CALIFORNIA APPLE COMMISSION ANNUAL REPORT 2017-2018

2017-2018

ANNUAL REPORT

CALIFORNIA APPLE COMMISSION

OFFICE

CALIFORNIA APPLE COMMISSION
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TABLE OF CONTENTS

SECTION III – APPLE EDUCATION

SECTION IV – PEST, DISEASE, & STADARDIZATION

SECTION V – CALIFORNIA APPLE EXPORT MARKETS

SECTION VI – CALIFORNIA APPLE DOMESTIC AND EXPORT STATISTICS

SECTION VII – INDUSTRY COMMUNICATIONS

MESSAGE FROM THE EXECUTIVE DIRECTOR

Alexander J. Ott
Executive Director

"The Commission's new leadership will continue to serve its vital role for the industry and will be ready for any future challenges."

It is with mixed emotions that I will be stepping down as your Executive Director at the conclusion of the 2017 – 2018 year. Over the last thirteen years of my service, our industry has seen many changes. The Commission continues to represent growers and handlers in "doing those things that an individual cannot do." Market access, research, standards, education, industry voice, and statistics, will continue to be the cornerstone of the Commission's focus.

Since the start of my leadership in 2005, the Commission has been successful in assisting the apple industry in many areas such as; obtaining new trucking routes to packing sheds; eliminating the starch-iodine granny smith standard; obtaining research grants totaling over $500,000 to assist the industry, funded research for new tools to combat fire blight for both organic and conventional growers; continuing to keep vital foreign markets open such as Canada, Mexico, and Taiwan; reducing burdensome and expensive inspections like Mexico and Taiwan; participating and representing the California apple industries with the U.S. Apple Association, and the U.S. Apple Export Council; assisting the industry in food safety issues and outbreaks; managing other organizations (California Blueberry Commission, California Blueberry Association, and California Olive Committee) to reduce repetitive costs for all organizations; presenting apple statistics and industry data to the industry to make necessary apple decisions; and representing the needs of the apple industry by meeting with the necessary officials when issues directly impacting the California apple industry arise.

It is my pleasure to present to you the Commission's 2017 – 2018 Annual Report. Although this will be my last report for the apple industry, the Commission's new leadership will continue to carry on the Commission's vital role for the industry and will be ready for any future challenges. Thank you again for your support of the California Apple Commission, and thank you for the opportunity to serve as your Executive Director.

High Regards,

Alexander J. Ott
Executive Director

CHAIRMAN'S MESSAGE

Dr. Steve Blizzard
Chairman

The California Apple industry experienced some adversities and successes over the past year. Despite the implementation of new wage and hour laws, environmental rules, and the Food Safety Modernization Act (FSMA), apple movement, as well as prices were exceptional.

The 2017 – 2018 annual report highlights the various work that the Commission has completed throughout the year. Research, market access, FSMA, pest and disease issues, Market Access Program (MAP) with the U.S. Apple Export Council, data collection, and statistics are just a few of the tools the Commission provides to the industry. Additionally, there are several intangibles that the staff provide, which include representing the industry's voice regarding issues that directly impact the California apple industry.

Some areas to highlight this year include the research conducted on both organic and conventional apples to combat fire blight. Additionally, please look at the new rules and regulations outlining the new FSMA law. These are very important as the Food and Drug Administration (FDA) will begin to enforce FSMA this year.

I would like to take the opportunity to say thank you to Alex Ott, our Executive Director, and congratulate him on his new position with the U.S. Pecan Council. I have no doubt that our new leadership team, led by Todd Sanders, will continue to represent and lead the California Apple Commission with great success.

Lastly, after serving the board for 21 years, I will be stepping down as the Chairman of the California Apple Commission. Although I will no longer serve as Chairman, I will remain on the board as a public member and continue to play an active role in the apple industry. Effective July 1, 2018, Jeff Colombini will lead the Commission as the Chairman, and I know that Jeff's voice will impact the industry greatly and will continue our successes into future years.

Thank you again for the opportunity to be your Chairman and thank you for your support of the Commission. I look forward to a successful 2018 – 2019 season for the California apple industry.

Sincerely,

Dr. Steve Blizzard
Chairman

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BOARD OF DIRECTORS

DISTRICT 1	DISTRICT 2	DISTRICT 3
Producer Member David Rider Bruce Rider & Sons Term: 7/2016-6/2020	**Producer Member** Chris Britton BK Partners Term: 7/2014-6/2018	**Producer Member** Jeff Colombini Lodi Farming Term: 7/2017-6/2021
Producer Member Lance Shebelut Trinity Fruit Sales Term: 7/2016-6/2020	**Producer Member** Virginia Hemly Chhabra Greene and Hemly Term: 7/2014-6/2018	**Producer Member** Steve Chinchiolo Riverbend Orchards Term: 7/2014-6/2018
Handler Member Bill Denevan Viva Tierra Term: 7/2017-6/2021	**Handler Member** VACANT Term: 7/2017-6/2021	**Handler Member** Tim Sambado Prima Fruitta Term: 7/2017-6/2021
Alternate Member VACANT Term: 7/2017-6/2018	**Alternate Member** Doug Hemly Greene and Hemly Term: 7/2017-6/2018	**Alternate Member** VACANT Term: 7/2017-6/2018
Public Member Dr. Steve Blizzard Term: 7/2017-6/2021	**Alternate Public Member** VACANT Term: 7/2014-6/2018	

DISTRICT MAP

CALIFORNIA APPLE ACREAGE TOTALS

COUNTY	
BUTTE	47.00
CALAVERAS	7.50
COLUSA	17.50
CONTRA COSTA	44.00
EL DORADO AND ALPINE	852.00
FRESNO	664.00
GLENN	1.00
INYO AND MONO	2.50
KERN	1,135.00
KINGS	3.00
LAKE	12.00
LOS ANGELES	10.00
MADERA	43.10
MARIPOSA	10.00
MENDOCINO	215.00
MERCED	1.00
MONTEREY	76.90
NAPA	1.20
NEVADA	32.00
PLACER	44.00
PLUMAS AND SIERRA	2.00
RIVERSIDE	28.00
SACRAMENTO	573.00
SAN BENITO	279.00
SAN BERNARDINO	305.00
SAN DIEGO	214.00
SAN JOAQUIN	2,330.00
SAN LUIS OBISPO	169.00
SAN MATEO	14.90
SANTA BARBARA	30.27
SANTA CRUZ	2,038.00
SHASTA	38.40
SISKIYOU	26.00
SONOMA	2,193.00
STANISLAUS	585.00
SUTTER	5.00
TEHAMA	47.00
TULARE	69.00
TUOLUMNE	156.00
VENTURA	486.00
YOLO	1,846.00
YUBA	10.00
TOTAL:	14,663.27

STATEMENT FOR ACTIVITIES
FISCAL YEAR ENDED JUNE 30, 2017

ASSETS

• CASH	$83,302
• ACCOUNTS RECEIVABLE	$ 8,311
• PREPAID EXPENSES	$13,078
• RESTRICTED CASH DUE TO PENDING LAWSUIT	$1,730,367
• PROPERTY AND EQUIPMENT NET OF ACCUMULATED DEPRECIATION OF $15,044 IN 2017 AND $12,992 IN 2016	$5,213
TOTAL ASSETS	**$1,840,271**

LIABILITIES

• ACCOUNTS PAYABLE	$44,493
• ACCRUED COMPENSATED ABSENCES	$23,591
TOTAL CURRENT LIABILITIES	**$68,084**

NET ASSETS

• RESTRICTED	
- ESCROW ACCOUNT	$1,730,367
• UNRESTRICTED	($41,820)
NET ASSETS	**$1,772,187**

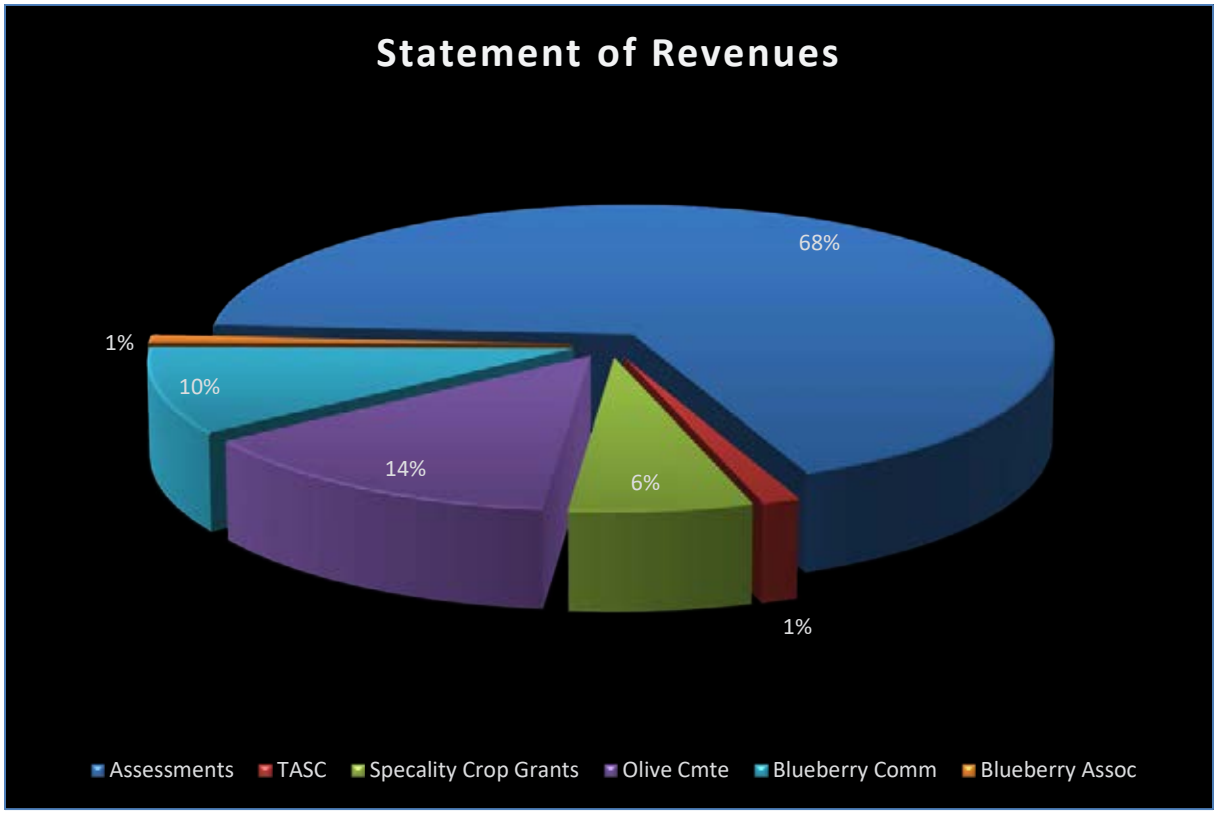
TOTAL LIABILITIES AND NET ASSETS $1,840,271

STATEMENT OF REVENUES

REVENUES

• ASSESSMENTS	$444,727*
• GRANT INCOME – TASC	$8,896
• SPECALITY CROP BLOCK GRANT	$42,811
• OLIVE MANAGEMENT FEES	$90,000
• BLUEBERRY MANAGEMENT FEES	$65,000
• BLUEBERRY ASSOCIATION MANAGEMENT FEES	$6,000

TOTAL REVENUES **$657,434**



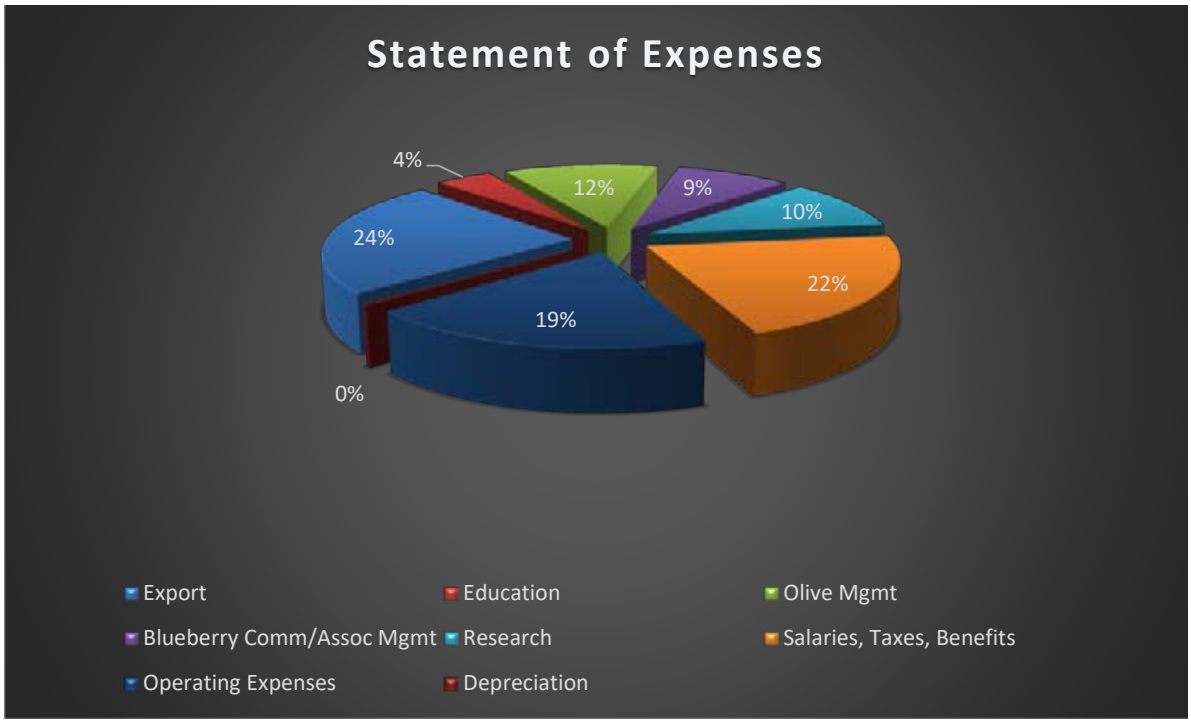
*Includes restricted revenues received pending current lawsuit. Restricted funds shall not be used in operating budget and are stored in a separate escrow account. These funds may not be released until lawsuit is finalized.

STATEMENT OF EXPENSES

EXPENSES

• EXPORT/MARKET DEVELOPMENT	$143,109
• EDUCATION	$26,028
• OLIVE MANAGEMENT	$70,835
• BLUEBERRY MANAGEMENT	$52,930
• RESEARCH	$61,338
• SALARIES, PAYROLL TAXES, BENEFITS	$128,783
• OPERATING EXPENSES	$115,803
• DEPRECIATION	$2,052

TOTAL EXPENSES **$600,878**



CHANGES IN NET ASSETS **$56,556**

NET ASSETS, BEGINNING OF YEAR **$1,716,308**

NET ASSETS, END OF YEAR **$1,772,187**

CALIFORNIA APPLE RESEARCH PROJECTS

2017-2018 RESEARCH SUMMARY

In 2017-2018, the California Apple Commission focused on four areas of research. Three of which were continuations of prior research, and one new project. Each of these research topics will continue to be areas of focus for the future, with an exclusion to the Shade Cloth project, as it was completed in February 2018, per the grant agreement.

In September 2014, the Commission received $313,707 through the CDFA Specialty Crop Block Grant Program to explore the effect of shade cloth on apples. This project began on October 1, 2014 and concluded in February 2018. The full report was disseminated throughout the industry and is also available on our website at Calapple.org.

In summary, our current projects are as follows:

1) Evaluation of new bactericides for control of fire blight of apples caused by Erwinia amylovora and evaluation of new postharvest fungicides for pome fruits - Dr. Jim Adaskaveg

2) Shade cloth benefits for apples - facilitated by CAC staff and research analyzed by Fruit Dynamics

3) Postharvest Quality and Physiology of 'Gala', 'Granny Smith,' and 'Fuji' Apples Subjected to Phytosanitary Irradiation. - Dr. Anuradha Prakash

4) Study on Mechanical Mass Harvesting of Cling Peaches[1] - Dr. Stavros Vougioukas

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[1]The CAC has partnered with the Cling Peach board for this research project. The research includes apples and is applicable to our industry as well.

Annual Report - 2018

Prepared for the California Apple commission

Project Title:	Evaluation of new biological controls for management of fire blight of apples caused by *Erwinia amylovora* and evaluation of new natural products as organic postharvest fungicides for pome fruits
Project Leader:	Dr. J. E. Adaskaveg, Department of Plant Pathology and Microbiology, University of California, Riverside CA 92521.
Cooperators:	D. Thompson, D. Cary, and H. Förster

SUMMARY

Fire blight management

1. Resistance in *E. amylovora* to streptomycin was found in 2017 in three of the seven orchards sampled. Results over the years support our recommendation that streptomycin can be used once a year effectively for most growers. In years with high- to moderate disease levels, pathogen populations exposed to multiple applications of streptomycin will be under selection pressure of the antibiotic, and this will allow re-emergence of resistant sub-populations. Data for 2018 collections are pending.
2. *E. amylovora* populations were found to be moderately copper-resistant. Additionally, we again frequently observed the occurrence of spontaneous mutant colonies emerging at higher copper concentrations, especially when using nutrient agar.
3. Field trials on the management of fire blight were conducted under high disease pressure on cvs. Granny Smith and Fuji, as well as on Bartlett pear.
   a. Among biological treatments, the rotation of Badge – Badge+lime sulfur – Blossom Protect/buffer showed the highest efficacy with a 41% reduction of disease compared with the control on 'Granny Smith'. Cueva, Blossom Protect, Serenade ASO+Badge, and Serenade ASO were less effective but disease was still significantly lower than the control. On pear, the preservatives Nisin and polylysine also resulted in reduction of disease.
   b. On 'Fuji' apple, the mixture of FireWall and Mastercop reduced the disease to the lowest level with a 72% reduction from the control. This treatment, however, resulted in an unacceptable high severity of fruit russeting.
   c. Mixture-rotation and rotation treatment programs with antibiotics (i.e., Kasumin, FireLine, FireWall) were very effective. Kasumin is currently considered a conventional treatment, however, efforts are underway to obtain an organic registration. The compound is a natural substance that is commercially produced by fermentation. In contrast to streptomycin and oxytetracycline, it has very minimal or no usage in human medicine.

Postharvest decay control

1. In laboratory studies, formulations of the bio-fungicide natamycin were compared, and two liquid formulations were found to be superior to the WP formulations in reducing decay. Natamycin was registered in 2016 under the trade name BioSpectra on citrus and stone fruits. Because it is a fermentation product, it is being proposed to the National Organic Standards Board (NOSB) as an organic treatment (PI submitted a letter of support to the NOSB).
2. In an experimental packingline study using in-line drench applications, BioSpectra was not very effective against blue mold, but was similarly effective against gray mold and Mucor rot when compared with Scholar or the newly registered Academy.
3. Academy (fludioxonil + difenoconazole) was highly effective against the three decays, similar to Scholar, and the addition of another 150 ppm of fludioxonil to the pre-mixture improved efficacy. Academy was previously also shown to be effective against bull's eye rot, Rhizopus rot, and Alternaria rot, and thus, has a wide spectrum of activity. Mixtures of BioSpectra with Scholar or Academy were also very effective against the three decays. This is important, because this presents an excellent resistance management strategy.

INTRODUCTION

Epidemiology and management of fire blight. Fire blight, caused by the bacterium *Erwinia amylovora,* is one of the most destructive diseases of pome fruit trees including apples. The disease causes a blackening of twigs, flowers, and foliage and is indigenous to North America but has since spread worldwide. In addition to cankers, the pathogen overwinters in flower buds, diseased fruit, small twigs, and branches. In the spring, blossoms are infected through natural openings in nectaries and pistils. After destroying the blossom, the bacteria spread into the peduncle, spur, and twig. Warm wet environments favor disease development. Inoculum may ooze as droplets from cankers or infected flowers, peduncles, and other infected tissues. Inoculum is spread by wind, rain, insects, birds, or by man, e.g., by means of contaminated pruning tools. Secondary infections may occur throughout the growing season.

Current chemical control programs for fire blight are based on protective schedules, because available compounds are contact treatments and are not systemic except for the antibiotic streptomycin. Control with conventional copper compounds is only satisfactory when disease severity is low to moderate. Historically, these treatments are only used during dormant and bloom periods because phytotoxicity commonly occurs on fruit as russeting. Subsequently, labeled rates of copper are at low amounts of metallic copper equivalent (MCE) that are at the limit of effectiveness. Additionally, in 2016-17, low to moderate levels of copper insensitivity in pathogen populations was again detected.

The antibiotics streptomycin and oxytetracycline have been used for many years for the management of fire blight, but they were removed from the approved list of organic treatments of apples and other pome fruits by the National Organic Standards Board (NOSB). Resistance to streptomycin was present at high incidence in populations of the fire blight pathogen in California between 2006 and 2011, but since then has declined to low levels in most orchards. Reduced sensitivity to oxytetracycline only has been found sporadically, and resistant populations did not persist. After a long delay, kasugamycin (Kasumin) is now registered in California. The antibiotic is currently not registered as an organic treatment and thus, organic growers have very limited choices for disease control.

New re-formulated copper products that can be used at reduced MCE rates and that have less contamination in their formulations that may cause phytotoxicity are available. Some of the coppers are OMRI-approved and these include Badge X2 (Gowan), CS-2005 (Magna Bon, Inc.), and Cueva (Certis). They have been reported to be effective against fire blight without causing phytotoxicity. Thus, research on OMRI-approved coppers needs to be continued especially if antibiotics are no longer approved, and these treatments were included in our 2018 field studies.

The biocontrol treatments Blight Ban A506 (*Pseudomonas fluorescens* strain A506) and Bloomtime Biological (*Pantoea agglomerans* strain E325), and the fermentation product of *Bacillus subtilis* Serenade (strain QST 713) have been very inconsistent over the years in their performance in our trials and were most effective under low inoculum levels and less favorable micro-environments. Serenade has become available as a new liquid formulation (ASO) that needed to be evaluated. The biocontrol Blossom Protect (*Aureobasidium pullulans*) was evaluated for the last several years and shown to be very effective under less to moderately favorable disease conditions and it is one of the most consistent biologicals that we have evaluated. In general, biocontrols are most effective when they are actively growing on the plant. Additives that can be used under field conditions have been evaluated, but their effect has also been inconsistent. Thus, we are evaluating other alternatives such as the natural fermentation compounds lactic acid, ε-poly-L-lysine, and Nisin that have known anti-bacterial activity and are used as natural preservatives in food. They potentially could qualify for organic production. In our 2018 studies, we prepared alginate formulations of the latter two products that have the potential to provide a slow release and higher persistence of the active compounds.

A novel way to inhibit bacterial pathogens could be the interference with vital processes such as the secretion of pathogenesis-related proteins. For this, the type III secretion system is used by many bacterial plant pathogens. Molecular work has led to the identification of inhibitors of this secretion system, and a laboratory has provided us with substantial amounts that could be tested in field studies. These potentially could qualify as organic treatments and therefore, were also evaluated in our 2018 studies. Our goal is to develop effective rotational programs for either organic farming practices with the use of copper and biologicals or conventional

programs with the use of antibiotics alone or in mixtures with fungicides, copper, biologicals, or possibly SAR compounds during bloom or as cover sprays during early fruit development.

Management of postharvest decays. Apples like other pome fruits can be stored for some period of time using optimum fruit storage environments. Still, postharvest decays caused by fungal organisms can result in economic crop losses during storing and marketing of fruit. The major postharvest pathogens of apples include *Penicillium expansum, Botrytis cinerea, Alternaria alternata, Mucor piriformis,* and *Neofabraea* spp. causing blue mold, gray mold, Alternaria rot (black mold), Mucor decay, and bull's eye rot, respectively. There is a deficiency in postharvest biocontrols and natural products for preventing decays in storage. BioSave 100 is one of the few materials currently available in the United States, but its efficacy is limited. The product Aspire has been discontinued. Still, other biological products are registered in other countries and these potentially could be evaluated for California conditions if registrants decide to market their products in the U.S.

In previously found that the bio-fungicide polyoxin-D (Ph-D, Oso, Tavano) was very effective in reducing the incidence of gray mold and Alternaria rot, but not of blue mold. We also demonstrated the efficacy of another bio-fungicide, natamycin (formerly pimaricin or EXP-13). This compound was registered in late 2016 as BioSpectra as a postharvest treatment for citrus and stone fruits. Natamycin showed very good to good efficacy against decays caused by *Penicillium*, *Botrytis*, and *Mucor* spp. For many years, it has been a federally-approved food additive to prevent mold growth, including *Penicillium* species, on dairy and meat products in the United States and other countries. Over this time, resistance in *Penicillium* species against natamycin has not occurred. Natamycin has an exempt registration status and it has been submitted to the NOSB for organic registration. In our studies over the past years, we noted a somewhat inconsistent efficacy of natamycin. Therefore, a goal was to improve its performance. In 2017/18, we compared several formulations of the bio-fungicide and we continued to evaluate its efficacy in an experimental packingline study together with the newly registered Academy (pre-mixture of fludioxonil and difenoconazole) with the goal of having additional postharvest fungicides for the apple industry of California.

OBJECTIVES

Fire blight research

1. Evaluate the efficacy of treatments for managing fire blight.
   A. Laboratory in vitro tests to identify and evaluate growth enhancers of biological control agents.
   B. Laboratory in vitro tests on copper and zinc products (registered copper products and new nano-particles as they become available) with newly identified additives (lactic acid, poly-L-lysine, and experimentals called SBH derivatives) that enhance the activity of these bactericides.
   C. Small-scale hand-sprayer tests using different treatment-inoculation schedules to evaluate coppers (e.g., Badge X2, CS-2005, Cueva, Champ), and biological treatments (e.g., Blossom Protect, Actinovate, Serenade, Taegro, Double Nickel 55) by themselves or in selected combinations (e.g., copper and Blossom Protect).
   D. Field trials with protective air-blast spray treatments:
      i. New formulations of copper (e.g., Badge X2, CS-2005, Cueva) possibly supplemented with nano-copper oxide (if laboratory assays show activity) with and without newly identified additives (lactic acid, poly-L-lysine, and an experimental called SDH).
      ii. Biological treatments (Blossom Protect, Serenade, Double Nickel 55) with and without the addition of growth enhancers.
      iii. Plant defense activators or SARs alone of in mixtures with other biological control treatments.

Postharvest research

2. Comparative evaluation of new postharvest fungicides
   A. Evaluate natamycin (BioSpectra) and other new postharvest fungicides such as Academy at selected rates against gray mold, blue mold, Alternaria decay, and bull's eye rot and compare to pyrimethanil and fludioxonil.
   B. Evaluate mixtures of these compounds.
   C. Determine baseline sensitivities. Baseline sensitivities for natamycin will be continued to be developed for additional fungal pathogens that are collected.

PLANS AND PROCEDURES

Isolation and culturing of* E. amylovora *and sensitivity testing against antibiotics and copper. Fire blight samples were obtained from pome fruit trees in the spring of 2017 and 2018 from commercial orchards. Infected plant material was surface-disinfested for 1 min using 400 mg/L sodium hypochlorite, rinsed with sterile water, cut into small sections, and incubated in 1 ml of sterile water for 15 to 30 min to allow bacteria to stream out of the tissue. Suspensions were streaked onto yeast extract-dextrose-$CaCO_3$ agar (YDC). Single colonies were transferred and the identity of the isolates as *E. amylovora* was verified by colony morphology and by PCR using primers specific for *E. amylovora* (Appl. Environ. Microbiol. 58:3522-2536). Strains were tested for their sensitivity to streptomycin and oxytetracycline using the spiral gradient dilution (SGD) method. Copper sensitivity of strains was determined by streaking bacterial suspensions (70% transmission at 600 nm) on CYE (casitone, yeast extract, glycerol) or nutrient agar amended with 0, 10, 20, or 30 ppm MCE. Growth was recorded after 2 days of incubation at 25C and was rated as +++ (growth not inhibited, similar to the control), ++ (growth inhibited as compared to the control), or + (growth sparse).

Field studies on the management of fire blight using protective treatments. Air-blast field studies on the relative efficacy of protective treatments were conducted in experimental cvs. Granny Smith and Fuji apple orchards at the Kearney Agricultural Research and Extension Center (KARE). All trees received a copper treatment at bud break to help reduce the high amount of inoculum present in these orchards that made evaluation of bactericide treatments difficult in the last couple of years. Four applications were done starting at 5-10% bloom and followed by phenology-based treatments until petal fall. Several rotation or mixture rotation programs were evaluated. Incidence of blight was assessed in early to mid-June based on the number of infected flower clusters of 200 clusters evaluated for each of the four single-tree replications. Additionally, potential phytotoxic effects of the treatments (e.g., fruit russeting caused by copper) were evaluated. Data were analyzed using analysis of variance and LSD mean separation procedures of SAS 9.4.

For comparison, field studies on fire blight were also conducted on Bartlett pear. In these trials some novel treatments were included such as type III secretion inhibitors, Nisin and polylysine mixed with alginate, as well as zinc nitrate. Three applications were done, and disease was evaluated on 90 spurs of each of the four single-tree replications seven days after the last application.

Efficacy of new postharvest fungicides for managing apple decays in storage. A comparison of three natamycin formulations (50WP, 10SC, 5EC) was conducted on 'Shinko' apple pears in the laboratory. Fruit were inoculated with *P. expansum* or *B. cinerea*, and treated using an air-nozzle sprayer after 11 h. Fruit were then incubated for 7 days at 20C.

'Granny Smith' fruit that were treated similar to commercial practices concerning harvest, handling, packing, and temperature-management of fruit were used in an experimental packingline study at KARE. Fruit were wound-inoculated with conidial suspensions of several decay fungi (*B. cinerea, P. expansum,* and *Mucor piriformis*) and treated after 16 to 18 h with test fungicides by an in-line drench that was followed by a CDA application with a carnauba-based fruit coating (i.e., Decco 230). Treatments included natamycin (BioSpectra), Scholar, and Academy (fludioxonil – difenoconazole pre-mixture). For each of four replications, 24 fruit were used. Data were analyzed using analysis of variance and averages were separated using least significant difference mean separation procedures of SAS 9.4.

RESULTS AND DISCUSSION

Antibiotic and copper sensitivity of* E. amylovora *strains collected in California. All 26 strains from seven locations collected in 2017 in Sacramento and Lake Co. were determined to be sensitive to oxytetracycline (Table 1); whereas, 8 of 25 strains from Sacramento Co. were resistant to streptomycin. Five of these 8 strains were highly resistant (MIC values >2000 mg/L) and three were moderately resistant (MIC values <30 ppm) (Table 1). Resistance was found in three of the seven orchards sampled, and all six strains from one orchard were either moderately or highly resistant. Results over the years support our recommendation that streptomycin can be used once a year effectively for most growers. In years with high- to moderate disease levels, pathogen populations exposed to multiple applications of streptomycin will be under selection pressure of the antibiotic, and this will allow re-emergence of resistant sub-populations. Data for 2018 collections are pending.

All 26 strains from Sacramento and Lake Co. did not grow on CYE (a growth medium with a low copper-binding capacity) amended with 20 ppm MCE (Table 1). They all grew similar to the non-amended control on the nutrient-rich nutrient agar at 20 ppm MCE. One strain still grew well at 30 ppm MCE on nutrient agar, whereas growth of the other strains was reduced at this concentration. Thus, as in 2015 and 2016, we conclude that current *E. amylovora* populations are moderately copper-resistant. Additionally, we again frequently observed the occurrence of spontaneous mutant colonies emerging at higher copper concentrations, especially when using nutrient agar. These mutants were not stable when sub-cultured on copper-free media and reverted back to sensitivity. If these mutants also occur in the field, however, under continued presence of selection pressure (i.e., copper sprays) they may successfully compete and cause disease.

We consider several factors that likely contributed to the failure of copper applications to control fire blight in the past: 1) Highly conducive disease conditions may low allow for the pathogen to overcome the suppressive action of copper; 2) Only low rates of copper are registered for fire blight management (approx. 170 MCE for the 0.5 lb rate of Kocide 3000) and this may allow growth of moderately Cu-resistant strains; 3) There is moderate copper resistance in *E. amylovora;* and 4), Selection of populations (spontaneous mutants) with higher copper resistance after repeated applications may lead to disease in the presence of copper. Furthermore, copper is bacteriostatic and does not kill the pathogen. Thus, use as a pre-bloom/early bloom treatment may have some benefits in suppressing bacterial oozing from cankers. Applying a contact bactericide with low to moderate toxicity will only provide marginal benefits because the pathogen causes a deep internal infection (i.e., cankers) and has a high reproductive capacity. This means that the pathogen will ooze from cankers (unaffected by copper) and disseminate to unprotected tissues if copper is not routinely applied. If several copper applications are done, however, russetting will occur on pome fruit varieties.

***Field studies on fire blight using protective treatments*.** Fire blight incidence in our research plots in the spring of 2017 was high, i. e., over 50% based on infected flower clusters of untreated control trees. On cv. Granny Smith apple, among organic treatments, the rotation of Badge – Badge+lime sulfur – Blossom Protect/buffer showed the highest efficacy with a 41% reduction of disease compared with the control (Fig. 1). Cueva, Blossom Protect, Serenade ASO+Badge, and Serenade ASO resulted in 38%, 34%, 32%, and 17% reductions, respectively, and these were all significantly lower than the control. Phytotoxicity on fruit after Cueva treatments had a rating of 1.2 on a scale from 0 to 4 (with 4 being the highest phytotoxicity). Treatments containing Kasumin (by itself or mixed with polylysine and zinc oxide or with Firewall) performed the best in this study with reductions in disease between 52% and 56%.

In the study on 'Fuji' apple, the mixture of FireWall and Mastercop reduced the disease to the lowest level with a 72% reduction from the control (Fig. 2). This treatment, however, resulted in an unacceptable high severity of fruit russeting (a rating of 3 of a maximum of 4). The mixture-rotation and rotation treatment programs with antibiotics (i.e., Kasumin, FireLine, FireWall) were also very effective with 62% and 57% reductions in disease, respectively. Phytotoxicity ratings were <0.3 for the latter treatments. Blossom Protect rotated or mixed with Serenade ASO was somewhat less effective, but still significantly the incidence of fire blight from the control, and there was no phytotoxicity.

Studies were also done on Bartlett pear where fire blight is generally more severe than on apple. New and experimental conventional and biological treatments were evaluated in two studies in three-spray programs, some of which could not be included in the apple studies (due to a limited number of trees available). In the first study, among biological treatments, the preservative Nisin was the most effective, reducing the incidence of blight from the untreated control by approximately 50% (Fig. 3). Nisin was less effective when prepared as an alginate formulation to provide a slower release of the material over time. One of the three type III secretion inhibitors (TS153) evaluated had a slight numeric, but not statistical, increase in disease as compared with Nisin; and Blossom Protect and Serenade ASO followed in efficacy with 34% to 35% reduction in disease. In this study, FireLine that was included as a standard conventional treatment, had the lowest incidence of disease in this plot with a 64% reduction as compared with the control (Fig. 3). The addition of the adjuvant Tactic did not increase efficacy of FireLine. Two type III secretion inhibitors and Serifel (*Bacillus amyloliquefaciens*) did not show efficacy in this study. Zinc nitrate and Serenade ASO by itself or mixed with Cueva showed some reduction of fire blight.

In the second study on pear, Kasumin mixed with FireWall showed the highest efficacy (as in many of our previous years' studies) with an 81% reduction in disease as compared with the control (Fig. 4). Other treatments containing Kasumin also performed well, except in the rotation with the natural product 1552 (treatments 1 and 3 in the rotation were done with 1552, treatment 2 was done with Kasumin). Cueva, polylysine (with or without alginate – zinc oxide), and Cueva mixed with the copper enhancer DAS-1 showed intermediate efficacy.

In conclusion, none of the new organic treatments or those of a natural origin (except Kasumin) showed high efficacy in the management of fire blight. In comparison with conventional treatments, those containing antibiotics were always the most effective. Blossom Protect was less effective than in many of our previous studies, but still significantly reduced the disease from the control. Other biological treatments to be considered are the liquid copper formulation Cueva and the preservatives Nisin and polylysine. We tried to improve the efficacy of the two preservatives with the addition of alginate. This was not very successful, but possibly, other additives could be tested. Kasumin is currently considered a conventional treatment, however, efforts are underway to obtain an organic registration. The compound is a natural substance that is commercially produced by fermentation of *Streptomyces* species. In contrast to streptomycin and oxytetracycline, it has very minimal or no usage in human and veterinary medicine. Thus, an organic registration seems plausible. A summary on the use of biological treatments for the management of fire blight has recently been prepared for the California Apple Commission.

High levels of overwintering cankers and disease on new growth in the spring were present at all of our field test sites because orchards were either experimental (apple) or were not commercially managed (pear). This made it difficult to obtain low disease levels for any of the treatments evaluated. Still, comparative efficacy data could be obtained, and absolute efficacy in a well-managed commercial orchard is expected to be higher.

Evaluation of postharvest treatments using single-fungicides, mixtures, and pre-mixtures. Postharvest studies focused on the efficacy of the new natural compound natamycin that is currently exempt-from-tolerance and registered as BioSpectra on citrus and stone fruits. The compound was submitted to the NOSB, and a letter was written by Dr. Adaskaveg in support of an OMRI listing. In laboratory studies, we compared the efficacy of several formulations in the control of blue mold and gray mold. Significant differences were observed, with the WP formulation the least effective (Fig. 5). The 5EC formulation was more effective than the 10SC formulation in the control of blue mold when used at 1000 ppm, but at 2000 ppm, these two performed the same. Still, Scholar used at 300 ppm was significantly more effective. For gray mold, both liquid formulations were highly effective, and the 10SC formulation resulted in similar low levels of decay than Scholar.

In an experimental packingline study using in-line drench applications, BioSpectra was not very effective against blue mold, but was similarly effective against gray mold and Mucor rot when compared with Scholar or the newly registered Academy (Fig. 6). Academy was highly effective against the three decays, similar to Scholar, and the addition of another 150 ppm of fludioxonil to the pre-mixture improved efficacy. Academy was previously also shown to be effective against bull's eye rot, Rhizopus rot, and Alternaria rot, and thus, has a wide spectrum of activity. Mixtures of BioSpectra with Scholar or Academy were also very effective against the three decays. This is important, because this represents an excellent resistance management strategy. Resistance to natamycin has not been reported previously to any *Penicillium* species, although the compound has been registered for food uses for over 20 years.

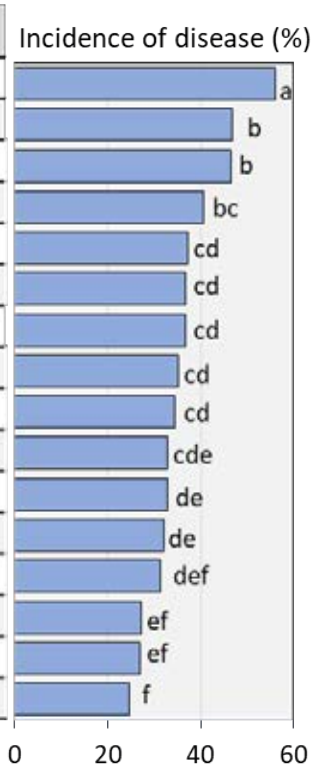
Table 1. Sensitivity of *E. amylovora* strains from California pome fruit orchards to streptomycin, oxytetracycline, and copper in 2017.

						Copper sensitivity - growth at:		
No.	Location No.	Isolate code	County	Strepto-mycin	Oxytetra-cycline	20 ppm CYE agar	20 ppm Nutrient agar	30 ppm Nutrient agar
1	1	1-1	Sacramento	S	S	-	++	+
2		1-2		S	S	-	++	+
3		1-3		S	S	-	++	+
4		1-4		S	S	-	++	+
5		1-5		S	S	-	++	+
6	2	2-1	Sacramento	HR	S	-	++	+
7		2-2		HR	S	-	++	+
8		2-3		MR	S	-	++	+
9		2-4		HR	S	-	++	+
10		2-5		HR	S	-	++	+
11		2-6		MR	S	-	++	+
12	3	3-1	Sacramento	HR	S	-	++	+
13	4	4-1	Sacramento	S	S	-	++	+
14	5	5-1	Sacramento	MR	S	-	++	+
15		5-3		S	S	-	++	++
16		5-5		S	S	-	++	+
17		5-6		S	S	-	++	+
18		5-7		S	S	-	++	+
19		5-9		S	S	-	++	+
20	6	6-1	Sacramento	S	S	-	++	+
21		6-2		S	S	-	++	+
22		6-3		S	S	-	++	+
23		6-4		S	S	-	++	+
24		6-5		S	S	-	++	+
25		6-6		S	S	-	++	+
26	7	7-1	Lake	S	S	-	++	+

Sensitivity to streptomycin and oxytetracycline was determined using the spiral gradient endpoint method. S = sensitive, MR = moderately resistant (MIC = <30 ppm), HR = highly resistant (MIC = >2000 ppm). Sensitivity to copper was determined by growth on amended CYE or nutrient agar. ++ = growth similar as in the non-amended control, + = reduction in growth.

Fig. 1. Efficacy of new mostly organic bactericides for management of fire blight of Granny Smith apples, Fresno Co. 2018

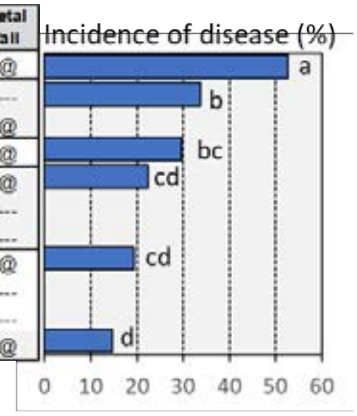
Treatment	Rate
Control	---
TS108 20% SL + Regulaid*	62.5 fl oz + 16 fl oz
Serenade ASO	64 fl oz
TS153 10% SL + Regulaid*	101 fl oz + 16 fl oz
Serenade ASO + Badge X2	64 fl oz + 16 oz
Blossom Protect + Buffer	20 oz + 8 lbs
TS28 10% SL + Regulaid*	107 fl oz + 16 fl oz
Cueva	3 qts
Kasumin 2L + Cueva	64 fl oz + 3 qts
Badge X2;X2+LS;BP+B;BP+B	16 oz
Kasumin 2L + Fireline	64 fl oz + 12 oz
ε Poly-L-Lysine + Zinc Oxide	13.2 oz + 32 oz
Kasumin 2L + Citric Acid	64 fl oz + 27 oz
Kasumin 2L	64 fl oz
Kasumin 2L + Firewall	64 fl oz + 8 oz
Kasumin 2L + ε Poly-L-lysine + Zinc Oxide	64 fl oz + 13.2 oz + 32 oz



Treatments were applied on 3-27 (5-10% bloom), 4-1 (20-40% bloom), and 4-9-18 (full bloom), and 4-14 (petal fall) using an air-blast sprayer at 100 gal/A. Disease was evaluated for 100 flower clusters (spurs) of each tree on 6-4-18. Abbreviations: X2 = Badge X2; LS= lime sulfur (6% rate); BP+B = Blossom Protect and buffer. All treatments had four, paired-tree replications (total of 8 trees). Limited material available for treatments using Regulaid thus only four, single-tree replications used.

Fig. 2. Efficacy of organic and conventional bactericides for management of fire blight of Fuji apples, Fresno Co. 2018

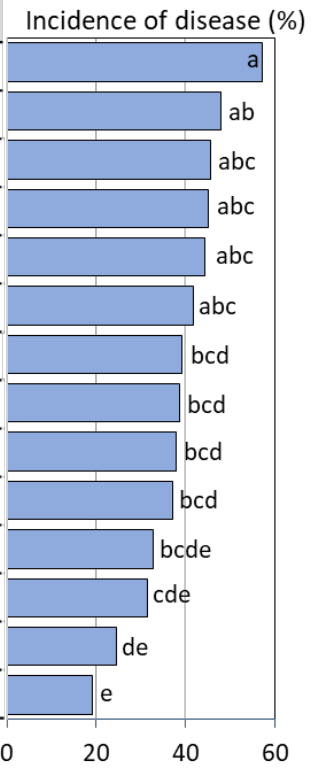
Treatment	Rate/A	5-10% bloom	20-40% bloom	Full bloom	Petal fall
Control	—	@	@	@	@
Blossom Protect/Buffer	20 oz/128 oz	@	---	@	---
Serenade ASO	64 fl oz	---	@	---	@
Blossom Protect/Buffer + Serenade ASO	20 oz/128 oz + 64 fl oz	@	@	@	@
Kasumin + FireWall	64 fl oz + 8 oz	@	---	---	@
FireWall + FireLine	8 + 16 oz	---	@	---	---
Kasumin + FireLine	64 fl oz +16 oz	---	---	@	---
Kasumin	64 fl oz	@	---	---	@
FireWall	8 oz	---	@	---	---
FireLine	16 oz	---	---	@	---
FireWall + Mastercop	8 oz + 4 pt	@	@	@	@



Treatments were applied on 4-6 (5-10% bloom), 4-9 (20-40% bloom), and 4-13-18 (full bloom), and 4-19 (petal fall) using an air-blast sprayer at 100 gal/A. Disease was evaluated for 100 flower clusters (spurs) of each tree on 6-4-18. All treatments had four, paired-tree replications (total of 8 trees).

Fig. 3. Efficacy of new mostly organic bactericides for management of fire blight of Bartlett pear, Sutter Co. 2018

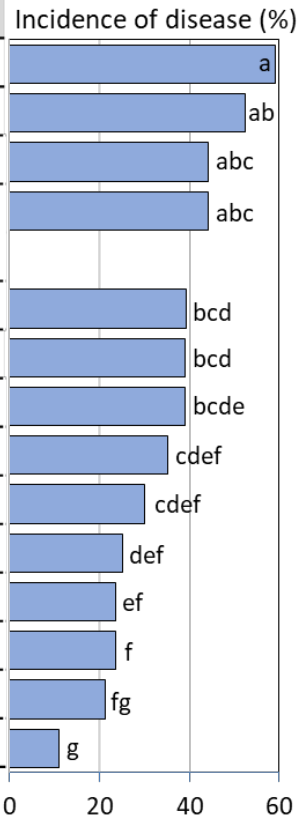
Treatment	Rate	Adjuvant
Control	---	---
TS28 10% SL	107 fl oz	Regulaid 16 fl oz
Nisin + Alginate	13.5 oz	NuFilmP 5 fl oz
Serifel	4 oz	NuFilmP 5 fl oz
TS108 20% SL	62.5 fl o	Regulaid 16 fl oz
Nisin + Alginate + Brandt ZnO	13.5 oz + 32 oz	NuFilmP 5 fl oz
Serenade ASO + Cueva	64 + 96 fl oz	---
Brandt ZnNO3	64 fl oz	NuFilmP 5 fl oz
Serenade ASO	64 fl oz	NuFilmP 5 fl oz
Blossom Protect + buffer	20 + 143 oz	---
TS153 10% SL	101 fl oz	Regulaid 16 fl oz
Nisin	13.5 oz	NuFilmP 5 fl oz
Fireline	16 oz	Tactic 8 fl oz
FireLine	16 oz	---



Treatments were applied on 3-28 (5% bloom), 4-3 (full bloom), and 4-11-18 (petal fall) using an air-blast sprayer at 100 gal/A. Early infections were observed on 4-11-18. Disease was evaluated for 90 spurs of each tree on 4-18-18. All treatments had four, single-tree replications used.

Fig. 4. Efficacy of new bactericides for management of fire blight of Bartlett pear, Sutter Co. 2018

Treatment	Rate	Adjuvant
Control	---	---
PolyLysine + Alginate	13.5 oz	NuFilmP 5 fl oz
Brandt ZnNO3	64 fl oz	NuFilmP 5 fl oz
Rotation 1552	28 oz	---
Kasumin	64 fl oz	
PolyLysine + Alginate + ZnO	13.5 + 32 oz	NuFilmP 5 fl oz
Cueva	96 fl oz	---
Polylysine	13.5 oz	NuFilmP 5 fl oz
DAS1 + Cueva	27 + 96 fl oz	---
Kasumin + Polylysine	64 fl oz + 13.5 oz	---
Kasumin	64 fl oz	---
Kasumin + Citric Acid	64 fl oz + 26.5 oz	---
Mycoshield	16 oz	Tactic 8 fl oz
Firewall	8 oz	---
Kasumin + Firewall	64 fl oz + 8 oz	---

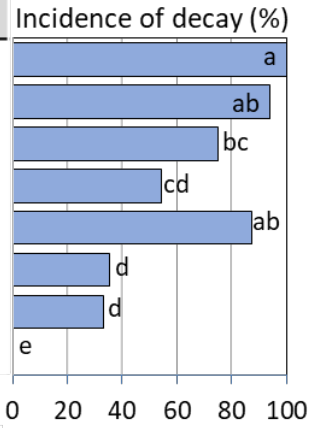


Treatments were applied on 3-28 (5% bloom), 4-3 (full bloom), and 4-11-18 (petal fall) using an air-blast sprayer at 100 gal/A. Early infections were observed on 4-11-18. Disease was evaluated for 90 spurs of each tree on 4-18-18. All treatments had four, single-tree replications used.

Fig. 5. Comparison of natamycin formulations for control of blue mold and gray mold in laboratory studies

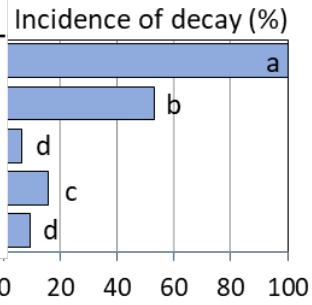
A. Blue mold

Treatment	Form.	Rate
Control	---	---
Natamycin	50WP	1000 ppm
Natamycin	10SC	1000 ppm
Natamycin	5EC	1000 ppm
Natamycin	50WP	2000 ppm
Natamycin	10SC	2000 ppm
Natamycin	5EC	2000 ppm
Scholar	230SC	300 ppm



B. Gray mold

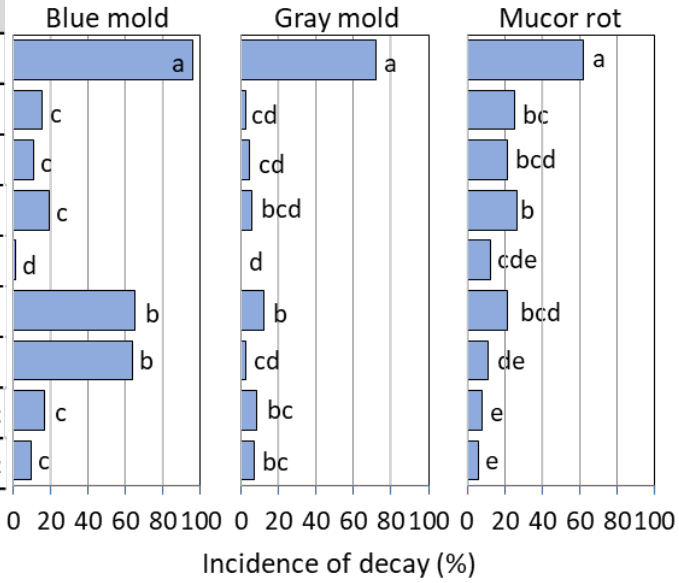
Treatment	Form.	Rate
Control	---	---
Natamycin	50WP	1000 ppm
Natamycin	10SC	1000 ppm
Natamycin	5EC	1000 ppm
Scholar	230SC	300 ppm



Apple pear fruit were wound-inoculated with *P. expansum* or *B. cinerea* and treated after 11 h of incubation at 20C using an air-nozzle sprayer. Fruit were then incubated for 7 days at 20C

Fig. 6. Evaluation of postharvest fungicides for managing postharvest decays of Granny Smith apple in an experimental packingline study

Treatment	Rate
Control	'---
Scholar SC	16 fl oz
Scholar SC	32 fl oz
Academy SC	16 fl oz
Academy SC + Scholar	16 fl oz + 8 fl oz
BioSpectra	500 ppm
BioSpectra	1000 ppm
BioSpectra + Scholar	500 ppm + 16 fl oz
BioSpectra + Academy	500 ppm + 16 fl oz



Fruit were wound-inoculated with *P. expansum, B. cinerea,* or *M. piriformis* and treated after 16-18 h as in-line drenches that were followed by a CDA application with carnauba fruit coating (Decco 330). Fruit were then incubated at 20C.

California Apple Commission Shadecloth Project

Specialty Crop Block Grant 16049
Final Report
December 2017

Table of Contents

Executive Summary

In 2016, Fruit Dynamics (FD) provided the California Apple Commission (CAC) with a final report for the 2014 Specialty Crop Block Grant (SCBG) dedicated to evaluating the benefits of shadecloth in commercial apple orchards in California. Due to the setbacks of that study, FD was contracted to complete an additional year of evaluation under the 2016 SCBG dedicated to the same subject. The following results are from this most recent season, 2017, and should be considered in the context of previous years' results, which are also included at the end of this document.

The orchards which participated in this year's study and the varieties of apples studied are the same as in the previous years. The shadecloth material was also the same, already provided by the previous grant.

This year's fruit data was taken from commercial packout reports; This was determined to be more complete than random samples collected from the orchards. Fruit quality was measured in packout/bin totals, size, firmness, and brix. Additionally, Granny Smith starch iodine data was collected this year to see if shadecloth caused any difference in fruit maturity. Further analysis to determine the effects of the shadecloth included the collection of orchard temperatures. Logistical challenges prevented the exact measurement of water and crop protective products used, but all participating growers completed a questionnaire regarding their experiences with these items of interest, and those responses are provided in this report.

Executive Summary, cont'd

The temperature at each site varied by location and micro climate, but overall the daily high temperatures under shadecloth averaged 2°F cooler than the control. This average differential was 1°F less than the previous year.

The Granny Smith variety had a higher packout per bin from the shadecloth treated areas; total production per acre was also higher. Packout per bin under shadecloth was reduced in Gala.

In the Gala and Fuji varieties, color was either unchanged or reduced by the use of the shadecloth selected by growers.

There were no major differences in fruit size, with the exception of the Pink Lady in the enclosed shade treatment, which had noticeably larger size.

The Fuji and Pink Lady lots were not segregated by treatment, so no comparative packout data is available.

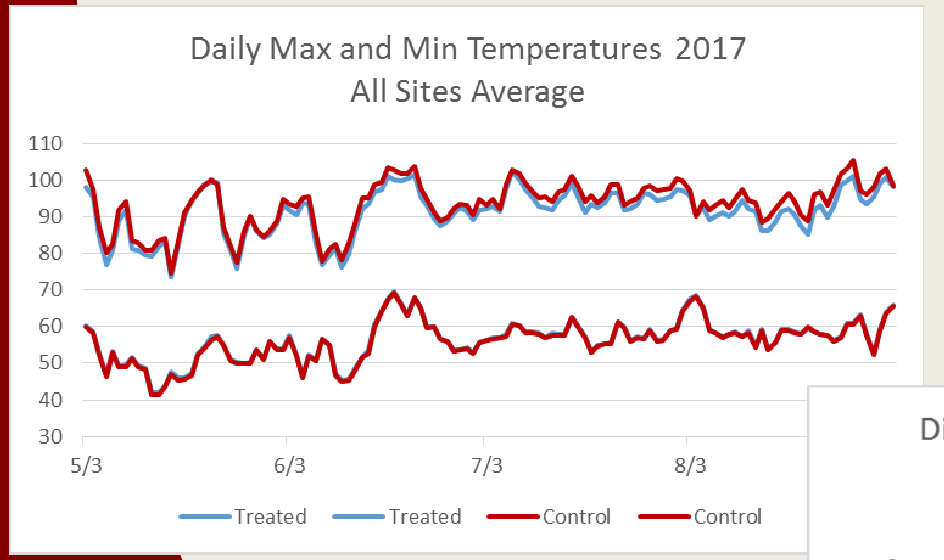
For the second consecutive year, Granny Smith fruit had a lower firmness under shadecloth.

The benefit of shadecloth on apples in California is a complex equation and must take into account many factors, including variety, plant density, row orientation, light reduction capacity and color of the material, and the area of coverage of the cloth (non-continuous vs continuous, for example). Growers of red or bicolored apple varieties were **not** interested in continuing the use of shadecloth by the end of this study, but the Granny Smith (green variety) grower was interested in trialing other applications. While Fruit Dynamics cannot make the decision for individual growers, it does appear that California apple growers who wish to produce fruit with high color may want to postpone commercial-scale application of shadecloth until further research clarifies a more beneficial treatment (% shade, correct color and coverage); and Granny Smith growers may consider shadecloth as a tool for the reduction of sunburn.

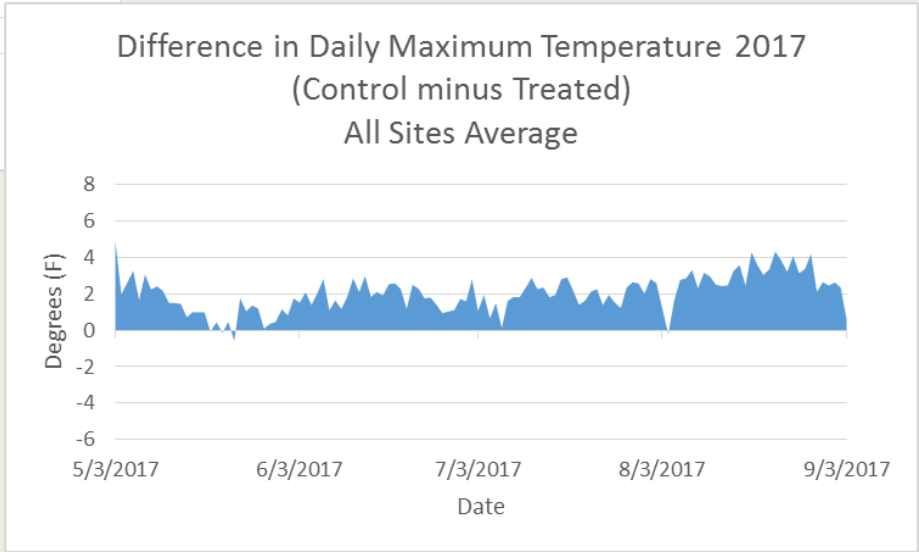
Orchard Temperatures

Shadecloth Project Report 12-17

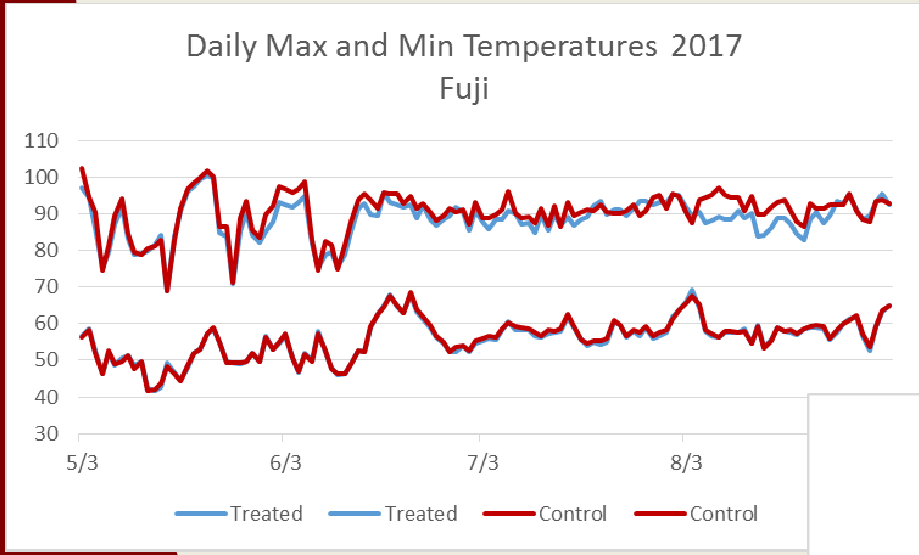
Apple Orchard Temperature – Average All Sites 2017
Treated vs Control



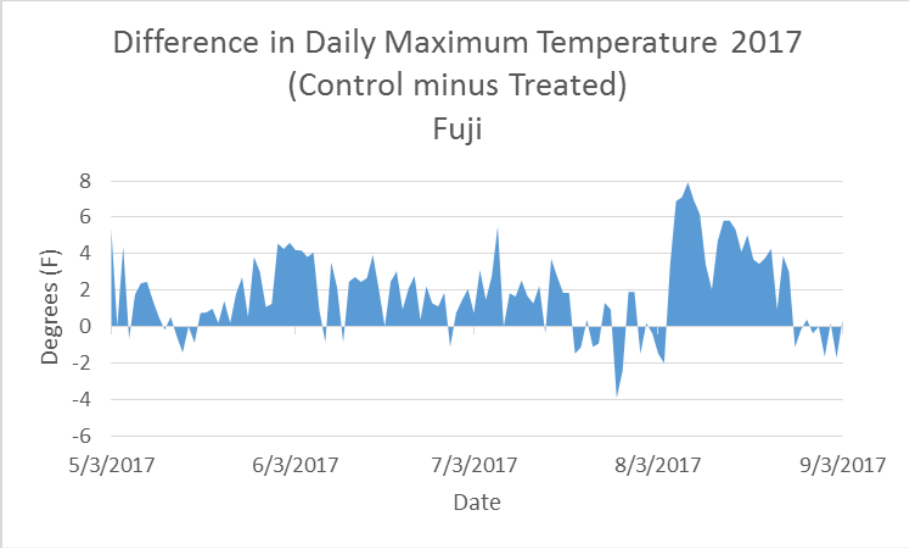
The combined average daily maximum temperature in the treated blocks was an average of 2°F lower than those in the control blocks. In some cases, it was as much as 4.9°F lower.



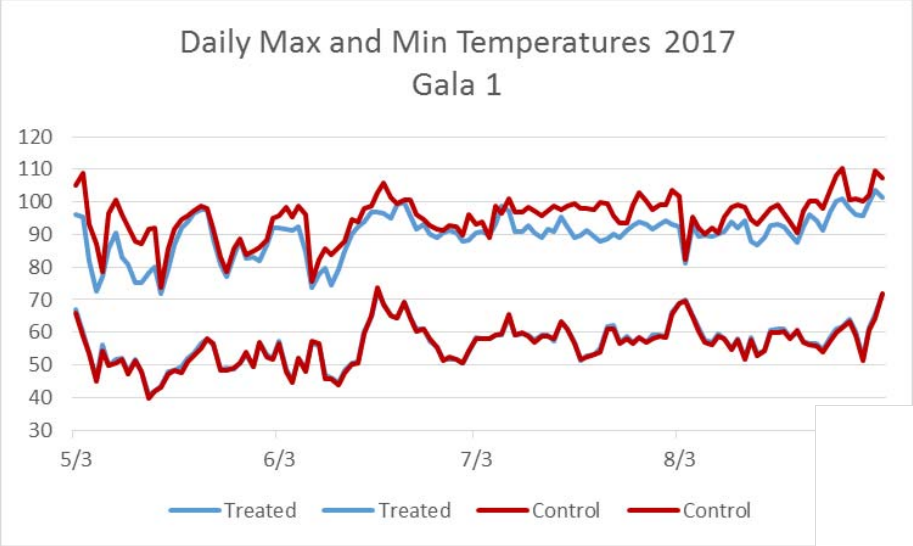
Shadecloth Project Report 12-17
Apple Orchard Temperature
Site A – Fuji – Tent
Treated vs Control: 2017 Season



At this site there were four sensors installed: two in control and two under shade (treated). Daily maximum temperature in the treated block was an average of 1.8°F lower than in the control block. In some cases, the differential was as much as 7.9°F.

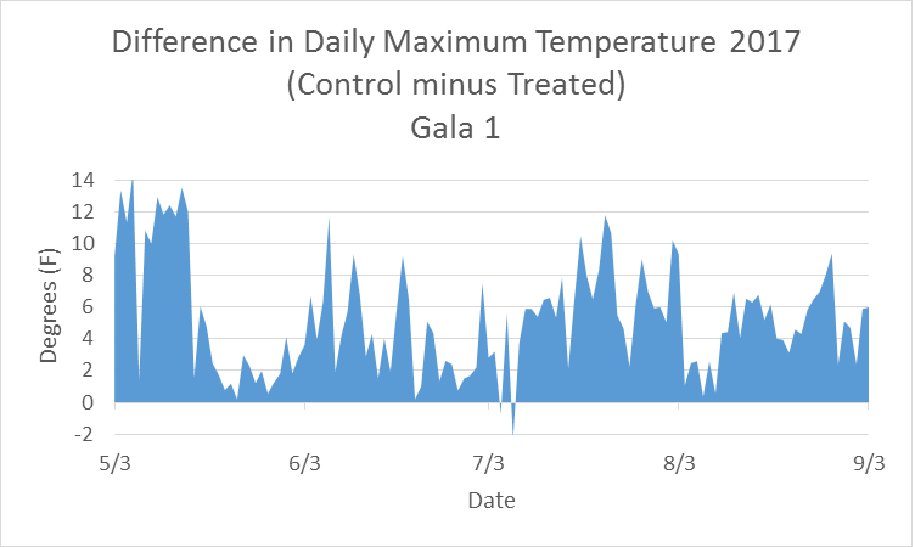


Shadecloth Project Report 12-17
Apple Orchard Temperature
Site B – Gala 1 – Tent
Treated vs Control: 2017 Season

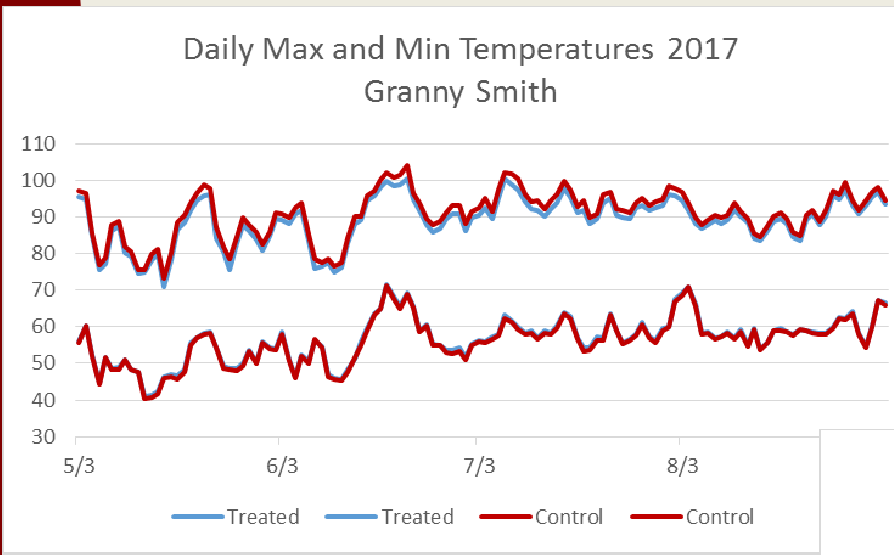


At this site, there were four sensors installed: two in control and two in shade (treated).

The daily maximum temperature in the treated block was an average of 5.2°F lower than in the control. In some cases it was as much as 14.5°F lower.

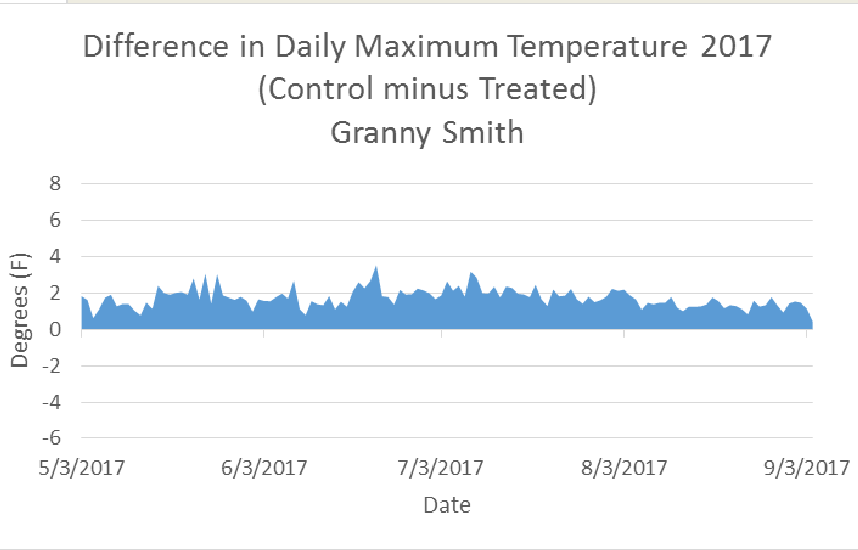


Shadecloth Project Report 12-17
Apple Orchard Temperature
Site C – Granny Smith – Tent
Treated vs Control: 2017 Season

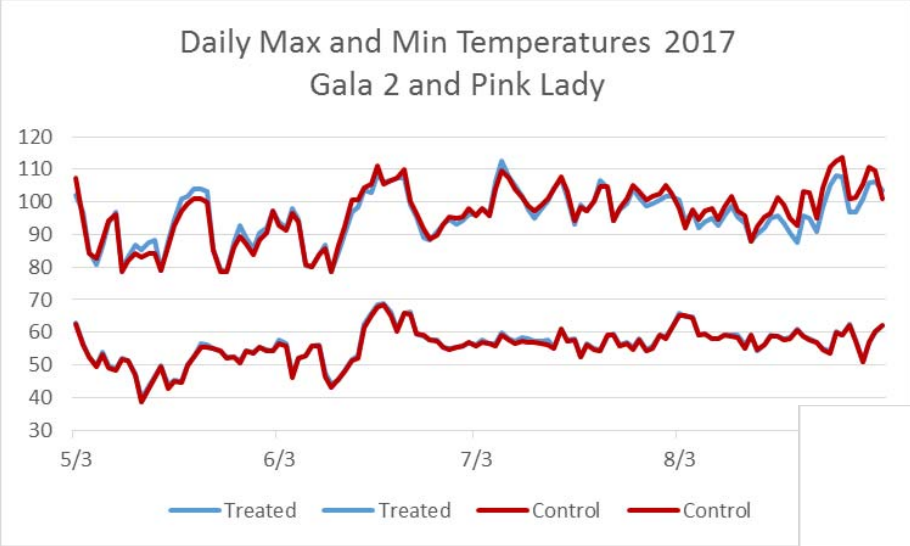


At this site, there were four sensors installed: two in control and two under shade (treated).

The daily maximum temperature in the treated block was an average of 1.75°F lower than in the control. In some cases, the differential was as much as 3.6°F. This minimal difference may be related to the slope, uneven terrain of the site, and/or the use of non-continuous shade.

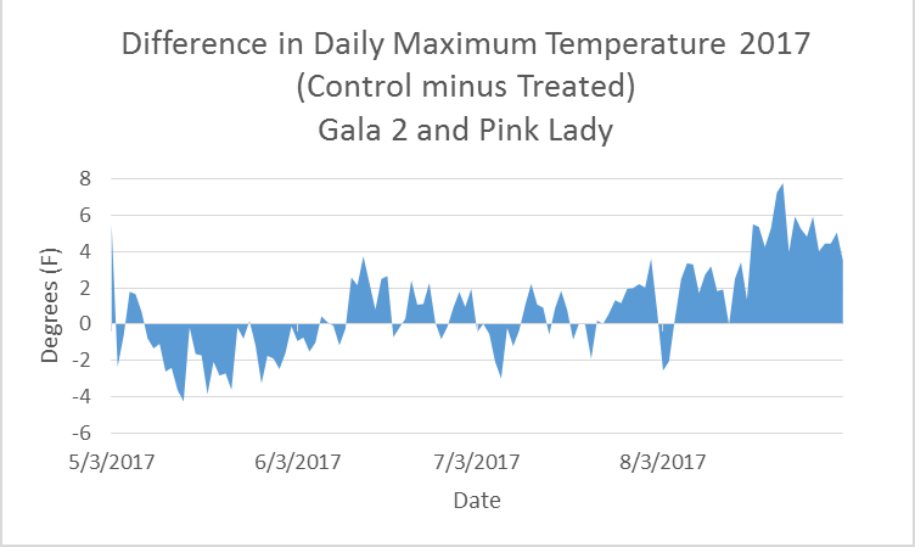


Shadecloth Project Report 12-17
Apple Orchard Temperature
Site D – Gala 2/Pink Lady – Enclosed Tarp
Treated vs Control: 2017 Season



At this site, there were four sensors installed: two in control and two under shade (treated).

The difference in maximum temperature was near zero, only 0.7°F cooler on average in the treated section, though it reached as much as 7.8°F cooler on some days.



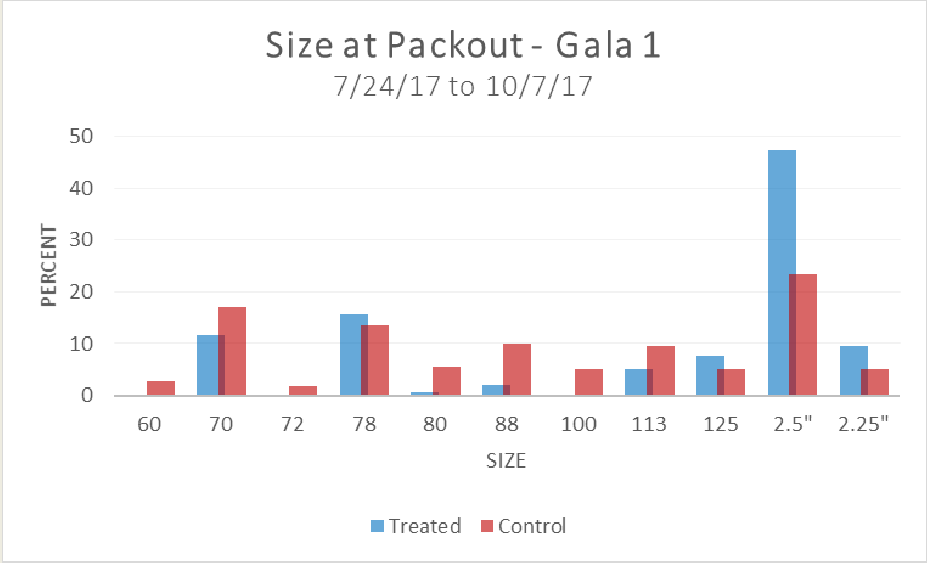
Gala 1

Tent (Continuous and Non-Continuous) vs Control

Shadecloth Project Report 12-17

Gala 1 Size (Packout)

Treated vs Control



Treated Packout: 76.1%

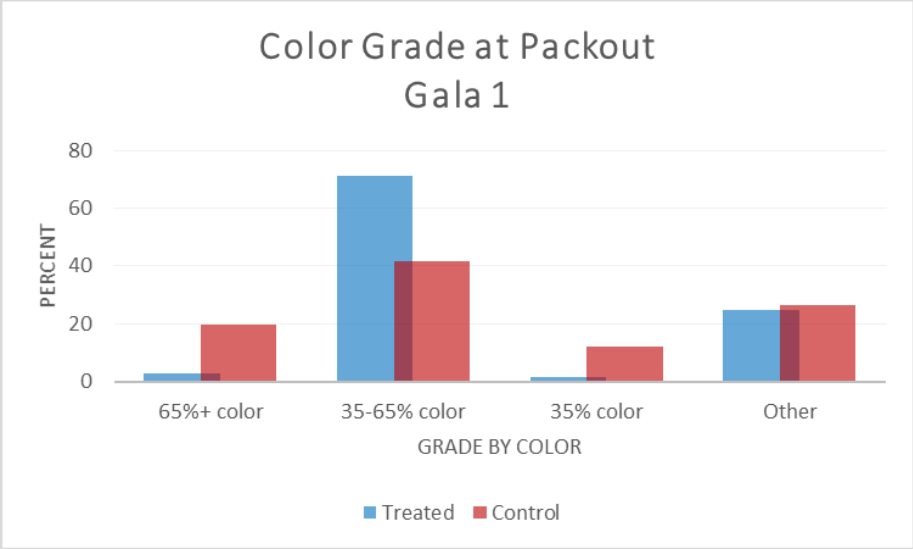
Control Packout: 80.9%

40

Shadecloth Project Report 12-17

Gala 1 Color Grade

Treated vs Control



The "Other" category may have included fruit with notable color but was sorted out due to defects.

41

Fuji

Tent and Drape Treatments vs Control

42

Shadecloth Project Report 12-17
Fuji - Control

Shadecloth Project Report 12-17

Fuji - Treated

There is no comparative packout or color grade data from this site because treated lots were not segregated from control lots during harvest.

Granny Smith

Tent Treatment (Non-Continuous) vs Control

Shadecloth Project Report 12-17

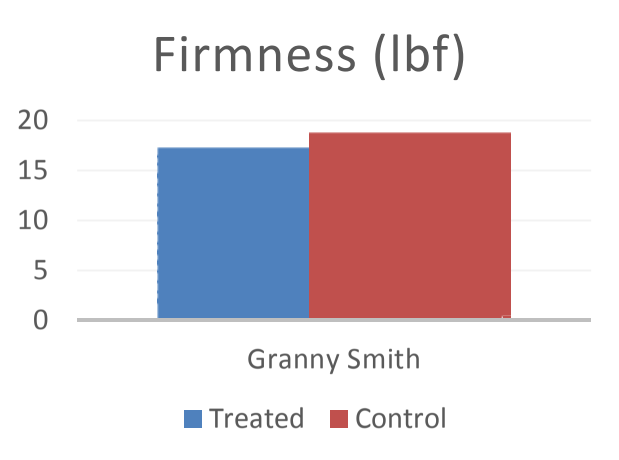
Granny Smith - Control

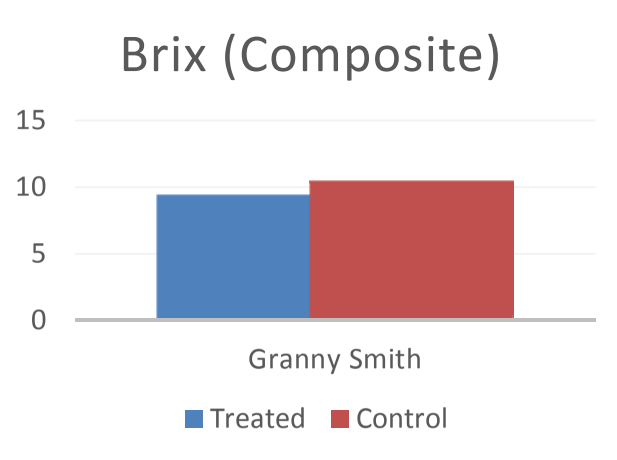
Shadecloth Project Report 12-17
Granny Smith - Treated

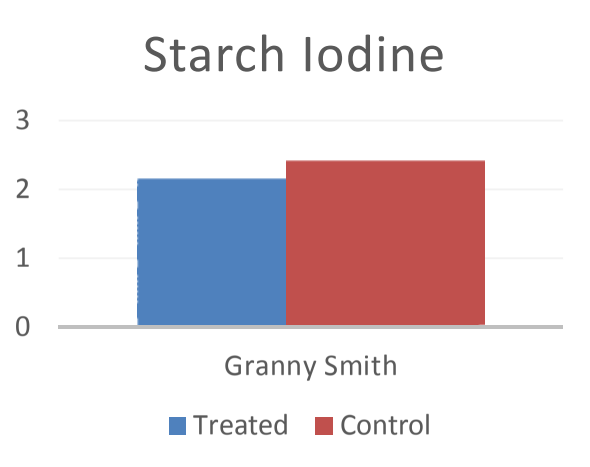
47

Shadecloth Project Report 12-17

Granny Smith – Firmness, Brix and Starch Iodine
Treated vs Control

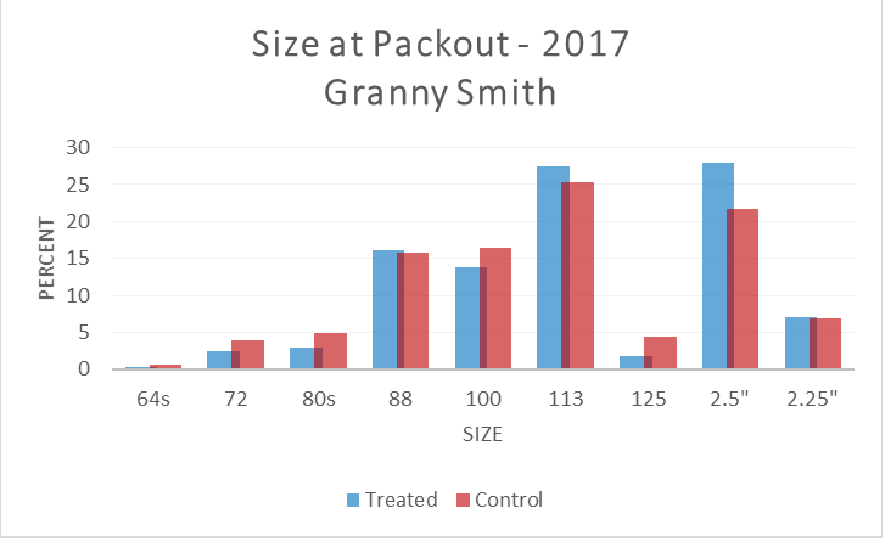






Shadecloth Project Report 12-17

Granny Smith Size (Packout)
Treated vs Control



Treated Packout: 79.7%
Control Packout: 71.1%

This higher percent packout is largely due to a lower occurrence of sunburn under the shade.

Shadecloth Project Report 12-17

Summary of Grower Observations Treated vs Control

Color:

In Galas, the effect of shadecloth on color ranged from no effect to actual retardation of color, with delayed harvest resulting in no increase in color. There was also a reduction of color in Fujis.

Sunburn:

The effect of the shadecloth on sunburn damage ranged from no effect to decreased incidence of sunburn and improved finish. Treated Granny Smith produced a 12% higher packout, primarily due to reduced sunburn.

Irrigation:

Water savings ranged from none in orchards where irrigation systems design required uniform application, to a 25% reduction in both surface irrigation and overhead cooling usage.

Pest/disease pressure and crop protection products:

As in 2016, there was a significant increase in powdery mildew in the enclosed shadecloth on Pink Lady (same as 2016); all other locations reported no difference.

Production:

In 2017, treated Granny Smith produced 12.9% more bins/acre than the control.

Shadecloth Project Report 12-17
Grower Observations, detailed
Treated vs Control

	Granny Smith	Fuji	Gala 1	Pink lady
What type of shadecloth did you use this year?			Same as last year--shade was not changed out	The same as last year
--% shade (light reduction capacity)	Don't know	25%	" "	22%
--style (drape, tarp, etc)		Drape and tarp	Structure used was T-Pee. 2 rows of continuous were also used.	Tarp
--continuous or non-continuous?	Non-continuous	Non-continuous	(some of both)	Continuous (enclosed)
In accordance with the Scope of Work for the study, would you say the shadecloth did or did not significantly improve: - color?		It did not improve color, it reduced it.	Color on Gala was retarded. Even waiting to pick fruit did not make up for difference in color.	No effect
- quality?	Shaded had less sunburn; main reason for higher packout	Aside from color reduction, the finish was better	No significant difference in quality	No effect
- size?	Shaded was similar or somewhat smaller, but that may be due to the heavier load	No change in size noted	No difference in size of fruit	Improved
Was there any difference in maturity dates between shaded and non-shaded fruit?	The shaded seemed to mature slower, but that may be due to the heavier load	No change	Internal maturity was similar but color retarded in shade	No
Can you give me any info about water use, both from surface irrigation and overhead sprinkler, between control and shade blocks?	The same amount of water was given to both because of the inability to treat differently.	Irrigation was reduced as was overhead cooling. Water use was reduced about 25%. That translates to $100/acre in electricity savings.	Irrigation was the same in both. Overhead sprinklers ran on average 1.5 hours less in shaded block. Water savings was therefore not substantial.	10% less under shade
Can you give me any info about crop protection material use or insect/disease pressures between control and shade blocks?	Also could not treat separately.	No difference	Both were treated the same	A whole lot more powdery mildew under shade
Based on packout, would you say the shaded fruit or unshaded fruit produced the best market returns? Can you provide any actual price data to illustrate your answers?	Shaded block ≈ 1 packed box more ≈ $10/bin additional value (in a normal market) PLUS extra crop load adds value. [Control] was about 9 bins per acre more so if you assume a value of $200 per bin it would be an increase in revenue of $1,800 per acre so my guess of $1,400 is a little lower than the results we had this year but I am not sure if we will always have this increase in cropload.	The unshaded fruit provided better returns. While I don't have actual data because the fruit wasn't separated, price is based on color. Since the color was lower on the shaded fruit, prices were lower.	In a year where fruit color is paramount then fruit from the shaded areas would have returned less. For 2017 color was not as important and there was very little (if any) market difference. Control (EC) had a better pack out and extra return of $1000/ac. (1 extra box/bin x $20 x 55 bin/ac).	Significant improvement in size, but too close to the end of the season to put a fine point on dollars
Did you notice any difference between control and shade blocks in regards to labor expenses?		No difference in costs. Although it was more pleasant to harvest in the shaded blocks.	General horticulture expenses were no different - they were treated the same. However the expense of putting up shade and fixing shade after wind storms can be significant.	Nothing significant
Will you be installing, or have you already installed, any additional shadecloth as a result of your experiences with this study?	Will be looking at testing continuous	Not at this time	No and no.	At this moment, the benefit seems to not outweigh the cost
Any other comments?	The heavier crop load under shade may have been from less fruit falling off during the growing season.	Based on a conversation with a shadecloth saleman from the Pacific Northwest, the % shading was too high. He stated that I could have used 15% light reduction and achieved just as good result from a sunburn perspective with[out] a dramatic reduction in color.	At this time I don't see a real benefit to shade in the Gala variety. Without cooling shade will not prevent sunburn significantly and color will be retarded, forcing later picks that still don't have the same color as non-shade. The expense of the structure and installation is also a real negative.	Magenta shadecloth may benefit the plant more than white.

Shadecloth Project Report 12-17

Shadecloth Economic Feasibility Assessment

All efforts have been made to provide an accurate and detailed feasibility assessment, however there were many logistical hindrances to collecting quantitative measurements. Conclusive observations include:

1. Shadecloth did not improve overall apple production per acre except in Granny Smith, which increased revenue by approximately $1,400 per acre.
2. Packout per bin was improved in Granny Smith, which increased revenue by an additional $700 per acre.
3. Packout per bin was lower in Gala, which decreased revenue by $1,000 per acre.
4. CPP usage was not measurably impacted except in an enclosed system, where there was a higher incidence of powdery mildew.
5. Water usage may be reduced by shadecloth, but further quantification is needed before water savings can be claimed as economically significant.
6. In red or bicolored apples, shadecloth negatively impacted skin color.

Observations by Fruit Dynamics indicate that there may be benefits in Granny Smith production but not in Gala, Pink Lady or Fuji production.

California Apple Commission Shadecloth Project

Specialty Crop Block Grant 14009
Final Report
January 25, 2017

Table of Contents

Table of Contents, cont'd

Executive Summary

Fruit Dynamics, Inc. staff collected apple fruit samples during the 2015 and 2016 seasons from California apple orchards designated by the CAC to conduct testing and determine any difference in fruit quality between those grown under shadecloth (treated) and those without shadecloth (control). Fruit quality was measured in visible color differences, size, firmness, brix, titratable acidity, packout grade, and absence of defects. Further analysis to determine the effects of the shadecloth included the collection of orchard temperatures and packout totals from the respective packing sheds. A cost-benefit analysis is also provided. This report covers 2 years, as outlined in the SCB grant awarded to the CAC, though data was very limited in the first year and thus the information represented here is largely the result of one year.

The orchards participating in this study are located throughout the Sacramento, Linden and West Modesto areas. The apple varieties analyzed included Gala (from 2 orchards), Fuji, Granny Smith and Pink Lady. Not all varieties were analyzed in all respects, due to some challenges in logistics of sample collection. In most of the orchards, the apples were grown on V-trellis systems, where the interior had more sun exposure than the exterior. Samples were collected from both interior and exterior sides of the tree. One orchard had two different treatments, continuous and non-continuous shade, and the temperature data from these are reported both combined and separately.

Executive Summary, cont'd

The temperature at each site varied due to location and micro climate, but overall the high temperatures under shadecloth stayed about 3°F cooler than that of the control.

Across varieties, control had more consistent color than the treated, and received more of the highest color rating at packout.

Also across varieties there were no major differences in size, though in the case of Pink Lady and Granny Smith, the treated produced slightly more large sizes at packout.

There were no major differences in firmness, except for Granny Smith which had a lower firmness under shadecloth.

Brix was more variable across treatments; the Gala 2 treated was about 1 point higher than control, but the Fuji control was about 1 point higher than the treated, and the others were either very close or lacked sufficient data.

There was no major difference in titratable acidity across treatments.

In defects at packout, treated Granny Smith had lower incidence of bitter pit, cork spot, sun burn and bruising (93% less than control); but it had almost 7 times the incidence of scab. In Pink Lady, treated fruit had lower incidence of sunburn, russeting, growth crack and San Jose Scale; but it had higher incidence of bruising, bitter pit, insect damage and windfalls.

Shadecloth Applications

Shadecloth Project Report 1-25-17

Shadecloth Applications
Tent / T-Pee

Light reduction capacity: 20%
Used on: Gala 1, Fuji, and Granny Smith

Shadecloth Project Report 1-25-17

Shadecloth Applications
Tent/T-Pee
Non-Continuous vs Continuous

Light reduction capacity: 20%
Non-Continuous shade used on: Gala 1,
Fuji and Granny Smith
Continuous shade used on: Gala 1

Shadecloth Project Report 1-25-17

Shadecloth Applications
Row-Interior Drape

Light reduction capacity: 25%
Used on: Fuji

Shadecloth Project Report 1-25-17

Shadecloth Applications
Enclosed Tarp

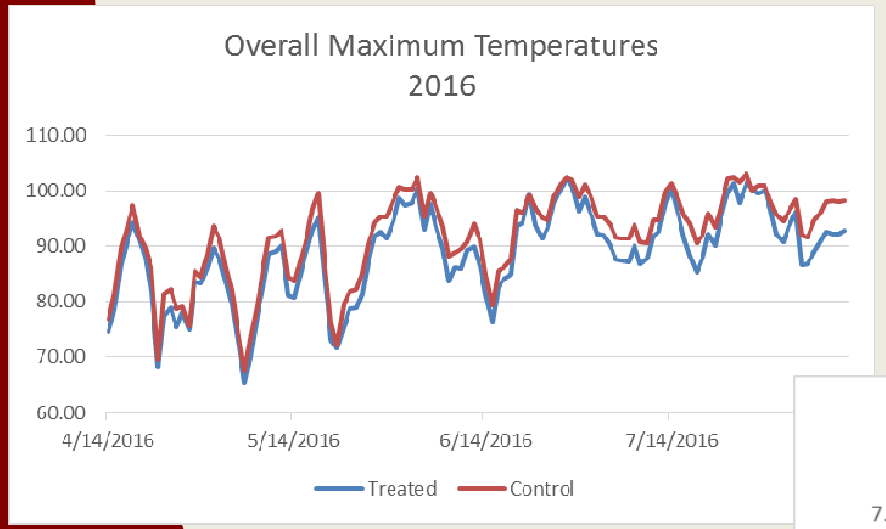
Light reduction capacity: 22%
Used on: Gala 2 and Pink Lady

Orchard Temperatures

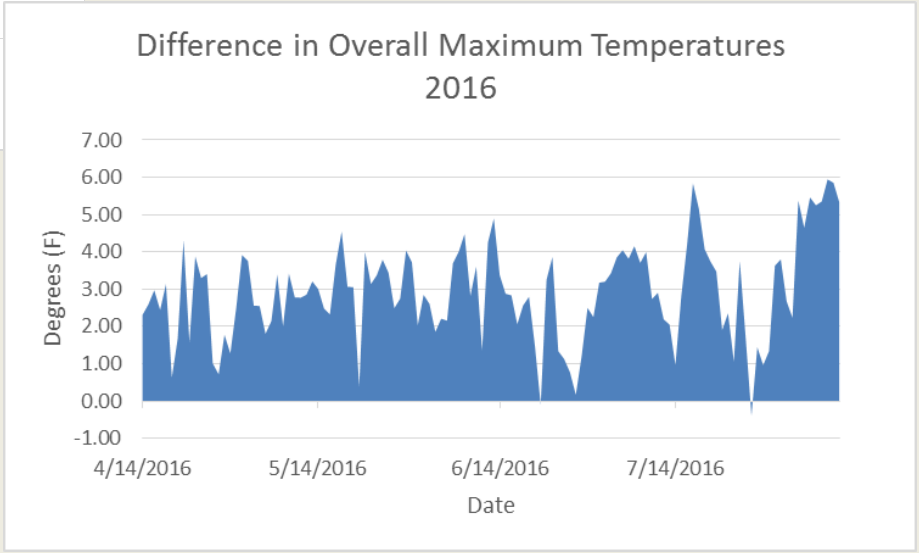
While this was a comprehensive study over the course of 2 years, there is only 1 set of temperature data from each site due to: 1) most sites not having shadecloth installed the first year, and 2) one site with temperature sensors which we were unable to locate the second year.

Shadecloth Project Report 1-25-17

Apple Orchard Temperature – Average All Sites 2016 Treated vs Control



The daily maximum temperature in the treated blocks was an average of about 3°F lower than those in the control. In some cases, it was up to 6°F lower.



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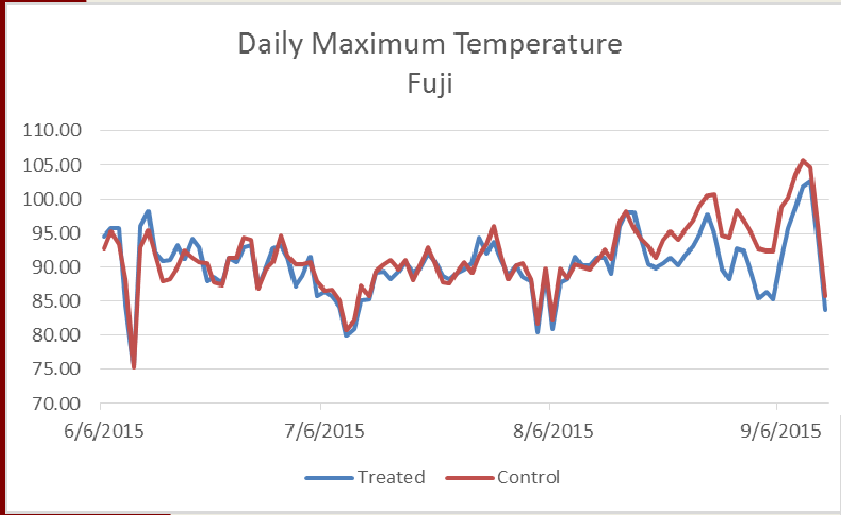
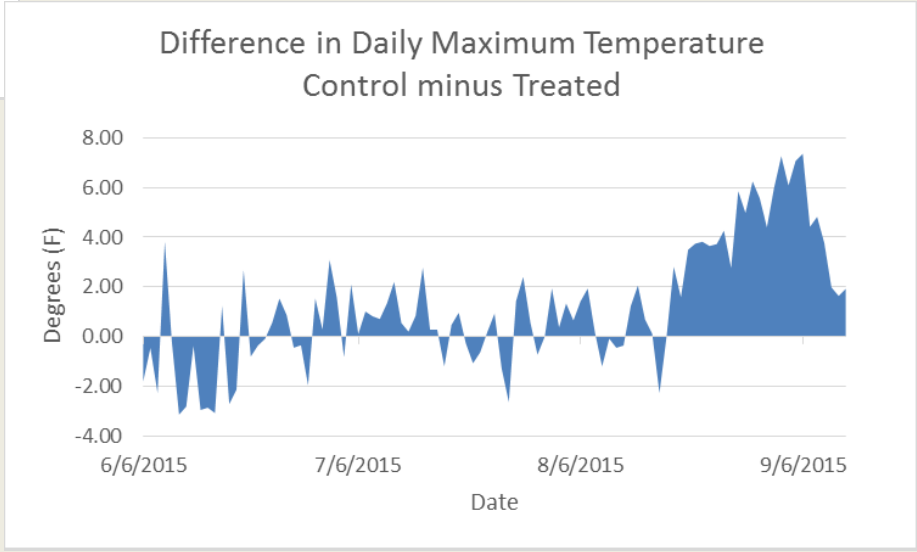
Shadecloth Project Report 1-25-17
Apple Orchard Temperature
Site A – Fuji – Tent
Treated vs Control: 2015 Season*

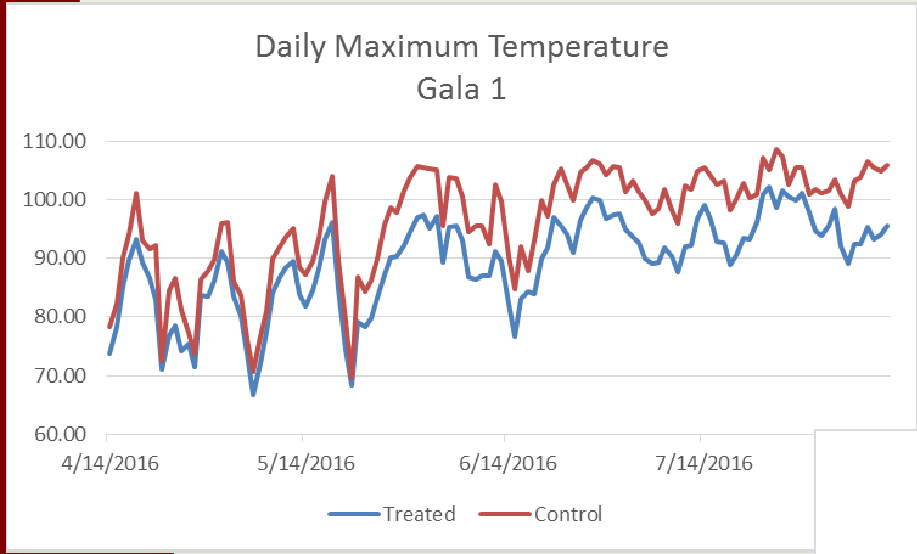


At this site, there were four sensors installed: two in control and two under shade (treated). The shadecloth was not installed until around August 18, 2015. The temperature differential becomes graphically evident at this point. Afterward, the daily maximum temperature in the treated block was an average of about 4°F lower than in the control block.

*All the sensors from the control area at this site could not be located post-harvest during 2016, so only 2015 data is shown.



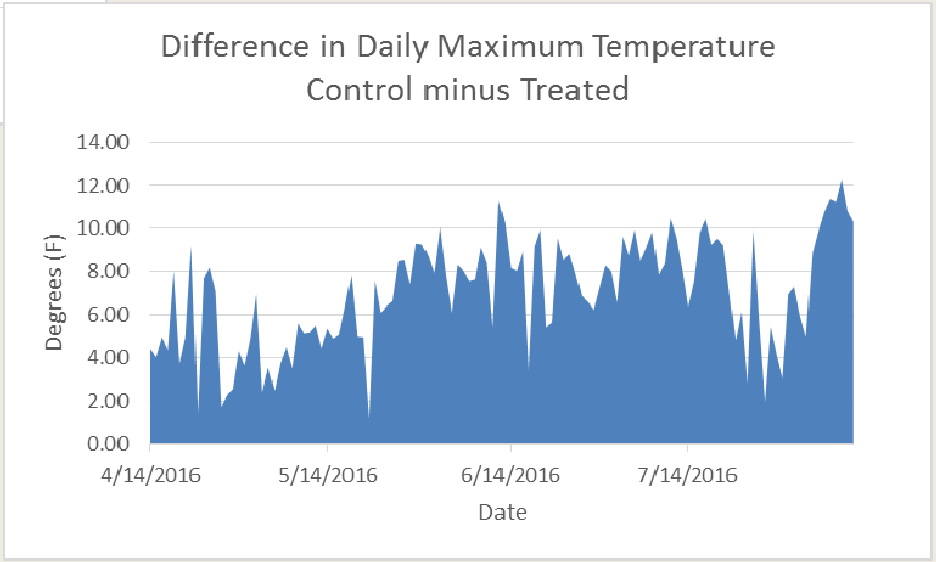
Shadecloth Project Report 1-25-17
Apple Orchard Temperature
Site B – Gala 1 – Tent
Treated vs Control: 2016 Season*



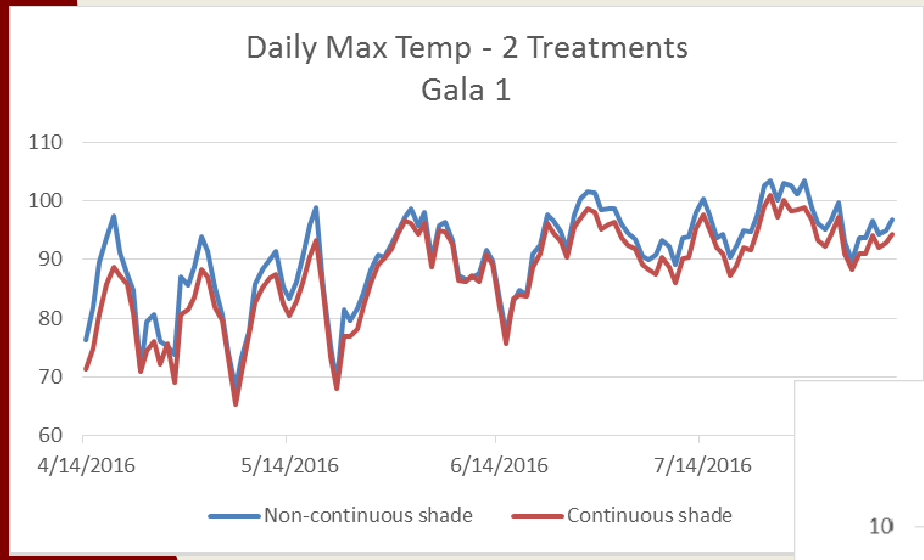
At this site, there were four sensors installed: two in control and two in shade (treated). Of the two in shade, one was placed under a treatment of continuous shade and one was placed under a treatment of non-continuous shade.

The daily maximum temperature in the treated block was an average of 6.97°F lower than in the control. In some cases it was as much as 11°F lower.

*There was no comparison data available from this site for 2015, due to the delay in shadecloth installation.

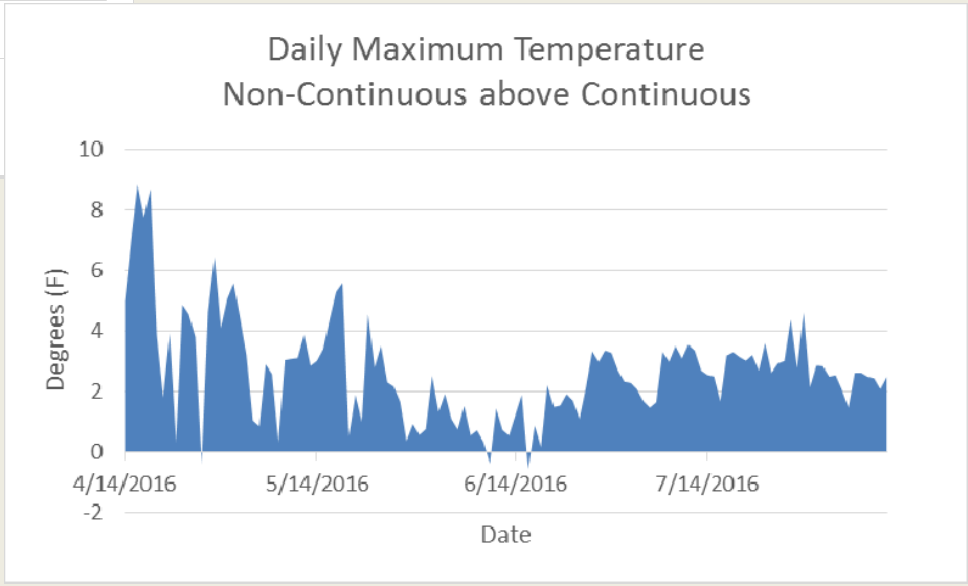


Shadecloth Project Report 1-25-17
Apple Orchard Temperature
Site B – Gala 1 – Tent
Continuous Shade vs Non-Continuous Shade

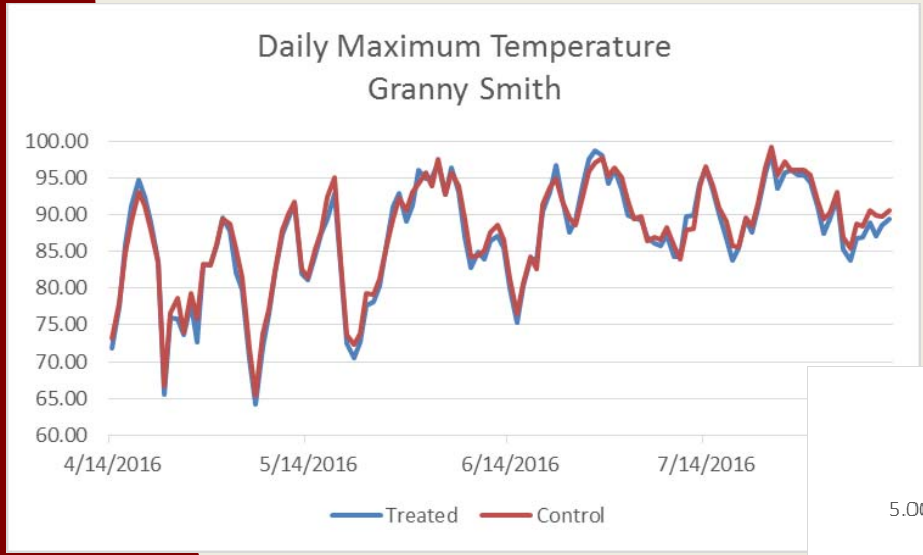


The daily maximum temperature under continuous shade was an average of 2.68°F lower than under non-continuous shade, and reached as much as 9°F lower.

The daily maximum temperature under continuous shade was an average of 8°F lower than the control, and reached as much as 13.5°F lower (not shown in graphs).

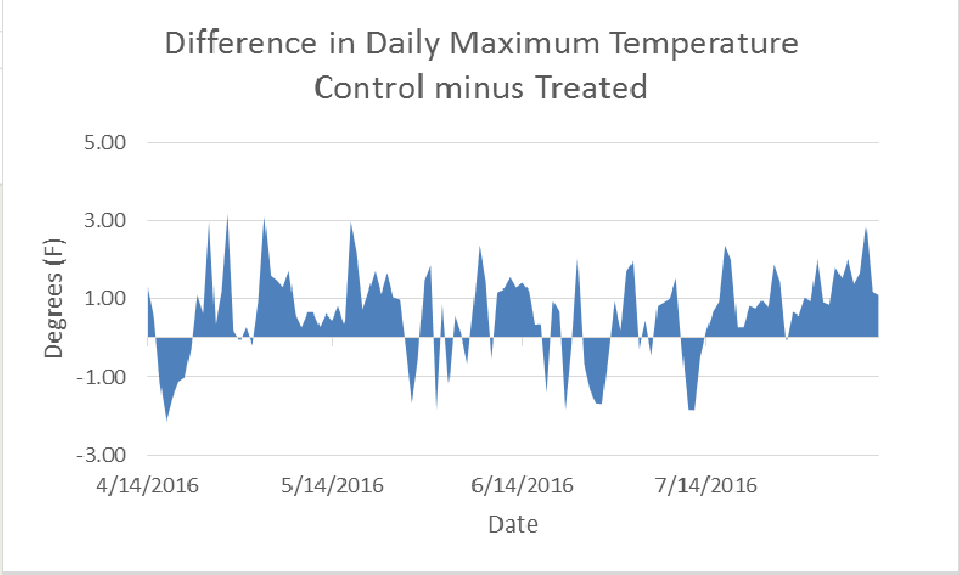


Shadecloth Project Report 1-25-17
Apple Orchard Temperature
Site C – Granny Smith – Tent
Treated vs Control: 2016 Season*



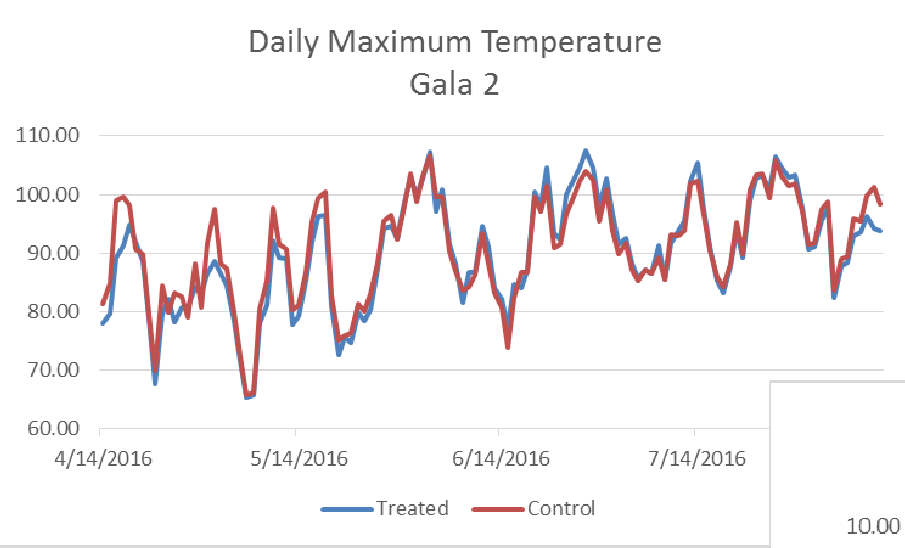
At this site, there were four sensors installed: two in control and two under shade (treated).

There was very little difference in maximum temperature between treated and the control. This may be related to the slope and uneven terrain of the site.



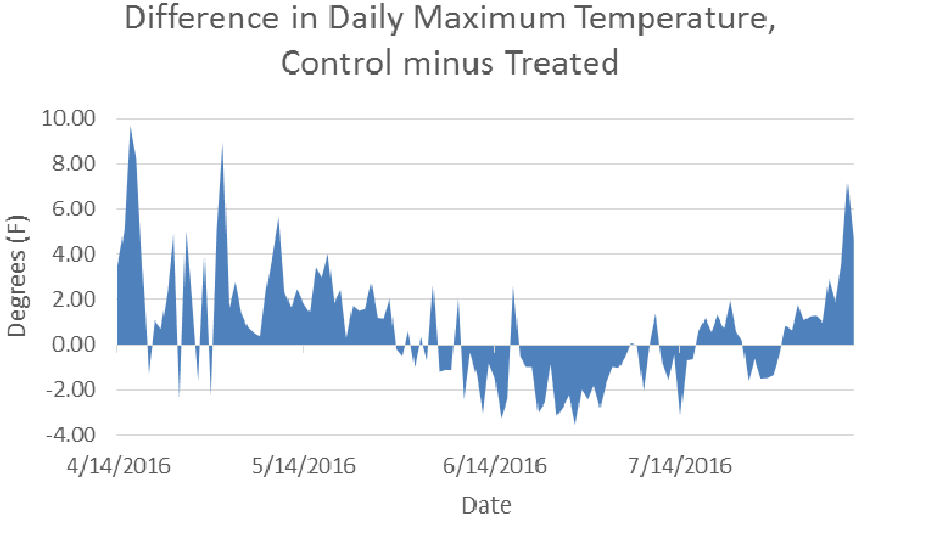
*There was no comparison data available from this site for 2015, due to the delay in shadecloth installation.

Shadecloth Project Report 1-25-17
Apple Orchard Temperature
Site D – Gala 2/Pink Lady – Enclosed Tarp
Treated vs Control: 2016 Season*



At this site, there were four sensors installed: two in control and two under shade (treated), but one in the control block could not be located post-harvest.

The difference in maximum temperature varied throughout the season, ranging from almost 10°F lower to almost 4°F warmer.



*There was no comparison data available from this site for 2015, due to the delay in shadecloth installation.

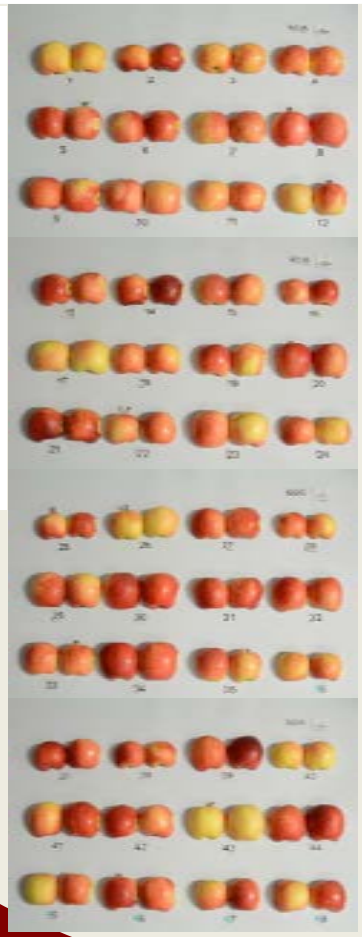
Gala 1

Tent (Continuous and Non-Continuous) vs Control

Shadecloth Project Report 1-25-17

Gala 1 Images - Sampled from Field 8/11/16

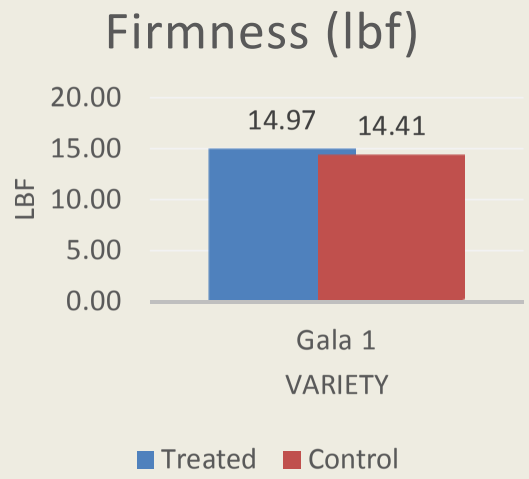
Treated vs Control

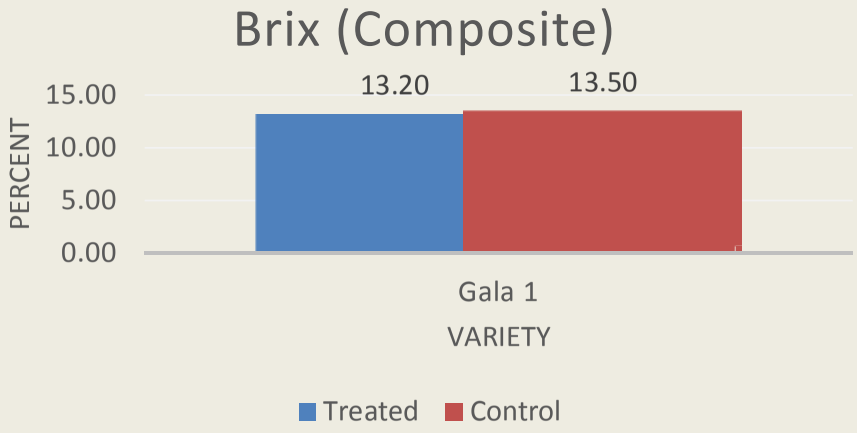
Treated		Control	
Observer comments: - *"Smaller size"* - *"Least color"* - *"Smaller size but more even"* - *"Smaller size (?)"*			Observer comments: - *"Larger size, color is the same"* - *"Color more consistent red"* - *"Size variations approx. the same"* - *"Better color and more consistent color"* - *"Better color"*

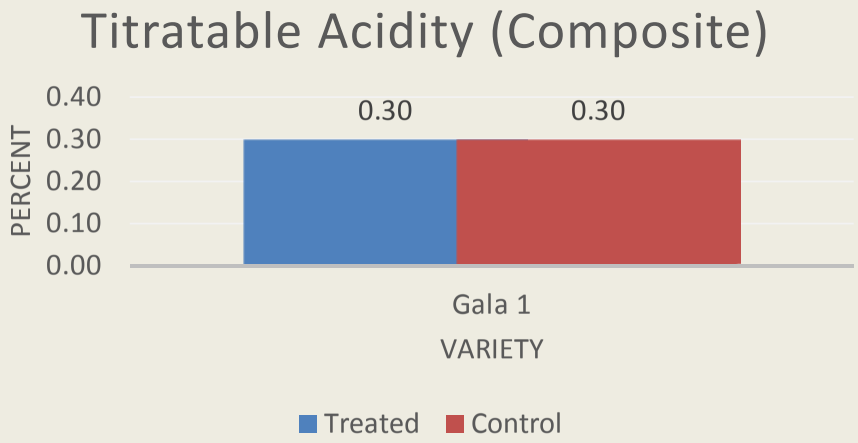
Shadecloth Project Report 1-25-17

Gala 1 – Sampled from Field 8/11/16

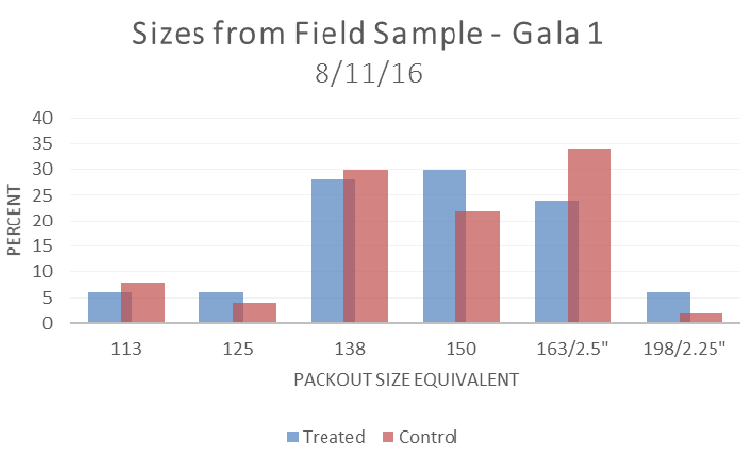
Treated vs Control

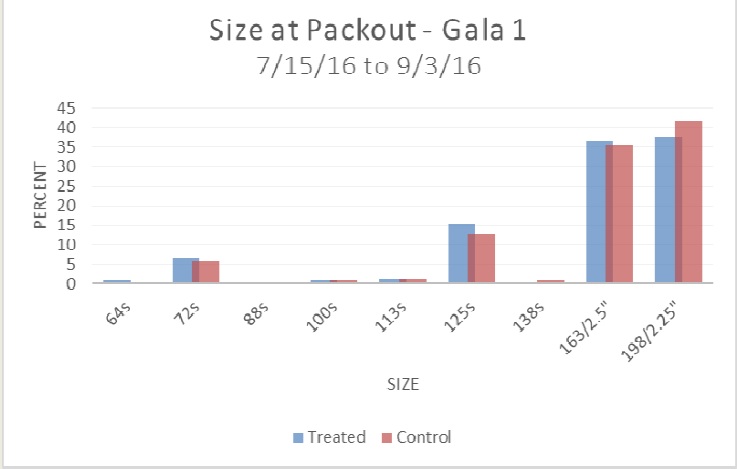






Shadecloth Project Report 1-25-17
Gala 1 Size
Treated vs Control





Packout Size Equivalents		
Size	Dia. (in)	Dia. (cm)
48	3.875	9.833
56	3.75	9.5
64	3.625	9.208
72	3.5	8.89
80	3.375	8.573
88	3.25	8.255
100	3.125	7.938
113	3	7.62
125	2.875	7.303
138	2.75	6.985
150	2.625	6.668
163	2.5	6.35
175	2.375	6.033
198	2.25	5.715

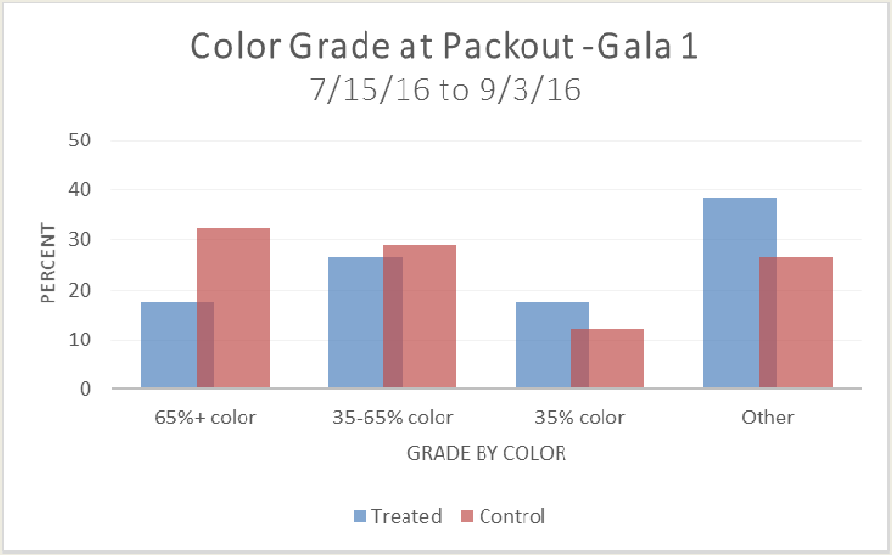
The graphs above show various size distributions, but the following mean fruit diameters from the field sample show no major size difference between treated and control:
6.54 cm (treated) vs 6.62 cm (control).

Note: This orchard was cropped very heavily.

Left: Chart adapted from information on the California Apple Commission website.

Shadecloth Project Report 1-25-17

Gala 1 Actual Packout Data
Treated vs Control



Treated Packout: 67%
Control Packout: 76.1%

The treated section produced fruit with less color than did the control.

The "Other" category may have included fruit with notable color but was sorted out due to defects.

Gala 2

Enclosed Tarp vs Control

Shadecloth Project Report 1-25-17

Gala 2 Images – Sampled from Field 8/11/16

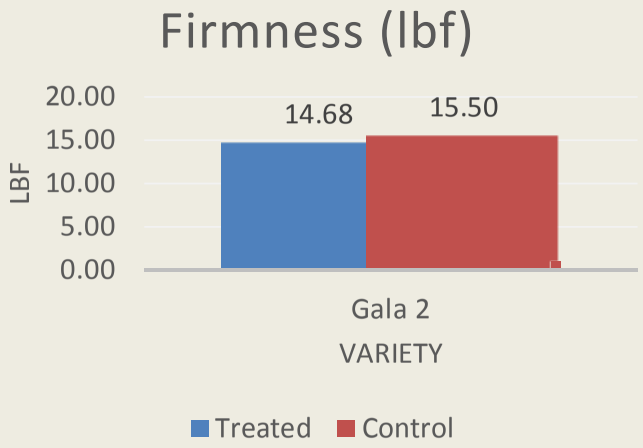
Treated vs Control

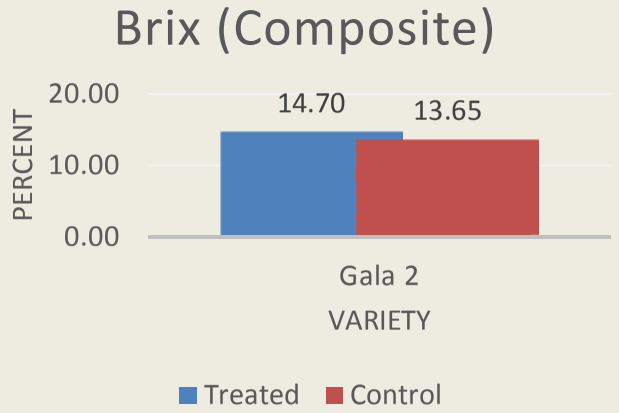
Treated		Control		
Observer comments: - *None available*				Observer comments: - *None available*

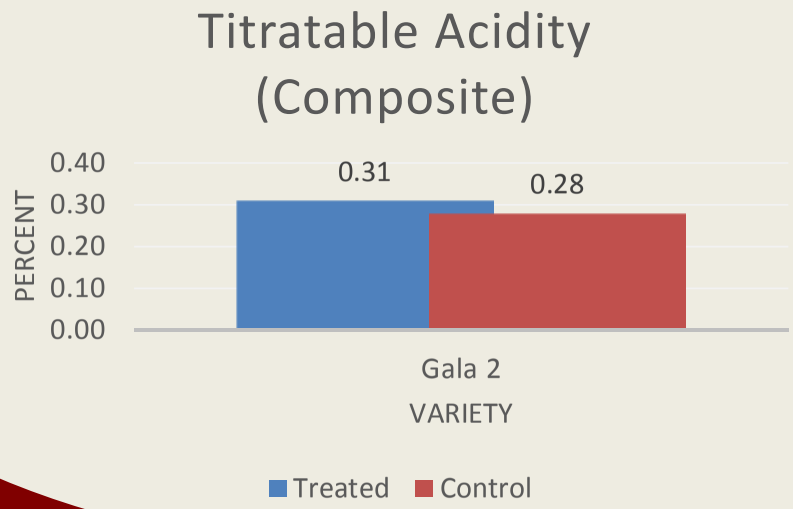
Shadecloth Project Report 1-25-17

Gala 2 – Sampled from Field 8/11/16

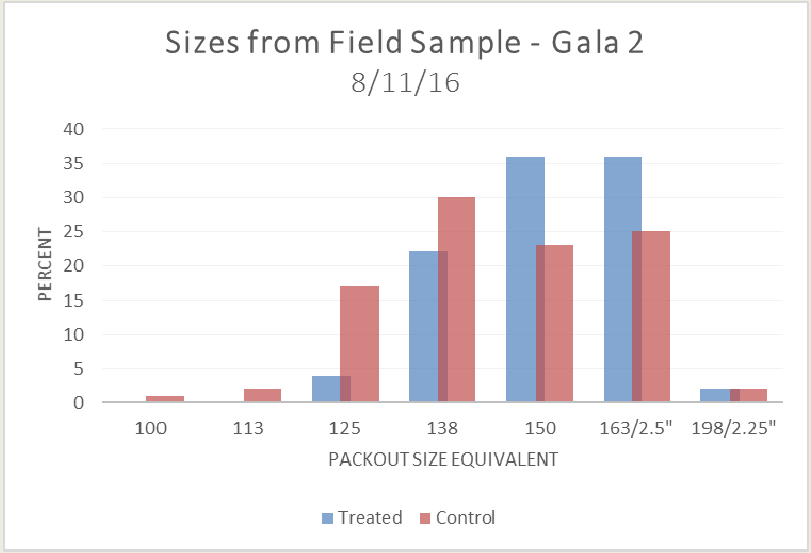
Treated vs Control







Shadecloth Project Report 1-25-17
Gala 2 Size
Treated vs Control



Packout Size Equivalents		
Size	Dia. (in)	Dia. (cm)
48	3.875	9.833
56	3.75	9.5
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88	3.25	8.255
100	3.125	7.938
113	3	7.62
125	2.875	7.303
138	2.75	6.985
150	2.625	6.668
163	2.5	6.35
175	2.375	6.033
198	2.25	5.715

The graph above shows various size distributions, but the following mean fruit diameters from the field sample show no major size difference between treated and control: 6.50 cm (treated) vs 6.63 cm (control).

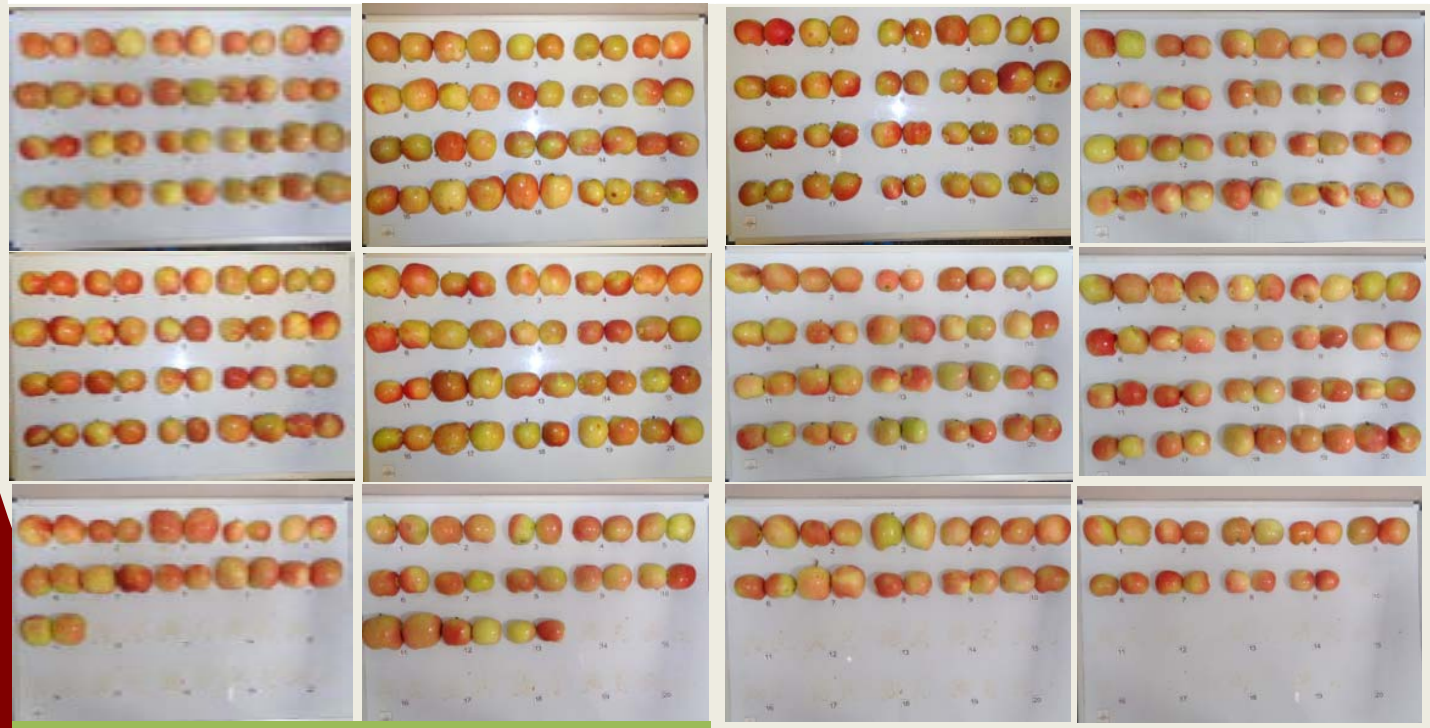
There was no packout data available from this orchard.

Fuji

Tent and Drape Treatments vs Control

Shadecloth Project Report 1-25-17

Fuji Images 2015 - Sampled from Field 8/21/15
Treated (Late Application) vs Control

Treated	Control
	
Tent Cover	

Shadecloth Project Report 1-25-17

Fuji Images 2016 - Sampled from Field 8/18/16

Treated vs Control: Row <u>Exteriors</u>

Treated		Control
Observer comments: - *"A little more even on size and has more green apples"* - *"Yellow/ green color and blush is not as red (more pink)"* - *"Larger size, better color, and more defects"*		Observer comments: - *"More dark red pigment and more size variation"* - *"More red and has more defects"* - *"Higher red color, larger fruit size, brighter finish"*
	Drape Cover / ***Tent Cover***	

Shadecloth Project Report 1-25-17

Fuji Images 2016 – Sampled from Field 8/18/16

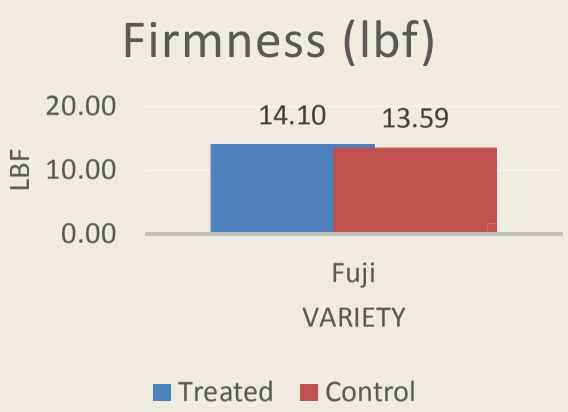
Treated vs Control: Row <u>Interiors</u>

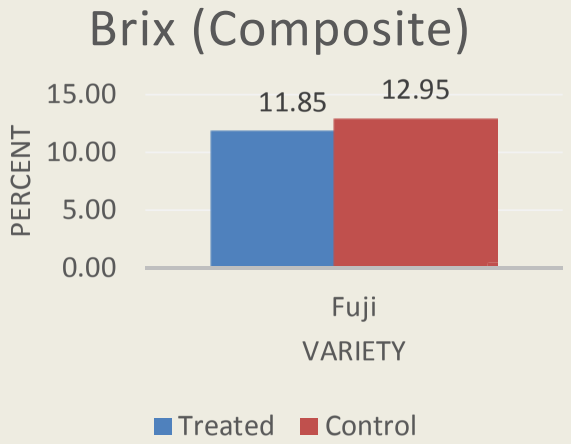
Treated		Control
Observer comments: - *"A little more even on size and has more green apples"* - *"Yellow/ green color and blush is not as red (more pink)"* - *"Larger size, better color, and more defects"*		Observer comments: - *"More dark red pigment and more size variation"* - *"More red and has more defects"* - *"Higher red color, larger fruit size, brighter finish"*
	Drape Cover / ***Tent Cover***	

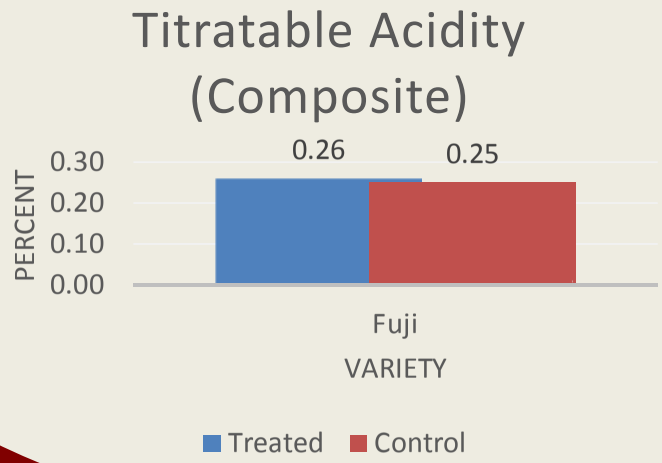
Shadecloth Project Report 1-25-17

Fuji – Sampled from Field 8/19/16

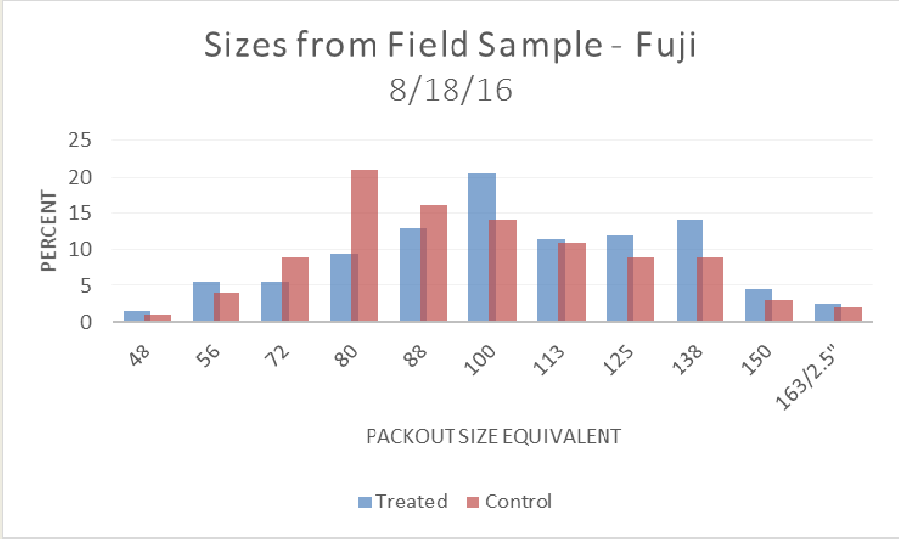
Treated (Combined) vs Control







Shadecloth Project Report 1-25-17
Fuji Size
Treated (Combined) vs Control



Packout Size Equivalents		
Size	Dia. (in)	Dia. (cm)
48	3.875	9.833
56	3.75	9.5
64	3.625	9.208
72	3.5	8.89
80	3.375	8.573
88	3.25	8.255
100	3.125	7.938
113	3	7.62
125	2.875	7.303
138	2.75	6.985
150	2.625	6.668
163	2.5	6.35
175	2.375	6.033
198	2.25	5.715

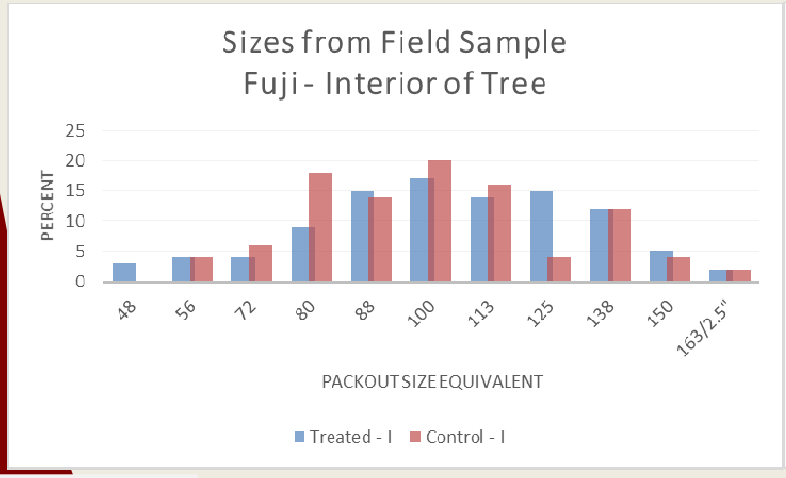
The graph above shows various size distributions, but the following mean fruit diameters from the field sample show no major size difference between treated and control: 7.75 cm (treated) vs 7.93 cm (control).

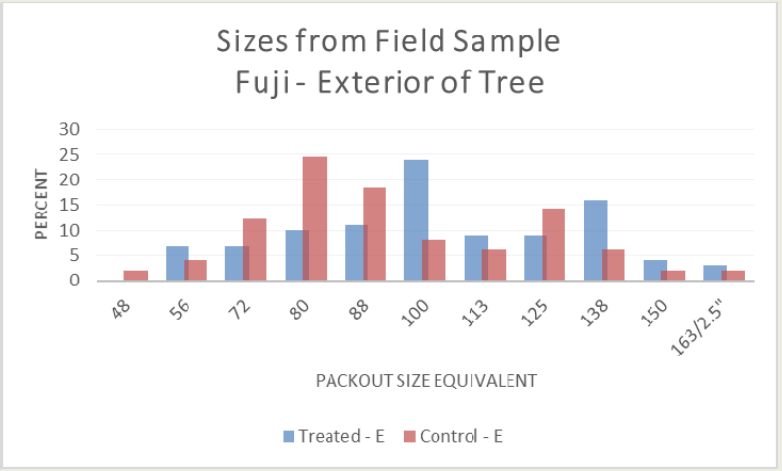
There was no packout data available from this orchard.

Shadecloth Project Report 1-25-17

Fuji Size – Interior and Exterior of Tree (8/18/16) Treated vs Control

The Interior part of the tree in a V-trellis system generally has more sun exposure, while the Exterior part of the row is generally more shaded. The data from each side of the tree at this site was calculated separately (as opposed to collectively on the previous page) to note any potential differences in impact by the shadecloth.





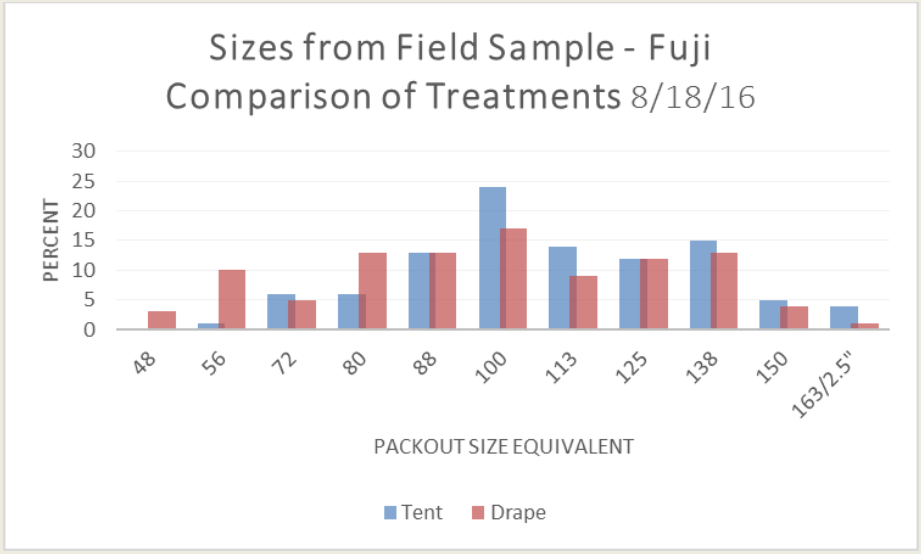
Packout Size Equivalents		
Size	Dia. (in)	Dia. (cm)
48	3.875	9.833
56	3.75	9.5
64	3.625	9.208
72	3.5	8.89
80	3.375	8.573
88	3.25	8.255
100	3.125	7.938
113	3	7.62
125	2.875	7.303
138	2.75	6.985
150	2.625	6.668
163	2.5	6.35
175	2.375	6.033
198	2.25	5.715

The graph above (upper left) shows various size distributions, but the following means from the Interior of the tree show that there is no major size difference between treated and control: 7.73 cm (treated) vs 7.84 cm (control).

The means from the Exterior of the rows (size distribution is shown in graph, upper right) reflect possibly a one-size difference between the control and treated: 7.77 cm (treated) vs 8.02 cm (control). The control produced the larger size when comparing the exteriors of the row.

Shadecloth Project Report 1-25-17

Fuji Size
Tent Shadecloth vs Drape Shadecloth



Packout Size Equivalents		
Size	Dia. (in)	Dia. (cm)
48	3.875	9.833
56	3.75	9.5
64	3.625	9.208
72	3.5	8.89
80	3.375	8.573
88	3.25	8.255
100	3.125	7.938
113	3	7.62
125	2.875	7.303
138	2.75	6.985
150	2.625	6.668
163	2.5	6.35
175	2.375	6.033
198	2.25	5.715

The graph above shows various size distributions, but the following means from the fruit diameters of the field sample reflect a one-size difference between Tent and Drape treatments when measured in packout size equivalent (left): 7.60 cm (Tent) vs 7.90 cm (Drape).

The Drape treatment resulted in the larger size.

Granny Smith

Tent Treatment (Non-Continuous) vs Control

87

Shadecloth Project Report 1-25-17

Granny Smith Images – Sampled from Field 8/24/16

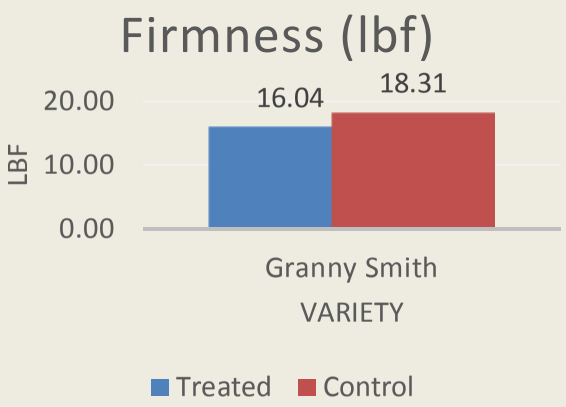
Treated vs Control

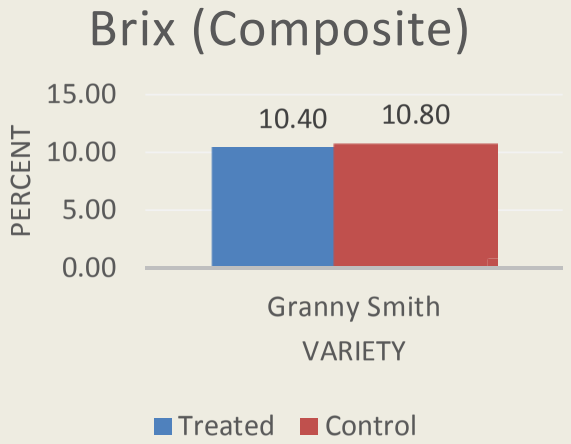
Treated		Control	
Observer comments: - *None available*			Observer comments: - *None available*

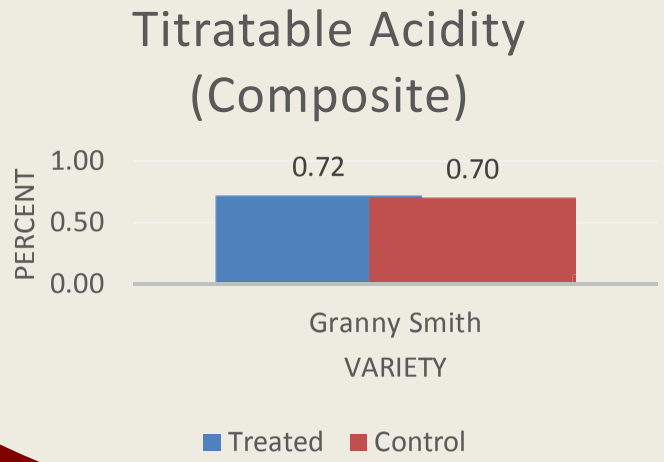
Shadecloth Project Report 1-25-17

Granny Smith – Sampled from Field 8/24/16

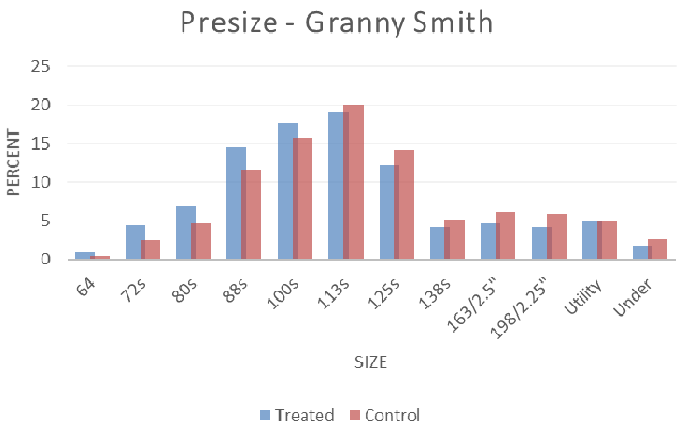
Treated vs Control

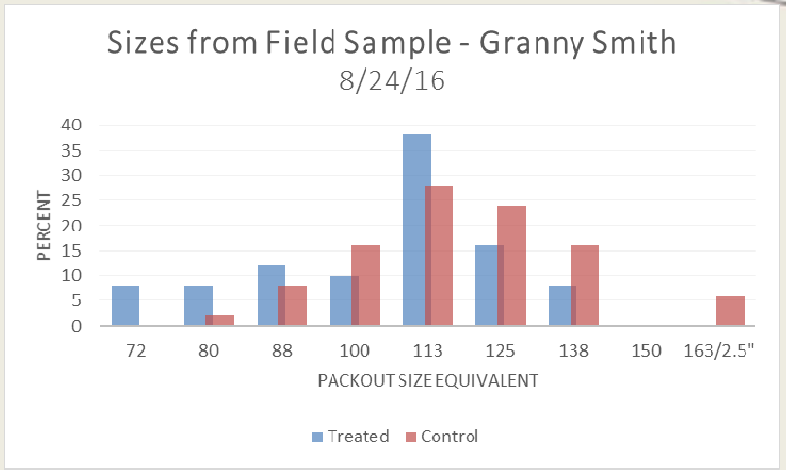


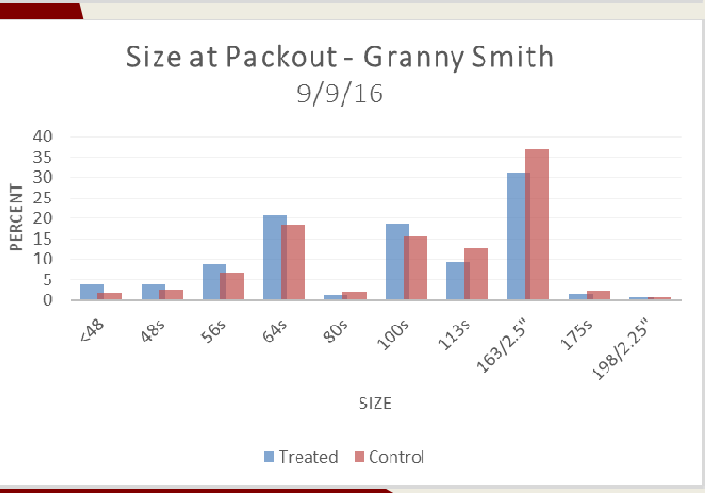




Shadecloth Project Report 1-25-17
Granny Smith Size
Treated vs Control







Mean fruit diameter from field sample: 7.71 cm (treated) vs 7.40 cm (control).

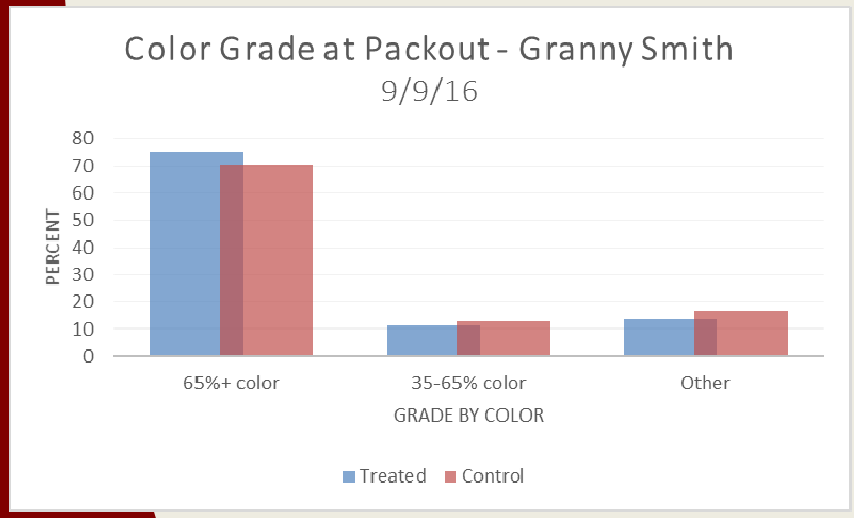
There a one-size difference between control and treated when measured in packout size equivalent (right) from the mean above; the treatment resulted in the larger size.

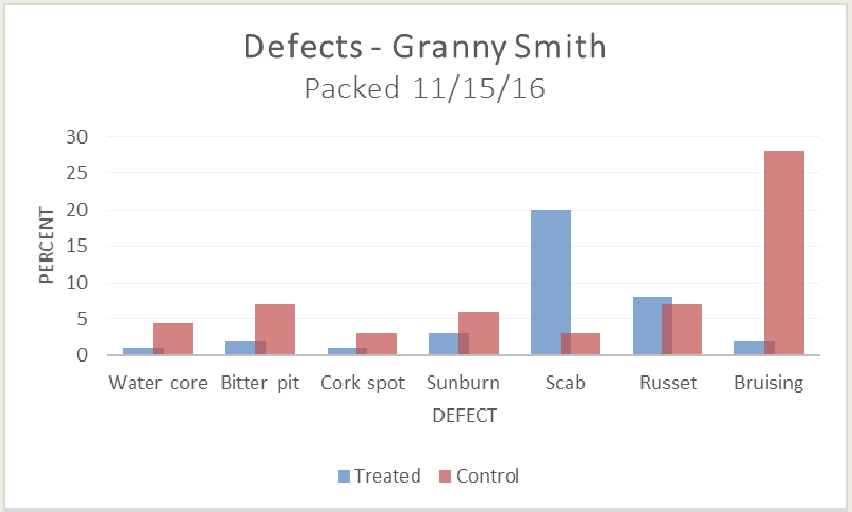
Packout Size Equivalents

Size	Dia. (in)	Dia. (cm)
48	3.875	9.833
56	3.75	9.5
64	3.625	9.208
72	3.5	8.89
80	3.375	8.573
88	3.25	8.255
100	3.125	7.938
113	3	7.62
125	2.875	7.303
138	2.75	6.985
150	2.625	6.668
163	2.5	6.35
175	2.375	6.033
198	2.25	5.715

Shadecloth Project Report 1-25-17

Granny Smith Packout – After CA* Storage
Treated vs Control



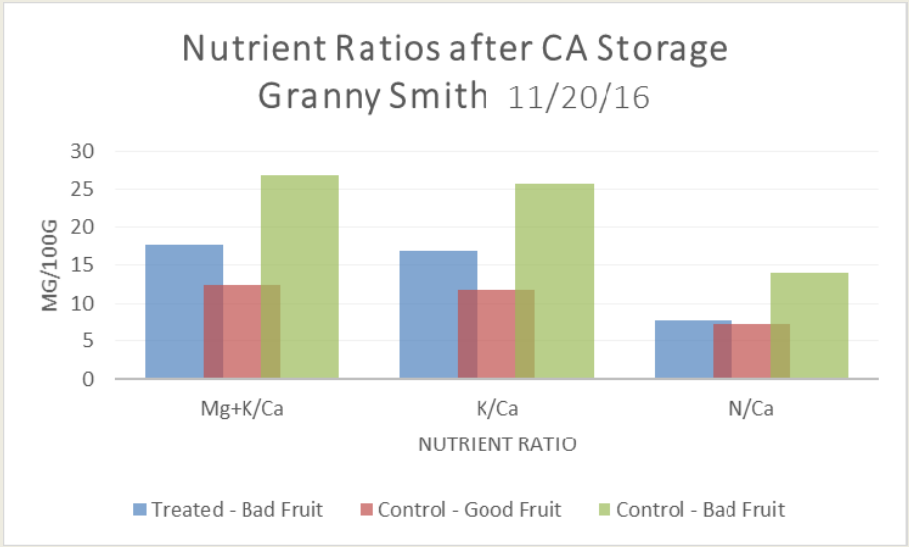


Treated Packout: 86.2%
Control Packout: 83.5%

***CA = Controlled Atmosphere**

Shadecloth Project Report 1-25-17

Granny Smith Packout – After CA Storage, cont'd
Treated vs Control



The bad fruit from the treated and the good fruit from the control had values you would expect given the appearance of the fruit after storage, according to one grower.
("Treated – Good Fruit" data was unavailable.)

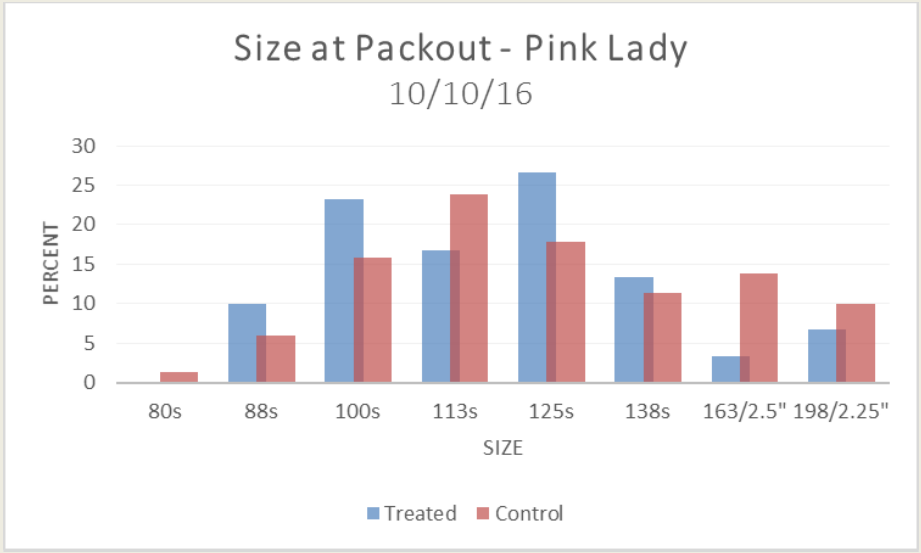
Pink Lady

Enclosed Tarp vs Control

Shadecloth Project Report 1-25-17

Pink Lady Size

Treated vs Control

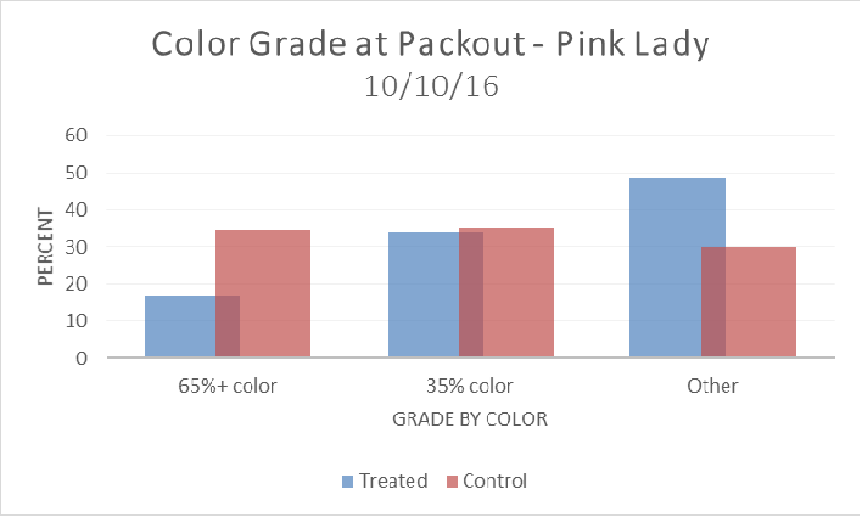


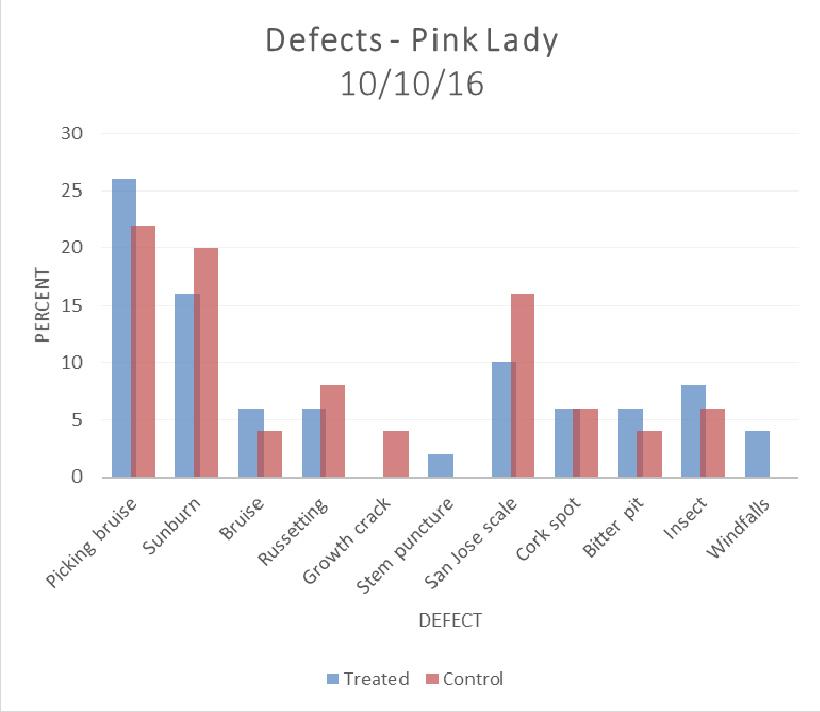
This orchard was not sampled from the field.

94

Shadecloth Project Report 1-25-17

Pink Lady Actual Packout Data
Treated vs Control





The treated section produced fruit with less color than did the control.

The "Other" category may have included fruit with notable color but was sorted out due to defects.

Treated Packout: 51%
Control Packout: 70%

Shadecloth Project Report 1-25-17

Grower Observations
Treated vs Control

Color:

"Tarp had significantly less color [than untreated fruit]. No difference in color with drape net." –Fuji grower

"The untreated area (evaporative cooling only) had better… color… than did the shadecloth area." –Gala 1 grower

Sunburn:

"I don't believe the T-Pee structure was adequate to prevent afternoon facing side of the tree from extreme heat and sun damage." –Gala 1 grower

"We did a partial row with complete coverage of the cloth and noticed much less sunburn in that section." –Gala 1 grower

"Treated (tarp and drape) had significantly less sunburn." –Fuji grower

"The untreated area (evaporative cooling only) had better size… and less sunburn than did the shadecloth area [no evaporative cooling]." –Gala 1 grower

Irrigation:

"More water was applied in the non-treated area through overhead cooling practice. Under-tree irrigation was the same in both sections and based on a % of daily ET." –Gala 1 grower

"Treated area (tarp) required less water…. Tarped area retained more soil moisture." –Fuji grower

"Shade cloth used less [water]." –Gala 2/Pink Lady grower

Shadecloth Project Report 1-25-17

Grower Observations, cont'd
Treated vs Control

Pest/disease pressure and crop protection products:

"No difference [in disease pressure or use of crop protection products]." –Fuji grower

"No noticeable difference. Both areas were treated the same." –Gala 1 grower

"Much higher rate [in treated area] of powdery mildew, we had a bunch of codling moth issues and rodent issues." –Gala 2/Pink Lady grower

Packout:

"No difference in yield [per acre]." –Fuji grower

"Tarp area had less color, so [higher color grade] was about 50% less." –Fuji grower

"Treated area yield was 61 bins/acre. Non-treated was 80 bins/acre. We had a much higher fruit drop in the treated area as well." –Gala 1 grower

"Too soon to tell." –Gala 2/Pink Lady grower

Other:

"Unless we can figure out a way to not have such a decrease in color, the tarped area won't be economically viable." –Fuji grower

"In my opinion we need a better structure [than T-Pee] and for Gala maybe a heavier, more dense cloth (30%?)." –Gala 1 grower

"PCA didn't like going inside tent." –Gala 2/Pink Lady grower

Shadecloth Project Report 1-25-17

Shadecloth Economic Feasibility Assessment

All efforts have been made to provide an accurate and detailed feasibility assessment, however no real conclusions can be made from one season in assessing the economic feasibility of shadecloth in California apple production. Preliminary observations include:

1. Shadecloth did not improve overall apple yield per acre.
2. CPP usage was not measurably impacted.
3. Water usage was anecdotally reduced.
4. In red or bicolored apples, shadecloth detrimentally impacted skin color.
5. With Galas and Pink Ladies, packout per bin decreased in treated fruit (12% and 27.1%, respectively).
6. With Granny Smith, packout per bin increased by (3.2%).
7. Size was improved in Granny Smith.
8. Postharvest disorders were reduced in Granny Smith.

Consensus among the participating growers is that another season is needed before the economic feasibility of using shadecloth in California apple production can be fully assessed. Initial observations indicate that there may be benefits in Granny Smith production but not in Gala, Pink Lady or Fuji production.

Postharvest Quality and Physiology of Apples Subjected to Phytosanitary Irradiation

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Introduction

A major export barrier for US specialty crops is the incidence of pests on agricultural commodities which are endemic to parts of the U.S. and that are not established in potential export destinations. For apples exported from California to Mexico, a key pest of concern is the Oriental fruit moth, *Grapholita molesta.* In 2016, following a request by the California Apple Commission, an addendum to the Operational Work Plan for Import of Articles Intended for Irradiation in Mexico from the United States was signed for CA origin apples intended to be irradiated in Mexico. Irradiation offers an economically beneficial alternative for California apple varieties, especially those targeted to the Mexican market, when Californian producers can take advantage of the earlier harvest compared to Washington State season. It also offers an alternative treatment to methyl bromide (MB) fumigation which can affect quality of certain apple varieties. More importantly, methyl bromide is slated for phase-out under the Montreal Protocol and irradiation offers another alternative for growers to use given that the only other option allowed is a 40/90 day cold treatment. Thus, an alternative pest mitigation option is very important to this industry.

However, irradiation can induce physiological responses in fruits, some beneficial and others harmful to fruit quality. Studies of irradiated apples and many other fruit have shown that the response of fresh fruit respiration to irradiation is highly dependent on cultivar, maturity and irradiation dose levels. The results of this project will help develop quality standards that growers and shippers can implement to ensure that the fruit is harvested and treated at the optimum maturity stage for irradiation, assure high post-treatment quality and shelf-life during commercial distribution and to integrate irradiation as a viable phytosanitary option into commodity export systems.

Preliminary work

We conducted a preliminary study to evaluate the response of apples treated with phytosanitary irradiation and subject to temperature conditions during export to Mexico. Freshly harvested apples were irradiated at 250 (target dose for Mexico) and 1,000 Gy with electron beam at Steri-tek (Fremont, CA) and then stored for 7 days at 1 °C (to simulate transportation from California to Mexico) and 7 days at ambient temperature (to simulate distribution and retail).

Upon treatment, all three varieties exhibited similar responses. Apples treated with 800-1,000 Gy exhibited an increase in ethylene production and respiration rate as compared to the control. During storage, ethylene levels in the irradiated apples dropped and remained low even during ambient temperature storage. Respiration rate, however, remained higher than the control throughout storage. The differences in respiration rate were not manifested in any of the quality parameters tested- color, browning index, malondialdehyde (MDA), sugar content and organic acids. At 250 Gy, firmness was not impacted.

Recent work

1. **Physiological changes induced by irradiation do not affect sensory properties of early and late-harvested Gala apples**

Introduction: Research on other climacteric fruits have shown that maturity stage can influence fruit physiology and quality of irradiated fruit. However, there is no research that analyzes the effect of phytosanitary irradiation on the quality of apples harvested and treated at different maturity stages.

Objectives:

1. Evaluate the impact of maturity stage on the physicochemical properties of irradiated apples.
2. Investigate the relationship between physiological changes and quality parameters during storage under conditions (1 week at 0-1°C plus 1 week at ambient temperature) that simulate export to Mexico from California

Results: The only differences between 'Gala' apples harvested three weeks apart was 13% higher titratable acidity and lower electrolyte leakage in early harvested apples. Irradiation had a strong suppressive effect on ethylene production which can be related to a decrease in ACC oxidase activity, and a transient increase in respiration rate. Irradiation at 1000 Gy impacted electrolyte leakage initially, but other attributes showed no impact of irradiation. Unlike most irradiated fruit, including apples, the texture was unaffected by irradiation even at 1000 Gy. Consumers were unable to differentiate between control and 310 Gy irradiated apples.

Conclusions: There were minimal differences in quality parameters or metabolism between the Gala apples harvested three weeks apart. Although the climacteric was suppressed and respiration rate elevated, no quality changes were observed in apples irradiated even at 1000Gy and stored for 16 days, indicating that Gala apples are highly tolerant to irradiation. In terms of quality, irradiation is highly feasible for phytosanitary treatment for Gala apples exported to Mexico.

Next Steps: A longer span between harvests would enable a more accurate assessment of the interaction of maturity stage and irradiation treatment on the physiology of Gala apples. Also, internal browning was observed in apples stored for five months (0-1°C), so the impact of irradiation on quality of apples in long term storage should be evaluated.

2. **Irradiation as an Alternative to Methyl Bromide Fumigation and DPA treatment of 'Granny Smith' Apples.**

Introduction: Storage scald and internal browning are major disorders in 'Granny Smith' apples that cause concern to apple growers. Methyl bromide fumigation (MeBr), used for phytosanitary treatment on apples, exacerbates surface scald. To prevent surface scald, 'Granny Smith' apples are dipped in diphenylamine (DPA), which is theorized to control scald by inhibiting ethylene production. However, DPA is considered to be a carcinogen and prohibited in Europe. Irradiation at 250 Gy is approved as a phytosanitary treatment for apples destined for Mexico and can serve as an alternative to MeBr, which is an ozone depleter and in the process of being phased out. Irradiation has been shown to reduce ethylene production in apples. Thus, it could possibly eliminate the need for DPA treatment as well.

Objectives: To evaluate the effect of irradiation on 'Granny Smith' apples and determine if it can preclude the use of both, DPA and MeBr.

Results: Control and fumigated apples showed high levels of scald when cold fruit was warmed to ambient temperatures. Storage scald was significantly ($p<0.05$) lower in irradiated apples, consistent with the lower concentrations of conjugated trienols and α-farnesene concentrations. The reduction in the concentrations of alpha-farnesene between 3 and 6 months was correlated to the expression of ethylene and substrate degradation during storage. However, 43% of apples irradiated at 1000 Gy showed internal browning after 90 days, and 56% after 6 months at 0-1°C.

Conclusions: Fruit treated with 310 Gy had the benefits of both, reduced scald and low internal browning incidence after 6 months in cold storage. Thus, irradiation at 250 Gy can serve as an alternate to fumigation with methyl bromide as well as DPA, serving to provide both, an environmental as well as a health benefit.




Project Title: Study on Mechanical Mass Harvesting of Cling Peaches
Project Leader: Stavros Vougioukas
Location: Biological and Agricultural Engineering Department, Un. of California, Davis.
Duration: 01-Jun-17 - 31-May-18
Report Authors: Stavros Vougioukas, Dennis Sadowski

ABSTRACT

Harvesting is one of the most labor-intensive operations in cling peach production. The manual harvesting cost for cling peaches amounts to 29.2% of the total operating cost and to 78% of the total harvest cost per acre. Labor cost will increase significantly due to recent legislation. In addition to cost, supply of skilled pickers is decreasing; hence, risk of losing crop is increasing too. Therefore, cling peach growers face a great need for mechanical harvesting solutions. The proposed research investigates a novel approach to intercepting fruits during a shake-and-catch operation, so that they are caught before they hit tree branches. A literature review of systems developed in the past was performed to identify promising approaches. Alternative catching surface designs and insertion mechanisms were explored and some were fabricated and tested. A novel design of a canopy-penetrating boom with inflatable side fingers was conceived. Preliminary fruit drop experiments were performed and verified the feasibility of intercepting falling fruits with inflated fingers. Also, an SCRI mechanical harvesting pre-proposal was submitted in fall 2017 to further promote this research.

INTRODUCTION

Harvesting is one of the most labor-intensive operations in cling peach production. A 2011 UC ANR production cost report for processing peach (cling and freestone) estimated the hand-picking and field-sorting cost for processing peaches at $1,200/acre, using $10.97 per hour for general labor including payroll overhead at 33% (Norton, Hasey, Duncan, Klonsky, & De Moura, 2011). This translated to 78% of the total harvest cost, which includes hauling to the packinghouse, and 29.2% of the total operating per acre cost. Labor cost will increase significantly due to recent legislation. Perhaps the greatest problem though, is that in addition to cost, supply of skilled pickers is decreasing; hence, risk of losing crop is increasing too. Therefore, cling peach growers face a great and urgent need for mechanical harvesting solutions.

Cling peaches can be harvested mechanically using tree shaking and fruit catching systems. However, excessive fruit damage is still a problem. Although improvements in the design of the shaker and the catching system can somewhat improve fruit quality, it is well known that a major source of mechanical damage is due to limb-fruit collisions during fruit-fall through the canopy. Existing shake-and-catch systems cannot address this problem. Some tree architectures, like Y-shaped trees with few overlapping scaffolds are easier to harvest mechanically (Peterson et al., 2005). Prototype limb-shaking harvesters for such trees have been developed (cherries: Peterson, Wolford,

2003b; apples: Peterson, Wolford, 2003b) with encouraging results. However, the majority of existing cling peach orchards in California have not adopted such architectures and solutions for existing orchards are needed.

The proposed research aims to investigate a novel approach to intercepting fruits at multiple heights during a shake-and-catch operation, so that they are intercepted before they hit tree branches. The long-term goal is to design, build and test a prototype system that inserts multiple catching surfaces into the canopy before shaking, and effectively reduces fruit damage during shaking and falling. The envisioned system would be compatible with existing fruit tree architectures and – as much as possible – with existing shaking operations and equipment, if with minor modifications. As prior work has shown, the principle of using multiple catching surfaces can be applied to various crops and tree architectures. Therefore, a key aspiration of our work is to develop a multi-fruit harvesting system, i.e., a system that can be customized and adopted to work with several fruit tree types.

OBJECTIVES

Three objectives were pursued. First, a detailed literature review of systems developed in the past was conducted, and designs were analyzed for their pros and cons. Alternative catching surface designs and insertion mechanisms were explored and some were fabricated and tested in the lab (1). Preliminary fruit drop experiments were performed to verify the feasibility of the conceived approach (2). Finally, an SCRI mechanical harvesting pre-proposal was submitted in fall 2017 (3).

LITERATURE REVIEW

A review of fruit harvesting systems reported in the literature was performed. Although there were many different approaches, most of them did not prove practical enough to be commercialized. For reasons of brevity, all these approaches are not included in the report. Three systems were found that were relevant to our proposed approach, i.e., use multiple-catching surfaces. Multi-level catch systems have been tried in the past for apples by Rehkugler & Markwardt, (1971) and Millier et al., (1973). Mehlschau et al., (1977) developed a similar system for plums and pears. Systems that intercepted and collected fruits at intermediate heights (Fig. 2, Fig. 3) had better performance compared to systems where fruits just ‘trickled down’ to be collected on a single catching surface Fig.1.

Fig. 1. Rehkugler & Markwardt, 1971.

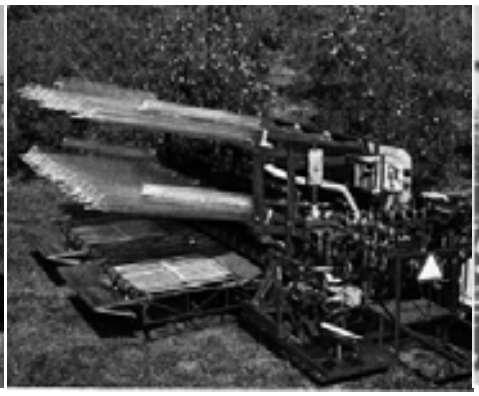

Fig. 2. Millier et al., 1973.

Fig. 3. Mehlschau et al., 1977.

However, labor availability and social issues at the time did not allow for more R&D on such machines. Further iterations on their design are very costly and to our knowledge have not been reported in literature.

Using funding by the Pear Advisory Board, the Cling Peach Mechanization Fund, and USDA-NIFA, the Bio-Automation Lab at UC Davis has built detailed models of pears and cling-peach trees and the positions of their fruits (Arikapudi, Vougioukas, Saracoglu, 2015; Arikapudi, Vougioukas, Jiménez- Jiménez, Khosro Anjom, 2016). We have also developed and utilized simulation models to confirm that properly deployed multi-level rods that penetrate into the canopy can intercept up to 90% of falling fruits before they hit any (digitized) tree branch (Munic et al., 2016). Of course, this number is an “optimistic” estimate, which however can be used to guide the design process. These results prompted the investigation of alternative designs for multi-level fruit catching surfaces.

PRELIMINARY DESIGN AND FRUIT DROP EXPERIMENTS

Alternative catching surface designs and insertion mechanisms were explored and some were fabricated and tested. Our team has converged to a novel design of a canopy-penetrating boom with inflatable side fingers. The particular design should have small penetration resistance during insertion into the canopy; this will be evaluated during the remaining period of this project. Preliminary fruit drop results are given next.

A prototype small boom with inflated side fingers was built, and drop experiments were conducted with different objects (pear, apple, and orange fruits). Fresh cling peaches were not available in December, when the experiments took place. However, the objects used spanned size (2.5’’ – 5.5’’) and weight ranges (115 – 348 gr) that include cling peaches.

Fig. 2. Subjects of drop experiments.

The prototype and two recorded video frames from an apple drop experiments are shown in Fig. 3.

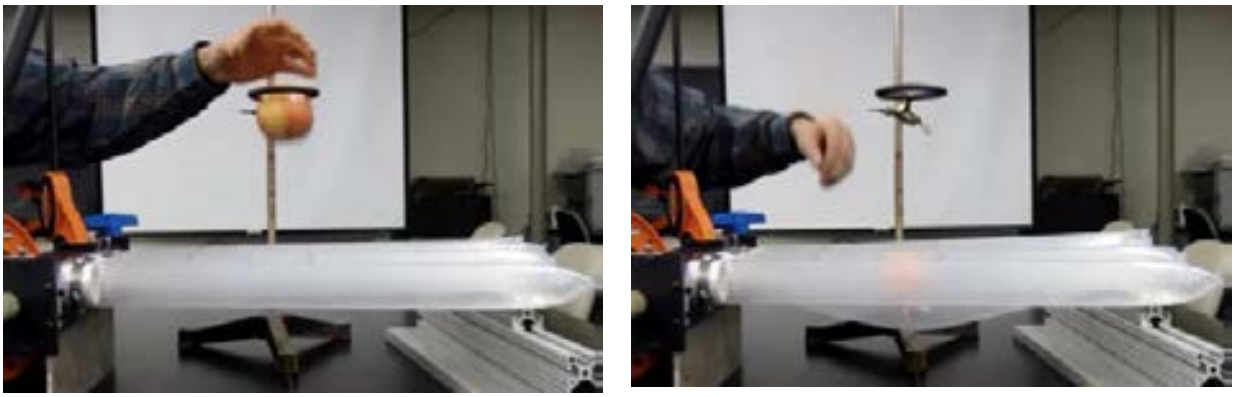

Fig. 3. Apple drop experiment; first and last frame of experiment's video.

Each object was dropped five times from heights of 8 and 12 inches respectively. The air pressure inside the fingers was 34 inches water (1.23 psi). Lower pressures were tested, but were not adequate to intercept reliably larger fruit. Each fruit was dropped at three different distances along the fingers (4, 7 and 10 inches respectively). These tests were not aimed at assessing fruit damage. The goal was to investigate the feasibility of intercepting lighter and heavier fruits, and to explore ranges of parameters for doing so. The drop results are given in Tables 1, 2 and 3.

Table 1: Small apple drop experimental results

t = thru; fruit dropped straight thru, though may have slowed down considerably
c = caught; fruit caught on tubes
r = roll; fruit hit tubes and rolled lengthwise down tubes before either falling thru or being caught
b = bounce; fruit bounced significantly before either falling thru or being caught

		Distance from finger edge (inches)		
Pressure: Max, 34 inwc	Drop #	4	7	10
Drop Height: 8 inches	1	b,c	b,c	b,c
With Support on far end	2	b,c	b,c	b,c
Small Apple, 2.5" diam, 115 g	3	b,c	b,c	b,c
	4	b,c	b,c	b,c
	5	b,c	b,c	b,c

		Distance from finger edge (inches)		
Pressure: Max, 34 inwc	Drop #	4	7	10
Drop Height: 12 inches	1	b,c	b,c	c
With Support on far end	2	b,c	b,c	b,c
Small Apple, 2.5" diam, 115 g	3	b,c	b,c	b,c
	4	b,c	b,c	b,c
	5	b,c	b,c	b,c

Small Apple

Table 2: Large apple drop experimental results

		Distance from finger edge (inches)		
Pressure: Max, 34 inwc	Drop #	4	7	10
Drop Height: 8 inches	1	b,c	b,c	c
With Support on far end	2	b,c	b,c	b,c
Large Apple, 3.05" diam, 185 g	3	b,c	b,c	c
	4	b,c	b,c	b,c
	5	b,c	b,c	b,c

		Distance from finger edge (inches)		
Pressure: Max, 34 inwc	Drop #	4	7	10
Drop Height: 12 inches	1	b,c	b,c	c
With Support on far end	2	b,c	b,c	c
Large Apple, 3.05" diam, 185 g	3	b,c	c	b,c
	4	b,c	b,c	c
	5	b,c	b,c	t

Large Apple

Table 3: Orange drop experimental results

		Distance from finger edge (inches)			
Pressure: Max, 34 inwc	Drop #	4	7	10	
Drop Height: 8 inches	1	b,c	b,c	c	
With Support on far end	2	b,c	b,c	c	
Large Orange, 3.5" diam, 348 g	3	b,c	c	c	
	4	b,c	b,c	t	
	5	c	c	b,c	
					Orange
		Distance from finger edge (inches)			
Pressure: Max, 34 inwc	Drop #	4	7	10	
Drop Height: 12 inches	1	b,c	b,c	t	
With Support on far end	2	b,c	b,c	t	
Large Orange, 3.5" diam, 348 g	3	b,c	c	b,c	
	4	b,c	b,c	t	
	5	b,c	c	c	

DISCUSSION

The preliminary results were very promising. It seems that inflated fingers at pressure 1.2 psi could intercept all fruits falling from heights ranging from 8 to 12 inches above the fingers. This height provides design specifications for the number of vertical booms of a large-scale fruit interception system. Fruits could be intercepted reliably up to 7'' away from finger base. At 10'' distance the fruits would fall through the fingers, in some cases; however, these decelerated fruits would be intercepted by fingers at one level below. This outcome provides design guidelines on finger length and required number of booms along the canopy. When lower pressure (e.g., 20'' water column) was used, some rolling was observed. Some limited bouncing did occur before the fruits would get caught and rest on the finger surfaces. This could be reduced with slightly decreased pressure. However, such limited bouncing is not expected to result in fruit damage.

More fruit drop tests will be conducted during the last months of this one-year project, which ends on May 31, 2018. Also, cling peach tree canopies will be digitized using a 3D scanner to quantify the canopy penetration resistance of boom-finger systems. Finally, a pre-proposal was submitted for SCRI funding; evaluation results are pending.

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2018 – 2019 FUTURE RESEARCH

1. Evaluation of New Postharvest Fungicides for Pome Fruits – Dr. Jim Adaskaveg
    a. Part of Dr. Adaskaveg's research in 2018-2019 will include a component specifically focused on organic controls of fire blight
2. Postharvest Quality and Physiology of 'Gala', 'Granny Smith,' and 'Fuji' Apples Subjected to Phytosanitary Irradiation - Dr. Anuradha Prakash
3. Study on Mechanically Mass Harvesting of Cling Peaches (apples are included) - Dr. Stavros Vougioukas

2018/2019	AMOUNT
Jim Adaskaveg - Evaluation of new bactericides for control of fireblight…	$23,000[1]
Anuradha Prakash - Postharvest Quality and Physiology…	$1,500[2]
Stavros Vougioukas - Study on Mechanically Mass Harvesting…	$2,500[3]
Fiscal Impact for 2018/2019	$27,000

[1]Research done by Dr. Adaskaveg will be done on both organic and conventional apples.
[2]This amount was donated by the California Apple Commission for apples that will be used in the study.
[3]The CAC has partnered with the Cling Peach board for this research project. The research includes apples and is applicable to our industry as well.

AES/CE MAR 84

Workgroup: Apple _____
Department: Plant Pathology/UCR

University of California
Division of Agricultural Sciences
PROJECT PLAN/RESEARCH GRANT PROPOSAL

Project Year: 2018-19 _____ Anticipated Duration of Project: 4th year of 4 years _____

Principal Investigators: J. E. Adaskaveg _____
Cooperating: D. Thompson. D. Cary, and H. Forster _____

Project Title: Evaluation of new biological controls for management of fire blight of apples caused by *Erwinia amylovora* and evaluation of new natural products as organic postharvest fungicides for pome fruits

Keywords: Biological control, natural products, organic treatments _____

JUSTIFICATION/ BACKGROUND

Epidemiology and management of fire blight. Fire blight, caused by the bacterium *Erwinia amylovora,* is one of the most destructive diseases of pome fruit trees including apples. The disease causes a blackening of twigs, flowers, and foliage and is indigenous to North America but has since spread worldwide. In addition to cankers, the pathogen overwinters in flower buds, diseased fruit, small twigs, and branches. In the spring, blossoms are infected through natural openings in nectaries and pistils. After destroying the blossom, the bacteria spread into the peduncle, spur, and twig. During warm, humid weather, ooze droplets consisting of new inoculum are exuded from the peduncles and other infected tissues. Inoculum is spread by wind, rain, insects, birds, or by man, e.g., by means of contaminated pruning tools. Secondary infections may occur throughout the growing season.

Current chemical control programs for fire blight are based on protective schedules using available registered compounds that are best used as contact treatments. Control with conventional copper compounds is only satisfactory when disease severity is low to moderate. Historically, these treatments are only used during dormant and bloom periods because russeting commonly occurs on fruit and thus, lowers fruit quality. Subsequently, labeled rates of copper are at low amounts of metallic copper equivalent (MCE) that are at the limit of effectiveness. In 2015-16, low to moderate levels of copper insensitivity in pathogen populations were detected. Spontaneous mutants were also found with high copper resistance (>30 ppm) when the pathogen was continuously exposed to copper in laboratory assays for determining copper sensitivity.

Antibiotics used for blight control in the United States include streptomycin (FireWall, Agri-Mycin), the less effective oxytetracycline (Mycoshield, FireLine), and kasugamycin (Kasumin) that was federally registered Sept. 2014 and in California in January 2018. The latter chemical is not used in human medicine or animal agriculture and thus, is designated as a bactericide. All three compounds target different sites in the protein biosynthesis pathway of the pathogen. Others have indicated that oxytetracycline is not persistent and degrades under UV light and rainfall in short periods of time (Christiano et al. 2009, Plant Disease 94:1213-1218). Pathogen resistance against streptomycin is common in California. Furthermore, from a regulatory perspective, streptomycin and oxytetracycline have been removed from the approved list of organic treatments of apples and other pome fruits by the National Organic Standards Board (NOSB). Thus, organic growers have very limited choices for disease control. Because kasugamycin is not an antibiotic as defined above, has a different MOA from other antibacterial products, and is organically produced by fermentation, this product should be submitted to the NOSB for approval as an organic treatment.

New re-formulated copper products that can be used at reduced rates of metallic copper equivalent (MCE) and that have less contamination in their formulations that may cause phytotoxicity are available. Some of the coppers are OMRI-approved and these include Badge X2 (Gowan), CS-2005 (Magna Bon, Inc.), and Cueva (Certis). They have been reported to be effective with minimal phytotoxicity. Thus, organic research on OMRI-approved coppers needs to be continued especially if antibiotics are no longer approved. Environmental and worker safety concerns about nano-particle products by the EPA have caused registrants to suspend development of these products. Still, evaluations of registered copper or zinc products (micro-particles) against *E. amylovora* can be continued. Additionally, in 2017-18, we identified copper-enhancing compounds such as the experimental SBH that can be added to copper to increase its activity so that the treatment can be more effective at low copper rates that do not cause phytotoxicity. We plan to continue to evaluate these compounds to improve the performance of copper.

In trials with biocontrols, Blossom Protect *(Aureobasidium pullulans)* was evaluated for the last several years and shown to be very effective and one of the most consistent biologicals that we have evaluated. Actinovate *(Streptomyces lydicus)* also showed promise in some trials especially when used at low rates and in combination with a sticker adjuvant but was still inconsistent. Thus, our research on organic alternatives needs to be continued. Other biological controls that have been developed for fire blight in the United States include the registered Blight Ban A506 bio-pesticide (*Pseudomonas fluorescens* strain A506), Serenade (fermentation product of *Bacillus subtilis* strain QST 713), as well as Bloomtime Biological FD Biopesticide (*Pantoea agglomerans* strain E325). Unfortunately, they have been very inconsistent in their performance. They are most effective under low inoculum levels and less favorable micro-environments. Thus, Serenade (using the new liquid formulation ASO) and Blossom Protect will be continued to be evaluated in 2018-19 in selected mixtures or in rotation with new copper products or other additives.

In general, biocontrols are most effective when they are actively growing on the plant. Several mechanisms have been described for biocontrol agents that lead to the control of the pathogenic agent including: (1) Competition; (2) Antibiosis or biochemical inhibition; (3) Site exclusion; (4) Parasitism; and (5) Systemic-acquired resistance. Thus, another aspect of our organic research that we have been working on is to enhance the growth of biologicals by adding nutrients to the tank mixture just prior to application. Growth enhancers tested to date have been inexpensive and have sometimes resulted in improved performance by favoring growth of the biocontrol organism as compared to the pathogen. The goal will be to test these growth enhancers in selected combinations and ultimately to use them in a rotation program.

Toxicity of some copper and sulfur products has been shown to some of the new biocontrols used in fire blight management. Copper is generally incompatible with bacterial biological controls, but compatible with yeast-based products. Sulfur is toxic to both fungal and bacterial biologicals. Testing needs to be extended among the biologicals, and different formulations of copper products need to be included. Liquid lime sulfur has activity against fire blight, however, it is phytotoxic to blossoms and is used for chemical thinning. We plan to evaluate low rates of copper in mixtures with yeast (fungal) biocontrols and organically-approved antibacterial products such as lactic acid, poly-L-lysine, and nisin that are currently used in the food industry and preservatives.

In research in 2017, use of the OMRI-approved LifeGard (Certis) to complement copper and other control materials as a systemic acquired resistance (SAR) treatment was unsuccessful. The active ingredient of LifeGard is a naturally occurring bacterium *(Bacillus mycoides* isolate J) that was shown to trigger the plant's natural immune response to pathogenic fungi, bacteria, and viruses in other plant systems similar to the non-organic compound acibenzolar-S-methyl (Actigard). In 2018, we initially evaluated a novel way to inhibit bacterial pathogens by the interference with vital processes such as the secretion of pathogenesis-related proteins. For this, the type III secretion system is used by many bacterial plant pathogens, and inhibitors of this mechanism (coded TS products) may interfere with the pathogens ability to enter the plant.

Our goal is to develop effective rotational programs for organic farming practices with the use of copper and biologicals, as well as conventional programs with the use of antibiotics alone or in mixtures with fungicides, copper, biologicals, or potentially other compounds during bloom or as cover sprays during early fruit development.

Management of postharvest decays. Apples like other pome fruit can be stored for some period of time using the correct storage environments. Still, postharvest decays caused by fungal organisms can cause losses that are economically detrimental to storing and marketing of fruit. The major postharvest pathogens of apples include *Penicillium expansum, Botrytis cinerea, Alternaria alternata, Mucor piriformis, and Neofabraea* spp. causing blue mold, gray mold, black mold, Mucor decay, and bull's eye rot, respectively. In California the former three are most common. There is a deficiency of postharvest biocontrols and natural products that are available to prevent decays in storage. BioSave 100 is one of the only materials currently available in the United States, but it is not very effective. Other products like Aspire have been discontinued. Still, new biological products have been registered in other countries.

In initial studies in 2013-14, we found that natamycin was similarly effective against a spectrum of postharvest pathogens as the fungicide Scholar in reducing the incidence of gray mold, Rhizopus rot, Mucor rot, and Alternaria decays, but it was not as highly effective against blue mold on apples, apple-pears, and pears. In 2016, natamycin was registered as the biopesticide BioSpectra 100SC. This fungicide has been federally-approved by the US-Food and Drug Administration (FDA) as a food additive to prevent mold growth, including *Penicillium* species, on dairy (e.g., cheese and yogurt) and meat products for many years in the United States. Over all the years in use, resistance in *Penicillium* species against natamycin has not occurred. Working with DSM, the producer, and Pace International, the registrant, we submitted a letter of support to the NOSB for approval of natamycin as an organic postharvest treatment of pome fruits. Currently natamycin is exempt from

tolerance by the US-Environmental Protection Agency (EPA). Therefore, our goal is to continue to evaluate natamycin and other new postharvest fungicides for the management of postharvest decays of apples.

Objectives for 2018-19

Fire blight research

1. Evaluate the efficacy of treatments for managing fire blight.
   - A. Evaluate growth enhancers (e.g., buffers) of biological control agents in lab and field trials.
   - B. Laboratory in vitro tests on copper and zinc products (registered copper products) with newly identified antibacterial, food additives (lactic acid, poly-L-lysine, and nisin) and experimental compounds (SBH derivatives) that enhance the activity of copper and possibly zinc.
   - D. Field trials with protective air-blast spray treatments:
     - i. Kasugamycin in combination with organic treatments to support organic petition to NOSB.
     - ii. New formulations of copper (e.g., Badge X2, CS-2005, Cueva) and SBH as a copper activity enhancer in combination or rotation with newly identified antibacterial, food additives (lactic acid, poly-L-lysine, and nisin).
     - ii. Biological treatments (Blossom Protect, Serenade) with and without the addition of growth enhancers.
     - iii. Blockers of bacterial infection that interfere with Type III secretion systems (e.g., TS products) alone or in mixtures with other biological control treatments.

Postharvest research

2. Comparative evaluation of new postharvest fungicides
   - A. Evaluate natamycin (BioSpectra) and other new postharvest fungicides such as Academy at selected rates against gray mold, blue mold, Alternaria decay, and bull's eye rot and compare to fludioxonil.
   - B. Evaluate mixtures of these compounds.

Plans and Procedures

Laboratory assays and small-scale field trials to evaluate the efficacy of treatments for managing fire blight. In laboratory assays we will evaluate new copper and zinc products, as well as copper-enhancing compounds (e.g., SBH) and newly identified antibacterial, food additives such as lactic acid, poly-L-lysine, and nisin) will be evaluated for their toxicity to *E. amylovora* in laboratory assays. Growth will be compared between non-amended and amended media, and the most effective additives will be selected for field trials.

In small-scale field tests in an experimental orchard, treatments using the copper products Badge, CS-2005, and Cueva, and the biological treatments Blossom Protect, and Serenade, will be applied to during bloom using small field sprayers. Treatments with biological control agents will also be mixed with growth enhancers; whereas copper treatments will be mixed with newly identified, food grade-additives (e.g., lactic acid, poly-L-lysine, and nisin) based on laboratory results. Additionally, Type III secretion inhibitors (TS products) will also be evaluated. After a selected time, blossoms will be spray-inoculated with *E. amylovora* (10^6 cfu/ml), inoculated branches will be bagged overnight, and disease will be evaluated based on the number of diseased blossoms per replication.

Field studies on the management of fire blight using protective treatments during the growing season. Air-blast sprayer field studies on the relative efficacy of protective treatments will be conducted in an experimental apple orchard at KARE. Four applications will be done (at pre-bloom, 10-20%, 60-80% full bloom, and petal fall). The relative efficacy of protective treatments (Kasumin, Badge X2, CS-2005, Cueva, Blossom Protect, Serenade), as well as of selected food grade-additives (e.g., lactic acid, poly-L-lysine, and nisin) based on laboratory results will be evaluated alone or in selected mixtures to develop integrated programs for resistance management. Incidence of new blight infections on blossoms and leaves in addition to potential phytotoxic effects of the treatments (e.g., fruit russeting) will be evaluated. Application timings will be determined based on temperature, rainfall, and host development. Treatments will be replicated four to eight trees. Data for chemical and biological control will be analyzed using analysis of variance and LSD mean separation procedures of SAS 9.4.

Efficacy of new postharvest fungicides for managing apple decays in storage. Fruit (cvs. Granny Smith and Fuji) will be treated similar to commercial practices concerning harvest, handling, packing, and temperature-management of fruit. Fruit will be wound-inoculated with conidial suspensions of several decay fungi (*P. expansum, B. cinerea, Alternaria* sp.) and treated after selected times. Natamycin (BioSpectra 100SC) will be evaluated in experimental packingline trials at Kearney Agricultural Center at selected rates by themselves or in mixtures. Four replications of 20-40 fruit per rep of will be used. For the new fludioxonil-difenoconazole pre-mixture (i.e., Academy), we will compare the efficacy of different application methods

(in-line drench, CDA, and T-jet). Treatments will be compared to fludioxonil. Data will be analyzed using analysis of variance and averages will be separated using least significant difference mean separation procedures of SAS 9.4.

Benefits to the industry

Fire blight research. With removal of antibiotics as treatments for organic production due to their use in human medicine and animal agriculture, research on organic alternatives are desperately needed for apple production. Because kasugamycin is not used in human medicine or veterinary science, has a different MOA from other antibacterial products, and is organically produced by fermentation, this product should be submitted to the NOSB for approval as an organic treatment. Furthermore, with the limited number of materials available to organic pome fruit growers, new active ingredients that are OMRI approved are needed for managing fire blight in an integrated approach. Our research project has identified biologicals with consistent and inconsistent performance and growth enhancers that may improve their overall performance. Information from this research project will help to develop integrated programs using rotations or mixtures of organic compounds (e.g., copper), biologicals (Serenade, Blossom Protect, etc.), possibly Type III secretion inhibitors, and food-grade, antibacterial additives to effectively manage the disease. Similarly, copper products used with compounds that enhance copper activity (e.g., experimental SBH derivatives) may help the organic apple industry manage fire blight without antibiotics. This information is being posted on the UCIPM website and in apple industry newsletters.

Postharvest decay management research. For the packer, the challenge is to develop management programs using new fungicides for control of gray mold, blue mold, Alternaria rot, and other decays of apple. The challenge to the industry is to store fruit and provide decay-free, wholesome fruit to local and distant markets. For this, fungicide management programs for apple need to be developed and continually adapted based on new organically-certified fungicides that will allow rotations and mixtures to optimize control of postharvest fungal pathogens. The development of several effective postharvest fungicide treatments including materials that are exempt from tolerance and potential certified as OMRI approved treatments will improve performance and greatly decrease losses of fruit from various decays during storage in a durable program that will be effective for many years. Thus, information from this research directly benefits growers and packers by identifying and registering new materials, as well as development of improved application practices for control of postharvest diseases of apples.

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Budget Request:
Budget Year: 2018-2019.
Funding Source: _____ Apple Commission of California _____

Salaries and Benefits:	Post-Docs/SRA		5,000
	Lab/Field Ass't		1,000
	Subtotal		6,000
	Employees' Benefits		3,500
		Subtotal	9,500
Supplies and Expenses*			12,000
Equipment			0
Operating Expenses/Equipment Travel (Davis Campus only)			0
Travel			1,500
Department Account No. _____		**Total**	**23,000**

* - Costs include expenses of $12,000 for maintaining an apple orchard at the Kearney AgCenter.

Originator's Signature: J. E. Adaskaveg _____ Date: 7-23-2018

Department Chair: Katherine Borkovich _____ Date: 7-23-2018

Liaison Office: _____ Date: _____

Postharvest Quality and Physiology of Apples Subjected to Phytosanitary Irradiation

Anuradha Prakash
Chapman University
prakash@chapman.edu

Next Steps:

1. Explore the effect of low-dose irradiation on expression of genes involved in ethylene biosynthesis in 'Granny Smith' apples.
2. Determine the cause of internal browning in irradiated apples stored for greater than 3 months.
3. Elucidate the mechanism between irradiation–induced reduction in ethylene and reduced scald formation.

Acknowledgements: We would like to thank Todd Sanders of the California Apple Commission, Jeff Columbini of Lodi Farming and Tim Sambado of Prima Fruitta for information and the apples and Steri-Tek for carrying out the irradiation treatment. This project was supported with funding from a USDA-TASC grant.

UNIVERSITY OF CALIFORNIA, DAVIS

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December 15, 2017

Chris Zanobini
California Cling Peach Board
142A Garden Highway
Yuba City, CA 95991-5512

Proposal entitled: ..... **"YEAR 2: Study on Mechanical Mass Harvesting of Cling Peaches"**
Principal Investigator: ..... **Stavros Vougioukas**
Requested Funds: **$33,073**
Period requested: ..... **04/01/2018 - 03/31/2019**

Dear Mr. Zanobini,

On behalf of The Regents of the University of California, Davis Campus it s our pleasure to present for your consideration the above-referenced proposal.

Please contact me with any administrative questions. We request correspondence pertaining to this proposal be sent via email to proposals@ucdavis.edu or mailed to the Office of Research Sponsored Programs Office, 1850 Research Park Drive, Suite 300 Davis, CA 95618-6153.

We look forward to working with you on this important project.

Sincerely,

Brooke Herevia
Contracts and Grants Analyst

**Please refer to Proposal No. 18-9602 on all future correspondence.*

Send Award Notice to:

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PO BOX 989062
West Sacramento, California 95798-9062

AES/CE MAR 84 Department: Biological & Agricultural Engineering

University of California, Davis

PROJECT PLAN/RESEARCH GRANT PROPOSAL

Project Year: 2018 Anticipated Duration of Project 3 Years
Project Leader: Stavros Vougioukas Location UC Davis
Cooperating Personnel:
Project Title: Study on Mechanical Mass-Harvesting of Cling Peaches.
Keywords: Harvesting, Productivity, Mechanization
Commodity(s): Cling peaches Relevant AES/CE Project No.

Problem and its Significance:

Harvesting is one of the most labor-intensive operations in cling peach production. A 2011 UC ANR production cost report for processing peach (cling and freestone) estimated the hand-picking and field-sorting cost for processing peaches at $1,200/acre, using $10.97 per hour for general labor including payroll overhead at 33% (Norton, Hasey, Duncan, Klonsky, & De Moura, 2011). This translated to 78% of the total harvest cost, which includes hauling to the packinghouse, and 29.2% of the total operating cost, per acre. Labor cost will increase significantly due to recent legislation. Perhaps the greatest problem though, is that in addition to cost, supply of skilled pickers is decreasing; hence, risk of losing crop is increasing too. Therefore, cling peach growers face a great and urgent need for mechanical harvesting solutions.

Prior Work

Cling peaches can be harvested mechanically using tree shaking and fruit catching systems. However, excessive fruit damage is still a problem. Although improvements in the design of the shaker and the catching system can somewhat improve fruit quality, it is well known that a major source of mechanical damage is due to limb-fruit collisions during fruit-fall through the canopy. Existing shake-and-catch systems cannot address this problem. Some tree architectures, like Y-shaped trees with few overlapping scaffolds are easier to harvest mechanically (Peterson et al., 2005). Prototype limb-shaking harvesters for such trees have been developed (cherries: Peterson, Wolford, 2003b; apples: Peterson, Wolford, 2003b) with encouraging results. However, the majority of existing cling peach orchards in California have not adopted such architectures and solutions for existing orchards are needed.

Multiple-catching surface systems have been tried in the past for fruits like apples (Rehkugler & Markwardt, 1971; Millier et al., 1973), and plums and pears (Mehlschau et al., 1977) with very promising results. Systems that intercepted and collected fruits at intermediate heights (Fig. 2, Fig. 3) had better performance compared to systems where fruits 'trickled down' to be collected on a single catching surface (Fig. 1).


Fig. 1. Rehkugler & Markwardt, 1971.

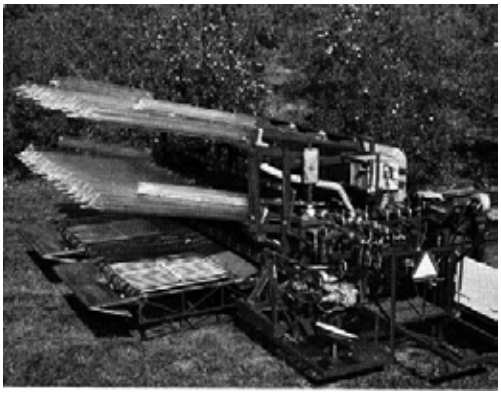
Fig. 2. Millier et al., 1973.


Fig. 3. Mehlschau et al., 1977.

However, labor availability and social issues at the time did not allow for more R&D on such machines. Further iterations on their design are very costly and to our knowledge have not been reported in literature.

Main goal:

As it was stated before, a major source of mechanical damage is due to limb-fruit collisions during fruit-fall through the canopy. The proposed research aims to investigate a novel approach to intercepting fruits during a shake-and-catch operation, so that they are intercepted before they hit tree branches. The main goal is to design, build and test a prototype system that inserts *multiple catching surfaces* into the canopy before shaking, and effectively reduces fruit damage during shaking and falling. The envisioned system would be compatible with existing fruit tree architectures and – as much as possible – with existing shaking operations and equipment, if with minor modifications. As prior work has shown, the principle of using multiple catching surfaces can be applied to various crops and tree architectures. Therefore, a key aspiration of our work is to develop a multi-fruit harvesting system, i.e., a system that can be customized and adopted to work with several fruit tree types.

The Bio-Automation Lab at UC Davis has built detailed models of pears and cling-peach trees and the positions of their fruits (Arikapudi, Vougioukas, Saracoglu, 2015; Arikapudi, Vougioukas, Jiménez- Jiménez, Khosro Anjom, 2016). We have also developed and utilized simulation models to confirm that properly deployed multi-level rods that penetrate into the canopy can intercept up to 90% of falling fruits before they hit any (digitized) tree branch (Munic et al., 2016). Of course, this number is an "optimistic" estimate, which however can be used to guide the design process. We are currently iterating on the multi-catch surface design and have devised ways to physically implement canopy-penetrating surfaces.

Specific Objectives Plans and Procedures:

Building a large-scale functional system will require significant resources. Our strategy has been to get 'seed funding' by splitting cost among several commodity Boards (year-1 of this project was funded by the CA Pear & Pest Management Board, Cling Peach mechanization Research Fund and CA Cling Peach Board with the same scope and funding amount requests). The seed funding was used to design and build prototypes and gather preliminary data that enabled the submission to USDA-NIFA of a large, multi-state Specialty Crops Research Initiative (SCRI) pre-proposal focused on mechanical tree fruit harvesting. Specific objectives are listed next, by year.

Year 1 (2017): Three objectives were pursued. Alternative catching surface designs and insertion mechanisms were explored (objective 1) and some were fabricated in the BAE Machine Shop and tested in the Bio-Automation lab. A key candidate design includes canopy-penetrating rods with inflatable side fingers (objective 2). An SCRI mechanical harvesting pre-proposal was submitted in December 2017 (objective 3). This pre-proposal gathered support from industry stakeholders and major land-grant University teams (UC Davis, Washington State, Michigan State, Penn State, Montana State).

Year 2 (2018): A full-size rod will be fabricated and tested in the lab via controlled fruit drop experiments to: optimize rod size and shape and parameters such as side-finger length, diameter, material thickness, inflation pressure, and finger curling curvature (Objective 1); a mechanism for rod extension and retraction will be designed and tested in the lab (Objective 2). Canopy penetration experiments will take place in orchards using 3D lidar and special flexible bending sensors to assess rod engagement with canopies and fruits (Objective 3).

Year 3: A half-size prototype of multi-level rods will be fabricated and actuation and control systems for its operation will be developed (Objective 1). The prototype will be tested in orchards. This will require access to a tree shaker (like a COE C7-E), collaboration with cling peach growers, and collaboration with the post-harvest center to assess postharvest fruit quality (objective 2). If SCRI is successful, this R&D will be performed without need for a budget.

References:

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Peterson, D.L., Whiting, M.D. and Wolford, S.D., 2003a. Fresh–Market Quality Tree Fruit Harvester Part I: Sweet Cherry. Applied engineering in agriculture, 19(5), p.539.

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BUDGET REQUEST

Budget Year 2018

Funding Source California Cling Peach Board

Salaries and Benefits			
Development engineer – Dennis Sadowski (25%)			16,616
Lab/Field Assistance (UCD UG student, 106 hours, spring & summer)			$1,276
Subtotal		Sub 2	$17,892
Employee Benefits		Sub 6	
Development Engineer			$8,662
Undergraduate student assistant			$19
		SUBTOTAL	$26,573
Supplies and Expenses Electronic, mechanical, pneumatic components. Padding materials, fruits.		Sub 3	$6,000
Equipment		Sub 4	
Travel		Sub 5	$500
		TOTAL	$33,073

Notes:

Originator's Signature _____ Date _____

COOPERATIVE EXTENSION

County Director _____ Date _____

Program Director _____ Date _____

AGRICULTURAL EXPERIMENT STATION

Department Chair _____ Date _____

LIAISON OFFICER _____ Date _____

D2454-2(1/84)
(Rev. 9/96)

- For all personnel at UC Davis, fringe benefits are based on UC Davis's federally negotiated composite rates, which are applied per title code and fiscal year.

A. Senior/Key Personnel.

Dr. Stavros Vougioukas: 0.6 calendar month effort in year 2. Will be the principal PI responsible for the project. He will work closely with the Senior Design Engineer to guide the design, and testing of prototypes.

B. Other Personnel:

Senior Design Engineer – Dennis Sadowski. Will work under the direct supervision of Dr. Vougioukas to design, fabricate and test prototypes for intercepting falling fruits.

Supplies

Electronic, mechanical, pneumatic components. Padding materials, fruits.

Equipment
N/A

Travel

Funds are requested to travel within CA to visit commercial farms of cooperating growers.

Start Date:	4/1/2018	Non-NIH	Title:	Study on Mechanical Mass Harvesting of Cling Peaches	Proposal Due Date/Archive:	8/31/2017
End Date:	3/31/2019		PI(s):	LEAD PI: STAVROS VOUGIOUKAS	12 Months	0 Months

Personnel	Salary Basis	*	Escalation:	Period 1	Period 2	Period 3	Period 4	FY Period 5	Multi Total
Name/Role:	Annual Salary	Project Period % Effort Per 1	Per 2	Per 3	Per4	Per5	Type	/12	Escal	4/1/18-3/31/19	-	-	-	-	4/1/18-3/31/19
1 Lead PI: VOUGIOUKAS, Stavros							CAL	12	3%	0	0	0	0	0	0
2 Dennis Sadowski 9Sr. Design Engineer	65,000	25%					CAL	12	3%	16,616	0	0	0	0	16,616
3 Undergrad $12/hr	24,960	5.00%					CAL	12	3%	1,276	0	0	0	0	1,276
4							CAL	12	3%	0	0	0	0	0	0
Total Salaries										**17,892**	**0**	**0**	**0**	**0**	**17,892**

	FY Split:	3/9	0/0	0/0	0/0	0/0				Escalations to fringe?	Yes
Benefits by Person	Code	%	%	%	%	%	Period 1	Period 2	Period 3	Period 4	Period 5	Total
1 Lead PI: VOUGIOUKAS, Stavr	Choose						0	0	0	0	0	0
2 Dennis Sadowski 9Sr. Design	D	51/52.5					8,662	0	0	0	0	8,662
3 Undergrad $12/hr	G	1.5					19	0	0	0	0	19
4 -	Choose						0	0	0	0	0	0
Total Benefits							**8,681**	**0**	**0**	**0**	**0**	**8,681**
Total Personnel							**26,573**	**0**	**0**	**0**	**0**	**26,573**

Equipment	Period 1	Period 2	Period 3	Period 4	Period 5	Total
						0
Total Equipment	**0**	**0**	**0**	**0**	**0**	**0**

Travel	International?	Period 1	Period 2	Period 3	Period 4	Period 5	Total
Travel within CA to commercial orchards	No	500					500
Total Domestic Travel		***500***	***0***	***0***	***0***	***0***	***500***
Total International Travel		***0***	***0***	***0***	***0***	***0***	***0***
Total Travel		**500**	**0**	**0**	**0**	**0**	**500**

Supplies	Period 1	Period 2	Period 3	Period 4	Period 5	Total
electronic, mechanical, pneumatic components, padding materials, fruits	6,000					6,000
						0
Total Supplies	**6,000**	**0**	**0**	**0**	**0**	**6,000**

Total Other Contractual Costs	0	0	0	0	0	0
Total Subaward/Contractual Costs	**0**	**0**	**0**	**0**	**0**	**0**

Other Expenses	Period 1	Period 2	Period 3	Period 4	Period 5	Total
Total Other Direct Costs	**0**	**0**	**0**	**0**	**0**	**0**

Total Direct Costs	**33,073**	**0**	**0**	**0**	**0**	**33,073**
Indirect Cost Base Rate Type: Other: (Enter Info Below)	0	0	0	0	0	0
Indirect Costs Base Type: CUSTOM Rate (%): 0.0%	*0*	*0*	*0*	*0*	*0*	*0*
Total Costs (Direct + Indirect)	**$33,073**	**$0**	**$0**	**$0**	**$0**	**$33,073**

APPLE EDUCATION

APPLE EDUCATION SUMMARY

The California Apple Commission strives to provide educational information in classrooms throughout California. Beginning July 1, 2018, the California Apple Commission will disseminate informational fact sheets, coloring pages, and other information specific to California apples to the California Foundation for Agriculture in the Classroom. The Foundation provides educational resources for students and facilitates outreach to California teachers and their students who have an interest in California agriculture.

The Commission's goal through the educational sponsorship is to create agriculture awareness in classrooms and create a basis for the appreciation of the importance of agriculture in the everyday lives of students. The Commission will continue striving to make a positive impact on the way students view agriculture and the world around them.

The Foundation provides informational guides to a variety of agriculture commodities. Their website provides books and videos for students, as well as pamphlets, lesson plans, and informational fact sheets for teachers to use in their classrooms. The learning materials provided on their website are created with all grade levels in mind, assuring the most effective learning material. The Learn About Ag. foundation also funds scholarships and grant opportunities for students in the agriculture industry. To learn more about what the Foundation has to offer, please visit their website: http://learnaboutag.org/index.cfm

The following is an example of a fact sheet that the Learn About Ag Foundation provides on their website for the California Blueberry Commission. The California Apple Commission will provide a similar fact sheet regarding apples that will contain various information on apples and their importance in California. This information will be distributed to schools in California and other educational institutes.

EXAMPLE

Commodity Fact Sheet

Blueberries

Information compiled by California Blueberry Commission

How Produced – Blueberries are part of the Ericaceae plant family, which includes the flowering azalea and heather plants. They grow best in acidic soil with plenty of water and good drainage. Highbush blueberries—the ones you find in grocery stores—grow on bushes planted in long rows. The bushes can grow up to 12 feet tall, but most peak at about 6 feet. In the spring, clusters of white blossoms pop up all over the bushes and are pollinated by bees. Each blossom eventually becomes a berry—first hard and green, then reddish purple, and finally blue.

California blueberries are harvested from May through July. For the fresh market, blueberries are mainly picked by hand. For other markets, blueberries are gathered with large machines that gently shake each bush so ripe berries fall into a catching frame.

Berries are gathered in large bins and transported by truck or tractor from the field to a packing plant, where they are sorted, cleaned, and packaged in clear clamshell containers. These containers are stored in large refrigerated rooms until they're taken to market.

History – When Europeans arrived on the continent, Native Americans were already using wild blueberries year-round. They dried blueberries in the sun and added them whole to soups, stews and meat, or crushed them into a powder which was rubbed into meat as a preservative. The Native Americans also used blueberries for medicinal purposes. They called blueberries "star berries" because the blossom end of each berry, the calyx, forms a perfect five-pointed star.

Native Americans developed one of the first blueberry baked goods, a simple pudding made with blueberries, cracked corn, and water. Many historians believe it was part of the first Thanksgiving feast.

During the 20th century, people didn't think wild blueberries could be domesticated. In 1908, Frederick Coville, a USDA botanist, began breeding wild blueberry plants with superior genetic traits. In 1912, with the help of Elizabeth White, the daughter of a New Jersey farmer, Coville successfully harvested a crop of plump and flavorful berries like those we enjoy today. The team sold the first commercial crop of blueberries in 1916.

Today, blueberries are found in nearly 4,000 products including pet food and cosmetics.

Varieties – With California's numerous micro-climates, many different blueberry varieties can thrive in the state. There are hundreds of varieties, but only about a dozen are sold commercially. Farmers usually grow several varieties at a time. When blueberries are harvested, varieties are combined which gives a batch of blueberries its varied colors, textures, and levels of sweetness. Each variety is unique in its size, shape, color, and taste.

Commodity Value – Over the past five years, blueberry production and consumption has almost tripled. California is one of the top six blueberry producing states in North America. In 2015-2016, blueberry growers received an average of $5.08/pound. California moved 44 million pounds of blueberries into domestic and export markets. Most of the state's crop stays in California, with some transported to other states. About 12 to 15 percent is exported, with Canada, Japan, and Southeast Asia being the top international markets.

Top Producing Counties – With 80 individual producers, blueberries are grown throughout California. In the most recent season, California farmers produced blueberries in 28 counties on approximately 7,000 acres. The greatest blueberry acreage can be found in Tulare County, where blueberries are grown on 1,410 acres. San Joaquin, Kern, and Monterey counties follow Tulare County in total acreage for blueberry production.

Nutritional Value – Blueberries are low in fat, a good source of fiber, and an excellent source of manganese. A one-cup serving of blueberries contains 80 calories and virtually no fat. One serving helps satisfy recommended daily fiber intake. Dietary fiber is important in maintaining digestive health and reducing the risk of heart disease. A single serving of blueberries delivers almost 25 percent of one's requirement of vitamin C, which helps the body maintain a healthy immune system. Blueberries are high in manganese. Manganese plays an important role in bone development and converting proteins, carbohydrates, and fats into energy.

For additional information:
California Blueberry Commission
(559) 221-1800
Website: www.calblueberry.org

U.S. Highbush Blueberry Council
www.blueberry.org

08/17 This is one in a series of fact sheets composed by the California Foundation for Agriculture in the Classroom (CFAITC). For additional educational materials: CFAITC, 2300 River Plaza Drive, Sacramento, CA 95833-3293 (916) 561-5625 ✣ (800) 700-AITC ✣ Fax: (916) 561-5697
Email: info@learnaboutag.org ✣ Website: LearnAboutAg.org

EXAMPLE

Blueberry Activity Sheet

Where are California's top 5 blueberry destinations?

Lesson Ideas

- Make a family tree showing several subfamilies, genera, and species related to the Ericaceae plant family.
- Write an expository paragraph highlighting different ways Native Americans used blueberries for medicinal purposes.
- Investigate the history of fruit crate labels. Create a vintage looking fruit crate label for California grown blueberries.
- Visit www.calblueberry.org and invent one of the recipes to serve your entire class.
- Create a bar graph comparing the vitamin C content of a variety of fruits and vegetables including blueberries.
- Early American colonists made blue paint by boiling blueberries in milk. Experiment with making different shades of blue before painting a masterpiece.
- Compare the cost per pound of fresh, frozen, and canned blueberries. Make a bar graph highlighting your findings. Track the cost over time and create a line graph.

Fantastic Facts

1. Blueberry bushes can grow up to 12 feet tall.
2. Blueberries are stored in large refrigerated rooms until they're taken to market.
3. The first commercial crop of blueberries was harvested in 1916.
4. Canada imports more California blueberries than any other country.
5. Tulare County has the greatest blueberry acreage.
6. One serving of blueberries provides the recommended amount of daily fiber.
7. Native Americans used wild blueberries for food and medicinal purposes.
8. Blueberry bushes grow best in acidic soil.
9. Fresh market blueberries are harvested by hand, while other markets (frozen, dried, canned) use machines.

Lesson Plan: Testing Soil pH

Introduction: Blueberries require acidic soils. UC Cooperative Extension recommends a soil pH between 4.8 and 5.5. If you plant blueberries in neutral or alkaline soils (soil pH 7 or higher) the plants will yellow and grow poorly, if at all.

Objective: Students will test soil pH and determine if it is adequate for growing blueberries. Students may amend the soil to attain the proper pH requirements.

California Standards: ELA CC RST.6-10.3, 7 NGSS: MS-LS1-5

Materials: pH soil strips (available at most garden centers), hand trowel, distilled water

1. Brainstorm with the class what plants need to grow. Record ideas. Be sure to include space, water, air, soil, light, and nutrients. Explain that when we talk about soil, there are minimum requirements the soil must meet. One of these requirements is the pH, or acidity, of the soil.
2. Collect a soil sample from a potential planting site. The soil should be collected from approximately 5-10 centimeters below the soil's surface.
3. Place the soil in a bowl. Pour distilled water into the bowl until the soil has the consistency of a thick stew. Stir the mixture to ensure the water is fully incorporated.
4. Hold a pH test strip at the plain reading end and dip the strip into the soil mixture for 20-30 seconds. Lift the pH strip from the water and dip it briefly in distilled water to clean off the soil.
5. Use the color codes key included in your pH test kit to read the pH of your soil.
6. Test the soil pH of several different sites around your home or school. Plot your data on a map. Provide a site recommendation based on evidence for planting blueberry bushes.
7. If your sites tested above pH 7, add acidifying material such as sulfur and ammonium-based fertilizers. Retest the soil. Add additional acidifying materials, testing as necessary, until you reach the desired level. Continue to add material periodically to maintain a low pH.

This Fact Sheet/Activity Sheet was developed by California Foundation for Agriculture in the Classroom in conjunction with California educators and meets the content education standards of the California Department of Education.

CA GROWN PARTNERSHIP

California Grown, also known as the Buy California Marketing Agreement (BCMA), is a joint effort of agricultural industry groups representing the products of California's farms, ranches, forests, and fisheries. Working as an advisory board to the California Department of Food and Agriculture, BCMA brings together industry and government resources to increase the awareness, consumption, and value of California agricultural products, helping the state's consumers enjoy the best of the California lifestyle.

California Grown is funded through public and private contributions by the U.S. Department of Agriculture, the California Department of Food and Agriculture, and California agricultural organizations.

The CAC participates as an active member of the California Grown partnership by attending regular board meetings and joining internal committees. Through this partnership, the CAC is able to feature California apples at various events including, California Agriculture Day at the Capitol, the Produce Marketing Association's Fresh Summit Exposition, and many more.

PEST, DISEASE & STANDARDIZATION

PEST, DISEASE, & STANDARDIZATION SUMMARY

The California apple industry continuously strives to produce a healthy and safe product. Through its work in pest, disease, and standardization, the Commission continues to partner with other entities to represent the industry on critical issues.

The Food Safety Modernization Act (FSMA) was signed into law on January 4th, 2011 by President Barack Obama. The purpose of the law mandates the U.S. Food and Drug Administration (FDA) to implement a "comprehensive, science-based, preventative control across the food supply". The FSMA rules are put in place to ensure specific actions are taken at each of the following points to prevent contamination. For several years, the Administration drafted several new rules including: Mitigation Strategies to protect Food Against Intentional Adulteration, Sanitary Transportation of Human and Animal Food, Produce Safety Rule, Foreign Supplier Verification Program, Accredited Third-Party Certification, Preventative Controls for Human Food, and Preventative Controls for Food for Animals. Although these rules have been drafted, guidance documents are still being formulated. The FDA has made it clear that the Administration plans to do an education roll out to assist growers, packers, and handlers on the implementation of the Act.

The commission will continue to update the industry as these new guidance documents are released. For more information, please visit the following link to view the most recent publication of the rules for the Food Safety Modernization Act:
https://www.fda.gov/Food/GuidanceRegulation/FSMA/

Please see the following pages for information regarding CDFA's Produce Safety Program for industry members, in addition to more information on the FSMA Produce Safety Rule itself.

Note: Compliance Date for Small Businesses: January 26, 2019. Compliance Date for Very Small Businesses: January 26, 2020.

CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE
Karen Ross, Secretary

May 30, 2018

Re: Produce Safety Program Website

Dear California Produce Associations:

The California Department of Food and Agriculture is pleased to inform you our new Produce Safety Program (PSP) has launched a website that will serve as a resource to California farmers who must comply with new regulations under the Produce Safety Rule (PSR).

The website, which can be found at www.cdfa.ca.gov/producesafety, includes basic information about the PSP and our efforts to help California produce farmers understand how to comply with the requirements of the PSR under the Food Safety Modernization Act (FSMA).

Our hope is that you will use this website and share it with your grower-members as the official resource for information about PSR implementation in California. Additional information will be added to the site in coming months. Currently, California produce farmers can use the website to learn about mandatory Produce Safety Rule Grower training that is required of at least one employee on every produce farm. Our website provides access to registration information for several courses being offered throughout the state that are subsidized by the U.S. Food and Drug Administration so that farms can complete the required training at a reduced price.

The site provides California produce industry members with some initial information about the upcoming PSP inspections that will be conducted by our staff on behalf of the FDA beginning in spring of 2019. To prepare for inspections, the Department is offering on-farm readiness reviews. Growers can schedule a review directly from the website. A Frequently Asked Questions section has been developed, along with some talking points that can be used to explain the new program to consumers. A regular blog is also part of the website and will be used to provide updates on program activities and resources.

In addition to the website, a Facebook page has been created for the program under @CDFAProduce Safety. Interested industry members can also join a mailing list to receive updates and information.

It is estimated over 20,000 farms in California are covered under the PSR, and we will need your assistance in reaching this audience with important information about the

new regulation. We encourage your organization to share these new resources with your membership. We also welcome any questions you may have.

Sincerely,

Karen Ross, Secretary
California Department of Food and Agriculture

Enclosures

cc: Natalie Krout-Greenberg, Director
Inspection Services Division

Steve Patton, Branch Chief
Inspection Services Division

Shelley Phillips, Supervising Senior Environmental Scientist
Produce Safety Program

FDA U.S. FOOD & DRUG ADMINISTRATION

September 13, 2017

Steve Patton
Branch Chief
1220 N Street
Sacramento, CA 95814

Dear Mr. Patton:

On September 12, 2017, the Food and Drug Administration (FDA) announced a postponement of the implementation of routine inspections of farms subject to the Produce Safety Rule until spring 2019. The announcement also addressed the extension of the compliance date for agricultural water standards and described how FDA will work with stakeholders to modify agricultural water standards in the future.

In light of this announcement, we are modifying the approach outlined in the cooperative agreements so that routine inspections will begin in spring 2019. This will allow states and FDA an opportunity to focus on issuing guidance and training plans, along with conducting On-Farm Advisory (Readiness) Reviews (OFRRs) in 2018. "For-cause" inspections (such as those related to outbreak investigations) will still occur, as needed, and will not change in light of this announcement. The new routine inspection timeline is as follows:

- Large Farms
  - Compliance Date - 1/26/2018; Inspection Start Date – March - June 2019
- Small Farms
  - Compliance Date - 1/28/2019; Inspection Start Date – March - June 2020
- Very Small Farms
  - Compliance Date - 1/27/2020; Inspection Start Date – March - June 2021

We ask that all State Produce Implementation Cooperative Agreement Program (CAP) grantees adjust their inspection implementation timelines according to the above schedule and reassess their strategic plans and budgets to determine the impact of these decisions, if any. We encourage states to consider reprogramming resources planned for inspections in 2018 to conducting OFRRs.

FDA, working closely with our association partners, is scoping out all activities that can be performed in lieu of routine inspections in Year 2. We will also be finalizing CAP-related information and decisions necessary to implement inspections in 2019. We will share this information with you no later than November 1, 2017, so you will have time to revise your strategic plans and budgets, if necessary, and submit them, along with your mid-year progress reports, by December 1, 2017.

U.S. Food & Drug Administration
10903 New Hampshire Avenue
Silver Spring, MD 20993
www.fda.gov

FDA U.S. FOOD & DRUG ADMINISTRATION

While reassessing your program's strategic plan and budget please be mindful that all other planned activities under your existing cooperative agreement will continue including:

- Developing and continually updating your strategic plan for produce safety (continuation from Year 1)
    - Developing, documenting, and tracking performance measures
- Conducting a jurisdictional self-assessment (continuation from Year 1)
- Establishing and verifying a farm inventory (continuation from Year 1)
- Conducting legislative research and continuing any efforts to obtain regulatory authority (continuation from Year 1)
- Developing program and program infrastructure (continuation from Year 1 and/or new)
    - Developing and implementing a continuing education program to ensure regulatory jurisdiction personnel are trained
    - Establishing ties with FDA's Produce Safety Network and FDA's Technical Assistance Network to ensure that any questions or issues are raised and state/territory regulators receive necessary technical assistance
    - Researching, designing, and implementing a compliance program for applicable produce safety regulations at the jurisdictional level, which includes:
        - Continuing program development work, but adjusting for the new targeted start date; and
        - Delaying implementation of the inspection program and redirecting those resources to OFRRs and other education and outreach programs
    - Continuing communication and collaboration amongst CAP stakeholders
- Performing education and outreach (continuation from Year 1 and/or new)
    - Evaluating educational needs and implementing an educational system to provide for an informed farming community
    - Participating in and providing opportunities for OFRRs

The implementation of the Food Safety Modernization Act (FSMA) and the Produce Safety Rule has been and continues to be a top priority for FDA. As you know, states have a long history of effectively working with and understanding your farming communities. Successful implementation of the Produce Safety Rule cannot happen without the support of our state partners who are helping food producers and growers understand and achieve the new requirements.

FDA is committed to ensuring our regulatory partners and industry have the tools needed to implement the new standards. As we continue to work together with FSMA implementation, we recognize that achieving our shared food safety goals is a continuous effort from all of us.

Thanks for your commitment to integration and food safety. We look forward to our continued partnership.

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part 112, of the FSVP regulation are still required to make necessary disclosures. Subsequent entities in the distribution chain will continue to be subject to applicable requirements related to food adulteration in Federal and/or state and local laws and regulations, e.g., part 117, part 507, and the Retail Food Code.

C. Enforcement Policy for Importation of Food Contact Substances Under the FSVP Regulation

The FSVP regulation requires food importers to develop, maintain, and follow an FSVP that provides adequate assurances that the foreign supplier uses processes and procedures that provide the same level of public health protection as those required under the preventive controls or produce safety provisions of FSMA (if applicable) and regulations implementing those provisions, as well as assurances that the imported food is not adulterated and that human food is not misbranded with respect to allergen labeling (21 CFR 1.502(a)). Among other things, the FSVP regulation (21 CFR 1.500-1.514) requires most food importers to do the following:

- Analyze the hazards for the foods they import (21 CFR 1.504);
- Evaluate the performance of their potential foreign suppliers and the risk posed by the foods to be imported (21 CFR 1.505); and
- Determine and conduct appropriate foreign supplier verification activities, such as onsite auditing of foreign suppliers, sampling and testing, and review of supplier food safety records (21 CFR 1.506).

The FSVP regulation applies (with certain exceptions) to the importation of food as defined in section 201(f) of the FD&C Act (see 21 CFR 1.500). Food contact substances are included in the definition of "food" for purposes of the FSVP regulation (21 CFR 1.500). However, for the reasons stated below, we intend to exercise enforcement discretion for importers of food contact substances with respect to the FSVP regulation.

A food contact substance is any substance that is intended for use as a component of materials used in manufacturing, packing, packaging, transporting, or holding food if such use of the substance is not intended to have any technical effect in such food (section 409(h)(6) of the FD&C Act (21 U.S.C. 348(h)(6)); 21 CFR 170.3(e)(3)). The term "food" is defined in section 201(f)(3) of the FD&C Act to include articles used as components of food. In the preamble to the FSVP final rule, we stated that the definition of "food" for purposes of FSVP includes food contact substances that are considered "food" in section 201(f) of the FD&C Act (80 FR 74225 at 74233). Therefore, the FSVP regulation applies to importers of food contact substances that meet the definition of "food" in section 201(f).

In the compliance date final rule, we extended the compliance date for the importation of food contact substances by 2 years so that we could consider how best to address concerns raised about the feasibility of importers of food contact substances meeting the FSVP requirements (81 FR 57784 at 57792-57793). As a result of this extension, the earliest that an importer would be required to comply with FSVP for the importation of food contact substances would be May 28, 2019.

- Subpart C of part 507 includes provisions for disclosure statements and written assurances that apply when a manufacturer/processor of food for animals identifies a hazard requiring a preventive control, does not control the identified hazard, and relies on an entity in its distribution chain to control the hazard (§§ 507.36(a)(2), (3), and (4), 507.36(c), 507.36(d), and 507.37). A manufacturer/processor that complies with these provisions of part 507 is not required to implement a preventive control for the identified hazard. The combination of these requirements was intended to provide assurance that the food will be processed to control the identified hazard before it reaches the consumer feeding the food to animals.
- Subpart F of part 507 specifies the elements to be included in the written assurances required by § 507.36(a)(2)(ii), (3)(ii), and (4)(ii). (See § 507.215(b).)

The FSVP regulation includes "customer provisions" that apply when an importer imports a food for which the hazards are controlled after importation (§ 1.507). As with the customer provisions in part 117 and part 507, the requirements in the customer provisions of the FSVP regulation were intended to provide assurance that the food will be processed to control the identified hazard before it reaches the humans or animals that would consume the food.

The produce safety regulation applies to "covered produce" as set forth in §§ 112.1 and 112.2. Produce that would otherwise be covered is eligible for an exemption from most of the requirements of the produce safety regulation if: (1) The produce receives commercial processing that adequately reduces the presence of microorganisms of public health significance (§ 112.2(b)(1)); and (2) certain other conditions are met, including requirements for disclosure statements and written assurances analogous to the requirements for disclosure statements and written assurances in the "customer provisions" required by part 117, part 507, and the FSVP regulation (§ 112.2(b)(2) through (4) and (6)).

FDA has received feedback from industry expressing concern that certain product distribution chains would require vastly more written assurances (and consequently resources to comply with the requirement) than anticipated by FDA during the rulemaking process (Ref. 1). For example, a manufacturing facility may sell food products subject to the customer provisions to a distributor, who may sell numerous items requiring assurances to multiple restaurants, cafeterias, delicatessens, and other distributors. It is estimated that this could result in hundreds or even thousands of written assurances needed by a single distributor (Ref. 1). After considering this feedback from industry, we stated our belief that the requirement for written assurance in the customer provisions of part 117 significantly exceeds the current practices of even the largest facilities; compliance by those facilities by September 19, 2016, may not be feasible; and it is appropriate to extend the compliance dates for 2 years for the written assurance requirements for part 117, part 507, the FSVP regulation, and the produce safety regulation while we considered the best approach to address feasibility concerns (81 FR 57784 at 57786).

FDA intends to initiate a rulemaking that takes into consideration the complex supply chain relationships and resource requirements. To provide sufficient time for us to pursue that rulemaking, we are exercising enforcement discretion with regard to the written assurance requirements of part 117, part 507, part 112, and the FSVP regulation until completion of that rulemaking process. In the meantime, entities with disclosure duties under part 117, part 507,

squash, winter sweet potatoes, and water chestnuts.

(2) Produce that is produced by an individual for personal consumption or produced for consumption on the farm or another farm under the same management, and

(3) Produce that is not a raw agricultural commodity.

(b) Produce is eligible for exemption from the requirements of this part (except as noted in paragraphs (b)(1), (2), and (3) of this section) under the following conditions:

(1) The produce receives commercial processing that adequately reduces the presence of microorganisms of public health significance. Examples of commercial processing that adequately reduces the presence of microorganisms of public health significance are processing in accordance with the requirements of part 113, 114, or 120 of this chapter, treating with a validated process to eliminate spore forming microorganisms (such as processing to produce tomato paste or shelf stable tomatoes), and processing such as refining, distilling, or otherwise manufacturing/processing produce into products such as sugar, oil, spirits, wine, beer or similar products; and

(2) You must disclose in documents accompanying the produce in accordance with the practice of the trade, that the food is "not processed to adequately reduce the presence of microorganisms of public health significance"; and

(3) You must either:

(i) Annually obtain written assurance, subject to the requirements of paragraph (b)(6) of this section, from the customer that performs the commercial processing described in paragraph (b)(1) of this section that the customer has established and is following procedures (identified in the written assurance) that adequately reduce the presence of microorganisms of public health significance; or

(ii) Annually obtain written assurance, subject to the requirements of paragraph (b)(5) of this section, from your customer that is not subject to the distribution chain subsequent to the customer will perform commercial processing described in paragraph (b)(1) of this section and that the customer

(A) Will disclose in documents accompanying the food, in accordance with the practice of the trade, that the food is "not processed to adequately reduce the presence of microorganisms of public health significance", and

(B) Will only sell to another entity that agrees in writing, it will either:

(*1*) Follow procedures (identified in a written assurance) that adequately reduce the presence of microorganisms of public health significance; or

(*2*) Obtain a similar written assurance from its customer that the produce will receive commercial processing described in paragraph (b)(1) of this section, and that there will be disclosure in documents accompanying the food, in accordance with the practice of the trade, that the food is "not processed to adequately reduce the presence of microorganisms of public health significance", and

(4) You must establish and maintain documentation of your compliance with applicable requirements in paragraphs (b)(2) and (3) in accordance with the requirements of subpart O of this part, including:

(i) Documents containing disclosures required under paragraph (b)(3) of this section; and

(ii) Annual written assurances obtained from customers required under paragraph (b)(3) of this section; and

(5) The requirements of this subpart and subpart Q of this part apply to such produce; and

(6) An entity that provides a written assurance under §112.2(b)(3)(i), or (ii) must act consistently with the assurance and document its actions taken to satisfy the written assurance.

§112.3 What definitions apply to this part?

(a) The definitions and interpretations of terms in section 201 of the Federal Food, Drug, and Cosmetic Act apply to such terms when used in this part.

(b) For the purpose of this part, the following definitions of very small business and small business also apply:

(1) *Very small business.* For the purpose of this part, your farm is a very small business if it is subject to any of the requirements of this part and, on a

FSMA Produce Safety Rule

What Produce Associations Need to Know

- California Department of Food Agriculture (CDFA) is launching the California Produce Safety Program, which will include educational information designed to assist California produce farms in understanding the requirements of the FDA's Produce Safety Rule and how to comply with this new regulation.
- Beginning January 26, 2018, California produce farms designated as "large" (those with annual sales greater than $500,000) are expected to comply with the Produce Safety Rule. Smaller farms will be phased in over the next few years.
- The Produce Safety Rule is mandatory throughout the United States beginning January 26, 2018. Any produce farm found to be out of compliance may be subject to regulatory actions.
- In 2018, the Produce Safety Program will be doing everything possible to inform and educate California produce farmers about the requirements of the Produce Safety Rule.

Who Must Follow the Produce Safety Rule?

- California farms producing fruits, nuts and vegetables must comply with this new rule.
- Multiple rules exist within the federal Food Safety Modernization Act (FSMA). The Produce Safety Program deals specifically with the Produce Safety Rule. Information about other FSMA Rules is available here.
- The exact rule an operation falls under will vary depending upon the type of activities performed. To determine if an operation falls under the Produce Safety Rule, please use this flow chart provided by The National Sustainable Agriculture Coalition.

CDFA Produce Safety Program Website Coming Soon

www.cdfa.ca.gov/producesafety/

CDFA is currently developing a new Produce Safety Program website. This will serve as the go to place for individuals looking for PSR information.

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Who is Exempt from the Produce Safety Rule?

- A list of exemptions from the Produce Safety Rule can be found here. Exemptions generally include the following:
- Thirty commodities have been identified by the FDA as exempt from the Produce Safety Rule because they are rarely consumed raw. Farms exclusively producing these commodities are not covered by the Produce Safety Rule. (Examples of exempt commodities include: dried kidney beans, potatoes and pumpkins.)
- Farms that grow produce only for personal consumption or very limited distribution may also be exempt from the law.
- Some farms may qualify for an exemption from the Produce Safety Rule if their sales are below certain levels or if they grow produce that is processed in a way that would kill pathogens. Farms falling in these categories will be required to verify their exemption status.
- If your organization represents commodities that may be eligible for a qualified exemption because the finished product is processed in a way that kills pathogens, CDFA strongly urges you to seek guidance from FDA regarding documentation requirements to verify this exemption.
- CDFA is also urging associations to work with industry members to ensure procedures for documentation for qualified exemptions required of both farmers and processors are well understood and communicated.

Education and Training

- FDA has determined that official Produce Safety Rule on farm inspections will begin in 2019. The Produce Safety Program will spend 2018 working to make sure California produce farmers understand the requirements of the Produce Safety Rule.
- An informational website providing detailed information on the Produce Safety Program will be available soon and CDFA will be conducting other outreach efforts to educate California produce farms about this new rule and how to comply.
- One of the first steps toward Produce Safety Rule compliance is for every produce farm to have an individual employed who has completed an FDA-recognized Produce Safety Rule Grower Training Course. The training need only be taken once and the certificate of completion belongs to the individual. Available courses are posted on the Produce Safety Alliance website here.
- CDFA has also contracted with outside organizations to provide subsidized Grower Training that meets Produce Safety Rule requirements. These courses are offered at a reduced rate and are being conducted throughout the state in both English and Spanish. A list of dates and locations of these courses is provided with this packet.
- In addition to the required Produce Safety Rule Grower Training, all produce farms must show documentation of ongoing food safety training of farm and contracted employees as part of the required practices under the Produce Safety Rule.
- Any information or assistance your association can provide to ensure farmers are meeting Produce Safety Rule training requirements is greatly appreciated.
- In preparation for official Produce Safety Rule inspections in 2019, CDFA's Produce Safety Program will be offering a series of On Farm Readiness Reviews (OFRR). These are designed to give produce farmers a better understanding of what they can expect from a Produce Safety Program routine inspection. Information on how to schedule an OFRR will be available very soon.

Information for the Public and Other Stakeholders

- Please note that California Produce Safety Program inspections are a means of verifying compliance and enforcement of the Produce Safety Rule. They are not meant to replace existing quality assurance activities that may be requested of farmers or handlers by their customers.
- Suggested messaging for use in talking about the Produce Safety Program with trade and consumers is included in this packet.
- CDFA urges you to share information contained in this packet with your membership.

Implementation of Required Food Safety Practices

- Produce farms with sales greater than $500,000 per year are expected to implement Produce Safety Rule practices beginning January 26, 2018. The full Produce Safety Rule requirements are available on the FDA website here.
- If your association has commodity specific guidelines that are aligned with the Produce Safety Rule, we encourage you to share these with your membership.
- We also urge you to advise your membership that private audit firms should conduct audits that are aligned with the Produce Safety Rule so that farmers are well prepared for Produce Safety Program inspections when they begin taking place in 2019.

Produce Safety Program Inspections

- CDFA has created a new unit as part of its Inspection Services Division specifically to conduct Produce Safety Rule inspections. This unit is known as the Produce Safety Program.
- Produce Safety Rule inspections will be done on behalf of the U.S. FDA. As such, Produce Safety Program inspectors are credentialed by the FDA and have specific education and training.
- As with all other programs within the CDFA's Inspection Services Division, Produce Safety Program inspectors are part of a public agency mandated to protect the food supply. Inspectors are accountable to the public, legislature and the industry; financially independent and unbiased; consistent and uniform, and are required to report potential public health threats to the California Department of Public Health.
- CDFA is working with an existing database of California farms acquired from other agencies and organizations to identify California produce farms that are likely subject to this new rule. Farms from this list will be selected for routine inspection by the Produce Safety Program on a random basis following verification of the farm's status.

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Suggested Messaging for Retail and Foodservice Produce Buyers

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About the Produce Safety Rule

- Beginning January 26, 2018, the Produce Safety Rule under the new Food Safety Modernization Act will become law on produce farms throughout the U.S.

- All California farms producing fruits, nuts and vegetables must comply with this new law. Some exceptions apply. Your supplier can provide verification if they are exempt from the Produce Safety Rule.

- The law will be phased in according to farm size over the next few years beginning in 2018 with large farms, defined as those with annual sales of $500,000 or more.

- To implement this new law across the nation, the U.S. FDA is working with State Departments of Agriculture to conduct inspections that will verify produce farms are in compliance with the Produce Safety Rule. .

- The U.S. FDA has determined that Produce Safety Rule on farm inspections will begin in 2019.

Implementation in California

- It is estimated some 20,000 produce farms in California are subject to the Produce Safety Rule.

- The California Department of Food and Agriculture has created a new unit as part of its Inspection Services Division specifically to conduct inspections that will verify compliance with the Produce Safety Rule. This unit is known as the Produce Safety Program.

- The goal of CDFA's Produce Safety Program is to assist and verify that California produce farms are following FDA's Produce Safety Rule.

- This is a big job and it will take time to fully implement. CDFA's goal is for Produce Safety Rule requirements to become ingrained in the culture of California produce farming so that our state is growing the safest produce possible

- The California Produce Safety Program's role is to first educate California produce farmers on the requirements of the Produce Safety Rule and then regulate farms to ensure they are following this new rule

About the Produce Safety Program Inspections

- California Produce Safety Program inspections are a means of verifying compliance and enforcement of the Produce Safety Rule. They are not meant to replace existing quality assurance activities provided by farmers or handlers

- Beginning in 2019, California produce farms will be selected for inspection by the Produce Safety Program on a random basis following verification of the farm's status.

- Unlike audit based certification programs, farms may not request an inspection, but will instead be selected by the Produce Safety Program.

Suggested Messaging for Consumers

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About New Food Safety Regulations for Produce

- Beginning on January 26, 2018 fruit, vegetable and nut farms in California and throughout the U.S. will be required to follow specific food safety practices under a new federal regulation known as the Produce Safety Rule.
- The U.S. Food and Drug Administration (FDA) has been charged with oversight of this new rule and it is being implemented in California by the California Department of Food and Agriculture (CDFA).
- Food safety practices required on farms are similar to what is required of restaurants or to precautions you might take in your own kitchen. The practices are designed to ensure produce is properly handled by workers who are trained to use good hygiene; to make sure farm equipment is sanitary; to ensure soils where produce is grown are safe and; that measures are in place to prevent contamination of produce by wildlife or nearby domesticated animals. Additionally, farmers are required to keep written records to document their farming practices.
- Many produce farms have been implementing these kinds of food safety practices on their farms for years.

What Consumers Can Expect from Produce Grown in California

- Routine on-farm inspections to verify farmers are following new food safety regulation will be conducted through an inspection unit created by the California Department of Food and Agriculture called the Produce Safety Program.
- It's estimated that 20,000 farms in California are subject to the Produce Safety Rule. It is the goal of CDFA that requirements of this new food safety rule become ingrained in the culture of California produce farming so that our state is growing the safest produce possible.
- Over the next year, the role of the California Department of Food and Agriculture's Produce Safety Program will be to educate California produce farmers about the requirements of the Produce Safety Rule.
- Beginning in 2019, CDFA's Produce Safety Program inspectors will conduct random, routine inspections of produce farms to ensure they are following the new law.
- Inspectors in California are credentialed by the FDA and have specialized education and training. The inspectors are part of a government agency charged with protecting the food supply. They provide independent, unbiased, consistent inspections of California produce farms.
- Most grocery stores and restaurants already require farmers to follow food safety practices on their farms. In addition, many organizations conduct research and provide food safety guidelines that produce farmers have been following for years.
- Requirements for produce safety on farms is now the law. Farmers found to be out of compliance with these new requirements may face economic, regulatory and legal consequences.

On-Farm Readiness Review

Introduction

The walk around questions (WAQ) are intended to help assessor(s) solicit information from the grower. It is not intended to cover all aspects of the Produce Rule, but what is considered the most important portions. The WAQ is to be used with the OFRR Resource Manual. The assessor(s) should have a good understanding of the produce rule and the manual before doing any readiness reviews.

The assessor should first talk to the grower about what portions of the Produce Rule apply to them. Use the OFRR Decision Tree which is located at Tab 1 in the manual. This will allow you and the grower to determine which parts to use for the walk through. Each Tab in the manual from 4-15 covers a different section of the Rule with a corresponding WAQ. The WAQ documents are setup as a series of questions. At the start of most questions is a section number in brackets i.e. [112.51] which refers directly to the Rule under that tab in the manual. If a written document is required, the section number will be followed by a capital D in parenthesis i.e. (D).

At the end of the walk through the assessor(s) should meet with the grower to review what was observed and make suggestions for improvement. The goal is not to point out everything that the grower may need to change, but the most important changes needed.

Walk Around Questions (WAQ)

Health and Hygiene (Tab 4)

Potential locations – immediately upon arrival if asked to sign an acknowledgment of food safety practices document, employee break area, hand wash station, restroom

[112.31]: How do you prevent ill or persons you suspect of being sick from coming into contact with produce and food contact surfaces?

[112.32]: What sort of hygiene expectations do you have for all your employees? Do you have glove, jewelry, or other similar policies?

[112.33]: What are your visitor policies or procedures related to health and hygiene.

Walk Around Questions (WAQ)

Preharvest Biological Soil Amendments of Animal Origin (5)

Potential locations – compost pile, compost storage, composting area

[112.52(a), 112.52(b)]: Does your farm use any soil amendments of animal origin, including agricultural tea?

[112.52]: If yes, how is it stored and handled prior to application?

[112.51(b)(5), 112.54] (D): Do you test the water for the tea and if so what for?

Do you spike the tea with anything (nutrients or other additives)?

[112.51, 112.54]: What type of soil amendments do you use? (Note to assessors: probe deeper regarding use of human waste, sewage sludge biosolids, manure, compost, bone meal, feather meal, fish emulsion, table waste, pre-consumer vegetative waste, etc.)

[112.52] When do you apply your amendments?

[112.56]: Do they contact the harvestable portion of the crop during or after application?

[112.56(a)(1)(i)]: How long do you wait before harvesting after application?

[112.53] (D): Does your farm use any human waste or sewage sludge biosolids?

[112.60(b)(1), 112.60(b)(2)] (D): Do you produce your own compost or purchase it pre-treated?

[112.60(b)(1)] (D): If you buy treated compost amendments, do you maintain a certificate or document from that supplier the microbial quality of the product at least annually?

[112.54, 112.55]: Is the process used to treat it scientifically valid (Ex.'s physical process (ex. thermal), chemical process (ex. High alkaline pH), biological process (Ex. composting) or a combination of these, and validated to show no detectable *Listeria monocytogenes*, *Salmonella* species and fecal coliforms or *E. coli* O157:H7 for purchased compost?

If you produce your own compost, where do you produce it and how is it stored?

[112.60(b)(1)( )], [112.60(b)(1)(iii)]. (D): Do you have a record of the process used to treat the amendment?

[112.60(b)(1)(ii)] (D): Do you have a record of the handling and storage of the amendment?

Walk Around Questions (WAQ)

Preharvest and Harvest Wild and Domestic Animals (Tab 6)

Potential locations - working animals, animal deterrents, walking field perimeter

[112.81]. Does your farm operation grow, pack or hold produce in an outdoor area or partially enclosed building? (May be obvious upon visiting farm operation)

[112.83]. Does your farm use grazing animals, working animals, or have animals entering production areas during the season?

[112.83(a)]; What steps do you take if you suspect that grazing animals, working animals, or animal intrusion will contaminate covered produce?

[112.83(b)]; How do you assess potential contamination during the season?

[112.112]; If contamination is found, how do you evaluate whether produce can be harvested?

* [112.22(b)(1); 112.30(a)]; What type of training do workers receive on dealing with contaminated produce at harvest?

Walk Around Questions (WAQ)

Preharvest Worker Training (Tab 7)

Potential locations - employee break area, hand wash station, restroom

*[112.21(a), 112.22(a)(1); When do you train your workers on hygiene? What do you cover? How often do you retrain? How do you handle new employees during the season?

*[112.21(b)]; What type of training to you or the supervisors of the workers receive?

*[112.22(b), 122.22(b)(3)]; Do you give different types of training for your field and packinghouse crews? If so what?

*[112.30] (D); Do you keep records of your trainings?

*[112.128]; What type of toilet facilities and handwashing stations do you provide?

*[112.130]; What supplies are included with the toilets and handwashing facilities

*[112.129(b)(2)]; How are they serviced?

*[112.129(b)(1), 112.131(c)]; What do you do if a portable toilet leaks, tips, or spills?

*[112.129(a)]; Where are toilets in relation to the work being done and how many do you have?

Walk Around Questions (WAQ)

Preharvest Sanitation (Tab 8)

Potential locations – production equipment, chemical storage, walking the field

[112.111]: Do you grow crops that are covered and not covered under the produce rule? If so, do you clean any shared equipment before using on covered produce?

[112.112]; Do you do a preharvest inspection of the growing area? What do you look for? What are your corrective actions if you find a problem? How do you ensure contaminated produce will not be harvested?

[112.123] (D); Do you inspect and maintain equipment, and when necessary clean and sanitize equipment used in the field before harvest? (Distinguish between cleaning and sanitizing). How do you do it? What sort of sanitizer do you use? How often?

112.140]; Do you keep records of equipment sanitation?

[112.132] How do you dispose of waste in the field to prevent contamination of produce and ag water?

On-Farm Readiness Review

Walk Around Questions (WAQ)

Preharvest Water (Tab 9)

Potential locations – water source (well or surface), water treatment system, distribution system

How do you use water before the harvest of crops on your farm (i.e., is it considered *agricultural water*)?

[112.42(a)(1)] (D); What are the sources of water used throughout the season [Municipal, Groundwater (i.e., wells), Surface Water (lakes, ditches, rivers or streams), How many?]?

Think about all the water used for irrigation, crop protection, frost protection, and dust abatement. How do the sources change during different times of year or with how you use the water?

[112.42(a)] (D): Do you inspect your water system? If so how often? What things do you look for in the inspection? (Ask the grower to walk through a typical inspection with you.)

[112.42(a)(4)] (D); What are the specific activities near the source or through the conveyances that impact the quality of these water sources (On this farm, from adjacent land)? How likely will these activities contaminate the water source?

[112.42(c)]: How do you protect your water sources? (physical access, backflow prevention)

[112.46] (D) How do you assess water quality for preharvest uses? Testing? How frequently and when? What test(s) [target organism, testing method] are you using? Do you know what your water unit testing is?

[112.47(b)]; How do you take your water samples?

Note: Exact requirements listed below are under review by FDA and may change. Also, water requirements do not go into effect for four years after implementation dates based on produce sales.

Municipal Source (a record of the annual testing from the municipality)
Ground water sources (4 tests total with 1 per year, per source)
Surface water sources (20 tests total with 5 per year, per source)

[112.44(b)] (D); Are you calculating a Geometric mean and STV?

[112.44(b)] (D); Does your water meet the *E. coli* criteria established in the PSR? (<126 CFU GM & <410 CFU)?

[112.45]; If your water happened to exceed the *E. coli* criteria, what corrective measures would you use to lower the risk?

[112.45(a)(1)] (D); If it did exceed the criteria, did you reinspect the system to look for problems before performing a corrective action?

* [112.45(b)(1)(i)(A)] (D); Are you applying a preharvest interval? How many days?

(D) Does your crop go to commercial processing? Is your buyer aware that risky produce (ie.high micro load water application preharvest) needs to be handled differently?

[112.45(b)(1)(ii)] (D); Postharvest treatment or storage? Do you have a validation to show its efficacy?
[112.45(b)(2)] (D); Re-inspecting the water system?
* [112.45(a)(2)] (D); Do you treat the water? If so, how?

[112.45 (b)] (D); Have you had to take any Corrective Actions this season?

[112.12 (a)] (D); Do you use an alternative to a requirement?
[112.49 (a)] (D); Alternative microbial indicator? Do you have scientific data to support it?
[112.49 (b)] (D); Alternative preharvest die-off? Do you have scientific data to support it?
[112.49 (c)] (D); Alternative minimum sample number in initial survey? Do you have scientific data to support it?
[112.49 (c)] (D); Alternative minimum sample number in annual survey? Do you have scientific data to support it?

Walk Around Questions (WAQ)

Harvest Worker Training (Tab 10)

Potential locations – employee break area, hand wash station, restroom, watching harvest

[112.112]; Do you inspect fields at harvest for signs of animal feces? What do you if feces in found on or around the produce?

[112.113]; How do you protect the produce from becoming contaminated during harvest?

[122.22(b)(2), 122.22(b)(3); What does a worker do if he/she fines containers that were not properly cleaned when harvesting?

[112.129]: What type of toilet facilities and handwashing stations do you provide?

[112.129]; How close are the toilet facilities located to the field during harvest?
[112.129(b)(2)]; How are they serviced?

[112.130]; What supplies are included with the toilets and handwashing facilities

[112.129(b)(1), 112.131(c)]; What do you do if a portable toilet leaks, tips, or spills?

[112.129(c); If you are growing in a greenhouse where are the toilets and handwashing stations located?

[112.21(a), 112.22(a)(1); When do you train your workers on hygiene? What do you cover? How often do you retrain? How do you handle new employees during the season?

[112.21(b)]; What type of training to you or the supervisors of the workers receive?

[112.21(c)]; How do you train workers that may not read or write or understand English?

[112.22(b), 122.22(b)(3)]: Do you give different types of training for your field and packinghouse crews? If so what?

[112.30) (D); Do you keep records of your trainings?

[112.22(a)(2); How do you inform visitors (including u pick) as to the health and safety issues around the operation?

Walk Around Questions (WAQ)

Harvest Sanitation (Tab 11)

Potential locations – watching harvest, looking at harvest equipment, looking at where harvest equipment is stored or cleaned

[112.22(b)] (D); What type of training do you give to the harvest crew?

[112.22(b)(1)] (D); What instructions do you give to the harvest crew related to dropped produce or produce which may be contaminated with manure or other animal feces?

[112.111]; Do you grow crops that are covered and not covered under the produce rule? If so, do you handle and/or store the crops together or use any shared equipment?

[112.112]; Do you do a preharvest inspection of the growing area? What do you look for? What are your corrective actions if you find a problem? How do you ensure contaminated produce will not be harvested?

[112.113]; How do you handle harvested produce to prevent contamination?

[112.114]; How do you ensure dropped produce is not distributed?

[112.116]; Do you reuse packing / harvest containers? If so, how are they cleaned and sanitized?

[112.123] (D); How frequently do you inspect and maintain equipment, and when necessary clean and sanitize equipment used in the field before harvest? (Distinguish between cleaning and sanitizing). How do you do it? What sort of sanitizer do you use? How often?
112.140; Do you keep records of equipment sanitation?

[112.125]; How do you ensure vehicles used to transport produce are cleanable (look for carpet, absorbent material, etc.), clean and/or sanitary?
[112.132] How do you dispose of waste in the field to prevent contamination of produce and ag water?

Walk Around Questions (WAQ)

Harvest Water (Tab 12)

Potential locations – water source, point of water use, during harvest

How do you use water (including ice) during the harvest of crops on your farm?
**[112.42(a)(1)] (D); What are your sources of water used at harvest?

Think about all the water used for equipment and direct food contact surface cleaning, hand wash water, for produce quality (freshening greens) and hydrocooling. How do the sources change during different times of year or with how you use the water?

**[112.42(a)] (D); Do you inspect your water system? If so how often? What things do you look for in the inspection? (Ask the grower to walk through a typical inspection with you.)

**[112.42(a)(4)] (D); What are the specific activities near the source or through the conveyances that impact the quality of these water sources (On this farm, from adjacent land)? How likely will these activities contaminate the water source?

**[112.42(c)]; How do you protect your water sources? (cross-connections, backflow prevention)

**[112.46] (D); How do you assess water quality for harvest uses? Testing? How frequently and when? What test(s) [target organism, testing method] are you using? Do you know what your water unit testing is? How do you take your water samples?

**[112.43] (D); Do you treat this water? If so, how?

**[112.45]. What do you do if a water test comes back higher than expected (a positive generic E. coli test)? How would you correct this on your farm?

[112.48(a)] Do you re-use or recirculate water? If so, how do you monitor recirculating water? How do you determine when it's time to change recirculated water?

**[112.43] (D); Do you use an antimicrobial (sanitizer, uV)? How do you use them? How do you monitor their effectiveness? How frequently do you monitor it?
(Depending on your sanitizer) How do you monitor the pH of this water?

[112.48(b)]; Are you familiar with water turbidity? How do you gauge/measure this?
[112.48(c)]; Based on what you harvest, is the temperature of the water a concern? How do you address it?

*[112.50(a)] (D); What documents do you keep related to your water sources, antimicrobial use, and testing?

Walk Around Questions (WAQ)

Postharvest Worker Training (Tab 13)

Potential locations – employee break area, hand wash station, restroom, watching packing

[112.129(a)]: Approximately how many workers do you have in the packinghouse?

[112.129(b)(1)]: Are there toilet facilities and handwashing stations available for the workers during produce packing and where are they located?
Who services the facilities and how frequently?

[122.22(b)(2), 122.22(b)(3): What does a worker do if he/she finds containers that were not properly cleaned after harvest?

[112.128]: What type of toilet facilities and handwashing stations do you provide?

[112.129], How close are the toilet facilities located to the packing area?
[112.129(b)(2)]: How are they serviced?

[112.130], What supplies are included with the toilets and handwashing facilities

[112.129(b)(1), 112.131(c)]: What do you do if a portable toilet leaks, tips, or spills?

[112.129(c)]: If you are growing in a greenhouse where are the toilets and handwashing stations located?

[112.21(a), 112.22(a)(1)]: When do you train your workers on hygiene? What do you cover? How often do you retrain? How do you handle new employees during the season?

[112.21(b)]: What type of training to you or the supervisors of the workers receive?

[112.21(c)]: How do you train workers that may not read or write or understand English?

[112.22(b), 122.22(b)(3)]: Do you give different types of training for your packinghouse crew? If so what?

[112.30] (D): Do you keep records of your trainings?

[112.22(a)(2): How do you inform visitors as to the health and safety issues around the operation and do you provide them with toilet and handwashing facilities?

Walk Around Questions (WAQ)

Postharvest Sanitation (Tab 14)

Potential locations –observe packing, observe cleaning/sanitation at packinghouse, chemical storage area, cold rooms and other storage areas

[112.111]; Do you harvest and handle both covered and non-covered produce? If so, do you separate covered and non-covered produce? If so, please describe separation (physical, time, handling, cleaning).

[112.113]; How do you handle produce that contacts the ground, packinghouse floor, or other non-food contact surface?

[112.123] (D); Do you clean and/or sanitize equipment?
- [112.123(c)(1)]; How do you clean equipment? Do you sanitize cleaned equipment? If so, how?
- [112.140]; Do you keep records? If so, what records?

[112.116]; How do you ensure your packaging materials are clean and sanitary?
- [112.116(a)]; How do you handle damaged or cracked containers?
- [112.115]; Does packaging allow for air flow?

[112.124]; Are you using any monitoring equipment i.e., temperature recorders, pH meters, etc.? If so, do you check their accuracy and how often?

[112.125]; How do you ensure vehicles used to transport produce are cleanable (ook for carpet, absorbent material, etc.), clean and/or sanitary?

[112.126]; Are building drains, wal's, ceil ngs and floors checked for leaks or other sources of contamination? How often are they cleaned? Are buildings adequate in size and construction (including adequate partitions and drainage)
- [112.126(a)(2)]; Is there standing water? If so, how is it addressed?
- [112.133]; Is plumbing sufficient?

[112.128]; Do you have a pest control program in place? If so, describe.

[112.127]; Are domestic animals allowed in the packinghouse?

[112.131]; What type of sewage system (septic, municipa , etc.) do you have for the packinghouse?

[112.132]; How often do you remove culled produce and trash from the packing area?

Walk Around Questions (WAQ)

Postharvest Water (Tab 15)

Potential locations – water source (well, connection to municipal) point of water use if during packing (hydrocooler, flume, dump tank, spray bar), sanitation

**[112.42(a)(1)] (D): What are your sources of water used during postharvest operations? (Think about all the water used for equipment and direct food contact surface cleaning, hand wash water, dump tanks, ice making, fluming and hydrocooling.)

**[112.42(a)] (D): Do you inspect your water system? If so how often? What things do you look for in the inspection? (Ask the grower to walk through a typical inspection with you.)

**[112.42(a)(4)] (D) What are the specific activities near the source or through the conveyances that impact the quality of these water sources (On this farm, from adjacent land)? How likely will these activities contaminate the water source?

**[112.42(c)]: How do you protect your water sources (cross-connections, backflow prevention)?

**[112.46] (D): How do you assess water quality for postharvest uses? Testing? How frequently and when? What test(s) [target organism, testing method] are you using? Do you know what your water unit testing is? How do you take your water samples? Are you familiar with the Microbial Water Quality standards required for postharvest water?

[112.48(a)]: Do you re-use or recirculate water? If so, please describe.
How do you determine when it's time to change recirculated water?

**[112.43] (D): Do you use an antimicrobial (sanitizer, UV)? How do you use them? How do you monitor their effectiveness? How frequently do you monitor it?
(Depending on your sanitizer) Do you monitor the pH of this water?

[112.48(b)]: Are you familiar with water turbidity? How do you gauge/measure this?
[112.48(c)]: Based on what you harvest, is the temperature of the water a concern? How do you address it?

**[112.45] (D) What do you do if a water test comes back higher than expected (a positive generic *E. coli* test)? How would you correct this in your packinghouse?

[112.50(a) (D): What documents do you keep related to you water sources, antimicrobial use, and testing?

CALIFORNIA APPLE EXPORT MARKETS

WORLD APPLE REVIEW

The publication of the World Apple Review was released two decades ago by Dr. Desmond O'Rourke to provide the apple industry with an insight into issues occurring across the global market. The report includes summaries of both current and future issues within the industry. The 2017 edition of The World Apple Review, called *Solving the Variety Puzzle*, has one dominant theme which identifies the key changes that are affecting our industry. Specifically, the review outlines changes that may affect areas such as production, trade, processing, consumption, marketing, pricing, and profitability in old and new apple varieties.

Other topics that this year's World Apple Review covers include the following and more:

- Can the period of recent prosperity be sustained?
- Demand for non-traditional fruits surging;
- More apples becoming available for export;
- Challenges penetrating markets in Middle East, Southeast Asia, South America;
- Apple demand responds slowly to income increases, strongly to price increases;
- How inflation and exchange rates are affecting global competition;
- Organics still winning the public relations battle over conventional fruit;
- Technology now an integral part of competition in fresh apples; and
- Labor anxiety is still pervasive. How close is automation as a solution?

These annual reviews have been beneficial in providing readers with an early insight and the knowledge to proactively address these issues as they arise in their businesses. Read more about the World Apple Review at www.e-belrose.com.

CALIFORNIA APPLE EXPORT AND DOMESTIC MARKET OVERVIEW

The California Apple Commission has culminated the final export numbers for the 2017/2018 season. California exported a total of 67,583 boxes, and has relied on apple exports less and less over the last several years for several reasons. First, the domestic pricing and early availability of California apples has priced out most foreign buyers. Second, the varieties that are increasing in California are varieties that are better suited for the domestic market rather than the international market. Third, the international apple market has become highly competitive. For example, China is flooding South East Asia with cheap apples which is squeezing California out of the market. Finally, international trade agreements have made trade more difficult with retaliatory tariffs being implemented around the world with apples normally on the list. Even with these barriers, California is still heavily focused on maintaining a presence and supportive role in the international apple arena. The CAC believes that with the assistance of the U.S. Apple Export Council, U.S. apples can be competitive in international markets, thus taking pressure off the domestic market.

California is still one of the largest exporters of apples in the United States and actively receives Market Access Program dollars to help maintain these necessary export markets. Last season, the Commission and the U.S. Apple Export Council received $944,272 for the 2017-2018 program year and will receive roughly the same for the 2018/2019 program year.

California receives a plethora of benefits from the allocated funding as we are one of the largest exporters on the Council and participate in almost every export program. Below is a list of the top five countries and U.S. states that California shipped to this season. Enclosed is an overview of specific markets that are important to California and info on markets that receive MAP, TASC, or EMP funding and all statistical shipping and destination information.

Top Countries

1) Canada	(59,175)
2) Mexico	(8,020)
3) Thailand	(290)

Top U.S. States

1) California	(759,593)
2) Texas	(209,808)
3) New Jersey	(164,389)

FOREIGN AGRICULTURAL SERVICE

The Foreign Agricultural Service (FAS) helps expand and maintain foreign markets for U.S. agricultural products by removing trade barriers and enforcing U.S. rights under existing trade agreements. The FAS works with foreign governments, international organizations, and the Office of the U.S Trade Representative to establish international standards and rules to improve accountability and predictability for agricultural trade. Additionally, FAS partners with the cooperators, such as U.S. Apple Export Council, to help U.S. exporters develop and maintain agricultural export markets. FAS distributes funding to these cooperators via the Farm Bill under programs such as the Market Access Program(MAP), Technical Assistance for Specialty Crops (TASC), and Emerging Market Programs (EMP). Each of these programs keeps U.S. products more competitive and counter the subsidized foreign competition in the international markets.

Currently, the California Apple Commission, through its partnership with the U.S Apple Export Council, received a share of the $944,272 for the 2017 – 2018 season. This funding allocation covered nine export markets, in which California participated in four of the markets. These dollars funded programs such as the Mexico inspection program, import and retail trade servicing within the export markets, consumer communication, trade missions, education, and market research. The overall allocation to the U.S. Apple Export Council for the 2018 – 2019 program year will be roughly $1,000,000.

CANADA

The United States remains the largest exporter of apples to Canada with nearly an 80% market share. Unfortunately, this luxury has been decreasing in recent years due to the influx of apples being exported from the southern hemisphere and China. Canada is California's largest export market and remains one of the largest export markets for the US Apple Export Council (USAEC). Several varieties are exported to Canada, with Gala and Granny Smith making up the majority of the volume coming from California.

In 2018, the USAEC began a new strategy in Canada, which included coordinating with California shippers and targeting specific retailers at specific times based on the shipments that were going to Canada – "following the fruit." The USAEC is going to continue this strategy in 2019 with the hopes of partnering with other commodities to pool resources. Additionally, the USAEC will also be focused on wholesalers or smaller regional retailers that are heavily invested in organics and niche markets. The USAEC will also use utilize geo targeting with ads that will be very specific based on zip codes. The USAEC has found that in addition to the major retailers, these smaller, regional outlets have been increasing their requests for California fruit and USAEC assistance.

Furthermore, in 2017-18, the USAEC began running the TASTEUS marketing Global Based Initiative (GBI). Initially this provided additional resources and funding to pair with the USAEC assets but due to some FAS staff reshuffling it became more of a burden than a benefit and most commodities dropped out of the program, including the USAEC.

The CAC has also been closely monitoring and discussing the US/Canada trade situation. Recently, in response to US imposition of steel and aluminum tariffs under-ruling 232, Mexico, Canada, and the EU have issued retaliation lists of products where high tariffs – mostly 25% will be imposed on US exports. Unfortunately, apples are high on the list. The CAC will continue to be involved in future discussions and will provide updates accordingly. An additional matter of concern is that Canada and Mexico are revisiting the Country of origin labeling (COOL) issue. The COOL issue was settled last year, but with the current political climate COOL, could very likely return.

The Foreign Agricultural Service will contribute $108,840 in 2018-2019 on behalf of the California Apple Commission to help maintain this market.

MEXICO

For the 2018-2019 season, the Mexico inspection program will begin the 4th year of the phase-out process of the newly negotiated work-plan. In the new work-plan, the inspector will arrive in August 2018 for the treatment facility inspection and return to Mexico 2 days later. The Mexico inspector will not return for a follow up inspection as USDA-APHIS will conduct the remainder of the inspections.

Additionally, the Commission, in conjunction with USDA-APHIS and Chapman University, was successful in adding irradiation as an additional treatment protocol to the Mexico export program. California apples are now allowed to be irradiated in the U.S. or Mexico (if tarped) as a treatment protocol. California apples are being used as a trial run for other commodities. With the help of Chapman University, research on irradiation and apples will continue throughout the 2018 - 2019 season.

On June 5, 2018, in response to U.S. imposition of steel and aluminum tariffs under-ruling 232, Mexico announced a 20% tariff on U.S. Apples, which will go into effect immediately. With many commodities being affected, the U.S. apple industry will have many allies to partner with. The CAC will be active in the situation, and please contact the CAC office if you have any questions or comments. An additional matter of concern is that Canada and Mexico are revisiting the Country of origin labeling (COOL) issue. The COOL issue was settled last year, but with the current political climate COOL, could very likely return.

The Foreign Agricultural Service will contribute $8,000 in 2018-2019 on behalf of the California Apple Commission to help maintain this market.

SOUTH EAST ASIA – INCLUDING TAIWAN

South East Asia (SEA), a region including Malaysia, Thailand, Indonesia, Singapore, Vietnam, Taiwan, and the Philippines, has historically been one of California's largest export markets, but has recently declined in importance. However, South East Asia continues to be a valuable market to the U.S. Apple Export Council. Over the last several years, California has relied less on the South East Asian market for a number of reasons. First, with the strong domestic market and a smaller Granny Smith variety crop, California has not had a need to export to SEA. Second, competition from China and Washington State have strained the window for California apples. Nearly 80% of China's overall apple exports are specifically focused on SEA. Finally, over the last several years, the USAEC has been focusing on expanding other varieties such as the Empire and Honeycrisp. These variety of apples are not grown in California but are growing in popularity in growing regions on the east coast and Michigan. The USAEC continues to promote and educate buyers on all U.S. apples which benefits all states, including Washington.

The main competition in SEA continues to be China and Washington State. The CAC and the USAEC realize that in sheer volume, California will not be able to compete. The objective is for the USAEC to compete in quality and therefore extend California's marketing window by several weeks. With many consumers concerned with quality and food safety, the USAEC believes that with precise targeting of specific retailers, extending California's marketing window can be achieved. According to the USAEC representative, health trends and food safety concerns are the key factors in the development of SEA's retail and wholesale markets. The USAEC will try and capitalize on these factors by "piggy-backing" on the promotional campaigns being conducted by the South East Asian governments, emphasizing the importance of fruits and vegetables for a healthy lifestyle.

The future of the SEA market is murky. With the current population of 600 million people, and growing quite substantially every year, the opportunity for apples exists. Unfortunately, as China increases their total apple production and other countries such as New Zealand, Australia, and Chile increase their ability to store apples long term, the SEA market begins to get squeezed due to proximity and price. For the USAEC, and more specifically California, remaining successful in the SEA market will require an increased emphasis on quality of size, color, taste, and the safety of the product. This must be emphasized by both the USAEC and the specific apple handlers.

In 2018-2019, the Foreign Agricultural Service will contribute $177,500 on behalf of the California Apple Commission to help maintain this market.

INDIA

Since India has one of the largest middle classes in the world in addition to a large upper class, the U.S. apple industry has been trying to expand access to this market. Initial difficulties within the Indian market included lack of infrastructure to transport and store apples. As retail giants such as Costco and Walmart gained access, they began investing in infrastructure and transportation, and the issues began to improve dramatically. Additionally, the retailer's investment was supported by additional investments and commitments by the Indian government to open the market to U.S. investments. This made India a very attractive market and helped expand the U.S. apple market share from 100k metric tons in 2009 to over 300k metric tons in 2016. Unfortunately, this growth has been stymied by the implementation of a 30% tariff on all U.S. apples being imported into India.

For California specifically, India is not a market of priority. The varieties grown in California and the availability of California apples are not conducive to California's marketing/shipping window. That being said, the CAC supports the U.S. Apple Export Council's push to gain a larger market segment. If large volumes of apples from Washington State and the Eastern U.S. are exported to India, it would greatly decrease the pressure domestically and could ease the strain on localized export markets such as Mexico and Canada.

The Foreign Agricultural Service and the U.S. Apple Export Council will contribute $120,000 on behalf of the California Apple Commission to help maintain this market.

RUSSIAN EFFECT ON EXPORTS

The ban on western products in Russia continues, and has sent a ripple throughout the world wide apple industry. Initially, the consensus was that China would fill the western apple export gap through traditional avenues and other avenues would be utilized by Poland to meet Russia's demand. This, however, did not happen. China began heavily exporting to SEA during the Listeria outbreak several years ago and never stopped. The small amount of apples that did go to Russia from China, did little to alleviate the pressure on the international market. Poland did use other avenues to export apples to Russia, but remained heavily focused on the EU market. Additionally, Poland has been aggressively pursuing access into the U.S. by claiming that they should fall under the EU work plan. This is extremely problematic and would put additional pressure on an already overcrowded domestic market. As of now, access has not been granted and the current political climate in regards to trade agreements could work in our favor.

SUMMARY FOR EXPORTS

Export markets will remain an area of focus even as exports from California have diminished. The California Apple Commission will remain a supportive member of the U.S. Apple Export Council due to the fact that apples that are exported will relieve pressure on the domestic market and keep prices relatively high.

CALIFORNIA APPLE DOMESTIC AND EXPORT STATISTICS

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2017-2018
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	CRIPP PINK	BRAEBURN	OTHER	TOTAL
ALABAMA	833	196					**1,029**
ARIZONA	15,402	12,684	2,952	1,876	44		**32,958**
ARKANSAS	16,638	3,338	3,420				**23,396**
CALIFORNIA	353,753	163,117.40	85,418.40	58,328.80	2,259	16,220	**679,096.60**
COLORADO	13,291	9,120	207		383	786	**23,787**
CONNECTICUT	1,127	308				1,960	**3,395**
FLORIDA	14,461	3,955.60	1,156		98	973	**20,643.60**
GEORGIA	58,261.20	52,055.70	8,825		7	497	**119,645.90**
HAWAII	280	515					**795**
ILLINOIS	10,380	7,154	1,586	784		321	**20,225**
INDIANA	12,528	7,679	1,813		68	651	**22,739**
IOWA	7,104	4,981					**12,085**
KANSAS	5,697	2,778	635				**9,110**
KENTUCKY	12,139	8,658	1,770	559	147	684	**23,957**
LOUISIANA	12,011	3,233	1,020				**16,264**
MAINE	8,880	3,000	1,380	1,003			**14,263**
MARYLAND	4,326	4,036	114	75		534	**9,085**
MASSACHUSETTS	2,177	4,141	294				**6,318**
MICHIGAN	22,080	4,465	3,786	1,875			**32,206**
MINNESOTA	14,802	17,265	2,176	98	410	420	**35,171**
MISSISSIPPI	1,320						**1,320**
MISSOURI	9,896	2,882	5,880				**18,658**
MONTANA							
NEBRASKA	1,334		2,580				**3,914**
NEVADA	3,332	1,257					**4,589**
NEW HAMPSHIRE							
NEW JERSEY	87,023	36,474	2,296	490	343	344	**126,970**
NEW MEXICO		980					**980**
NEW YORK	8,808	16,276	7,668	477			**16,953**
NORTH CAROLINA	5,490	817	77		227	271	**6,882**
OHIO	33,762	18,563	3,971			98	**56,394**
OKLAHOMA	8,280	5,094	5,739			357	**19,470**
OREGON	1,470	389	98		229	469	**2,655**
PENNSYLVANIA	6,511	3,302	2,041	2,311	126	530	**12,510**
SOUTH CAROLINA	1,421						**1,421**
TENNESSEE	9,151	5,599	1,591	3,548			**19,889**
TEXAS	114,599	35,204	17,319	5,379		1,263	**173,764**
UTAH	8,649	2,891					**11,540**
VERMONT							
VIRGINIA	9,282	5,593	1,568				**16,443**
WASHINGTON	52,905	7,332	147		294	501	**61,179**
WISCONSIN	6,743	335	3,436		28	155	**10,697**
WYOMING	4,392		2,620				**7,012**
TOTAL	**951,658.20**	**405,326**	**300,434**	**99,919**	**6,964**	**42,436**	**1,750,856**

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2016-2017
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	PINK LADY	BRAEBURN	OTHER	TOTAL
ALABAMA	6,429	588	5,640				12,657
ARIZONA	36,216	28,494	765	4,837	400		77,312
ARKANSAS	13,800		3,840				17,640
CALIFORNIA	208,719	169,507	146,279	66,989	3,611	26,982	622,087
COLORADO	10,465	882	588		559	547	13,041
CONNECTICUT		686	98				784
FLORIDA	58,350	8,882	10,836		98	2,104	80,270
GEORGIA	31,989	13,808	6,062	88	98		52,045
HAWAII	405		1,614				2,019
ILLINOIS	50,886	5,546	5,140				61,573
INDIANA	19,781	1	4,367		363	1,324	25,836
IOWA	3,905	2,086	175	147	7		6,320
KANSAS	560		176				736
KENTUCKY	10,359	419	3,584		441	1,882	16,685
LOUISIANA	10,197	784	720				11,701
MAINE	8,880	3,000	1,380	1,003			14,263
MARYLAND	436	1,302	49			1,470	3,257
MASSACHUSETTS	1,918	702	294				2,914
MICHIGAN	30,174	2,922	4,507				37,603
MINNESOTA	24,279	42,951	6,099	1,212	294	1,987	76,823
MISSISSIPPI	10,143	98	2,640				12,881
MISSOURI	28,121	1,958	4,679				34,758
MONTANA							
NEBRASKA	10,620		180				10,800
NEVADA	12,019	21,686	14,809	5,065			53,579
NEW HAMPSHIRE		70					70
NEW JERSEY	1,653	1,504			47		3,204
NEW MEXICO	16,100	10,329	2,820	240			29,489
NEW YORK	10,811	16,276	3,525	1,564			32,176
NORTH CAROLINA	16,502	247	4,285		49	1,407	22,490
OHIO	34,717	836	5,943			686	42,182
OKLAHOMA	16,406	12,214	4,020	4,100			36,740
OREGON	70	46	98		49	70	333
PENNSYLVANIA	26,187	24,401	7,969	2,311		364	61,232
SOUTH CAROLINA	11,620	441	2,040				14,101
TENNESSEE	15,066	2,352	3,479				20,897
TEXAS	83,273	20,873	16,661	8,012	23	3,422	132,264
UTAH	30,975	3,120	9,747	4,350			48,192
VERMONT			98		484		582
VIRGINIA	13,200	196	2,141				15,537
WASHINGTON	6,144	3,430	3,128		98	191	12,991
WISCONSIN	19,219	2,688	3,157		343		25,407
WYOMING	5,180		200				5,380
TOTAL	**895,776**	**405,326**	**300,434**	**99,919**	**6,964**	**42,436**	**1,750,856**

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2015-2016
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
ALABAMA	21,302	455	1,552				23,309
ALASKA	217						217
ARIZONA	28,834	15,001	735	2,596			47,166
ARKANSAS	10,214	160	325				10,699
CALIFORNIA	240,232	163,692	120,450	49,540	8,910	29,721	612,547
COLORADO	6,853	441	540		196	119	8,149
CONNECTICUT	196	49					245
FLORIDA	57,843	10,004	5,635	25	266	119	73,892
GEORGIA	25,217	12,066	4,220				41,503
HAWAII	392		645				1,037
ILLINOIS	42,631	21,879	7,268	490	441	322	73,031
INDIANA	25,827	4,375	2,394		357	47	33,000
IOWA	3,159	2,266	49	56	21		5,551
KANSAS	1,880	147		595			2,622
KENTUCKY	15,272	848	1,313		390	190	18,013
LOUISIANA	14,208	4,599	2,991				21,798
MAINE	8,515	3,398					11,913
MARYLAND	588	2,122	49				2,759
MASSACHUSETTS	4,760	2,425	309	877	27	98	8,496
MICHIGAN	23,078	3,692	7,090	98	98		34,056
MINNESOTA	8,128	32,437	147	1,922	1,058	539	44,231
MISSISSIPPI	12,558	195	969				13,722
MISSOURI	31,929	7,839	5,605				45,373
NEBRASKA	11,887	260					12,147
NEVADA	14,280	9,782	9,045	4,144			37,251
NEW HAMPSHIRE	98	196				21	315
NEW JERSEY	2,800	2,366	35		391	98	5,690
NEW MEXICO	18,311	14,588	2,176	2,278	301		37,654
NEW YORK	15,790	18,715	2,161	294			36,960
NORTH CAROLINA	18,743	4,611	3,825		112		27,291
OHIO	34,639	5,433	4,923		145	98	45,238
OKLAHOMA	18,967	7,795	4,005				30,767
OREGON	539	882	98		82	31	1,632
PENNSYLVANIA	24,206	21,171	5,475	1,029			51,881
RHODE ISLAND	1						1
SOUTH CAROLINA	11,775	260	520				12,555
TENNESSEE	8,586	2,906	946				12,438
TEXAS	101,285	37,828	13,882	11,278	178	49	164,500
UTAH	26,866	3,499	2,786				33,151
VIRGINIA	6,611	130					6,741
WASHINGTON	4,601	244					4,845
WISCONSIN	22,636	4,365	4,330				31,331
WYOMING	4,110	2,836	1,365				8,311
Total	**930,566**	**425,958**	**217,859**	**75,222**	**12,973**	**31,452**	**1,694,032**

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2014-2015
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
ALABAMA	19,241	3,962	1,369	1,950			26,522
ARIZONA	14,444	24,323	4,745	582	49		44,143
ARKANSAS	8,005	455	65	975			9,500
CALIFORNIA	189,811	275,407	124,793	12,261	3,236	55,912	661,422
COLORADO	1,666	8,363	2,932		525	1,846	15,332
CONNECTICUT	203	49					252
FLORIDA	41,915	15,708	9,603	2,517	49	308	70,100
GEORGIA	17,531	16,499	4,928	975	147	49	40,129
HAWAII	121						121
ILLINOIS	23,628	16,548	8,195	2,296	443	1,078	52,188
INDIANA	21,419	5,479	2,674	2,656	273	1,596	34,097
IOWA	2,805	6,327	166		93		9,391
KANSAS	759	3,001	25		98		3,883
KENTUCKY	8,443	1,450	294	975		392	11,554
LOUISIANA	5,855	2,685	2,579	1,460			12,579
MAINE	5,155	1,011		975			7,141
MARYLAND	774	8,267	98			929	10,068
MASSACHUSETTS	6,523	21,987	735	1,521	98	772	31,636
MICHIGAN	11,469	5,176	6,129		97		22,871
MINNESOTA	3,224	32,643	182	294	977	250	37,570
MISSISSIPPI	3,642	650	780	843			5,915
MISSOURI	20,588	8,420	5,560	2,360			36,928
NEBRASKA	10,673	520	650	1,235			13,078
NEVADA	11,446	11,657	1,225	975			25,303
NEW HAMPSHIRE						143	143
NEW JERSEY	539	17,332	1,176			224	19,271
NEW MEXICO	7,595	11,026	1,865	650			21,136
NEW YORK	7,274	46,356	2,164	1,612	28	14	57,448
NORTH CAROLINA	13,728	5,187	3,479	975	30	87	23,486
OHIO	27,916	8,354	4,554	1,967		954	43,745
OKLAHOMA	14,000	2,930	3,161	1,820			21,911
OREGON	2,450	98	49		98	216	2,911
PENNSYLVANIA	22,817	34,032	3,859	2,275	355	1,005	64,343
SOUTH CAROLINA	10,182	1,531	455	649			12,817
TENNESSEE	7,364	5,156	1,040	975			14,535
TEXAS	93,389	66,219	19,958	12,899	98	3,117	195,680
UTAH	5,819	3,138	1,820	650			11,427
VIRGINIA	14,345	4,890	1,550	1,170			21,955
VERMONT			14			35	49
WASHINGTON	6,798	11,134		650		145	18,727
WISCONSIN	9,782	2,810	3,306	975			16,873
WYOMING	15,203	2,025	1,340	650			19,218
TOTAL	688,547	692,806	227,517	62,767	6,694	69,072	1,747,405

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2013-2014
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
ALABAMA	17,359	940		98	294		18,692
ARIZONA	21,303	10,779	1,618	4,035	427		38,162
ARKANSAS	11,709						11,709
CALIFORNIA	223,144	426,553	173,135	102,500	8,041	36,557	969,932
COLORADO	3,396	1,979	359	70	196	1,48	7,481
CONNECTICUT	851						851
DIST. OF COLUMBIA	931						931
FLORIDA	31,727	6,234	3,909	70	583	469	42,993
GEORGIA	12,703	9,871	3,587		441	49	26,651
HAWAII	405	98	1,785				2,288
ILLINOIS	41,011	5,532	3,968	2,695		442	53,648
INDIANA	16,402	18,087	1,632	533		728	37,382
IOWA	2,403	3,925	1,715	903	1,078		10,024
KANSAS				430			430
KENTUCKY	10,043	5,902	245	80	490	523	17,283
LOUISIANA	4,822	83	1,785	15			6,705
MAINE	1,950	1,666					3,616
MARYLAND	1,798	196	128	441	14	642	3,219
MASSACHUSETTS	5,612	14,423	2,372	2,691	343	1,116	26,557
MICHIGAN	8,770	8,987	5,375		224		23,356
MINNESOTA	1,920	23,794	441	828	1,597	405	28,985
MISSISSIPPI	7,152						7,152
MISSOURI	26,910	3,136	2,190	490			32,726
NEVADA	9,787	13,275	49				23,111
NEW HAMPSHIRE	77	294	98		371	147	987
NEW JERSEY	1,225	7,109	296	889	752	1,246	11,517
NEW MEXICO	13,368	93	142		28		13,631
NEW YORK	5,804	18,127	1,050	2,564	1,225		28,770
NORTH CAROLINA	9,202	3,418	3,129		21	70	15,840
OHIO	18,018	5,054	6,986	2,366		852	33,276
OKLAHOMA	20,949						20,949
OREGON	147	1,591			49	314	2,101
PENNSYLVANIA	13,292	21,603	4,659	885	337	1,420	42,196
SOUTH CAROLINA	3,345	352		49			3,746
TENNESSEE	5,690	5,647		2,532			13,869
TEXAS	99,327	126,276	3,950	16,169	920	1,463	248,105
UTAH	16,700	2,614		1,195			20,509
VIRGINIA	1,847	2,221			784		4,852
WASHINGTON	10,019	49,734				98	59,851
WISCONSIN	2,430	28	2,249		49		4,756
WYOMING	2,976						2,976
TOTAL	**686,538**	**799,625**	**226,852**	**142,530**	**18,264**	**48,022**	**1,921,832**

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2012-2013
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
ALABAMA	7,357	9,864	186				17,407
ARIZONA	17,341	16,655	4,374	1,294	21		39,685
ARKANSAS	3,998						3,998
CALIFORNIA	216,877	297,090	94,785	45,606	5,645	15,727	678,730
COLORADO	12,799	8,610	2,401	266	125	1,674	25,875
CONNECTICUT	343	539					882
FLORIDA	32,641	16,582	4,880	29		98	54,230
GEORGIA	19,698	16,398	8,218	2,940	147		47,401
HAWAII	1,079	1,027	1,244				3,347
IDAHO	490						490
ILLINOIS	27,676	14,968	1,581	9,124	411	1,238	54,998
INDIANA	10,106	6,154	3,357		98	671	20,386
IOWA	952	3,846	98	294	1,019		6,209
KANSAS	2,500	819		294			3,613
KENTUCKY	7,181	24,046	260		196	98	31,781
LOUISIANA	2,413	1,664	4,164				8,241
MAINE	854	6,514					7,368
MARYLAND	3,528	12,831	2,037	1,390	14	532	20,332
MASSACHUSETTS	13,181	20,379	3,087	1,420	392	21	38,480
MICHIGAN	20,278	21,915	18,758		21		60,972
MINNESOTA	2,010	43,745	693	581	695	2,049	49,773
MISSISSIPPI	6,829						6,829
MISSOURI	23,265	19,175	3,049				45,489
MONTANA	196			182			378
NEBRASKA	1,708						1,708
NEVADA	3,450	10,680	296				14,426
NEW HAMPSHIRE	147	245	52			1,459	1,903
NEW JERSEY	603	10,569	472			1,299	12,943
NEW MEXICO	3,899	147					4,046
NEW YORK	10,400	28,939	1,205	1,716	56	42	42,358
NORTH CAROLINA	2,399	4,811	1,313				8,523
NORTH DAKOTA		209					209
OHIO	22,938	10,808	2,874	1,743	49	980	39,392
OKLAHOMA	9,288	49	455				9,792
OREGON	3,309	2,891		686		137	7,023
PENNSYLVANIA	14,849	27,839	1,889	4,471	35	1,310	50,393
SOUTH CAROLINA	2,764	3,136					5,900
TENNESSEE	9,751	7,925		490			18,166
TEXAS	81,150	84,894	9,104	19,239	978	2,551	197,916
UTAH	11,847	777	399	1,540	35		14,598
VERMONT	49						49
VIRGINIA	1,894	2,296	377				4,567
WASHINGTON	9,238	14,858	134	1,070	147		5,447
WISCONSIN	7,845	294	287	91	444		8,961
WYOMING	5,178		175				5,353
TOTAL	639,296	754,189	172,204	94,466	10,528	29,886	1,700,568

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2011-2012
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
ALABAMA	14,602	14,319		147			29,068
ARIZONA	33,583	27,018	3,405	5,160		1,653	70,819
ARKANSAS	9,425						9,425
CALIFORNIA	187,132	251,077	102,186	48,385	2,600	60,198	651,580
COLORADO	18,294	15,684	3,009	1,596	303	1,429	4,0316
CONNECTICUT	3,388	1,568	98				5,054
DIST. OF COLUMBIA	196	196				686	1,078
FLORIDA	35,384	30,768	2,588		21	3,174	71,935
GEORGIA	31,182	17,718	7,505	2,450		3,058	61,913
HAWAII	294	98	343				735
IDAHO	133	539					672
ILLINOIS	41,511	35,830	4,893	3,920	245	5,609	92,009
INDIANA	34,460	31,970	3,103		210	2,925	72,668
IOWA	483	5,497	32		234		6,246
KANSAS	2,604	4,440	198	588		1,675	9,506
KENTUCKY	14,240	23,990	882		147	1,397	40,656
LOUISIANA	13,133	5,045	3,220				21,398
MAINE	1,631	11,870					13,501
MARYLAND	6,451	17,761	21,655	7,028		3,155	56,050
MASSACHUSETTS	4,949	37,752	4,655	6,909	156	8,272	62,693
MICHIGAN	26,632	21,455	7,670	196	420	4,953	61,326
MINNESOTA	11,598	54,720	49	2,429	1,742	19,808	90,347
MISSISSIPPI	3,705	3,045					6,750
MISSOURI	2,7841	16,293	5,754	1,637		3,466	54,992
MONTANA	245	1,077					1,322
NEBRASKA	7,605	7,163		168			14,936
NEVADA	7,319	7,323	245			1,134	16,021
NEW HAMPSHIRE	350	420			21	290	1,081
NEW JERSEY	6,344	18,777	196		14	812	26,143
NEW MEXICO	11,473	5,948	49				17,470
NEW YORK	8,182	36,120	2,128	3,393		5,186	55,009
NORTH CAROLINA	8,000	24,677	2,974	416	63	273	36,404
NORTH DAKOTA		28		40		147	215
OHIO	42,361	24,357	7,017	539	98	1,428	75,800
OKLAHOMA	13,444	12,475	1,533		145	49	27,646
OREGON	2,685	4,004	196			962	7,848
PENNSYLVANIA	19,164	33,233	2,856	7,894	258	3,615	67,020
RHODE ISLAND		147					147
SOUTH CAROLINA	1,160	10,472				294	11,926
TENNESSEE	15,619	12,703		1,746		2,058	32,127
TEXAS	91,224	93,039	6,795	19,445	441	7,071	21,8016
UTAH	27,451	13,053	4,420	735		98	45,757
VERMONT	196	49					245
VIRGINIA	8,295	11,546	686			1,134	21,661
WASHINGTON	18,581	28,204	6,569		49	7,093	60,496
WISCONSIN	8,934	10,636	665	196	33	637	21,101
WYOMING	18,420	5,235	1,820				25,475
TOTAL	**839,913**	**989,347**	**209,396**	**115,018**	**7,201**	**153,739**	**2,314,612**

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2010-2011
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
ALABAMA	14,342	49					14,391
ARIZONA	59,031	42,189	714	490	1,593	269	104,286
ARKANSAS	3,960	3,700					7,660
CALIFORNIA	336,880	360,229	258,476	84,676	16,105	27,485	1,083,854
COLORADO	10,817	6,159	2,093	1,909	49	1,225	22,252
CONNECTICUT		2940					2,940
DIST. OF COLUMBIA	854	784	98				1,736
FLORIDA	25,780	13,003	4,368	240	128	499	44,018
GEORGIA	20,929	15,512	4,246	1,078		927.1	42,692
HAWAII	987	123	441				1,551
ILLINOIS	40,796	25,316	4,796			538	71,447
INDIANA	16,546	9,054	4,375		98	1,939	32,012
IOWA	2,072	2,058			49		4,179
KANSAS	98	98		1,073			1,269
KENTUCKY	14,323	1,074	147	5,880	514		21,938
LOUISIANA	4,234	5,499	1,995				11,728
MAINE	1,738	17,983					19,721
MARYLAND	3,647	23,335	1,239	2,177		1,470	31,868
MASSACHUSETTS	4,879	56,419	2,205	5,376	245		69,124
MICHIGAN	5,150	14,247	6,037	652	245		26331
MINNESOTA	9,996	49,460	245	2,695	326	441	63,163
MISSISSIPPI	6,039						6,039
MISSOURI	15,068	10,924	2,660	1,470	98		30,221
MONTANA				49			49
NEBRASKA	4,175						4,175
NEVADA	18,566	24,762	49				43,377
NEW HAMPSHIRE	441	147			147	288	1,023
NEW JERSEY	7,135	23,917	985	273		1,331	33,641
NEW MEXICO	11,296	2,798	244		98		14,436
NEW YORK	7,020	68,482	1,905	1,118	98		78,624
NORTH CAROLINA	12,746	6,768	4,011	50	529	1	24,105
NORTH DAKOTA	98						98
OHIO	13,440	5,911	5,295	5,864		190	30,700
OKLAHOMA	12,915	8,098	1,934	196			23,143
OREGON	7,470	947	2,176	486	87	273	11,439
PENNSYLVANIA	24,328	27,605	4,684	1,078	539	378	58,612
SOUTH CAROLINA	6,650	7,806					14,456
TENNESSEE	13,569	6,692	1,862	1,862			23,985
TEXAS	102,382	74,606	10,105	24,338	1,835	1,883	215,150
UTAH	22,768	147	116	490	28		23,549
VIRGINIA	6,860	4,508		637			12,005
WASHINGTON	9,543	13,650	4,620			196	28,009
WEST VIRGINIA				3			28,009
WISCONSIN	9,943	5,528	1,610	539			17,620
WYOMING	8,590	5,637	2,240				16,467
TOTAL	**898,106**	**948,167**	**335,972**	**144,701**	**22,812**	**39,334**	**2,389,092**

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2009-2010
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
ALABAMA	22,663						22,663
ARIZONA	26,552	1,9541	3,420	2,798		91	52,402
ARKANSAS	13,630	3,885					17,515
CALIFORNIA	149,145	369,232	102,671	56,641	9,459	7,272	694,421
COLORADO	8,166	4,477	6,486	1,253	955	625	21,962
CONNECTICUT	588	1,813					2,401
DIST. OF COLUMBIA	196	98					294
FLORIDA	41,921	7,412	4,711		98	798	54,940
GEORGIA	15,769	6,911	4,354		490	196	27,720
HAWAII	963	196	1,470				2,629
IDAHO							0
ILLINOIS	30,488	13,201	7,799	392	294	1,478	53,652
INDIANA	32,647	12,166	5,726	238	245	392	51,414
IOWA		3,318	141	980	14		4,453
KANSAS	132		679	294			1,105
KENTUCKY	12,877	5,831	98		147	175	19,128
LOUISIANA	6,530	2,140	2,625				11,295
MAINE	4,140	22,842					26,982
MARYLAND	2,598	27,267	3,758	98	147	536	34,404
MASSACHUSETTS	3,773	38,984	2,914	3,073	2,082	21	50,847
MICHIGAN	20,237	27,456	882	4,265			52,840
MINNESOTA	5,537	33,074	35	490	147	1,055	40,338
MISSISSIPPI	6,480	769	49				7,298
MISSOURI	24,122	3,360	3,555	2,591			33,628
MONTANA	441	294	98		49		882
NEBRASKA	10,755	2,040					12,795
NEVADA	9,400	4,428					13,828
NEW HAMPSHIRE	196	949	147			226	1,518
NEW JERSEY	9,596	18,128				484	28,208
NEW MEXICO	10,685	196	147	98	49		11,175
NEW YORK	12,789	61,930	4,221	2,606	2,576	327	84,449
NORTH CAROLINA	12,041	2,212	2,115			21	16,389
NORTH DAKOTA	98						98
OHIO	31,194	12,076	2,655	3,670		439	50,034
OKLAHOMA	16,354	1,505	2,520				20,379
OREGON	2,298	5,037	1,666		98	189	9,288
PENNSYLVANIA	21,725	30,759	4,277		667	963	58,391
SOUTH CAROLINA	8,970	1,054					10,024
SOUTH DAKOTA							0
TENNESSEE	23,015	8,267	98				31,381
TEXAS	90,441	61,265	7,539	22,239	245	1421	183,150
UTAH	24,394	6,667	3,724	224			35,009
VIRGINIA	9,983	4,465	398				14,846
WASHINGTON	14,969	6,605	5,334			105	27,013
WISCONSIN	9,708	3,820	2,800	147	182		16,657
WYOMING	15,253	3,504					18,757
TOTAL	**763,463**	**839,175**	**189,114**	**102,097**	**17,945**	**16,814**	**1,928,608**

CALIFORNIA APPLE COMMISSION-UNITED STATES
DOMESTIC SHIPMENTS 2008-2009
(MEASURED IN BOXES)

STATE	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
ALABAMA	17,805	10,038	3,914				31,757
ALASKA	98						98
ARIZONA	24,454	30,298	4,107	1,078		24	59,961
ARKANSAS	6,475	525					7,000
CALIFORNIA	274,786	673,536	177,101	93,594	4,384	25,446	1,248,847
COLORADO	12,467	17,015	3,761	3,111	844	1,260	38,458
CONNECTICUT	196	2,707					2,903
DIST. OF COLUMBIA	98						98
FLORIDA	47,269	21,400	1,081	98	234	3,263	73,345
GEORGIA	15,113	23,352	4,315		147	735	43,662
HAWAII	1,116	677	2,709				4,502
IDAHO	5,261	539	294				6,094
ILLINOIS	21,029	34,519	3,986	343	98	2,298	62,273
INDIANA	15,385	18,390	2,816	1,260	84	1,957	39,892
IOWA	588	3,094					3,682
KANSAS	1,793	1,029	147	245			3,214
KENTUCKY	11,478	12,793	1,274	666		310	26,521
LOUISIANA	5,026	4,782	875				10,683
MAINE		13,174					13,174
MARYLAND	9,307	44,072	735	1,323	196	49	55,682
MASSACHUSETTS	13,838	74,234	1,568	2,030		247	91,917
MICHIGAN	35,521	67,219	8,872	9,342			120,954
MINNESOTA	7,742	30,086	787	1,666	28	2,464	42,773
MISSISSIPPI	7,868	4,646	98				12612
MISSOURI	27,449	16,864	3,066	774	98		48,251
MONTANA		91				49	140
NEBRASKA	5,605	3,525					9,130
NEVADA	49	3772	196				4,017
NEW HAMPSHIRE	196	735			221	285	1,437
NEW JERSEY	11,738	46,759	441		441	372	59,751
NEW MEXICO	7,450	2,742			186		10,378
NEW YORK	11,631	84,835	2,033	2,295	285	758	101,837
NORTH CAROLINA	21,744	8,981	2,905				33,630
NORTH DAKOTA		49					49
OHIO	33,557	34,912	4914	6057	147	349	79,936
OKLAHOMA	10,081	3,379	935				14,395
OREGON	8,598	9,562	2170	735	294	4,403	25,762
PENNSYLVANIA	18,972	32,776	977	294	441	859	54,319
SOUTH CAROLINA	4,345	4,896					9,241
SOUTH DAKOTA	98						98
TENNESSEE	18,900	21,901		1,022			41,823
TEXAS	98,687	130,521	11,938	27,833	245	2,759	27,1983
UTAH	14,046	11,734	3,798	2,205			31,783
VIRGINIA	13,701	10,329	882	147			25,059
WASHINGTON	20,675	26,060	2,597			471	49,803
WISCONSIN	11,926	5,619					17,545
WYOMING	8,355	3,960					12,315
TOTAL	**882,516**	**1,552,127**	**255,292**	**156,118**	**8,373**	**48,358**	**2,902,784**

CALIFORNIA'S TOP 5 STATES
(MEASURED IN BOXES)

	2002 - 2003	
1	California	1,348,951
2	Texas	279,028
3	Massachusetts	126,021
4	New York	191,624
5	Illinois	141,671

	2003 - 2004	
1	California	1,409,491
2	Texas	328,190
3	New York	212,095
4	Florida	153,483
5	Illinois	130,305

	2004 - 2005	
1		
2	California	1,385,719
3	Texas	289,084
4	New York	172,145
5	Michigan	113,914
	Florida	104,664

	2005 - 2006	
1	California	1,281,242
2	Texas	269,165
3	Massachusetts	127,127
4	New York	125,481
5	Michigan	103,177

	2006 - 2007	
1	California	1,067,289
2	Texas	277,094
3	Missouri	181,318
4	Florida	106,220
5	Ohio	94,765

	2007 - 2008	
1	California	881,602
2	Texas	216,450
3	New York	71,673
4	Arizona	65,570
5	Ohio	58,515

	2008 - 2009	
1	California	1,071,112
2	Texas	253,561
3	Michigan	109,280
4	New York	87,951
5	Massachusetts	75,794

	2009 - 2010	
1	California	694,422
2	Texas	183,150
3	New York	84,449
4	Pennsylvania	58,392
5	Florida	54,940

	2010 - 2011	
1	California	1,083,854
2	Texas	215,150
3	Arizona	104,286
4	New York	78,624
5	Illinois	71,447

	2011 - 2012	
1	California	651,580
2	Texas	218,016
3	Illinois	92,009
4	Minnesota	90,347
5	Ohio	75,800

	2012 - 2013	
1	California	678,730
2	Texas	197,916
3	Michigan	60,972
4	Illinois	54,998
5	Florida	54,230

	2013 - 2014	
1	California	969,932
2	Texas	248,105
3	Washington	59,851
4	Illinois	53,648
5	Florida	42,993

	2014 - 2015	
1	California	661,422
2	Texas	195,680
3	Florida	70,100
4	Pennsylvania	64,343
5	New York	57,448

	2015 - 2016	
1	California	612,547
2	Texas	164,500
3	Florida	73,892
4	Illinois	73,031
5	Pennsylvania	51,881

	2016 - 2017	
1	California	622,088
2	Texas	132,264
3	Florida	80,270
4	Arizona	77,312
5	Minnesota	76,823

	2017 - 2018	
1	California	979,097
2	Texas	173,764
3	New Jersey	126,970
4	Georgia	119,646
5	Washington	61,179

EXPORT TOTALS
2017-2018
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	OTHER	TOTAL
CANADA	35,203.20	17,736.90	1,368	4,671	196	**59,175.10**
MALAYSIA	49		49			**98**
MEXICO	427	7,593				**8,020.00**
PUERTO RICO	294	245				**539**
THAILAND	290					**290**
TOTAL	**36,263.20**	**25,574.90**	**1,417**	**4,671**	**196**	**68,122.10**

EXPORT TOTALS
2016-2017
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	BRAEBURN	CRIPPS PINK	OTHER	TOTAL
CANADA	53,736	15,360	245	225	147	483	70,196
MEXICO	1,896	8,820					10,716
TAIWAN			5,552				5,552
TOTAL	55,632	24,180	5,797	225	147	483	86,464

EXPORT TOTALS
2015-2016
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
CANADA	34,166	9,394	549	133	546	196	44,984
HONG KONG							
INDIA							
INDONESIA							
MALAYSIA							
MEXICO	11,760	6,853					19,908
PANAMA	514	6,853	6,853.00				661
PUERTO RICO		6,853					49
SRI LANKA							
TAIWAN			6,853.00				13,682
THAILAND							
VIETNAM							
TOTAL	46,440	17,689	14,280	133	546	196	79,284

EXPORT TOTALS
2014-2015
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	TOTAL
CANADA	62,546	21,849	9,420	441	343	94,599
HONG KONG	882					882
INDIA		950				950
INDONESIA		4,831				4,831
MALAYSIA		17,933				17,933
MEXICO	6,762	4,389				11,151
PHILLIPPINES		3,910				3,910
PUERTO RICO		686				686
SRI LANKA		2,885				2,885
TAIWAN		2,940	25,912			28,852
THAILAND		9,690				9,690
VIETNAM		980				980
TOTAL	70,190	71,043	35,332	441	343	177,349

EXPORT TOTALS
2013-2014
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	BRAEBURN	OTHER	TOTAL
CANADA	74,805	43,226	13,388	196	490	132,105
ECUADOR		2,696				2,696
FRENCH POLYNESIA	294					294
INDONESIA		980				980
MALAYSIA		46,509				46,509
MEXICO	199	30,985				31,184
PERU		931				931
PHILLIPPINES		6,860				6,860
PUERTO RICO	49					49
SINGAPORE		4,662				4,662
SRI LANKA		11,680				11,680
TAIWAN	19	4,786	5,504			10,309
THAILAND		7,825				7,825
UNITED ARAB EMIRATES		4,655				4,655
VIETNAM		3,900				3,900
TOTAL	75,366	169,695	18,892	196	490	256,084

EXPORT TOTALS
2012-2013
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
CANADA	147,268	57,066	9,635	980	147	931	216,027
COLOMBIA		2,875					2,875
COSTA RICA	911						911
EL SALVADOR	931						931
HONG KONG		1,029					1,029
INDONESIA		2,940					2,940
MALAYSIA		31,713					31,713
MEXICO	13,425	26,278					39,703
PANAMA		1,617					1,617
PERU		3,087					3,087
PHILLIPPINES		2,903					2,903
PUERTO RICO		42					42
SINGAPORE		5,419					5,419
SRI LANKA		900					900
TAIWAN		5,152	31,384				36,536
THAILAND		9,775					9,775
VIETNAM		980					980
TOTAL	162,535	151,776	41,019	980	931	309,197	309,197

EXPORT TOTALS
2011-2012
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
CANADA	161,846	49,674	2,450	2,143		16,675	232,788
COLOMBIA		980					980
ECUADOR		5,965					5,965
HONG KONG		965					965
INDONESIA		1,940					1,940
MALAYSIA		30,818					30,818
MEXICO	9,968	8,799		2,058			20,825
PANAMA		7,791					7,791
PERU		2,940					2,940
PHILLIPINES		2,910					2,910
SRI LANKA		5,880					5,880
TAIWAN		0	15,629				15,629
THAILAND		5,769					5,769
TOTAL	171,814	124,431	18,079	4,201	0	16,675	335,200

EXPORT TOTALS
2010-2011
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
CANADA	51,241	63,779	98	1,617		147	116,882
COLOMBIA		980					980
ECUADOR		294					294
HONG KONG		3,038					3,038
INDIA		245					245
INDONESIA		14,592					14,592
MALAYSIA		13,643					13,643
MEXICO	17,339	17,297					34,636
NEW ZEALAND		980					980
PERU		2,900					2,900
PHILLIPINES		3,871					3,871
SINGAPORE		4,580					4,580
TAIWAN	2,664	2,590	31,700				36,954
THAILAND		3,890					3,890
VIETNAM		4,900					4,900
TOTAL	71,244	137,579	31,798	1,617	0	147	242,385

EXPORT TOTALS
2009-2010
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
CANADA	73,846	54,643	1,127	392		119	130,127
COLOMBIA		1,960					1,960
COSTA RICA	900	98					998
ECUADOR		1,680					1,680
EL SALVADOR	2,700						2,700
INDIA		1,078					1,078
INDONESIA		13,173					13,173
JAMAICA	45						45
MALAYSIA		38,509					38,509
MEXICO	13,197	2,058					15,255
PANAMA	490	1,078	267				1,835
PERU		2,254					2,254
PHILLIPINES		1,917					1,917
SAUDI ARABIA		2,156					2,156
SINGAPORE	840	17,234					18,074
TAIWAN	5,840	6,589	59,033				71,462
THAILAND	900	4,760					5,660
UNITED ARAB EMIRATES		14,065					14,065
UNITED KINGDOM	1,820						
VIETNAM		980					
TOTAL	100,578	164,232	60,427	392	0	119	324,768

EXPORT TOTALS
2008-2009
(MEASURED IN BOXES)

COUNTRY	GALA	GRANNY SMITH	FUJI	CRIPPS PINK	BRAEBURN	OTHER	TOTAL
CANADA	93,120	130,021	8,858	147		906	233,052
COLOMBIA		931					931
COSTA RICA		441					441
ECUADOR		4,200					4,200
HONG KONG		1,928					1,928
INDIA		3,920					3,920
INDONESIA		11,260					11,260
JAMAICA	392						392
MALAYSIA		129,263	196				129,459
MEXICO	58,409	38,038	3,773				100,220
NEW ZEALAND		5,128					5,128
PANAMA	994	6,603	784				8,381
SINGAPORE		44,532					44,532
SRI LANKA		6,878					6,878
TAHITI	30						30
TAIWAN		1,927	68,341				70,268
THAILAND		2,860					2,860
UNITED ARAB EMIRATES		3,528					3,528
UNITED KINGDOM				16,443			16,443
TOTAL	152,945	391,458	81,952	16,590	0	906	643,851

HISTORICAL PACK OUT REPORT

(MEASURED IN BOXES)

VARIETY	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015-2016	2016-2017	2017-2018
FUJI	295,886 295,886	337,244 337,244	249,541 249,541	367,770.3 367,770.3	227,475 227,475	213,223 213,223	245,745	262,849.80	232,140.00	306,231.00	166,135.4
GALA	714,879 714,879	1,035,461 1,035,461	864,044 864,044	969,350.2 969,350.2	1,011,727 1,011,727	801,831 801,831	761,904	758,736.90	977,006.40	951,408.40	987,921.4
GRANNY SMITH	1,244,291 1,244,291	1,943,585 1,943,585	805,345 805,345	1,085,746 1,085,746	1,113,778 1,113,778	905,965 905,965	969,320	763,849.30	443,648.00	429,506.20	469,634.6
CRIPPS PINK	165,477 165,477	172,708 172,708	102,489 102,489	146,317.5 146,317.5	119,219 119,219	95,446 95,446	142,530	63,208.60	75,355.30	100,066.00	77,683.8
BRAEBURN	24,831 24,831	8,373 8,373	17,945 17,945	22,297.9 22,297.9	7,201 7,201	10,675 10,675	18,460	6,694.10	13,519.60	7,189.40	4,663
ARKANSAS BLACK				6,796.4 6,796.4							
GOLDEN DELICIOUS			739 739	1,452 1,452					5.00		
GRAVESTEIN				8 8							
HONEYCRISP				9,010.6 9,010.6			8,998	6,192.00			
JONAGOLD	492 492										
LADY APPLE				293.13 293.13							
PIPPIN				274 274							
RED DELICIOUS	780 780		678 678	512 512	639 639	671 671	2,015	2,778.00	1,366.00	2,547.00	1,842
SPITZENBERG				180 180							
SUNDOWNER	1,177 1,177										155
SWEETIE								2,766.00			
OTHER	26,355 26,355	49,264 49,264	15,516 15,516	21,469 21,469	169,775 169,775	30,146 30,146	37,499	57,679.00	30,277.00	40,372.00	25,233
Total Packed	**2,474,168**	**3,546,635**	**2,056,297**	**2,631,477**	**2,649,814**	**2,057,957**	**2,186,471**	**1,924,753.70**	**1,773,317.30**	**1,837,320.00**	**1,733,268.20**
Total Shipped	**2,474,168**	**3,546,635**	**2,056,297**	**2,631,477**	**2,649,814**	**2,057,957**	**2,186,471**	**1,924,753.70**	**1,769,710.30**	**1,837,320.00**	**1,733,268.20**

INDUSTRY COMMUNICATIONS

APPLE COMMUNICATIONS

The California Apple Commission takes pride in ensuring our audience is kept up to date with issues concerning the apple industry. The CAC is on social media. Please follow us on the following social media outlets and let us know what you think. We would love to know what you want to hear more about.

Facebook.com/CaliforniaAppleCommission

Pinterest.com/calapple

The Commission has published a series of newsletters throughout the season, and they are included in this year's annual report. The Commission encourages you to sign up for our newsletters that are available both online and in hard copy. To sign up for the California Apple Commission's online newsletter, visit Calapple.org under the "About Us" tab. You can subscribe in the newsletter section. To subscribe to our hard copy newsletter please contact the Commission office. The Commission sends out newsletters on a bi-monthly basis.

CALIFORNIA APPLE COMMISSION

Newsletter

Issue No. 128 May/June 2018

CAC ALEXANDER J. OTT NAMED EXECUTIVE DIRECTOR OF THE AMERICAN PECAN COUNCIL

The California Apple Commission's Alexander J. Ott has taken a new position as Executive Director of the American Pecan Council. He will begin his position July 1, 2018. He served as Executive Director for the California Apple Commission for the past 13 years, in addition, he also served as Executive Director for the California Blueberry Commission and the California Olive Committee and will relocate from California to Texas to lead the American Pecan Council. We are honored and grateful for the outstanding leadership and service as Executive Director to the California Apple Commission and wish Alexander all the best in his future venture.

HOUSE OT VOTE ON TWO IMMIGRATION BILLS

Speaker of the House, Paul Ryan (R-WI), announced in June, that the House of Representatives will vote next week on two bills, one addressing border security and immigration reform measure and the other addressing Deferred Action for Childhood Arrivals (DACA). Conservatives have been clear that any deal must mandate that all employers verify the legal status of employees, known as E-Verify. Moderates sternly communicated that any discussion of E-Verify must also include a guest worker program. For more information, please contact your district congressman or the Commission office.

USAPPLE SECRETARY COLOMBINI SPEAKS ABOUT NAFTA, CHINESE TARIFFS AT PRESS CONFERENCE

California Apple Commission board member and USApple Association Secretary, Jeff Colombini, of Lodi Farming in Stockton, CA, spoke at a press event in Acampo, CA, alongside other California growers and state agriculture leaders, on the importance of maintaining the North American Free Trade Agreement (NAFTA) and duty-free access to the Chinese market. "NAFTA is critical to the economic health of both the California and U.S. apple industries," Colombini told reporters. "Under the agreement, the apple industry has quadrupled its exports to Mexico and double its exports to Canada with combined purchases of nearly $450 million per year. Colombini also spoke about the impact of China's retaliatory tariffs on agriculture commodities, including a 15% tariff on U.S. apples. "This is a tremendous concern as China has significant growth potential because it doesn't grow the many apple varieties we grow and Chinese consumers are excited to experience those unique taste profiles," said Colombini. "The retaliatory tariffs imposed by China will hurt the apple growers' ability to maintain and expand this emerging market." For more information on China or any export market, please contact the Commission office.

MEXICO TO IMPOSE TARIFFS ON APPLES

The Mexican government has said it will impose retaliatory tariffs on U.S. goods, including fresh and dried apples, blueberries, and other produce items, in response to the Trump Administration announcing it would impose tariffs on steel and aluminum from Canada, Mexico, and the European Union on effective June 1. The tariff was needed on steel and aluminum imports because overcapacity in those industries globally is thought to be hurting US steel mills and aluminum smelters by driving down the prices of their product, forcing many out of business. NAFTA, generally prevents the US, Mexico and Canada from imposing tariffs on imports from one another, but President Trump has been a severe critic of NAFTA, and the three countries are holding negotiations on possible changes to the free trade deal. The US Apple Association and the CAC has been in contact with the Trump Administration officials as well as with our trade contacts at the Mexican and Canadian embassies.

SENATE AG COMMITTEE PASSES FARM BILL

In June, the Senate Agriculture Committee marked up and passed the Agriculture Improvement Act of 2018, by a vote of 20-1. Many provisions are important to our industry. These include:

- Full funding for trade programs such as the Market Access Program (MAP) and the Technical Assistance for Specialty Crops Program (TASC);
- $80 million in funding for all specialty crops under the Specialty Crop Research Initiative (SCRI) and new prioritization for mechanization projects;
- Full $85 million in funding for the Specialty Crop Block Grant Program (SCBGP) with $5 million set aside for multi-state programs to be administered through the Agricultural Marketing Service (AMS).

TAIWAN TRAINING SEMINAR

On June 11, 2018, the California Apple Commission held the Taiwan training seminar. The seminar is organized in conjunction with USDA-APHIS with the intent on training the necessary personnel from different packing sheds in the process of detecting Codling Moth as outlined by the Taiwan work plan. If you would like to participate in a future seminar or have any questions, please contact the Commission office.

TODD SANDERS NAMED EXECUTIVE DIRECTOR OF THE CAC

Todd Sanders has been named Executive Director of the California Apple Commission. His selection was approved by the Commission's Board of Directors at the May 3, 2018, meeting. He replaces Alexander Ott, who has accepted a new position with the American Pecan Council and will relocate from California to Texas to lead the APC. Prior to be chosen as Executive Director of the CAC, Mr. Sanders, served as the Director of Trade and Technical Affairs for the California Apple Commission since 2005. In addition, Mr. Sanders will also serve as Executive Director to the California Blueberry Commission and the California Olive Committee. He graduated from California State University, Fullerton with a B.A. degree in Psychology and a Master's Degree in International Relations from California State University, Fresno.

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ELIZABETH CARRANZA TO BE NAMED DIRECTOR OF TRADE AND TECHNICAL AFFAIRS OF THE CAC

On July 1, the California Apple Commission will welcome a new Director of Trade and Technical Affairs, Elizabeth Carranza. Elizabeth was a former intern of the CAC and graduated from California State University, Fresno with a degree in Agricultural Business. Upon graduation, Elizabeth went on to serve as a Congressional intern in Washington, DC and then returned to California to hold the position of Program Supervisor for the California Olive Committee. Throughout the past two years in this role, Elizabeth worked under the direct supervision of Todd Sanders in overseeing the California Olive Committee's newly established international export programs. Currently, and with the onset of this new position, Elizabeth is pursuing a higher education in the form of a Master's Degree in Communication Management online from the University of Southern California to be completed in 2019.

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CALENDAR OF EVENTS

- **United FreshMKT Expo**
  -Date: June 25-27, 2018
  - Chicago, Illinois
- **Apple Crop Outlook & Marketing Conference**
  -Date: August 23-24, 2018
  -Chicago, Illinois
- **Asia Fruit Logistica**
  -Date: September 4-7, 2018
  -Hong Kong, China

CALIFORNIA APPLE COMMISSION

Newsletter

Issue No. 127 March/April 2018

CAC MEETS WITH US APPLE EXPORT COUNCIL

On March 14, 2018, the CAC met with the US Apple Export Council to discuss current market access and USAEC funding. The USAEC is expected to receive approximately 1 million dollars in funding which will be utilized throughout 7-10 markets. USAEC assists the Commission and other U.S. Apple producing states in obtaining Market Access Program (MAP) and Technical Assistance for Specialty Crop (TASC) dollars for foreign markets. California currently receives MAP dollars for inspectors and in-county representatives for Canada, Mexico, and Southeast Asia. USAEC markets include: Canada, Central America, India, Mexico, Southeast Asia, and the United Kingdom.

COMMISSION ATTENDS CAPITOL HILL DAY

On March 13-15, 2018, the California Apple Commission visited Washington D.C. The purpose of this meeting was to attend the US Apple Association Board meeting, and to meet with key Congressional members to provide information on current problems that face the California apple industry. Issues discussed were the Market Access Program (MAP), Technical Assistance for Specialty Crops (TASC), labor, crop insurance, and the upcoming 2018 Farm Bill that Congress is currently writing. For more information, please contact the Commission office.

CONGRESS REACHES DEAL ON SPENDING BILL

Congressional leaders finalized a $1.3 trillion budget bill that will keep the federal government open through the remainder of the current fiscal year, ending September 30, 2018. This is good news because a government shutdown is unlikely to happen, preventing disruption to programs including H-2A processing. It also means important programs such as specialty crop research, Market Access Program (MAP), and crop insurance will continue to be funded. The deal is reported to include $1.6 billion in funds for border security, but does not include funds for a wall, mandate E-Verify or include guestworker or DACA provisions. For apple growers who belong to co-ops, this should result in a status quo as regards to their bottom lines and deductions. For more information, please contact the Commission office.

DISCUSSIONS BEGIN ON 2018 FARM BILL

The U.S. Farm Bill is a comprehensive piece of legislation that Congress is currently writing. It covers most federal government policies related to agriculture in the United States. The Farm Bill comes up for renewal every five years. Many individuals and organizations contribute to the Farm Bill, including members of government and special interest groups. The provisions of the Farm Bill are divided into what are called "Titles", which are overarching categories related to food and farming in the U.S. The 2014 Farm Bill had 12 titles, and new titles can be added during the re-authorization process. Several things to note, if included in the 2018 Farm Bill, will be the re-examination of crop insurance, and a trade policy revamp.

FIRE BLIGHT POWERPOINT PRESENTATION AVAILABLE

On January 30, 2018, members of the California apple industry met to discuss the Fire Blight research for apples in California. Dr. Jim Adaskaveg, Department of Plant Pathology and Microbiology, of UC Riverside, gave a presentation on the topic of Organic and Conventional Fire Blight research. Fire Blight is caused by the bacteria *Erwinia amylovora* and is one of the most destructive diseases of pome fruit trees, including apples. Dr. Adaskaveg's Fire Blight presentation is available on line by visiting www.calapple.org, or you may request a copy by contacting the Commission office.

CHINA TARGETS U.S. AGRICULTURE IN IMPOSING NEW TARIFFS

China is imposing new tariffs on meat, fruit, and other products from the United States as retaliation against tariffs approved by President Trump on imported steel and aluminum. The announcement follows warnings Chinese officials have made for several weeks in an escalating trade dispute, between the world's two largest economies. China's Customs Tariff Commission is increasing the tariff rate and imposing a new 15 percent tariff on 120 other imported U.S. commodities, including almonds, apples and berries which could end up hurting the American farmers. The Commission will be following closely and will continue to update the industry as needed.

COMMISSION MEETS WITH UNDERSECRETARY MCKINNEY

On April 24, 2018, the Commission met with USDA Undersecretary for Trade and Foreign Agricultural Affairs Ted McKinney, and the California State Board of Food and Agriculture President Don Cameron. The purpose of the meeting was to discuss the importance of international trade markets to California agriculture. Specifically, the discussions focused on the new tariffs implemented by China, the India market, the constant changing MRLs for export markets, including the EU, and the North American Free Trade Agreement (NAFTA). Currently, California exports approximately 8 – 15 percent of its apple crop. However, export issues that directly impact the Washington State crop will have an indirect effect on California apples. If apples are not exported, those apples may stay in the domestic market, driving down prices when increasing supply. It is important to ensure that these markets remain open and competitive in order to ensure that both international and domestic markets remain healthy. The Commission will continue to communicate the importance of free and fair trade with the administration and update the industry as these issues continue to move forward.

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APPLE BITES

Apple & Sunflower Seed Salad

Ingredients:

- 2 California Granny Smith Apples
- ½ C Sunflower Seeds
- 1 head Romaine Lettuce
- 2 Dill pickles, diced
- 2 Tomatoes, diced
- ½ C of your favorite salad dressing

Directions:

- In a large bowl, mix together the Granny Smith apples, sunflower sedes, lettuce, pickles, and tomatoes. Pour dressing on top, toss, and enjoy!

**Recipe courtesy: www.allrecipes.com*

CALENDAR OF EVENTS

- **United FreshMKT Expo**
  -Date: June 25-27, 2018
  - Chicago, Illinois
- **Apple Crop Outlook & Marketing Conference**
  -Date: August 23-24, 2018
  -Chicago, Illinois
- **Asia Fruit Logistica**
  -Date: September 4-7, 2018
  -Hong Kong, China

CALIFORNIA APPLE COMMISSION

NEWSLETTER

Issue No. 126 January/February 2018

USDA SECRETARY ROLLED OUT FARM BILL & LEGISLATIVE PRINCIPLES

During the week of January 24, 2018, U.S. Secretary of Agriculture Sonny Perdue, was at Pennsylvania State University touring facilities and meeting with faculty and students. The secretary toured Reinford Farms in Mifflintown, PA. and attended a luncheon town hall meeting where he rolled out the U.S. Department of Agriculture's Farm Bill and legislative principles for 2018. The principles were outlined in a four-page document, which states its goal as "to be responsive to the American people and improve services while reducing regulatory burdens on USDA customers." In addition, Secretary Perdue toured Central Pennsylvania's Food Bank in Harrisburg, and held a roundtable discussion on nutrition assistance.

USAPPLE GOVERNMENT AFFAIRS COMMITTEE MEETING

On January 24, 2018, The USApple Government Affairs Committee, Board of Directors, and State apple executives met on Capitol Hill in Washington, D.C. They met with two special guests from the Trump Administration. The special guest for their morning meeting was Ray Starling, from the White House staff, where he is Special Assistant to President Trump for Agriculture, Trade, and Food Assistance. The topic of discussion was working on the trade and immigration issues along with workforce concerns. The second guest to join the group for a discussion and lunch was Ted McKinney, USDA Undersecretary for Trade and Foreign Agricultural Affairs. The two guests joined the group for about 45 minutes and both were more interested in hearing the group's position, than delivering a speech. USApple serves the interests of the nation's apple growers on a wide range of issues including agricultural labor, export promotion, specialty crop farm bill programs, and federal nutrition programs.

For more information please contact Dianne Kurrle of U.S. Apple Association at (703) 442-8850.

SHADECLOTH PROJECT

On January 30, 2018, members of the California apple industry met to discuss the Shadecloth Research Project. The meeting was held at Prima Frutta Packing, in Linden, CA. Eric Gaarde of Fruit Dynamics, Inc. provided the final report on the Shadecloth project, and discussed both Organic and Conventional Applications. The benefits of Shadecloth could include water usage, increase in apple color, and decrease in overall orchard temperature. The Shadecloth project is funded through the California Department of Food and Agriculture Specialty Crop Block Grant (SCBG), and is available on line by visiting www.calapple.org. or you may request a hard copy by contacting the Commission office.

FIRE BLIGHT RESEARCH

On January 30, 2018, members of the California apple industry met to discuss the Fire Blight research for apples in California. Dr. Jim Adaskaveg, of the Department of Plant Pathology and Microbiology, of UC Riverside, gave a presentation on the topic of Organic and Conventional Fire Blight research. Fire Blight is caused by the bacteria *Erwinia amylovora* and is one of the most destructive diseases of pome fruit trees including apples. For more information on fire blight management, please refer to our latest annual report. If you would like a copy, please contact the Commission office.

COMMISSION ATTENDS FRUIT LOGISTICA

On February 7-9, 2018, the California Apple Commission participated in Fruit Logistica, Berlin, Germany, through the U.S. Apple Export Council. Fruit Logistica is the largest fresh fruit trade show in the world, it covers the fresh produce business and offers a complete picture of the latest innovations, products, and services in the international supply chain. This

trade show provides the Commission the unique opportunity to reach a vast audience of retailers and importers from around the world. If you would like more information, please contact the Commission office.

CAC WELCOMES NEW INTERN

In December 2017, the CAC welcomed aboard a new intern, Emily Baker. Emily is a junior at California State University, Fresno where she is pursuing a Bachelor's Degree in Agriculture Business. Emily is from Merced, California and currently resides in Fresno, California. Her hobbies include crafting, redoing furniture, her dogs, traveling, and much more all while spending time with her family and friends. Emily has a passion for agriculture and is extremely excited to experience all the aspects of agriculture that the Commission has to offer. She looks forward to the valuable knowledge that she will gain through this internship experience.

BOARD OF DIRECTORS

eDisclosure for e-Filing FORM 700

As outlined by CDFA and the Fair Political Practices Commission (FPPC) all Board of Directors filers must complete the necessary Form 700. Board members are now eligible to submit your Form 700 electronically through eDisclosure. To access the eDisclosure system and complete your e-filing Form 700, please log on to **https://form700.fppc.ca.gov/.** Upon login you will see a list of positions that you are required to file Form 700's for. Once completed, your Form will be saved in your online-filing cabinet under "Previous Filings" menu. **As a reminder the Form 700 is due April 2, 2018.** Should you have any problems accessing or completing your eDisclosure Form 700, please contact Rene Robertson at (916) 324-3722 or via email at Form700@fppc.ca.gov .

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CALENDAR OF EVENTS

- **US Apple Capitol Hill Day**
  -Date: March 15, 2018
  -The Washington Court Hotel, Washington, DC
- **Canadian Produce Marketing Association (CPMA) Convention & Trade Show**
  -Date: April 24-26, 2018
  -Vancouver, BC, Canada
- **United FreshMKT Expo**
  -Date: June 25-27, 2018
  -Chicago, Illinois

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CALIFORNIA APPLE COMMISSION

NEWSLETTER

Issue No. 125 November/December 2017

U.S. FARM EXPORTS HIT 3rd HIGHEST LEVEL ON RECORD

On November 16, 2017, U.S. Secretary of Agriculture, Sonny Perdue, announced that U.S. exports totaled $140.5 billion in fiscal year (FY) 2017, increasing more than $10 billion from the previous year. This marks the third-highest export level on record. Secretary Perdue stated in a press release, "U.S. agriculture depends on trade. It is great to see an increase in exports and we hope to open additional markets to build on this success." Last year, the United States was the largest export customer for China, with shipments valued at $22 billion, followed by Canada at $20.4 billion, exports to Mexico $18.6 billion, and Japan $11.8 billion. California apple's number one export market is Canada followed by Mexico and SE Asia. Exports continue to be our important components for the California apple industry. Additionally, the CAC participates in the US Apple Export Council (USAEC) which aids in educating consumers about foreign markets. The California apple industry received over $200,000 in assistance through the US Apple Export Council's activities. For more information on the agricultural export data, please visit Global Agricultural Trade System (GATS) at https://apps.fas.usda.gov/gats/.

HOUSE TAX BILL COULD CUT FARM BILL PROGRAMS

On November 15, 2017, the House of Representatives passed the tax bill that could possibly eliminate several farm bill programs and services critical to farmers, ranchers and rural communities. The Congressional Budget Office (CBO) issued a letter to the House Minority and Ways and Means Committee, stating that the tax bill would add $1.5 trillion to the deficit over the next ten years. The Statutory Pay-As-You-Go (PAYGO) Act, would automatically force budget cuts to take effect, resulting in the complete elimination of many important exiting programs, including many utilized by the apple industry. These automatic cuts could be applied to the Specialty Crop Research Initiative, Specialty Crop Block Gants and the Market Access Program (MAP). The California Apple Commission receives grant dollars from several of these programs. These programs include Shade Cloth, Research and MAP dollars for Canada and Mexico. The US Apple Association (USAA) will continue to assist apple producing states in an effort to save these programs for additional information please contact the USAA or the Commission office.

COMMISSION ATTENDS PMA

On October 18-20, 2017, the California Apple Commission attended the Produce Marketing Association's (PMA) annual convention and exposition in New Orleans, Louisiana. PMA allows the Commission to meet and maintain relationships with other industry leaders as it connects with the industry on being updated on current industry topics and workshops. The Commission also participated in a breakfast that was hosted by the US Apple Export Council (USAEC). The breakfast brought together major foreign buyers, consumers and government officials interested in importing apples from California and the US. If you would like more information regarding PMA or the USAEC breakfast gathering, please contact the commission office. Next year's PMA will be held in Florida.

MICHIGAN LISTERIA OUTBREAK

On December 19, 2017, the California Apple Commission received word that a packer in Michigan had a positive test for listeria in their facility. As a result of the find, the packing house did a voluntary recall and responded quickly in notifying retailers. To date, no consumers have reported illness.

The Commission has been working with U.S. Apple Association, Michigan and other apple producing states in monitoring the news media and addressing any concerns arising from this issue. To date, according to U.S. Apple Association, the story has not picked up national attention.

Lastly, the Commission has not received information on where the listeria was found in the facility. The Commission will continue to update the California members as information becomes available.

Should you have any questions, please do not hesitate to contact the Commission office.

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The California Apple Commission Wishes You A Joyous Happy Holiday and a Bright New Year!

OUR OFFICE WILL BE CLOSED DECEMBER 22 & 25, 2017 & JANUARY 1, 2017 IN OBSERVANCE OF THE HOLIDAYS.

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APPLE BITES

California Sugarless Apple Pie

INGREDIENTS:

- 5 California Fuji apples (about 2 lbs.)
- 1 or 2 California Granny Smith apples
- 2 tablespoons cornstarch
- ¾ cup apple juice concentrate, thawed
- 3 tablespoons butter
- ½ teaspoon cinnamon, ground mace & allspice
- ½ teaspoon vanilla and unbaked pastry for two-crust 9" pie

DIRECTIONS:

Peel, core and slice apples; set aside. Dissolve cornstarch in 2 tablespoons cold apple juice
Concentrate; set aside.
2. Combine remaining concentrate and butter in 10 inch skillet. Heat to boiling.
3. Stir in apple slices. Cover and steam 3 to 5 minutes until apples are heated through.
4. Stir in cornstarch mixture. Cook, stirring gently, until thickened and clear.
5. Add seasonings and vanilla; stir well. Set aside.
6. Line ungreased glass pie pan with pastry. Spoon in filing and spread evenly. Top with second
Crust. Seal and flute edges. Cut slits in top crust.
7. Bake at 425°F for 15 minutes; reduce heat to 350°F and bake 20-30 minutes more or until crust is golden brown.

CALENDAR OF EVENTS

- **Fruit Logistica**

  -Date: February 7-9 , 2018

  -Berlin, Germany

- **US Apple Capitol Hill Day**

  -Date: March 15, 2018

  -The Washington Court Hotel, Washington, DC

- **January CAC Board Meeting**

  -Date: TBD

  -Fresno Office

CALIFORNIA APPLE COMMISSION

NEWSLETTER

Issue No. 123 July/August 2017

ARCTIC APPLES

This Fall, the genetically modified Arctic apple will now be available in select super markets across the U.S. The Arctic apple was developed by Okanagan Specialty Fruits, Inc. and was engineered for enzymatic browning resistance. This unique trait in these apples prevents them from browning, even when they are bitten, sliced or bruised. These apples have the same composition and nutritional values as conventional apples, but their Arctic Advantage will add value to the industry as this non-browning quality will help with the prevention of food waste. The first variety that will be available this fall is the Arctic Golden, with the Arctic Granny and Arctic Fuji varieties to follow. To read more about Artic Apples, please visit arcticapples.com.

USDA PREDICTS 7% DROP IN APPLE CROP

The United States Department of Agriculture's (USDA) crop production report estimates a 7% decrease of apple production from last year. The USDA assumes the crop (both fresh and processed) will total 248.6 million 42-pound cartons, down from 268.4 million cartons a year ago. The estimate also includes an increased amount of apple production from Eastern states, a large decrease in production from Central U.S. states, and a slight decrease for Western growing regions. To read more about this article, please visit thepacker.com/news/2017-apple-crop-down-7-usda-predicts.

U.S. APPLE OUTLOOK CONFERENCE

Staff from the California Apple Commission recently attended the U.S. Apple Outlook and Marketing Conference in Chicago, Illinois. The conference was hosted by the U.S. Apple Association and the purpose of the event was to create and maintain relationships with key leaders from all sectors of the apple industry. For more information on the U.S. Apple Outlook Conference, please visit usapple.org.

CA APPLE MEXICO INSPECTOR

In mid-July, the Mexico inspector arrived in California to start the California/Mexico apple export program. Rafael Enrique Castro Romero was this year's inspector. In accordance with the California/Mexico work plan, the Mexico inspector must certify all packing sheds and fumigation chambers intending on exporting apples to Mexico. If you have any questions regarding the Mexico Export Program, please contact Todd Sanders at the Commission office.

ASIA FRUIT LOGISTICA

Staff from the California Apple Commission spent September 6-8th, 2017 at the Asia Fruit Logistica trade show in Hong Kong. The purpose of the trip is for industry members and representatives to create and

maintain relationships with other key individuals in the fresh produce industry. This year, there were 665 companies showcasing their products. For more information on Asia Fruit Logistica, please contact the Commission office.

CAC ANNUAL REPORT

In the near future please be on the lookout for the California Apple Commission Annual Report. The Annual Report includes information on current and future research, education projects, market reports, and other pertinent industry information. If you would like a copy, please contact Tabitha Francis at the Commission office.

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APPLE BITES

SUPER PROTECTOR JUICE

INGREDIENTS:

2 cups/115 g chopped broccoli, stems and florets

2 large oranges, peeled and seeded

1 large California apple, cored

DIRECTIONS:

1. Juice the broccoli, oranges, and California apple, in that order.
2. Run the pulp through again to extract as much liquid as possible.
3. Serve immediately

CALENDAR OF EVENTS

- **United Fresh Public Policy Conference**
  -Date: September 18-20, 2017
  -Location: Washington, D.C.
- **Produce Marketing Association Expo**
  -Date: October 20-21, 2017
  -Location: New Orleans, LA

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