of the ON/OFF yields of an alternate bearing cycle.

Objective for 2020: To determine the efficacy of two crop thinning treatments applied to one side of the tree one year and then the other side of the tree annually versus every other year to mitigate alternate bearing and then to select the best strategy and combine it with PGR treatments to increase annual yield and 2-year cumulative total yield and yield of commercially valuable size fruit to greater than the sum of a 2-year ON/OFF cycle in an alternate bearing orchard. The two crop thinning treatments compared were: (1) a foliar application of the plant growth regulator (PGR) 1-Naphthalene Acetic Acid (NAA) (ALCO® Olive Stop™; AMVAC Corp., already registered for use on olive) applied at full bloom at the manufacturer's suggested rate to only one side of ON-crop 'Manzanillo' olive trees; and (2) removing fruit by pruning (mechanical hedging) one side of ON-crop 'Manzanillo' olive trees. Thereafter, the treatments are used to remove inflorescences or fruit on alternating sides of the tree annually or every other year. The final strategy will be one that succeeds in achieving annual yields that are significantly greater than OFF-crop yields and equal to 60% to 70% of the average ON-crop yield for an orchard with the 2-year cumulative yield distributed equally in each year of a 2-year cycle and with total yield and yield of commercially valuable size fruit greater than sum of the 2-year ON-/OFF-crop cycle in an alternate bearing orchard.

<u>Research Accomplishments for 2020</u>.

1) <u>Treatment effects on return bloom in 2020.</u>

A visual estimate of bloom was made for the east and west sides of each tree before treatments were applied to determine the effect of the previous year's treatments on return bloom. The results for the east and west sides of each tree were averaged to give a value per tree. Bloom estimates for 2020 provided important information on the effects of the 2019 treatments on return bloom in 2020 (Table 1). The bloom estimates confirmed that treating trees with NAA or pruning on one side of the tree and then other on an annual basis removed bloom too frequently and resulted in significantly lower average return bloom for trees in these treatments compared to applying the treatments to alternate sides of the tree every other year (Table 1). The data in Table 1, compare the average estimated 2020 return bloom for trees in treatments 2 and 3, which had the first side of the tree treated in 2018, an ON-crop year and were allowed to recover for 1 year before the second side of the tree was treated in 2020 with the average estimated bloom for trees in treatments 5 and 6, which were treated on one side of the tree one year and then the other side of the tree the following year for 4 consecutive years. Return bloom is greater for trees treated every other year than annually for NAA-treated and pruned trees, respectively.

2) **Treatment effects on yield in 2020.**

We also made visual estimates of yield on the east and west side of the trees with a calculated average for each tree just prior to harvest (Data not shown). There was a strong correlation between the average estimated bloom per tree and the average estimated yield per tree ($r = 0.86$, $P < 0.0001$). Both average estimated bloom per tree and average estimated yield per tree were strongly correlated with total yield as kg per tree at harvest ($r = 0.80$, $P < 0.0001$ and $r = 0.88$, $P < 0.0001$, respectively). Yield per tree was as expected based on the bloom estimates. However, we expected a great bloom estimate and yield for the treatment applying NAA to one side of the tree and then the other side every other year (Treatment 2) (Table 1). Over the course of our research, the NAA and pruning treatments, for the most part, have given similar results. The NAA product might have over thinned in response to three days of day-time temperatures ≥ 95 °F that occurred three days after application. This possibility is behind the registration of a new NAA product by AMVAC (Mandolin®) that is less sensitive to high temperatures and thus, less prone to over-thinning. Mandolin® will replace Olive Stop®. Our goal is to test this new product over the next two years. Alternatively, this result might indicate that thinning treatments should not be imposed if the bloom average on the untreated side of the tree in the current year is less than 2 on a scale from 0 to 3. The estimation of bloom is not onerous, requiring only a quick walk or drive through a block and would enable growers to make a more informed decision on whether to thin with NAA or prune in a given year or not. We are continuing to investigate whether or not thinning should be done when bloom estimates are less than 2 and the problem of over-thinning related to high temperature.

3) **Treatment effects on fruit size and quality in 2020.**

The effect of the NAA and pruning treatments on fruit size distribution compared to the ON- and OFF-crop control trees is presented in Table 2. Only ON-crop control trees produced subpetite size fruit (5 kg/tree) ($P = 0.0054$). ON-crop control trees and trees pruned on one side of the tree and then the other side every other year produced the most petite, small and medium size fruit. All trees produced similar yields of large size fruit and extra-large fruit (1 kg/tree).

In order to maximize the yield of commercially valuable size fruit, we investigated the relationship between total yield and yield of medium and large size fruit to determine at what total yield (kg/tree) the greatest yield of medium and large size fruit is obtained. Using our data set of more than 500 tree-years, median yield was 110 kg/tree, indicating 50% of the trees in the data set produced ≥ 110 kg/tree but 50% of the trees in the data set produced less.The major change in fruit size distribution occurs around 90-100 kg per tree (Fig. 1). Lower yields are associated with more extra-large and large size fruit at harvest. At 90-100 kg/tree total yield, the yield of large and medium size fruit are equal and the majority of fruit per tree. As total yield increases the yield of medium size fruit continues to increase with yield of large size fruit stable up to 140 kg/tree. However, at total yields greater than 120 kg/tree, there is a significant increase in the yield (kg/tree) of petite size fruit and then small size fruit, which contniues as total yield increases. Thus, further increases in total yield beyond 110-120 kg/tree increase yield of smaller fruit of limited commercial value that contribute to alternate bearing. There is a strong significant negative relationship between average fruit size and total yield (r = -0.87, $P < 0.0001$). Note: that low yielding trees produce low yields of all size fruit. This is a limited set of data. We will continue to investigate the relationship between total yield, yield of commercially valable size fruit (medium+large) and the severity of alternate bearing to identify the target total yield that maxizes profit and return bloom and yield. Please advise us if you wish for us to focus on different or additonal fruit size categories.

In 2020, the percentage of black and partially black fruit was again positively correlated with fruit size (r = 0.57, $P < 0.0001$), i.e., negatively correlated with total yield. Thus, the ON-crop control trees and trees treated with NAA or pruned on one side of the tree and then the other side every other year had 78% (NAA) to 86% (pruning) green fruit, whereas the OFF-crop control trees and trees treated with NAA or pruned on one side of the tree and then the other side every year had only 50% (OFF-crop control) to 66% (pruning) green fruit.

A summary of what we have learned over the past four years.

4) Treatment effects on return bloom 2017-2020.

Examination of the bloom estimates prior to treatment (Table 3) and resulting yields (Table 4) for the four years of the research confirms that thinning treatments (NAA or pruning) should not be applied if estimated bloom on the side of the tree that will be left untreated in the current year is less than 2.0, as the resulting total yields are too low. Thus, flexibility in the application of a fruit thinning strategy will be required rather than strict adherence to a prescribed pattern of treatment. This is especially true when a climate event initiates a new alternate bearing pattern as in 2019, when all trees were "ON" independent of the previous year's crop load. Treatments should have been applied in 2019 and not in 2020. Yield results from using NAA versus pruning have typically been similar, except for the application NAA in Treatment 2 in 2020 (Table 4). We anticipate that growers will able to interchange the use of NAA and pruning to maintain the size of their trees as desired or opt for pruning in a year of exceptionally warm temperatures at bloom that might result in over-thinning with NAA.

5) Treatment effects on yield 2017-2020.

In all cases, treatments were first applied to ON-crop trees. All trees in the experiment have now produced two ON crops and two OFF crops. (Table 4). All treatments have reduced the severity of alternate bearing based on the calculated Alternate Bearing Index (ABI) for each 2-year ON-/OFF-yield cycle. ABI = (year 1 yield – year 2 yield)/(year 1 yield + year 2 yield), in which yield is total kilograms of fruit per tree and the difference in yield between years 1 and 2 is expressed as an absolute value. An ABI of zero means no alternate bearing, whereas an ABI of one is complete alternate bearing, i.e., crop one year, no crop the other year (Pearce and Dobersek-Urbanc, 1967). From 2017 to 2020, ABI has decreased in treated trees from an average of 0.75 to 0.55. The average for the untreated ON-/OFF-crop control trees for this period decreased to 0.68. However, the ABI for trees treated every other year is significantly lower than for trees receiving the same treatments annually for 2018-2019 and 2019-2020 ($P < 0.0001$), which indicates less variation in annual yield when trees are treated on one side and then the other side every other year.

6) Treatment effects on fruit size and quality 2017-2020.

We have previously reported significant benefits on the yield of commercially valuable size fruit and yield of green-colored fruit (prevention of fruit blackening) in response to fruit thinning treatments to even out yield in an alternate bearing orchard. An additional benefit of our research was the documentation of the strong inverse relationship between the proportion of black and partially black fruit per tree at harvest and total yield per tree (r = - 0.60; P < 0.0001) first observed by Dr. Fichtner, with OFF-crop control trees having the largest proportion of black and partially black fruit and the fewest green fruit (only 54%) (P < 0.0003), especially at later harvest dates. Conversely, the proportion of fruit that remained green through harvest increased in parallel with total yield per tree (r = 0.60; P < 0.0001) with the majority (90%) of the fruit remaining green on ON-crop control trees and NAA and pruned trees having 81% and 75% green fruit, respectively (P < 0.0003). Thus, a greater proportion of green fruit might be another benefit derived from fruit thinning strategies to increase return yield following the ON-crop year.

Having more uniform yields also stabilizes the yield of commercially valuable size fruit. The 2-year cumulative yield for 2019+2020 of medium and large size fruit averaged for the ON- and OFF-crop control trees was 107.3 kg/tree. Trees treated with NAA or pruned on one side of the tree and then the other side every other year produced 110.1 and 158.1 kg/tree of medium and large size fruit per tree, respectively. Trees treated with NAA or pruned on one side of the tree and then the other side every year produced 140.5 and 69.8 kg/tree of medium and large size fruit, respectively. Thus, with the use of either NAA or pruning on one side of the tree and then the other side every other year, the reductions in 2-year cumulative total yield observed for 2019+2020 (Table 4) resulted in equal or greater yields of medium and large size fruit relative to the average for the ON- and OFF-crop control trees. The results suggest the that these strategies should increase grower return.

Goal for the next two years.

Taken together, the results of this research identify the strategy of applying NAA or pruning treatments starting in an ON-crop year with reapplication every other year as the better strategy for evening out annual yields in an alternate bearing orchard, improving yield of commercially valuable size fruit, and reducing the yield of black fruit at harvest. The goal for the next two years is to further increase bloom and yield of commercially valuable size fruit following the ON-crop year using PGR materials (not requiring a new registration) that were shown to increase summer vegetative shoot growth and fruit size during the ON-crop year, and bud break the following spring on nonbearing shoots in our earlier research to maintain good fruit size in higher yield years and to increase return bloom following ON-crop (higher yield) years. We will also test the efficacy of the new AMVAC NAA product, Mandolin® to replace Olive Stop®, for fruit thinning of olive because it is less prone to over-thinning due to high temperatures. This product should help to further stabilize yields and fruit size. We will also test the efficacy of Liqui-Stick, as requested by the COC. The overall goal of our next research is to optimize the NAA (two NAA products) and pruning strategies applied to one side of the tree and then the other side of the tree every other year with flexible application of this strategy in combination with PGR-materials (not requiring new registration) that maximize total yield and yield of commercially valuable size fruit annually, such that the sum of two annual yields is greater than the sum of the ON/OFF yields of an alternate bearing cycle.

References:

Chao, Y.Y. 2014. Alternate Bearing in Olive (*Olea europaea* L.). MS Thesis. University of California, Riverside, CA.

Fichtner, E., Lovatt, C.J. 2018. Alternate bearing in olive. Acta Hortic. 1199:103-108. doi:10.17660/ActaHortic.2018.1199.17and PGRs

Fichtner, E.J., Y.Y. Chao, L. Ferguson, J.S. Verreynne, L. Tang and C.J. Lovatt. 2017. Repeating cycles of ON and OFF yields in alternate bearing olive, pistachio and citrus trees — *Different mechanisms, common solutions*. Acta Hort. (In press, due out in July 2021).

Pearce, S.C. and S. Dobersek-Urbanc. 1967. The measurements of irregularity in growth and cropping. J. Hort. Sci. 42(3):295–305.

Sibbett, S. (2000). Alternate bearing in olive trees. California Olive Oil News. 3(12),1

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Table 1. Effect of crop load and two fruit thinning treatments, foliar application of the PGR NAA at full bloom and
pruning 28 days after full bloom (May 31) in 2019 to one side of the tree and then the other annually or every other
year on the intensity of the 2020 bloom of 'Manzanillo' olive trees (estimated prior to full bloom on May 5, 2020, using the scale in footnote "z") and total yield as kg/tree.

2019[y]	2020	2020 Bloom estimate[z] (Before 2020 treatment)			2020 yield
Treatments		West side of tree	East side of tree	Average per tree	kg/tree
1 OFF-crop control	ON-crop control	2.3 a[x]	2.6 a	2.4 a	79.3 a
2 No treatment in 2019; treated every other year	NAA – West side of tree @ full bloom	1.8 bc	1.8 bc	1.8 bc	28.5 b
3 No treatment in 2019; treated every other year	Pruned - West side of tree @ 28 days after full bloom (June 2)	2.1 ab	2.3 ab	2.2 ab	59.6 a
4 ON-crop control	OFF-crop control	0.6 d	0.8 d	0.7 e	9.7 c
5 NAA - West (OFF crop) side of tree @ full bloom	NAA - East side @ full bloom	1.4 c	1.2 cd	1.3 cd	24.2 b
6 Pruned - West (OFF crop) Side of tree @ 28 days after full bloom (May 31)	Pruned - East side @ 28 days after full bloom (June 2)	0.1 e	1.5 c	0.8 de	20.4 b
P-value		< 0.0001	< 0.0001	< 0.0001	< 0.0001

[z] Bloom was evaluated on the following scale: 0, no inflorescence; 1, low floral intensity; 2, medium floral intensity;
and 3, high floral intensity.

[y] All trees were topped in July 7, 2017, May 30, 2018, May 31, 2019 and June 1, 2020. All trees were skirted on July
1, 2020

[x] Mean values within a vertical column followed by different letter s are significantly different at the specified *P* level
by Fisher's Protected LSD test.

Table 2. Effects of crop load and two fruit thinning treatments, foliar application of the PGR NAA at full bloom and pruning after full bloom (June 26, 2017, May 20, 2018, May 31, 2019, and June 1, 2020) to one side of the tree and then the other annually or every other year on 'Manzanillo' olive tree bloom estimate, total yield and fruit size distribution in 2020. [z]

2018[y]	2019	2020	Total yield and yield of fruit in each fruit size category[z] (kg/tree)					
Treatments			Bloom	Total	Petite	Small	Medium	Large
1 ON-crop control	OFF-crop control	ON-crop control	2.4 a	79.3 a	12.8 a	26.2 a	19.3 a	13.8 a
2 ON crop - NAA east side of tree @ full bloom	No treatment in 2019; treated every other year	NAA-West side of tree	1.8 bc	28.5 b	1.8 b	5.5 b	7.5 bc	10.5 a
3 ON crop - Pruned east side of tree @ 28 days after full bloom (May 30)	No treatment in 2019; treated every other year	Pruned-West side of tree	2.2 ab	59.6 a	9.8 a	18.9 a	15.4 a	12.7 a
4 OFF-crop control	ON-crop control	OFF-crop control	0.7 e	9.7 b	0.0 b	0.1 c	0.6 c	6.3 a
5 NAA east (OFF crop) side of tree @ full bloom	NAA - west side @ full bloom	NAA-East side of tree	1.3 cd	24.2 b	2.1 b	3.1 b	7.5 bc	8.7 a
6 Pruned east (OFF crop) side @ 28 days after full bloom (May 30)	Pruned - west side @ 28 days after full bloom (May 31)	Pruned-East side of tree	0.8 de	20.4 b	0.5 b	3.2 b	5.7 bc	9.7 a
P-value			< 0.0001	< 0.0001	0.0024	< 0.0001	0.0221	0.4696

[z] Undersize (≤ 2.01 g), sub-petite (2.02-2.51 g), petite (2.52-3.23 g), small (3.24-3.55 g), medium (3.56-4.30 g), large (4.31-5.00 g), and x-large (5.01- 6.98 g).

[y] All trees were topped on July 7, 2017, May 30, 2018, May 31, 2019, and June 1, 2020. All trees were skirted on July 1, 2020.

[x] Mean values within a vertical column followed by different letters are significantly different at the specified *P* level by Fisher's Protected LSD test.

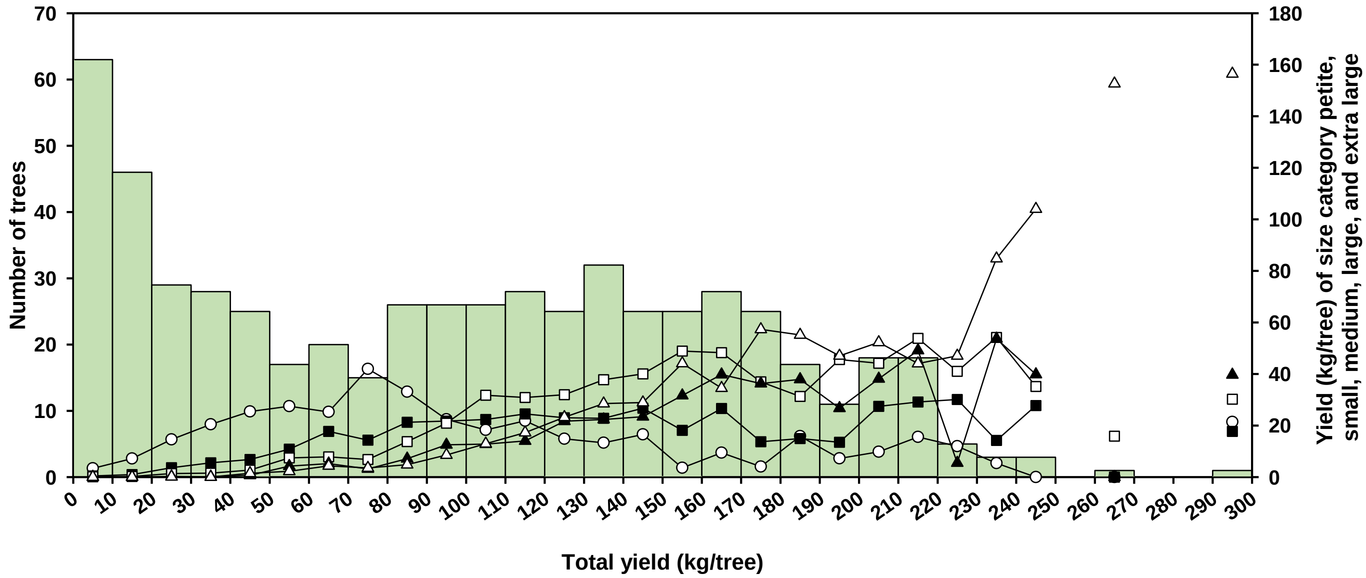

Figure 1. The green bars are the number of trees in the data set having total yields of 0-10 kg/tree, > 10-20 kg/tree, > 20-40 kg/tree, etc. The lines indicate the change in yield (kg/tree) for fruit of packing carton sizes Petite (2.52-3.23 g) (-Δ-), Small (3.24-3.55 g) (-▲-), Medium (3.56-4.30 g) (-□-), Large (4.31-5.00 g) (-■-) and X-Large (5.01- 6.98 g) (-○-) as total yield increases.

Table 3. Effects of crop load and two fruit thinning treatments, foliar application of the PGR NAA at full bloom and pruning after full bloom (June 26, 2017, May 30, 2018, May 31, 2019, and June 2, 2020) to one side of the tree and then the other side annually or every other year on 'Manzanillo' olive tree on estimated return bloom the following year in 2018, 2019 and 2020 prior to treatment. Data in bold red indicate bloom to be thinned in a specified year.

2017[z]	2018	2019	2020	2018	2018	2019	2019	2020	2020
Treatment[z]				W/E	Avg.	W/E	Avg.	W/E	Avg.
1 OFF-crop control	ON-crop Control	OFF-crop control	ON-crop control	2.7a[y] /2.6a	2.7 a	1.3c/1.8cd	1.6 b	2.3a/2.6a	2.4 a
2 No treatment	NAA-East side of tree	No treatment	NAA-West side of tree	2.2a/2.3a	2.3 a	1.8b/2.1bcd	1.9 b	1.8bc/1.8bc	1.8 bc
3 No treatment	Pruned-East side of tree	No treatment	Pruned-West side of tree	2.6a/0.4b	2.6 a	1.9b/1.6d	1.8 b	2.1ab/2.3ab	2.2 ab
4 ON-crop control	OFF-crop control	ON-crop control	OFF-crop control	0.7bc/0.4b	0.6 b	2.6a/2.8a	2.7 a	0.6d/0.8d	0.7 e
5 NAA-West side of tree	NAA-East side of tree	NAA-West side of tree	NAA-East side of tree	1.1b/0.9b	1.0 b	2.5a/2.4ab	2.4 a	1.4c/1.2cd	1.3 cd
6 Pruned-West side of tree	Pruned-East side of tree	Pruned-West side of tree	Pruned-East side of tree	0.6c/0.9b	0.7 b	2.7a/2.2bc	2.4 a	0.1e/1.5c	0.8 de
P-value				< 0.0001/ < 0.0001	< 0.0001	< 0.0001/ 0.0002	< 0.0001	< 0.0001/ < 0.0001	< 0.0001

[z] All trees were topped on July 7, 2017, May 30, 2018, May 31, 2019 and June 1, 2020.

[y] Mean values within a vertical column followed by different letters are significantly different at the specified *P* level by Fisher's Protected LSD test.

Table 4. Effects of crop load and two fruit thinning treatments, foliar application of the PGR NAA at full bloom and pruning after full bloom (June 26, 2017, May 30, 2018, May 31, 2019, and June 2, 2020) to one side of the tree and then the other side annually or every other year on 'Manzanillo' olive tree annual yield in 2017, 2018, 2019 and 2020, 2-year cumulative for 2017+2018, 2018+2019, and 2019+2020.

2017[z]	2018	2019	2020	2017	2018	2019	2020	Cumulative yield		
Treatment[z]				Yield (kg/tree)	Yield (kg/tree)	Yield (kg/tree)	Yield (kg/tree)	2017+2018 (kg/tree)	2018+2019 (kg/tree)	2019+2020 (kg/tree)
1 OFF-crop control	ON-crop Control	OFF-crop control	ON-crop control	25.3 c[y]	121.5 a[x]	134.6 d	79.3 a	146.9 a	256.1 a	213.8 a
2 No treatment	NAA-East side of tree	No treatment	NAA-West side of tree	20.3 c	83.6 b	156.1 bcd	28.5 b	103.8 a	239.7 abc	184.7 b
3 No treatment	Pruned-East side of tree	No treatment	Pruned-West side of tree	15.4 c	100.5 ab	141.6 cd	59.6 a	115.9 a	242.0 abc	201.2 ab
4 ON-crop control	OFF-crop control	ON-crop control	OFF-crop control	103.9 a	26.8 c	211.4 a	9.7 c	130.7 a	238.2 abc	221.1 a
5 NAA-West side of tree	NAA-East side of tree	NAA-West side of tree	NAA-East side of tree	71.3 b	39.6 c	179.8 b	24.2 b	110.9 a	219.3 bc	204.0 ab
6 Pruned-West side of tree	Pruned-East side of tree	Pruned-West side of tree	Pruned-East side of tree	69.3 b	47.5 c	161.4 bc	20.4 b	116.9 a	208.9 c	181.7 b
P-value				< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.1182	0.0724	0 .0419

[z] All trees were topped on July 7, 2017, May 30, 2018, May 31, 2019 and June 1, 2020.

[y] Mean values within a vertical column followed by different letters are significantly different at the specified *P* level by Fisher's Protected LSD test.

****INFORMATION ONLY****

FROM: RESEARCH SUBCOMMITTEE

SUBJECT: UPDATE ON CA SPECIALTY CROP BLOCK GRANT PROGRAM APPLICATIONS

BACKGROUND:

- On July 13, 2021 the California Department of Food and Agriculture (CDFA) announced they will be accepting proposal for one-time specialty crop block grants. In addition to the regular SCBGP funding authorized by the Farm Bill, the United States Congress has awarded additional one-time SCBGP funding to state department of agriculture due to the COVID-19 impacts on the food system.
- The COC will be submitting two grant proposal ideas:
    1. Machine harvesting of existing mature trees coupled with a cost of production study.
    2. A sustainability assessment in partnership with the Olive Oil Commission.

******ACTION REQUIRED******

FROM: RESEARCH SUBCOMMITTEE

SUBJECT: RESEARCH PRIORITIES FOR 2022

BACKGROUND:

- Each year the Research Subcommittee sets priorities of research they would like executed on their behalf for the following year. These efforts are to fund more specific and calculated research to enhance the benefits to the industry. Once the priorities are set they are provided to the University of California liaisons to request proposals from researchers. Proposals will be reviewed for funding in November by the subcommittee.
- On the following page are the 2021 Research Priorities.

2021 RESEARCH PROJECTS FOR THE CALIFORNIA OLIVE COMMITTEE

Researcher	Project	Amount
Giulia Marino Louise Ferguson	Timing Ethylene Applications as a Function of Heat Unit Accumulation	$24,470
Carol Lovatt Elizabeth Fitchtner	Managing Alternate Bearing in Olive with PGRs and Pruning	$27,230
Giulia Marino Louise Ferguson	Precise Water Management Strategies for Table Olive Orchards in California	$54,303
Reza Ehsani Louise Ferguson	Combining trunk shaking and canopy shaking for a highly efficient, low cost olive harvester-Mature Trees	$69,997
J. E. Adaskaveg	Epidemiology and management of olive knot caused by Pseudomonas savastanoi pv.savastanoi	$16,650
J. E. Adaskaveg	Management of foliar diseases of olive (peacock spot)	$10,000
Georgia Drakakaki	Characterization of Olive Fruit Abscission Zone in Response to Ethylene Applications and as a Function of Developmental Stage	$64,260
Jim Stewart	Southern San Joaquin Valley Olive Fruit Fly Monitoring Project	$9,950
Ernie Simpson	Sacramento Valley Olive Fruit Fly Monitoring Project	$6,500
	Contingency Fund	$ 20,000.00
	Total	**$303,360**

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California Olive Committee Research Priorities for 2021

The California Olive Committee Research Subcommittee met and established the 2021 research priorities. These priorities must be conducted only on Manzanillo and Sevillano ripe olive varieties. The priorities are:

- Mechanical Harvesting for high density orchards and existing orchards
- Mechanical harvesting transition
- Cost study to determine which trees are convertible for trunk shaking
- Loosening Agents
- Management of black scale
- Management of olive knot
- Canopy Management
- Olive Fruit Fly Trapping
- Evaluation of drone technology and satellite imagery to measure canopy density and yields
- Olive DNA evaluation