2014-2015
California Olive Committee
ANNUAL REPORT

CALIFORNIA RIPE OLIVES

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CALIFORNIA RIPE OLIVES

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Olive Heritage

A History as Old as Western Civilization

The wild olive (oleaster) grows in most countries of the Mediterranean, even in Southeast Asia and other areas. It is an unimpressive straggly plant, with little resemblance to the olive tree, Olea europaea, which may have been first cultivated as early as five thousand years ago in Crete and Syria.

New World Transplant

The olive tree flourished in Spain, Tunisia, Morocco and Mediterranean countries for thousands of years, but it was not until the mid-sixteenth century that there is a record of cuttings being carried to Peru by the Spaniards. In the 1700s Franciscan monks brought the olive to Mexico and then north to California by way of the missions. The first cuttings were planted in 1769 at the San Diego Mission. However, it was not until the late 1800s that commercial cultivation began in warm, sunny valleys of Central and Northern California.

An Industry Founded by a Housewife

In the 1800s many acres of olive trees were planted because of the demand for olive oil. Freda Ehmann and her son, Edwin, purchased such an orchard in the Oroville area of Northern California around that time. Soon, with the trees barely producing and oil prices dropping, only their tough German heritage convinced them to continue to search for other outlets for their fruit. Consulting with a Berkeley professor on processing methods, Freda began experimenting with 280 gallons of olives in barrels on the back porch of her home. The black olives she produced were a decided success and the California Ripe Olive Industry was born. Freda Ehmann's grandson would later write: "Where science and chemical exactness had failed, the experience and care of a skillful and conscientious housewife succeeded."

The California Olive Industry Today

Today, the California Olive Industry consists of two canneries which process the 80,000 to 125,000 tons of olives produced by approximately 27,000 acres growing in the warm inland valleys of the state. There are about 1,000 growers with orchards varying from as few as five acres to multi-crop farms with over 1,000 acres. Tulare County in the central San Joaquin Valley has over 56 percent of olive acreage, while Kern, Fresno and Madera counties account for about 8 percent. In the Sacramento Valley to the north, Glenn, Tehama, Shasta and Butte counties represent about 36 percent of the acreage.

The California Varieties

California has two main varieties —Manzanillo, which represents most of the acreage; Sevillano, which produce the larger sizes. Approximately 70-80 percent of ripe olives consumed in the United States come from California. Over 90 percent of the California crop is processed as black ripe olives. The remaining olives are processed into various specialty styles or crushed for olive oil.

Cultivation and Harvest

The mild winters and hot dry summers of California's great valley are reminiscent of the olive's native Mediterranean home. The olive tree tends to be alternate bearing, producing a large crop one year with a smaller crop the next.

Modern cultivation practices of pruning and thinning have helped to minimize this characteristic to some extent. The trees bloom in May with delicate, cream-colored flowers. By mid-September, the harvest begins. Olives destined for the canneries are picked when they are still green, but beginning to show a little color. Most olive orchards are picked by hand except for a few larger acreages, which are mechanically harvested by machines that shake the trees and catch falling olives in a frame. Dumped into bins, the olives are taken to the cannery where they are sorted, graded and put in large tanks filled with storage solution.

Curing

Olives, as they come from the tree, are too bitter to eat without some kind of curing. There are many different methods used around the world. In California, most olives become California black ripe olives. A few become specialty olives.

Black Ripe Olives

These olives are processed in a lye curing solution that leaches the bitterness out. California Ripe Olives have a firm texture and smooth, mellow taste. Once curing is complete, a series of cold water rinses removes every trace of curing solution. During the curing process, which takes several days, a flow of air bubbling through the olives produces the natural, rich dark color. A trace of organic iron salt (ferrous gluconate) is added to act as a color fixer so the olives will have less tendency to fade after the cans are stored.

Canning is the final step. Ripe olives are canned in a mild salt brine solution and, because they are a low-acid product, are heat sterilized under strict California State health rules.

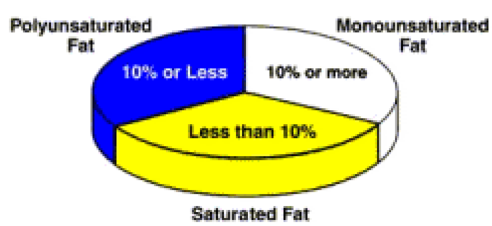
To ensure consistent quality, color, flavor and texture all canned Ripe Olives packaged in California are inspected by the U.S. Department of Agriculture. California Ripe Olives come whole, pitted, sliced, chopped or wedged. They are readily available year round in the grocery store.

California Ripe Olive Calories and Sizes

Sizes	Average Calories Per Ripe Olive	Approx. No. of Olives in 15 gram serving
Small	4	6
Medium	5	5
Large	6	4
Extra Large	7	3
Jumbo	7	3
Colossal	9	2
Super Colossal	12	1

Monounsaturated Fats: A Nutritious Choice
Select your fat sources wisely, by decreasing consumption of foods high in saturated fats and choosing foods high in monounsaturated fats more often.

California Ripe Olives are a good source of monounsaturated fat. There are only two grams of fat in a 15 gram serving, with the majority of fat coming from monounsaturates and part of the remaining fats being essential fatty acids. One serving contains only three percent of your total fat intake for the day. Contrary to what you may think, olives are not high in calories. In fact, an extra large Black Ripe Olive has only seven calories - and a serving equal to only 25 calories! This makes olives an ideal snack or ingredient for adding flavor and variety to the lower fat meals you prepare.



Fats are not Created Equally
It's important to understand the different types of fat and those foods most commonly associated with them. Fats are generally classified as saturated, polyunsaturated and monounsaturated. While some fats - saturated - are linked to elevated levels of LDL-cholesterol ("bad" cholesterol) in the blood, mono-unsaturates actually lower "bad" LDL levels. It's critical to pay attention to the type of fat in various foods. Focus on decreasing saturated fats and choosing sources of monounsaturated fats like those found in olives and olive oil. Here are the basics:

Saturated Fat Most commonly found in foods of animal origin. Sources include red meats (beef, pork, lamb), poultry, dairy products, eggs and coconut and palm oils.

Polyunsaturated Fat Most often found in foods of plant origin. Sources are corn, safflower, sunflower and sesame oils and some nuts and seeds.

Monounsaturated Fat Also found in foods of plant origin. Sources include olives and olive oil along with canola oil, nuts and avocados.

Recommended Sources of Fat Health experts recommend that no more then 30 percent of daily calories come from fat sources with most of your fat intake coming from polyunsaturated and monounsaturated fats.

Fat and Cholesterol: There is a Link
Simply put, cholesterol - made in the body primarily in your liver - is a "cousin" of fat belonging to a chemical group called lipids. Cholesterol and fat travel in the bloodstream in packages called "lipoproteins."

Medical experts are concerned about the two main ways that cholesterol is carried in your bloodstream. One is low-density lipoproteins, LDL-cholesterol is considered "bad," because a high level of LDL-cholesterol increases the risk of fatty deposits forming in the arteries, which in turn increases the risk of heart disease. The other way that cholesterol is carried in the bloodstream is in high-density lipoproteins, or HDL (good)-cholesterol. HDL seems to have a protective effect against heart disease. In fact, low levels of HDL (good)-cholesterol are related to an increased risk of heart disease.

Choose Your Fat Wisely
To protect against heart disease, it's important to lower LDL-cholesterol, and **not** the HDL-cholesterol. Polyunsaturated fats can help lower (bad) LDL-cholesterol, but at the same time, they have also been found to lower the (good) HDL-cholesterol. That's why nutrition authorities recommend that monounsaturated fats be the major source of fat in the diet. Monounsaturates, like the fat found in olives and olive oil, can help lower (bad) LDL-cholesterol while maintaining or raising the (good) HDL-cholesterol.

Identifying Fats - Being a Better Label Reader
Look for the Nutrition Facts panel, like the one shown here for ripe olives, to get information about the product's serving size and the amounts of nutrients like fat, sodium, and fiber. Remember all foods fit into a healthy diet as long as you balance your choices. A specific food is neither "good" nor "bad"; rather, it's your total daily diet that counts.

1. **Serving sizes** are now standard for similar foods. All other information on the label is related to serving size.

2. **Calories and Calories from Fat** are shown. The non-fat calories include carbohydrate and protein.

3. **Total Fat, Monounsaturated, Polyunsaturated and Saturated Fat** represent the grams of fat in a single serving. Some products may not have all of these listed. Look for the term monounsaturated and select the best sources like olives and olive oil.

4. **Total Carbohydrate** lists the amount in grams per serving.

5. **% Daily Value** shows how foods fit into a daily diet of 2,000 calories. For example, the % Daily Value column shows the fat in a serving compared to 65 grams of fat - the amount recommended for a 2,000 calorie a day diet.

Care and Storage

California Ripe Olives are packed in a light brine solution, not only to bring out the flavor of the fruit, but also to protect them in transportation. The recommended shelf life for unopened cans is 36-48 months. They may be stored at room temperature.

Once opened, store unused California Ripe Olives in their original brine in the open can and cover with plastic wrap to allow oxygen to permeate. Do not store California Ripe Olives in an airtight container as harmful toxins may develop. If the original brine has been discarded, replace with a solution of one cup of water and 1/2 teaspoon salt in order to keep the olives wet and free from external odors. Partially used cans of California Ripe Olives may be held in the refrigerator for up to ten days.

WHAT IS THE COC?

Established under a Federal Marketing Order

Federal Marketing Order No. 932 was established in 1965 by olive growers and canners under the Agricultural Marketing Agreement Act of 1937 to effect the orderly marketing of olives grown in California.

The California Olive Committee administers the marketing order programs. The Committee, serving for a period of two years, consists of eight producer members, plus 8 alternates, representing the growers from our olive growing districts. This is in addition to eight handler members plus 8 alternates.

Decisions made by the Committee are subject to approval by the Secretary of United States Department of Agriculture. At the present time, provisions of the Marketing Order apply only to black and green canned ripe olives and not to tree-ripened, Spanish style, olive oil, Sicilian, Greek, or other styles of olive. The program is funded by an assessment, established every December, on each ton of olives received for use as canned ripe olives.

Committee Functions and Expenditures

Committee functions and expenditures fall into four main categories:

A. Administrative
B. Crop & Processing Research
C. Incoming & Outgoing Inspection
D. Marketing and Public Relations

Administrative

The Committee employs an Executive Director and staff responsible for administering all aspects of the program. Their duties include compiling statistical data for the industry, ensuring compliance with the Order, and overseeing marketing and public relations functions.

Crop and Production Research

Each year the olive industry funds research conducted by the University of California and others on various issues effecting the production. In recent years, funds have been allocated to combat the olive fly flavor profiling, mechanical harvesting, and disease prevention.

Incoming and Outgoing Inspection

1. Incoming regulations set up under the Order state that each lot of natural condition olives received by a handler, designated for canned ripe olives, are size-graded by California State inspectors and classified as canning, limited, undersize, or culls to ensure fair payment to the grower for their fruit.
2. Outgoing regulations require that inspection be made of canned olive products by inspectors of the U.S. Department of Agriculture to ensure standards of size, color and flavor are met. The outgoing inspection also ensures that handlers dispose of undersize and cull obligations into outlets other than canned ripe olives. Outgoing regulations also apply to imported canned ripe olives.

Marketing Program

The Committee executes various marketing and PR efforts to promote and build awareness about California Ripe Olives. Efforts include utilization of social media, partnerships, news media and special events.

MESSAGE FROM EXECUTIVE DIRECTOR

Alexander J. Ott
Executive Director of the California Olive Committee

The California Olive Committee (COC) has seen many changes since its inception in 1965. In the 1960s, reporting and standards were critical to ensuring that the industry was on a level playing field. Fast forward 50 years later and the tasks have not slowed down. In a global economy, issues that impact one part of the world, begin to test our way of life here in California. These global challenges, coupled with the ever changing economy, additional rules, regulations, costs, environmental concerns, labor, and drought, dare farmers to become innovative and proactive to address these issues while still maintaining a profitable industry.
To move forward, the industry established a Strategic Action Plan that assists the industry to: *"Provide and maintain a viable and profitable table olive industry."* Specifically, the COC will focus on:

- Standards & Enforcement;
- Research;
- Exports;
- Marketing & Education; and
- Industry Relations.

In short, in order to address the industry's concerns, the industry must "adapt or die." In order to turn the corner and continue to succeed, the industry has made great strides in preparing for the next several years. However, with a plan in place, implementation coupled with the continued participation of the industry are critical to ensure success.

In an effort to assist the industry in outlining the COC's activities, the Committee is pleased to present the 2015 annual report. Although the Committee has issued annual reports in the past, this new format provides a list of all reports and activities that the Committee contemplated in 2015. We hope you will find these materials useful.

Thank you again for your continued support and please do not hesitate to contact us to provide feedback on how we may continue to assist you and the industry.

High Regards,

Alexander J. Ott
Executive Director

CHAIRMAN'S CORNER

Michael Silveira
Chairman
California Olive Committee

Most of us growers understand today, that the Table Olive Industry in California is competing in a global economy. This has created a serious impact to our California growers due to competing table olive growing nations who export into the United States and are heavily subsidized, such as those nations belonging to the European Economic Union, or have a tremendous advantage of inexpensive labor such as those nations in North Africa. Beside the global economic issues, our industry in California is faced with new regulations, invasive pest issues, escalating labor costs and environmental concerns. To meet these challenges the California Olive Committee (COC) created a Strategic Action Plan spear headed by its internal Executive Sub-Committee. The mission of this plan is to: “Provide and maintain a viable and profitable table olive industry.” The action plan, as of this writing, has been implemented by all of our Sub-Committees which includes the Executive, Research, Marketing, and Inspection. The Strategic Action Plan is the framework to meet the challenges going forward and I want to thank your elected COC representatives for all of their hard work in its implementation.

I want to finish in thanking the California Table Olive Growers for their support of their Federal Marking Order, the California Olive Committee, which has celebrated a 50 year birthday recently. I also want to say it has been a privilege and pleasure to serve as your Chairman these past years and I look forward in assisting our Table Olive Industry in the months ahead.

Sincerely,

Michael Silveira

STAFF

Alexander Ott

Executive Director

aott@calolive.org

Denise Junqueiro

Director of Programs & Services

denise@calolive.org

Todd Sanders

Director of Trade & Technical Affairs

tsanders@calolive.org

Janette Ramos

Office Manager

jramos@calolive.org

Liza Ramon

Program Coordinator

liza@calolive.org

California Olive Committee

2565 Alluvial Ave. Ste. 182
Clovis, CA 93611

(559) 456-9096 Tel.
(559) 456-9099 Fax

www.calolive.org

2014 2015

BOARD OF DIRECTORS

PRODUCERS

DISTRICT #1 (Counties of Alpine, Tuolumne, Stanislaus, Santa Clara, Santa Cruz all counties north thereof)

Members	Alternates
Ed Curiel	Pablo Nerey
Chris Henderson	Heath Burreson
Scott Patton	Michael Silveira

DISTRICT #2 (Counties of Mono, Mariposa, Merced, San Benito, Monterey, and all counties south thereof)

Members	Alternates
Pat Ricchiuti	Gary Bodine
Rod Burkett	Buck Bonilla
David DePaoli	David Hails
Mark Heuer	Jacob Sertich
Mark Hendrixson	Art Hutcheson

HANDLERS

Members	Alternates
Cody McCoy	Tim T. Carter
Paul McGinty	Julia Workman
Phil Quigley	Andal Allison
James Thomas	Tom Rickard
Janet Edwards	Larry McCutcheon
Felix Musco	Benjamin Hall
Bill McFarland	Kristin Daley
Dennis Burreson	Scott Hamilton

DISTRICT MAP

2015 Producing County Report: in Commercial Acreage

County	SEVI	MANZ	OTHER	**Grand totals**
Butte	17	219	147	383
Colusa	-	-	-	-
Fresno	22	466	2	490
Glenn	453	2,976	18	3,447
Kern	-	-	-	-
Madera	23	188	-	177
San Joaquin	85	33	59	177
Shasta	-	12	-	12
Tehama	1,323	2,644	125	4,092
Tulare	292	10,135	60	10,474
Grand Total	**2,215**	**16,603**	**411**	**19,229**

Source: COC

ASSESSMENT RATES & BUDGET

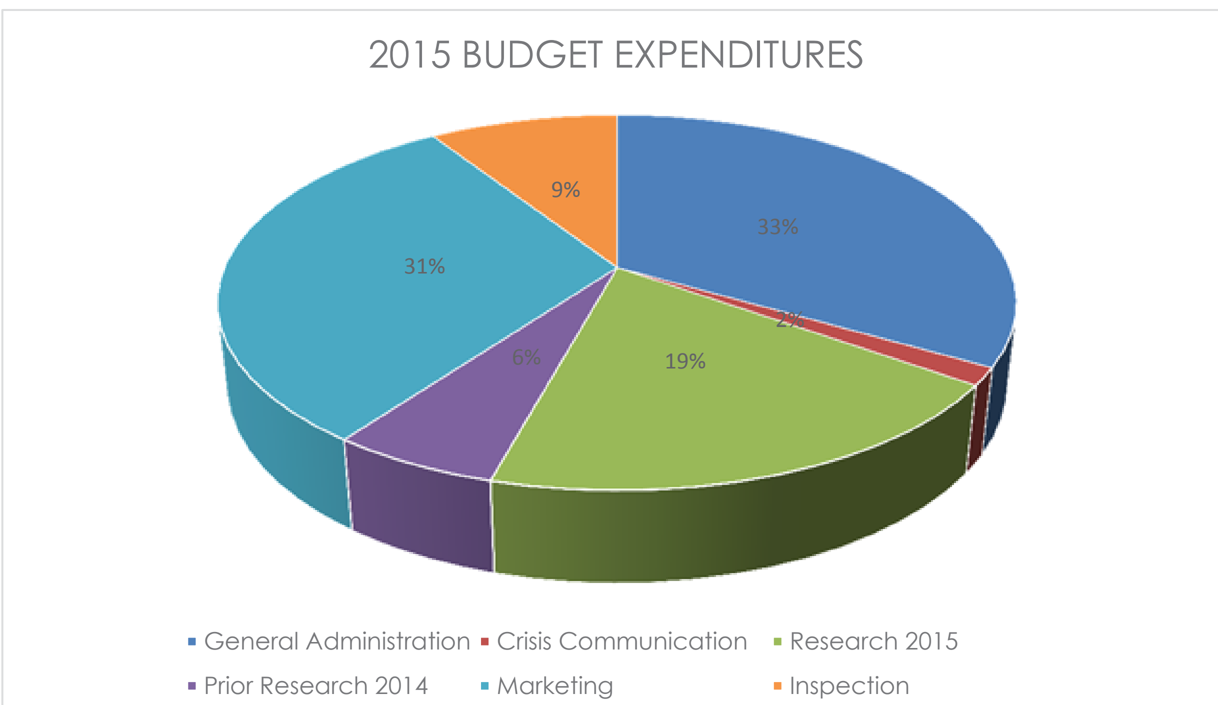
California Olive Committee
Assessment Rates and Budgets: 1965-2015

Crop	Assmt Rate per Ton ($)	Assess Tons ($)	COC Admin ($)	Research ($)	Marketing ($)	Brand ($)	Total Budget ($)
1965-66	1.5	n/a	43,800	16,200			60,000
1965-67	1.75	49,298	65,500				65,500
1965-68	2.5	n/a	52,000				52,000
1965-69	6.5	69,218	80,617	17,075	232,580		330,272
1965-70	6.5	53,157	76,430	17,397	185,000		278,827
1965-71	9	36,730	80,472	15,000	219,528		315,000
1965-72	13	35,077	92,000	46,000	420,850		558,850
1965-73	13	20,009	84,595	22,500	160,000		267,095
1965-74	15	57,393	97,960	35,000	653,391		786,351
1965-75	15	48,939	97,550	43,000	1/ 624,945		765,495
1965-76	15	52,245	117,350	26,100	1/ 753,100		896,550
1965-77	14	62,151	127,526	22,000	741,474		891,000
1965-78	12	33,881	102,262	26,738	450,000		579,000
1965-79	15	102,959	117,350	35,000	1,017,650		1,170,000
1965-80	14.33	49,424	116,000	40,000	1,040,128		1,196,128
1965-81	16.73	71,447	114,859	44,775	1,330,991		1,490,625
1981-82	28.26	38,964	123,143	33,887	899,600		1,056,630
1982 Interim			58,450	47,868	250,780		357,098
1983-COC	12.65	114,622	142,250	50,242	1,299,030		2,544,222
1983-BC	8.93					1,052,700	
1984-COC	26.22	47,276	141,832	37,526	1,052,660		2,009,518
1984-BC	16.54					777,500	
1985-COC	19.8	79,118	150,700	60,000	1,316,060		2,162,360
1985-BC	8.25					635,600	
1986-COC	20.91	83,361	148,800	61,185	1,534,250		2,318,235
1986-BC	6.92					574,000	

Fiscal Year	Assmt Rate	Assess Tons	COC Admin	Research	Marketing	Capital	Total Budget
1987	20.03	95,424	189,550	80,500	1,592,350		1,862,400
1988	23.92	57,300	435,434	51,948	1,140,100		1,627,482
1989	25.39	74,200	312,014	79,032	1,511,250		1,902,296
1990	20.68	100,000	337,540	94,500	1,627,250	8,650	2,067,940
1991	20.23	104,600	353,545	126,000	1,635,000		2,114,545
1992	20.68	57,192	348,230	65,000	1,419,000		1,832,230
1993	25.75	147,000	393,000	80,000	2,323,000		2,796,000
1994	27.21	101,000	384,730	80,000	3,258,860	25,000	3,748,590
1995	30.04	69,300	389,650	80,000	2,412,000		2,881,650
1996	28.26	62,182	388,350	213,000	1,999,435		2,600,785
1997	14.99	144,075	390,890	173,375	1,595,000		2,159,265
1998	17.10	85,585	357,900	50,000	1,308,500	34,000	1,750,400
1999	26.18	67,990	352,685	466,150	1,123,640		1,942,475
2000	21.73	122,113	356,190	903,550	1,212,495		2,472,235
2001	27.90	46,374	343,490	408,337	596,415		1,348,242
2002	10.09	123,439	339,650	250,000	811,935	27,000	1,428,585
2003	13.89	89,006	347,090	250,000	633,500		1,230,590
2004	12.18	102,727	360,563	225,000	633,500	(Insp)50,000	1,269,063
2005	15.68	85,862	337,014	200,000	680,000		1,217,014
2006	11.03	114,761	290,421	210,000	800,700		1,301,121
2007	47.84	16,270	252,171	365,775	362,450		980,396
2008	15.60	108,059	288,552	500,000	750,000	(Insp)50,000	1,588,552
2009	28.63	49,250	359,549	495,000	627,800		1,482,349
2010	44.72	22,150	324,923	300,000	255,000	(Insp)50,000	929,923
2011	16.61	151,683	335,900	1,093,009	700,000	(Insp)75,000	2,203,909
2012	31.32	25,587	333,500	333,791	480,000	(Insp)50,000	1,197,291
2013	21.16	74,755	333,800	213,018	637,380	(Insp)105,000	1,289,198
2014	15.21	86,110	346,500	217,582	565,600	(Insp)37,800	1,167,482
2015	26.00	35,399	465,500	259,231	450,000	(Insp)122,000	1,296,731

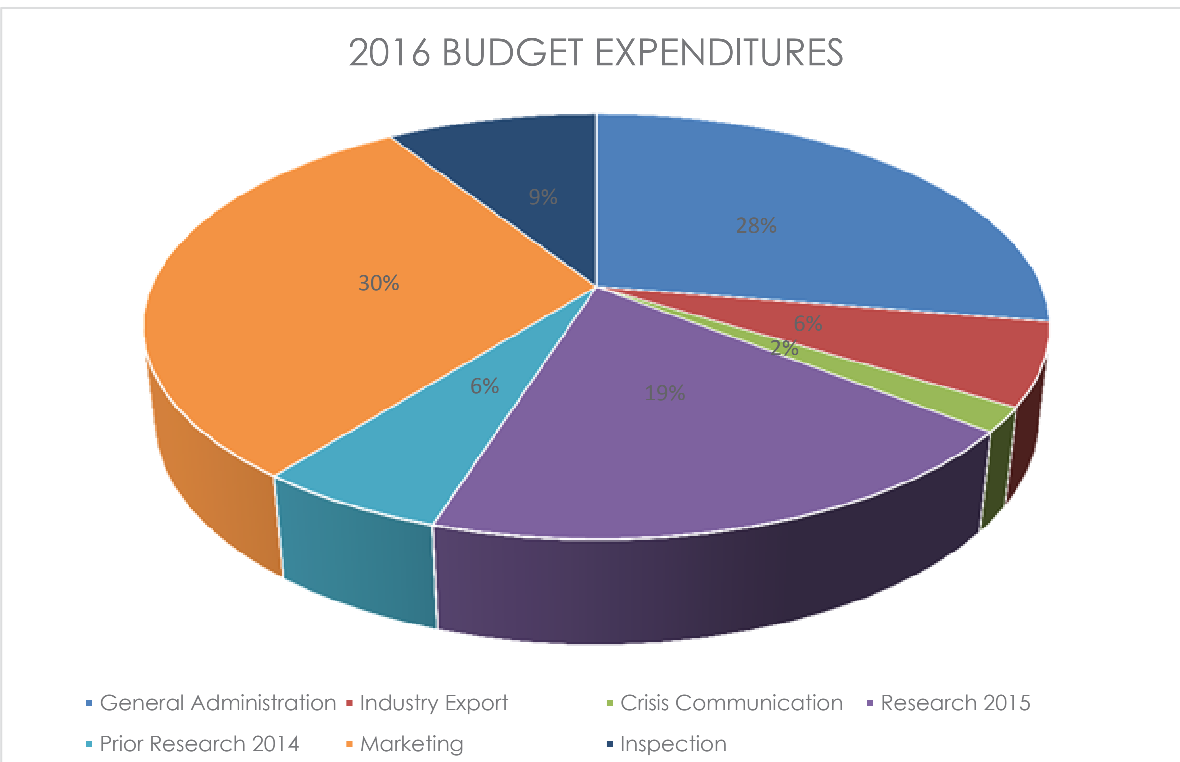
BUDGET FOR ACTIVITIES
FISCAL YEAR 2015

General Administration	**$465,500**
• General Administration Expenditures	$445,500
• Crisis Communication	$20,000
Research 2015	**$259,291**
Prior Research 2014	**$77,341**
Marketing	**$411,500**
Inspection	**$122,000**
TOTAL BUDGET	**$1,374,072**



BUDGET FOR ACTIVITIES
FISCAL YEAR 2016

General Administration	**$484,800**
• General Administration Expenditures	$374,000
• Crisis Communication/Attorney	$25,000
• Industry Export Studies	$85,000
Research 2016	**$210,815**
Prior Research 2015	**$33,541**
Marketing	**$689,300**
Inspection	**$102,000**
TOTAL BUDGET	**$1,558,956**



STRATEGIC PLANNING

STRATEGIC PLANNING SUMMARY

In 2014, the California Olive Committee (COC) adopted and implemented a strategic action plan for the Committee. The meeting brought together all segments of the California ripe olive industry including: The California Olive Committee, the California Olive Growers Association, and the California Olive Growers Council.

The meeting discussed all aspects of the industry and how all organizations could work together with the mission of the industry to: "*Provide and maintain a viable and profitable table olive industry.*"

The Committee will focus on eight items, placed into five categories. The following document is a summary of the California Olive Committee's Strategic Action Plan that was adopted in July of 2014. For a copy of the full strategic planning session, please contact the Committee office.

CALIFORNIA OLIVE COMMITTEE

PROPOSED STRATEGIC ACTION PLAN

Prepared by

California Olive Committee Management & Staff

July 31, 2014

On May 6, 2014 the California Olive Committee's Strategic Planning Sub-Committee Committee approved nine strategic focuses. As requested by the Sub-Committee, management has outlined necessary items and objectives needed in order to implement the Strategic Focus of the Sub-Committee's Strategic Plan. The Proposed Strategic Action Plan (SAP) outlines: focus, specific items for each focus, timeline and budget in order to fund these activities. This document specifically outlines issues relating to each of the nine focuses and provides a roadmap to implement these items. **These items are specific to the Committee's responsibilities and do not factor the necessary budgets for the trade associations to do their assigned activities.** Although other issues may rise to the Committee's attention, the focuses provide management and staff guidance on what is important to the California olive industry while allowing for flexibility for the management and staff to address issues not necessarily identified in this paper.

This document is intended to be a tool for the Committee's Board of Directors, membership, management, and staff when approaching challenges to the California Olive industry. Additionally, this action plan should be monitored, updated and reviewed on a periodic basis to ensure that the Committee is staying the course.

APPROVED FOCUSES FOR COMMITTEE[1]

According to the Strategic Action Plan, eight focuses were approved. These included:

- *Maintain and address* Regulatory compliance, concerns, and issues;
- *Effective* Communication for the industry and its components;
- *Leverage* Quality (marketing);
- *Conduct* Research;
    - Improving Harvest Costs;
    - Modernization;
- *Maintain, address and implement* Federal Marketing Order, Grades, Standards (varieties & styles)
- *Apply, receive and implement* Grants, MAP, TASC, EMP dollars
- *Review and implement* Quality standards; and

[1] Dan Block, "California Olive Committee: Where do we go from here? 2006" (D.W. Block Associates, 2003) 6-7.

- *Enforce* Standards (Section 8e).

ORGANIZATION OF FOCUSES

These eight focuses can be organized into five areas. Each area should have a Committee specifically to address the given areas, thus in turn assisting in implementing the focuses.

- Standards & Enforcement
  - *Enforce* Standards (Section 8e).
  - *Review and implement* Quality standards
  - *Maintain, address and implement* Federal Marketing Order, Grades, Standards (varieties & styles)
  - *Maintain and address* Regulatory compliance, concerns, and issues;
- Research
  - *Conduct* Research;
    - Improving Harvest Costs;
    - Modernization;
- Exports
  - *Apply, receive and implement* Grants, MAP, TASC, EMP dollars
- Marketing, & Education
  - *Leverage* Quality (marketing);
- Industry Relations
  - *Effective* Communication for the industry and its components

The following provides specific items for these areas. Each item contains specific issues that fall within the focus of the Committee. Several of these items are short-term goals while others will continue to be ongoing and will need staff to continually monitor the issue(s). It should be noted that these are items that are of current focus – meaning that as other challenges arise, the Committee should see how these challenges fit into the eight focuses of the Committee and then adopt an action plan for that specific issue(s).

1) STANDARDS & ENFORCEMENT

- Review of Federal Marketing Order and US Grading Standards;
- Research different varieties and potential standards for varieties;
- Review and research dollars and enforcement measures for rejected product;
- Implement electronic reporting; and
- Maintain communication with necessary government officials to enforce standards and enforcement.

2) RESEARCH

- Improving harvest costs;
- Modernization;
- Economic and Import analysis for table olives; and
- Pest and disease research

3) EXPORTS

- MAP & TASC applications
- Grants to assist in export markets

4) MARKETING & EDUCATION

- Quality;
- Buy California;
- Educating about availability; and
- Education on benefits of olive industry

5) INDUSTRY RELATIONS

- Outreach to industry on issues impacting industry; and
- Social media updating public on table olive industry

CALIFORNIA OLIVE COMMITTEE

STRATEGIC ACTION PLAN RECOMMENDATIONS

Prepared by Staff

July 31, 2014

The following recommendations have been suggested in order to implement the Committee's strategic plan as proposed by the Strategic Planning. Specifics of the plan are outlined within the comprehensive Strategic Action Plan Document.

Recommendations:

- Have Executive Committee provide guidance and parameters for all Sub-Committees.
- Add to the Executive Sub-Committee to identify export markets and be the lead on Market Access Program (MAP) and Technical Assistance of Specialty Crop (TASC) dollars.
- Fund the Export portion of the Sub-Committee to bring in the necessary experts for grant creation.
- Have the Executive Sub-Committee review table olive grades and standards and make a recommendation to the standards and enforcement Sub-Committees.
- As part of the Executive Sub-Committee, prepare a trip or two to D.C. to maintain relationships with the necessary government officials in order to communicate concerns or changes to standards and enforcement.
- Have a meeting with representatives of the other table olive entities to ensure that communication and issues are streamlined and shared.
- Continue to have Sub-Committees review their yearly objectives to achieve the Committee's strategic plan focuses.
- In order to ensure that the Committee is carrying out its goals, a review of the Strategic Plan should be held yearly by the Executive Sub-Committee.

INSPECTION

INSPECTION SUMMARY

The COC inspection programs continued to evolve, progress, and provide more value to the industry. The inaugural year for the Olive Electronic Reporting System (OERS) was in 2014. In 2015, the system was refined. The COC added more features to help with congestion at the scale house including: bin tag print outs, a new entry application, and improvements for the users of the system.

OERS has a login and account feature for every grower. Growers now receive real time data and testify of its ability to create greater returns. Using the data, growers have better access for crop decision making. For example, growers may use this system to assist in timing of picking, identifying accelerated ripening, or review crop "trash" reports at the receiving station. This technology, at the click of button, provides growers with the tools and opportunity to manage their orchards and review certificates with maximum efficiency.

In addition to the OERS system, the COC and the industry continue to capitalize on technology in an effort to provide real value. Currently, the industry started transitioning from using cable graders to optical sizers on all varieties except Sevillano. The optical sizer cuts down on labor, processors time, and provides a higher degree of accuracy. Additionally, it decreases subjectivity in the grading process.

If any growers have an interest in seeing the optical sizer at work, please contact your canner field representative. If you have any questions about OERS or would like to know how to use the system, please feel free to contact our office. User manuals for growers can also be found at calolive.org, within the industry section, under inspection.

INCOMING INSPECTION CHART

CALIFORNIA OLIVE COMMITTEE
INCOMING INSPECTION REQUIREMENTS
2014-2015

U.S Standards & Marketing Order Sizes		Acceptable Count Ranges and Mid-Points (Per Pound)							
		Variety Group 1				Variety Group 2			
		Sevillano		Ascolano**		Obliza		Mission/Manzanillo*	
Size Designation	Average Count Ranger Per Pound	Acceptable Count Range	Mid Point	Acceptable Count Range	Mid Point	Acceptable Count Range	Mid Point	Acceptable Count Range	Mid Point
Undersize	226-up	Undersize 106 - Up		Undersize 181 - UP		Undersize 181 - Up		Undersize 206 - up	
Sub-Petite	181-225							181-205	193
Petite	141-180			158-174	166	158-174	166	158-174	166
Small	128-140			132-138	135	136-140	138	132-138	135
Medium	106-127			110-122	116	110-122	116	110-122	116
Large	91-105	91-105	98	91-105	98	95-101	98	91-105	98
Extra-Large Sev "L"	76-90	82-90	86	--	--	--	--	--	--
Extra-Large	65-90	--	--	67-85	72-80	65-88	72-80	65-88	72-80
Extra-Large Sev "C"	65-75	67-73	70	--	--	--	--	--	--
Jumbo	47-60	47-60	47-60	47-60	47-60	47-60	47-60	47-60	47-60
Colossal	33-46	33-46	33-46	33-46	33-46	33-46	33-46	33-46	33-46
Super Colossal	32 or less	32 or less	32 or less	32 or less	32 or less	32 or less	32 or less	32 or less	32 or less

* Manzanillo includes Haas

** Ascolano includes St. Agostino and Barouni

	Undersize
	Limited Sizes

OUTGOING INSPECTION CHART

CALIFORNIA OLIVE COMMITTEE
OUTGOING INSPECTION REQUIREMENTS
2014-2015

<table>
<tr><th colspan="9">Size Requirements and Percentage Tolerances</th></tr>
<tr><td>Size Designation</td><td colspan="2">SEVILLANO</td><td colspan="2">ASCOLANO*</td><td colspan="2">OBLIZA</td><td colspan="2">MISSION/ MANZANILLO**</td></tr>
<tr><td>Undersize</td><td colspan="2" rowspan="5">Undersize</td><td colspan="2" rowspan="2">Undersize</td><td colspan="2" rowspan="2">Undersize</td><td colspan="2">Undersize</td></tr>
<tr><td>Sub-Petite</td><td colspan="2" rowspan="2">35% less than 1/205lb.</td></tr>
<tr><td>Petite</td><td colspan="2" rowspan="3">35% less than 1/180lb.</td><td colspan="2" rowspan="2">35% less than 1/180lb.</td></tr>
<tr><td>Small</td><td colspan="2">128-140</td></tr>
<tr><td>Medium</td><td colspan="2">106-127</td><td>106-127</td><td rowspan="7">All Sizes 5 % less than 1/ 140 lb.</td></tr>
<tr><td>Large</td><td colspan="2" rowspan="2">35% Less than 1/105lb.</td><td colspan="2">91-105</td><td>91-105</td><td rowspan="6">All sizes 5 % less than 1/ 127 lb.</td><td>91-105</td></tr>
<tr><td>Extra Large</td><td rowspan="2">65-90</td><td rowspan="5">All sizes 5 % less than 1/ 105 lb.</td><td rowspan="2">65-90</td><td rowspan="2">65-90</td></tr>
<tr><td>Extra Large</td><td colspan="2">65-75</td></tr>
<tr><td>Jumbo</td><td rowspan="2">47-60
33-46</td><td rowspan="3">All sizes 5% less than 1/ 75 lb.</td><td rowspan="2">47-60
33-46</td><td rowspan="2">47-60
33-46</td><td rowspan="2">47-60
33-46</td></tr>
<tr><td>Colossal</td></tr>
<tr><td>Super Colossal</td><td>32 or less</td><td>32 or less</td><td>32 or less</td><td>32 or less</td></tr>
<tr><td></td><td colspan="2">Tolerance (by count)
35% under 1/ 75
but not more than
10% under 1/ 86</td><td colspan="2">Tolerance (by count)
35% under 1/ 105
but not more than
10% under 1/ 113</td><td colspan="2">Tolerance (by count)
35% under 1/ 127
but not more than
7% under 1/ 138</td><td colspan="2">Tolerance (by count)
35% under 1/ 140
but not more than
7% under 1/ 166</td></tr>
</table>

* Ascolano includes St. Agostino and Barouni

** Includes Haas variety

	LIMITED USE SIZE and PERCENTAGE TOLERANCES
	Tolerances apply to MINIMUM WHOLE OR PITTED CANNING SIZE: Sevillano- Extra Large "C"; Ascolano- Large; Obliza- Medium; Mission/Manzanillo- Small

RESEARCH

2014-2015
RESEARCH SUMMARY

In 2014-2015, the California Olive Committee focused on seven areas of research.

Our current projects are as follows:

ANNUAL RESEARCH REPORT

California Olive Board and California Olive Oil Commission

December 2015

Project Year: 2015

Principal Investigators: J. E. Adaskaveg

Project Title: Epidemiology and management of olive knot caused by *Pseudomonas savastanoi* pv. *savastanoi*

Cooperating: D. Thompson, K. Nguyen, H. Förster (UC Riverside), D.M. Lightle (UCCE - Glenn Co.), and E. Fichtner (UCCE-Tulare Co.)

Keywords: Bactericides, Biological controls, and Systemic Acquired Resistance (SAR) compounds

BACKGROUND

The bacterium *Pseudomonas savastanoi* pv. *savastanoi* (Psv) is the causal agent of olive knot and occurs throughout olive (*Olea europaea*) growing regions of the world including California (Young, 2004). The pathogen enters through wounds causing hyperplastic outgrowths (knots, tumors, galls, etc.) on branches and infrequently on leaves and fruit. Olive knot is one of the most economically important diseases of olives as infection may lead to tree defoliation, dieback, and reduced tree vigor, which ultimately lowers fruit yield and quality (Schroth, 1973). Psv can be found as both an endophyte and epiphyte of the olive phyllosphere, but the main source of inoculum are Psv residing in olive knots. Inoculum production of the pathogen is promoted during wet periods when it is exuded from knots and disseminated by rain, wind, insects, birds, as well as human activity. We demonstrated that inoculum is produced very rapidly after wetting olive knots. The opportunistic pathogen takes advantage of wounds caused by natural leaf abscission, frost, and hail damage, as well as cultural practices such as pruning and harvesting. These latter orchard practices also lead to direct mechanical damage of the knots and exposure of inoculum. After entering its woody host, the pathogen actively induces knot formation by production of indoleacetic acid (IAA) and cytokinins. In California, infections occur mostly during the rainy season (late fall, winter, and spring) but knots do not develop until active growth initiates in the spring. Infections can occur at fairly low temperatures (5-10 C) and thus, wetness is the main limiting factor for the disease. Historically, the most susceptible table olive cultivars are Manzanillo, Sevillano, Ascolano, and Mission but the oil cultivars are also very susceptible. None of the currently grown olive cultivars is resistant to the pathogen. For our studies, we are using cvs. Manzanillo and Arbequina, and in our experience both can have high incidence and severity of disease. Development of olive knots on wounded, inoculated branches depends on inoculum concentration, environmental conditions, and olive cultivar (Penyalver, 2006).

We determined the minimum threshold inoculum concentration for cvs. Manzanillo and Arbequina for knot development. Management strategies should keep Psv populations below these threshold values. Knot formation is usually localized to the initial entry point of the bacterium. Systemic movement of the pathogen, however, has also been observed in rare cases (Wilson and Magie, 1964). In spring 2014 evaluations of our fall 2013 trials in commercial and experimental olive orchards, we observed systemic movement of Psv which we never observed in any of our previous trials. Infections caused bark blistering and cracking as well as development of knots in proximity to and away from the initial point of inoculation. In most severe cases, inoculated branches and whole trees died. Potential causes of systemic movement have not been well characterized. Thus, one of our objectives is to determine environmental or other factors leading to these symptoms and whether the pathogen is migrating internally or externally on the host. In preliminary investigations, we have been able to reproduce environments in growth chamber studies that lead to systemic movement of the bacterium in olive plants. More detailed studies are currently in progress and some preliminary studies are reported here. This information will contribute to knowledge on the epidemiology of the pathogen and possibly identify new management strategies.

Sanitation and prevention are the most successful strategies for management of olive knot. Any horticultural practice that promotes tree health, minimizes tree stress, and results in less leaf drop will reduce infections. Pruning and removal of knots during dry periods (i.e., summer and early fall) reduces inoculum and avoids re-infection at pruning sites. Because the bacteria may be carried on pruning equipment, frequent disinfection of equipment is necessary. Painting galls with Gallex is an effective therapeutic treatment but is very labor intensive and is considered impractical. Spray applications of copper-containing bactericides have been very effective in minimizing the disease, however repeated applications are generally needed to protect wounds as they occur over the year. A minimum of two applications is usually necessary: one in the fall immediately after harvest (before the rainy season) and a second one in the spring just prior to leaf drop. Additional applications may be needed during winter rains or spring/summer hail-storms. New copper formulations have been developed to reduce the metallic copper equivalent while maintaining the efficacy of the treatment. Our evaluations of copper sensitivity in populations of the olive knot pathogen indicated a reduced sensitivity of all strains with several strains showing an increased level of resistance. These results demonstrate a potential risk of resistance development of Psv to copper with its continued and often exclusive use. Although the combination of copper and mancozeb is highly toxic to strains of Psv less sensitive to copper, the EPA will not allow additional crops to be added to the mancozeb label. Thus, we initiated a search for other compounds that could be mixed with copper to increase its activity. We have identified amino-thiadiazole (ATD), a food-grade additive, as a synergistic compound that increases the activity of copper against copper sensitive and less sensitive strains in the laboratory. Field trials have been completed in fall of 2014 and spring of 2015. Still other compounds need to be developed to reduce exposure of any one mode of action to populations of the pathogen. Additionally, because olive knot infections occur mostly during the rainy period, knowledge on the persistence of treatments is critical. Thus, the efficacy of copper and other compounds like antibiotics alone and in mixtures with adjuvants that may increase the persistence of these treatments has been evaluated.

We have been instrumental in the development of the new agricultural antibiotic kasugamycin (Kasumin) for several bacterial diseases of agronomic crops in the United States. Kasugamycin has high activity against *Erwinia* and *Pseudomonas* species and moderate activity against *Xanthomonas* species and other plant pathogenic bacteria. A second antibiotic oxytetracycline (Mycoshield, Fireline) has also been identified. We found these compounds to be the most promising new treatment for preventing olive knot in our field studies, including in a commercial application to inoculated branches. Additional field trials have been performed to compile data to support the registration of kasugamycin and oxytetracycline on olives. Kasugamycin and oxytetracycline are currently federally registered on pome fruit crops (e.g., apples and pears), whereas their use on olives has been approved as "A" priorities by IR-4 for the 2015 and 2016 seasons. We are involved with these IR-4 residue studies. Other products including antimicrobial peptides from commercial sources were also evaluated in 2015. Several systemic acquired resistance (SAR) compounds (e.g., Actigard, Regalia, quinoxyfen - Quintec, and USF2018A) were effective in our previous studies, but not equivalent to copper or kasugamycin. New trial data from 2015 suggest that it may not be possible to achieve consistent disease control using SAR compounds by themselves, and their development in combination with conventional treatments such as with antibiotics and copper may be more realistic.

We have also been working on sanitation treatments as part of an integrated olive knot management program. We demonstrated that guanidine, chlorhexidine, and quaternary ammonia compounds (QACs) were highly toxic against the olive knot pathogen in laboratory studies. Citrox, a natural product derived from citrus extracts, and the quaternary ammonia sanitizers were also highly effective in disinfecting hard surfaces that were contaminated with Psv. The QACs are volatile, leave near zero residues, and are not corrosive to equipment. Deccosan 321 (MaQuat 615-HD) was registered for use on olives in California in 2015. We initiated field trials in the spring of 2015 to compare QAC performance to chlorine in reducing the spread of Psv on olives from contaminated field equipment. We will test additional parameters that may affect the efficacy of the sanitizers such as inoculum concentration and post-inoculation treatment time. Field evaluations of the material as an equipment sanitizer was accomplished this year with very promising results. Additionally, we evaluated a new non-phenolic QAC, KleenGrow, for use as a protective treatment directly on trees. Unfortunately, KleenGrow was not effective when used as a protective treatment in a foliar spray on olive wounds before inoculation.

Research Objectives

1) Epidemiology – pathogen genetic variability, inoculum availability, threshold inoculum level for disease induction, systemic movement of Psv
   a. Monitor galls for production of inoculum over time
   b. Evaluate the effects of inoculum concentration on disease development
   c. Investigate environmental factors that may lead to systemic movement of Psv
   d. Track the systemic movement (endophytic or epiphytic) of Psv on the olive host using selective re-isolation techniques and microscopy
2) Evaluate populations of the pathogen for laboratory sensitivity to chemicals
   a. Population dynamics of copper-resistant in relation to copper-sensitive strains of Psv
3) Test the performance of an equipment sanitizer (e.g., quaternary ammonium) under field conditions in comparison to chlorine.
4) Field trials on efficacy of bactericides and SAR compounds.
   a. Protective (pre-infection) vs. post-infection activity of treatments; proper timing and application of SAR compounds; effects of inoculum concentration on the efficacy of SAR compounds
   b. Develop copper activity-enhancing materials such as mancozeb, amino-thiadiazole (ATD), and dodine
   c. Determine the efficacy of a new, non-phenolic-based quaternary ammonium formulation (i.e., KleenGrow) for use as a protective treatment on olives
   d. Persistence of different copper formulations with and without the addition of lime, pinolene, or carnauba-based additives under simulated rain conditions.

Materials and Methods

1a. Monitor galls for production of inoculum over time. Olive knots attached to twigs were washed and sampled after selected time periods in order to enumerate Psv population levels and to determine the extent of inoculum produced or exuded by knots during multiple rain events.

1b. Evaluate the effects of inoculum concentration on disease development. Greenhouse and field trials were performed on cvs. Manzanillo and Arbequina to investigate the effects of Psv inoculum concentration on disease incidence for leaf scar and lateral wounds inoculated with either a copper-sensitive or copper-resistant strain. Olive twigs were wounded and inoculated with selected concentrations of these strains ranging from $2x10^5$ to $2x10^8$ CFU/ml and scored for disease incidence after symptoms (knots) developed. In field studies, treatments of copper hydroxide or kasugamycin were applied to wounds that were inoculated with various inoculum concentrations to examine treatment efficacy under different disease pressures. A greenhouse trial was carried out in the spring of 2015 at UCR. Field trials at UC Davis were done in the fall of 2014 and were repeated in the spring of 2015. All field plant inoculation studies that are described in this report have durations of at least four to six months because knots do not develop until plant growth occurs. In growth chamber and greenhouse studies, young and succulent plants that are continuously growing were incubated for 2 to 3 months before symptoms developed.

1c. Investigate environmental factors that may lead to systemic movement of Psv. Young potted olive trees of cvs. Manzanillo were placed into a growth chamber and exposed to -5°C for 8 h. Multiple inoculation and wounding scenarios that were tested included:

i. Wounding and inoculating plants with Psv before placing into the cold chamber. This experiment simulates olive trees that are damaged and inoculated (i.e., hail storm, harvest damage followed by rain event, etc.) before occurrence of a freezing event.
ii. Spray inoculating plants without wounding before placing into the cold chamber. This determines if a freezing event creates Psv-susceptible tissue that can be infected by the bacterium that is already present on the surface during the event (Psv pre-existing as an epiphytic colonizer).

iii. Wounding and placing plants into the cold chamber and inoculating wounds afterwards. This simulates olive trees that are wounded (mechanically or naturally) and are then exposed to a freezing event with subsequent rain and inoculum dispersal.
iv. Placing plants into the chamber followed by spray inoculating the whole plant. This determines if a freezing event creates Psv-susceptible tissue that can be infected when the bacterium is introduced afterwards (i.e., rain dispersal of Psv from knots after a freezing event).

These scenarios allow us to elucidate whether freezing damage can predispose olives to Psv infection by creating new wounds or increasing colonization of existing tissue damage, and if the migration of the bacterium on frost-damaged tissue is external, internal, or possibly both.

1d. Track the systemic movement (endophytic or epiphytic) of Psv on the olive host using selective re-isolation techniques and microscopy. Plants used in objective 1c. studies will be further evaluated by tracking movement of the bacterium using selective re-isolation techniques and microscopy. Olive twig tissue samples will be taken at various distances away from the initial inoculation point over several months to monitor movement of the bacterium. Tissue will be examined using scanning electron microscopy as well as re-isolating Psv on selective media. The Psv strain used will have unique characteristics (copper-resistance) that will allow for the discrimination of the inoculated strain from Psv strains that may be residing epiphytically on the olives (although all plants used did not have olive knot symptoms).

2. Population dynamics of copper-resistant and copper-sensitive strains of Psv. Additional strains of Psv were collected from an orchard in Glenn Co. where a copper-resistant Psv strain was recovered previously. Strains were tested for sensitivity to copper using a serial dilution method and for sensitivity to the antibiotics kasugamycin, oxytetracycline, and streptomycin using the spiral gradient endpoint (SGE) method.

3. Test the performance of an equipment sanitizer (e.g., quaternary ammonium) under field conditions in comparison to chlorine. The quaternary ammonium compound (QAC), MaQuat 615-HD was tested in field trials in the spring of 2015 and compared to sodium hypochlorite (bleach solution) in reducing the spread of Psv by contaminated field equipment. We utilized a handheld gas-powered hedger to simulate larger commercial pruning equipment. The hedger was used to trim and injure olive branches, simulating damage that would likely occur during commercial pruning operations. The hedging blades (metal teeth) were contaminated (sprayed with a suspension of Psv) and the hedger was subsequently used to prune healthy (symptomless) trees. For treatments, the contaminated blades were sprayed with selected disinfectants at experimental or labeled rates and exposure durations before pruning trees. In some treatments, hedging was followed by additional copper and copper-kasugamycin foliar applications on newly hedged olives to possibly obtain greater reduction in disease incidence. These trials were performed at UC Davis.

4a. Protective (pre-infection) vs. post-infection activity of SAR compounds and effects of inoculum concentration on the efficacy of SAR compounds. SAR compounds were field-tested against olive knot during the fall of 2014 and evaluated in the spring of 2015, focusing on the effects of Psv inoculum concentrations. Foliar sprays of SAR compounds were applied to entire cvs. Manzanillo and Arbequina olive trees until runoff 3 days before wounding and inoculating with a copper-sensitive Psv strain. Psv inoculum concentrations ranged from $2x10^5$ to $2x10^8$ CFU/ml. SAR compounds evaluated included Regalia, Proalexin, Stout, Actigard, and Quintec at experimental or field labeled rates.

4b. Develop copper activity-enhancing materials such as mancozeb, amino-thiadiazole (ATD), and dodine. Field trials were performed during the fall of 2014 and spring of 2015 in two olive orchards (UC Davis and Yuba Co.) to test copper treatments mixed with etridiazole (Terrazole), amino-thiadiazole-thiol (ATD), mancozeb (Manzate Prostick), famoxadone + cymoxanil (Tanos), or dodine (Syllit) to determine if any enhancement in disease control could be achieved as compared to copper alone. Treatments using kasugamycin at low (100 ppm/A) and high rates (200 ppm/A) were also evaluated along with high rates of copper hydroxide (7 lb/A).

4c. Determine the efficacy of a new, non-phenolic-based quaternary ammonium formulation (i.e., KleenGrow) for use as a protective treatment on olives. The non-phenolic quaternary ammonia compound KleenGrow was tested as a protective treatment in a greenhouse trial in fall of 2014 and in several field trials in the fall of 2014 and spring of 2015. KleenGrow treatments were applied to olive twig wounds before being inoculated with a Psv suspension.

4d. Persistence of different copper formulations with and without the addition of lime, pinolene, or carnauba-based additives under simulated rain conditions. A copper persistence trial was performed on young cv. Manzanillo trees in the fall of 2014 and repeated in the spring of 2015 at UC Davis. Olive twigs were wounded and treated with several copper and copper-adjuvant treatments (lime – calcium hydroxide, pinolene – NuFilm-P, or a carnauba-based additive – Washgard). After air-drying, trees were overhead irrigated with micro-misters to simulate a 30-min rain event. Treated wounds were then spray-inoculated with a copper-sensitive Psv strain.

Results and Discussion

***1a.* Monitor galls for production of inoculum over time.** This trial is currently in progress. Results are pending and will be available in the next report.

1b. Evaluate the effects of inoculum concentration on disease development. In greenhouse trials performed during the spring of 2015, similar results were obtained as reported in 2014. Leaf scars were less susceptible to infection as compared to lateral wounds except for the highest inoculum concentration for both cultivars and strains tested. Higher disease incidence was observed for the higher Psv concentrations ($2x10^7$ and $2x10^8$ CFU/ml) in most cases, but other factors may contribute to disease development (e.g., the growth stage of olive plants – when growth is less active, fewer knots develop). Knots were also substantially larger on some plants while much smaller or absent on others. Inoculated young, succulent, green twigs produced knots more readily than older woody twigs. Both copper-sensitive and -resistant strains were equally virulent under greenhouse conditions.

In field trials conducted during the fall of 2014 at UC Davis using the same inoculum concentration range and a copper-sensitive Psv strain, higher disease incidence was observed on cv. Arbequina than on cv. Manzanillo for both leaf scar and lateral wound inoculations. Again, inoculated leaf scars typically developed fewer knots at the lower inoculum concentrations (incidence of 12.5 and 22.5% for cvs. Manzanillo and Arbequina, respectively, using $2x10^5$ CFU/ml) while lateral wounds had high levels of disease for all concentrations ranging from 45-75% and 80-100% incidence for cvs. Manzanillo and Arbequina, respectively. Copper hydroxide performed well in reducing disease incidence at all inoculum concentrations on both lateral and leaf scar wounds for either cultivar ($\leq$ 22.5% incidence). Kasumin 2L at the 100-ppm rate reduced disease on lateral wounds when lower inoculum concentrations were used (Fig. 1). The different slopes of the regression lines indicate that bacterial concentration affected the performance of kasugamycin more than that of copper.

Past trials have shown that concentrations of $2x10^5$ CFU/ml of Psv can produce some disease depending on plant age, wound type, and Psv strain. Also, inoculated greenhouse plants had higher disease incidence than field grown plants and knots developed faster (2.5 months in the greenhouse vs. 4-6 months in the field). Thus, $2x10^5$ CFU/ml could be considered a threshold concentration for disease induction. Consistent high levels of disease resulted when plants were inoculated with $2x10^7$ CFU/ml Psv, and somewhat less consistent disease levels were achieved with $2x10^6$ CFU/ml. We have found that these higher concentrations may potentially be exuded from living knots but dilution occurs during their dispersal due to precipitation, runoff, or plant canopy size. Thus, reduced inoculum levels are likely present on susceptible tissue. Therefore, treatments that are less effective when artificially inoculated with a substantial amount of bacteria may not be indicative of actual effectiveness under field conditions. Thus, we evaluated treatment efficacy using very high disease pressure. High copper concentrations are needed to maintain some level of effectiveness even under these conditions and higher rates of kasugamycin showed similar results in our chemical field trials (see data for objective 4b). The cultivars Manzanillo and Arbequina had some variability in disease incidence among trials, but both should be considered as highly susceptible to Psv.

1c. Investigate environmental factors that may lead to systemic movement of Psv. In a growth chamber-greenhouse study performed in October 2015, olive plants that were wounded and inoculated developed typical knots localized to the wound after 2.5 months. Only in scenario (ii) where plants were wounded, inoculated, and then exposed to cold did we observe symptoms of systemic movement. Small nodules were noted several centimeters from the point of inoculation. On some branches, nodules were produced even more than 10 cm away from the inoculation point. Interestingly, for twigs that were wounded and cold exposed before inoculation, no knots developed away from the inoculation point. Symptoms were examined recently (10 weeks after inoculation), and nodules will be sampled and used for re-isolation at a later time to confirm the presence of Psv. Eight hours of cold exposure was too severe for cv. Manzanillo plants because this caused major branch dieback and no data could be obtained. Repeat trials will limit cold exposure to 4 h to reduce dieback while still providing some frost damage. Non-wounded plants that were spray-inoculated before or after cold exposure have presently not developed any symptoms. Thus, existing injury may be necessary for infection, and subsequent frost damage may assist in systemic movement of the bacterium. In these preliminary studies, cold injury alone did not facilitate infection of Psv. Additional studies will be undertaken in 2016 to repeat the current study as well as including the addition of protective treatments on frost-injured plants inoculated with Psv to determine if treatments can reduce disease intensity.

1d. Track the systemic movement (endophytic or epiphytic) of Psv on the olive host using selective re-isolation techniques and microscopy. This is pending on development of symptoms (on surviving branches of objective 1c) as well as repeating the trial with shorter cold exposure duration to reduce branch dieback.

2. Population dynamics of copper-resistant in relation to copper-sensitive strains of Psv. An additional 20 Psv strains were recovered from a location where we previously detected copper-resistance. Copper sensitivity tests indicated that 2 and 3 of the 20 strains obtained were resistant (>50 mg/L MCE) or moderately (20 to 30 mg/L MCE) resistant to copper, respectively. All strains, however, were sensitive to the antibiotics kasugamycin, streptomycin, and oxytetracycline (Tables 1 and 2).

3. Test the performance of an equipment sanitizer (e.g., quaternary ammonium) under field conditions in comparison to chlorine. Deccosan 321 performed exceptionally well when used to sanitize pruning equipment that was contaminated with a high concentration of Psv (Fig. 2). For disease control on Manzanillo olives, Deccosan 321 sanitation alone was similar in efficacy as compared to chlorine or the Deccosan plus subsequent copper or copper-antibiotic foliar treatment. On cv. Arbequina, additional foliar applications of copper hydroxide or of copper hydroxide-kasugamycin mixtures to newly hedged olives significantly decreased the occurrence of olive knots from that of the chlorine treatment and numerically improved the performance from the Deccosan alone treatment. Equipment sanitation with sodium hypochlorite was also effective, but with less disease reduction as compared to Deccosan 321 (Fig. 2).

4a. Pre-infection (protective) vs. post-infection activity of SAR treatments and effect of inoculum concentration on the efficacy of SAR compounds. Most SAR compounds tested did not significantly reduce disease incidence as compared to controls treated with water. At the lowest concentration of Psv, Proalexin resulted in a significant decrease in disease incidence on lateral wounds (3.3% incidence) as compared to the water control with 27% incidence in one study. In a few cases, Quintec resulted in some reduction of knot formation when trees were inoculated with 2×10^6 CFU/ml Psv, but not to satisfactory levels. Still, none of the SAR treatments provided a consistent reduction in disease. Possible explanations include: rates evaluated may not have been sufficient for activating plant defensive mechanisms, timing of application was not appropriate, or these compounds may not trigger a SAR reaction in olive plants. In comparison, Kocide 3000 at 3.5 lbs/A that was used as a control treatment in these studies provided high and consistent levels of disease control for the entire range of Psv inoculum concentrations used.

4b. Develop copper activity-enhancing materials such as mancozeb, amino-thiadiazole (ATD), and dodine. In the fall 2014 Davis trial on cv. Arbequina where a copper-sensitive Psv strain was used, all copper-containing treatments performed similarly, reducing disease incidence by at least 74% on lateral wounds (Fig. 3). On cv. Manzanillo, similar results were obtained using the copper-sensitive strain, with disease incidence reduced by treatments containing copper by at least 90% (Fig. 4). When a copper-resistant strain was used in the fall 2014 trial, copper alone at the highest labeled rate (7 lb/A) performed better than any of the mixture treatments on lateral wounds of both cultivars (disease reduction by at least 74%; Figs. 5 and 6).

In the fall 2014 trial in the Yuba county cv. Arbequina orchard, the 7-lb rate of copper again was the best treatment on lateral wounds reducing disease by 96 or 83% using a copper-sensitive or -resistant strain, respectively (Fig. 7a and 8a). Kocide 3000 (3.5 lb/A) - mancozeb (2.4 lb/A) mixture treatments performed equally well to copper (7 lb/A) for a copper-sensitive strain (Fig. 7), while kasugamycin at 200 ppm worked well against a copper-resistant strain (Fig. 8). Data from the repeat trial in spring of 2015 indicated that copper-containing and kasugamycin treatments performed well in reducing knot incidence when a copper-sensitive strain was used (Figs. 7). Using a copper-resistant strain, kasugamycin containing treatments and copper at the highest rate were the best treatments on lateral wounds (Fig. 8).

In summary, the addition of experimental compounds to copper hydroxide did not improve copper performance compared to copper alone in most cases, and copper at the maximum labeled rate gave excellent disease reduction, especially to copper-sensitive Psv strains. Kasugamycin at 200 ppm/A gave comparable results to high rates of copper. Thus, mixtures of copper at maximum rates with high rates of kasugamycin should give exceptional olive knot control and field tests have been performed to evaluate this treatment in the fall of 2015 (results pending). This may be the best strategy for disease prevention and the mixture with two modes of action will minimize the development and spread of copper and potential kasugamycin resistance. All field trials performed in fall of 2014 and spring of 2015 included lateral wound inoculations, and leaf scar wounds will be examined in future studies using different concentrations of Psv inoculum.

4c. Determine the efficacy of a new, non-phenolic-based quaternary ammonium formulation (i.e., KleenGrow) for use as a protective treatment on olives. KleenGrow did not reduce knot incidence when sprayed at the maximum labeled rate (0.38 fl oz/gal) to wounds that were subsequently inoculated with Psv in all trials (greenhouse and field). The labeled rate may not be effective for olive knot control or this material may not be effective when used as a protective treatment directly on olives.

4d. Persistence of different copper formulations with and without the addition of lime, pinolene, or carnauba-based additives under simulated rain conditions. In the fall 2014 trial, all copper treatments significantly reduced disease incidence on inoculated lateral wounds as compared to the control. No disease developed on wounds treated with Kocide 3000 (7 lbs/A) or Kocide 3000 (3.5 lbs/A) - Washgard (2.5 gal/A) (Fig. 9). Still, there was no significant difference in disease incidence between the high rate of copper and treatments with the half-rate of copper mixed with adjuvants (e.g., Washgard, Quintec, Omni Oil, or NuFilm). In a spring 2015 repeat trial, copper at the high rate had the lowest disease incidence numerically, but statistically was similar to all other Kocide treatments with adjuvants (Fig. 9). The low rate of Kocide (3.5 lb/A) without adjuvants had statistically higher disease incidence than the high rate.

Acknowledgements

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Table 1. In vitro sensitivity to copper of 20 Psv strains collected from one orchard in Glenn Co. in 2015

Copper sensitivity*	No. strains
Sensitive	15
Moderate	3
Resistant	2
Total	20

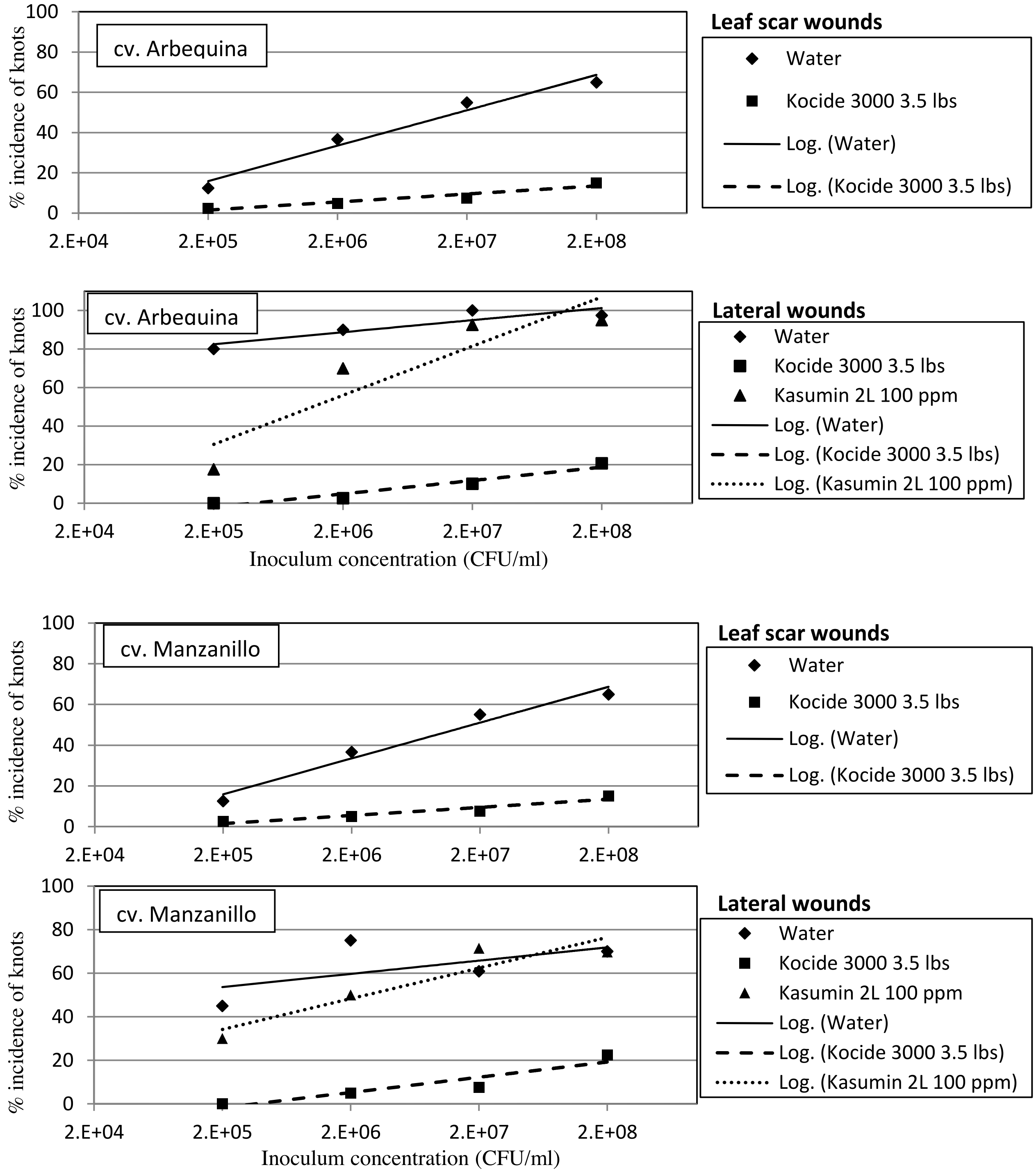
* - Sensitivity to copper was determined by growing strains on media amended with 0, 10, 20, 30, or 50 mg/L metallic copper equivalent (MCE). Copper sensitive: growth at ≤10 mg/L MCE; moderate copper sensitivity: growth at 20 and 30 mg/L MCE; and copper-resistant: growth at ≥50 mg/L MCE.

Table 2. In vitro sensitivity to three antibiotics of 20 Psv strains collected from Glenn Co. in 2015

Oxytetracycline		Streptomycin		Kasugamycin	
LIC*	MIC	LIC	MIC	LIC	MIC
0.15	0.23	0.15	0.4	2.46	4.92

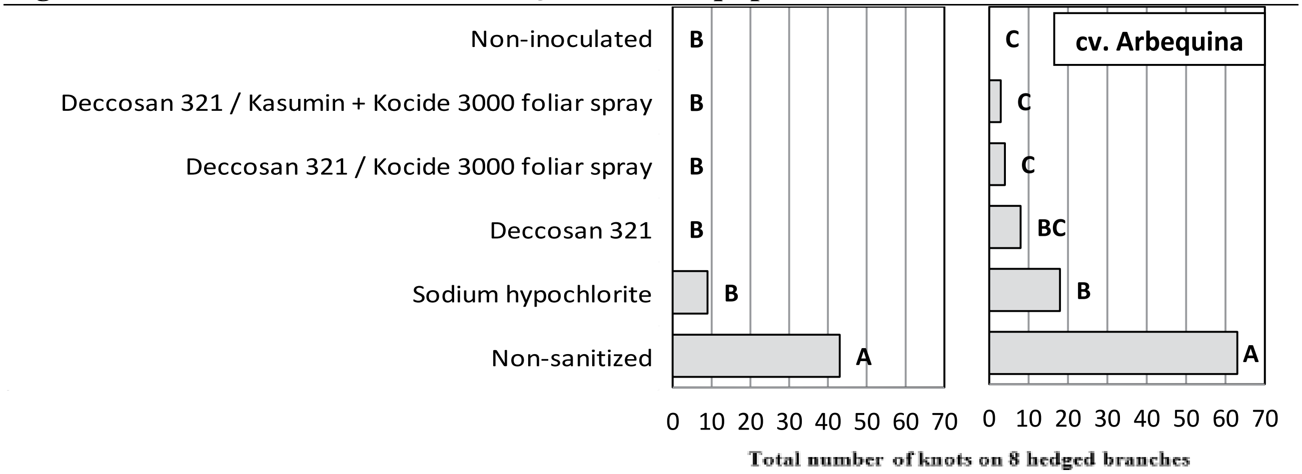
* - Average lowest inhibitory concentrations (LIC) and minimal inhibitory concentrations (MIC; growth inhibited by ≥95%) for 20 Psv strains from an olive orchard where copper resistance was previously detected. Inhibitory values were determined using the SGE method.

Fig. 1. Effect of inoculum concentration and pre-infection foliar spray treatments on disease incidence of cvs. Arbequina and Manzanillo olives in field trials in the fall of 2014



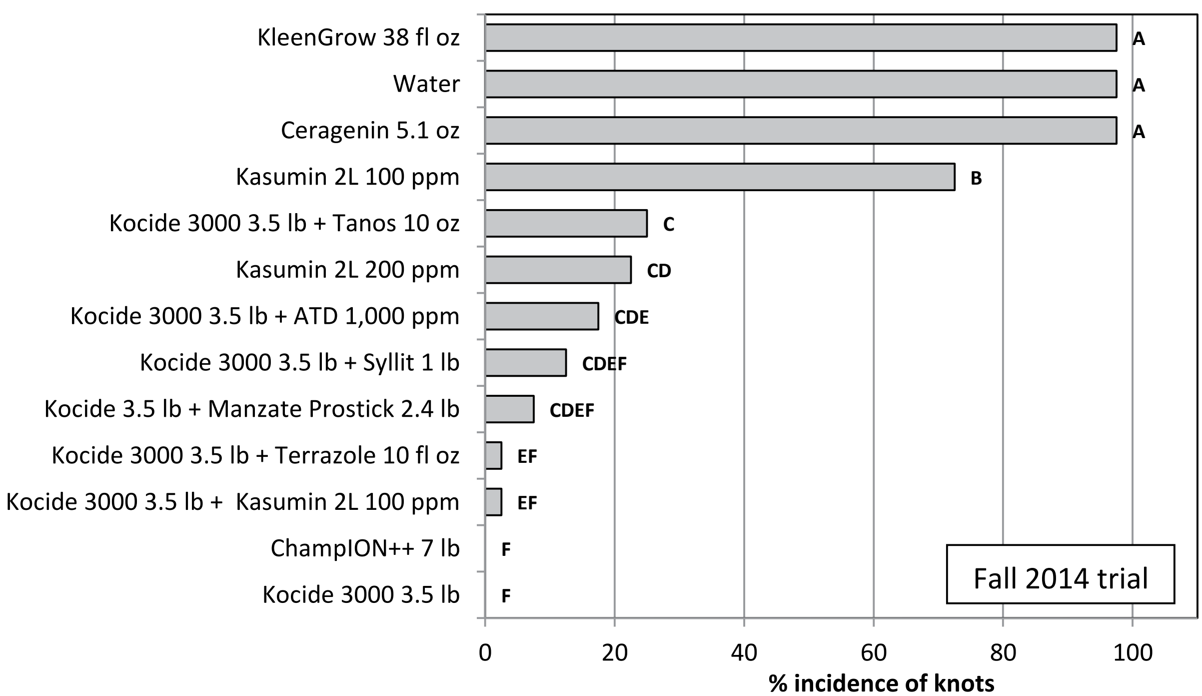
Branches were wounded (leaf scar and lateral wounds) and inoculated with selected concentrations ($2x10^5$ to $2x10^8$ CFU/ml) of a **copper-sensitive** Psv strain. Some wounds were also spray-treated with Kocide 3000 or Kasumin 2L. Knot development on inoculated wounds was evaluated 9-months post-inoculation.

Fig. 2. Performance of Deccosan 321 (QAC) as an equipment sanitizer under field conditions



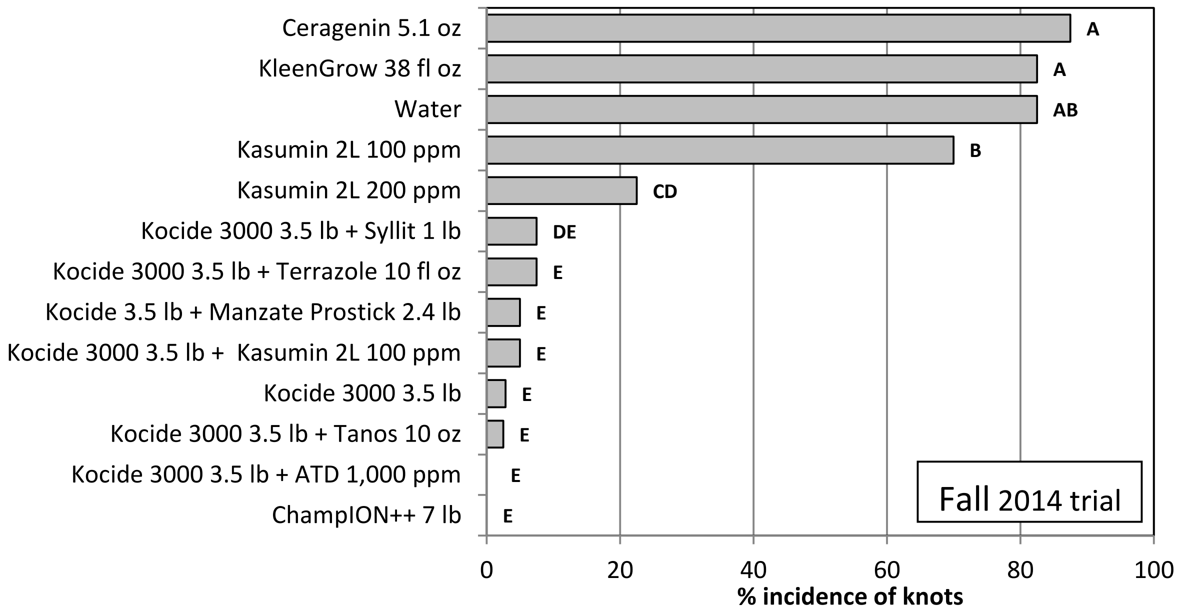
Olive branches were pruned with a hedger that was contaminated with a **copper-sensitive** strain of Psv ($2x10^7$ CFU/ml). The hedger was not sanitized or sanitized with Deccosan 321 (2000 mg/L) or sodium hypochlorite (50 mg/L). Branches were not treated or treated with a foliar application with Kocide 3000 (3.5 lb/A) or Kocide 3000 + Kasumin (100 mg/L). Disease evaluations were performed 6 months after the start of the trial.

Fig. 3. Evaluation of new foliar treatments for management of olive knot of cv. Arbequina caused by a copper-sensitive Psv strain - Field trial at UC Davis



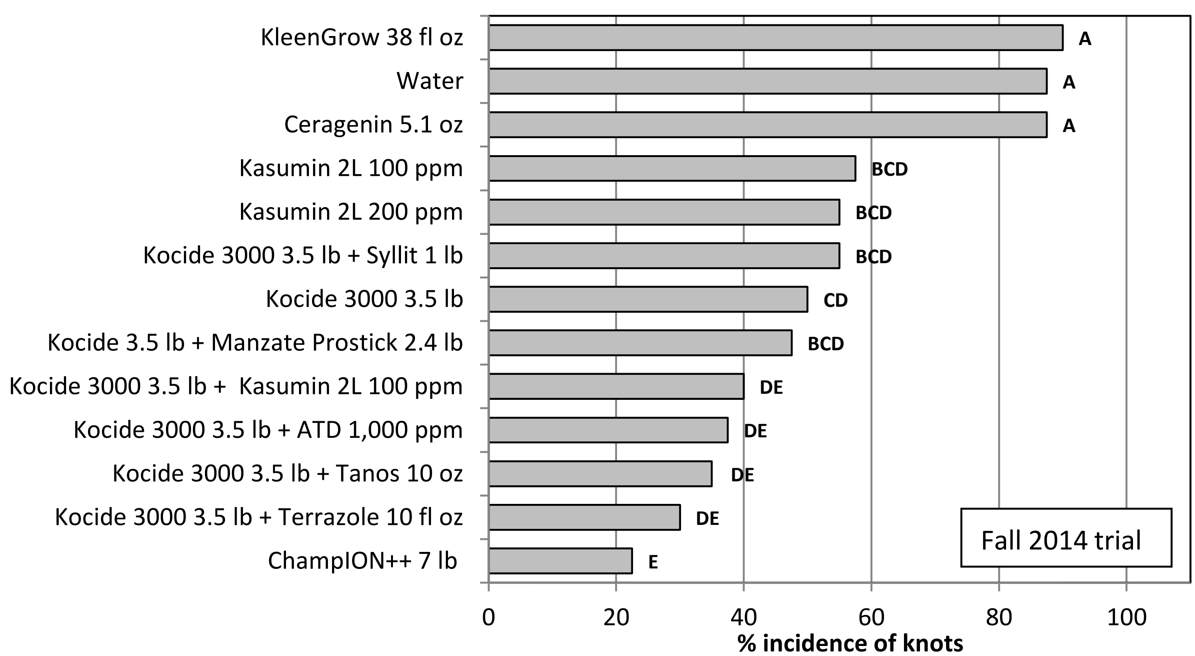
Olive branches of cv. **Arbequina** were injured with lateral wounds and foliar treated. After air-drying, wounds were spray-inoculated with a **copper-sensitive** Psv strain at $1x10^8$ CFU/ml. Treatments with same letters are not significantly different based on a least significant difference mean separation test.

Fig. 4. Evaluation of new foliar treatments for management of olive knot of cv. Manzanillo caused by a copper-sensitive Psv strain - Field trial at UC Davis



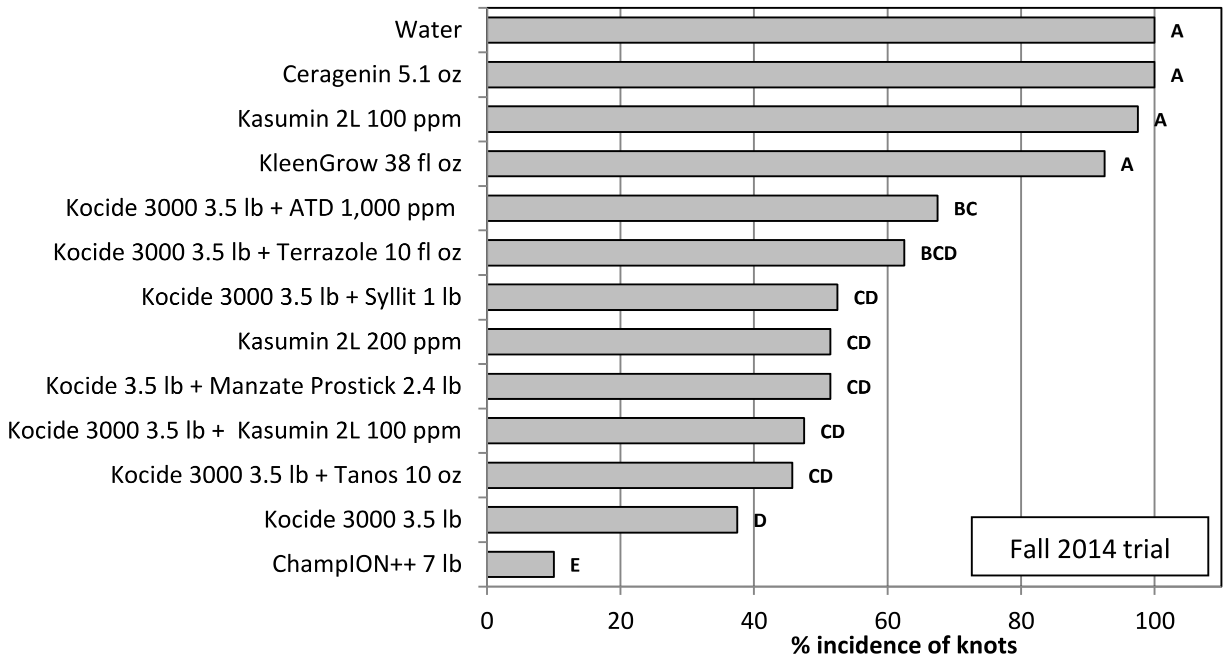
Olive branches of cv. **Manzanillo** were injured with lateral wounds and foliar treated. After air-drying, wounds were spray-inoculated with a **copper-sensitive** Psv strain at $1x10^8$ CFU/ml. Treatments with same letters are not significantly different based on a least significant difference mean separation test.

Fig. 5. Evaluation of new foliar treatments for management of olive knot of cv. Arbequina caused by a copper-resistant Psv strain - Field trial at UC Davis



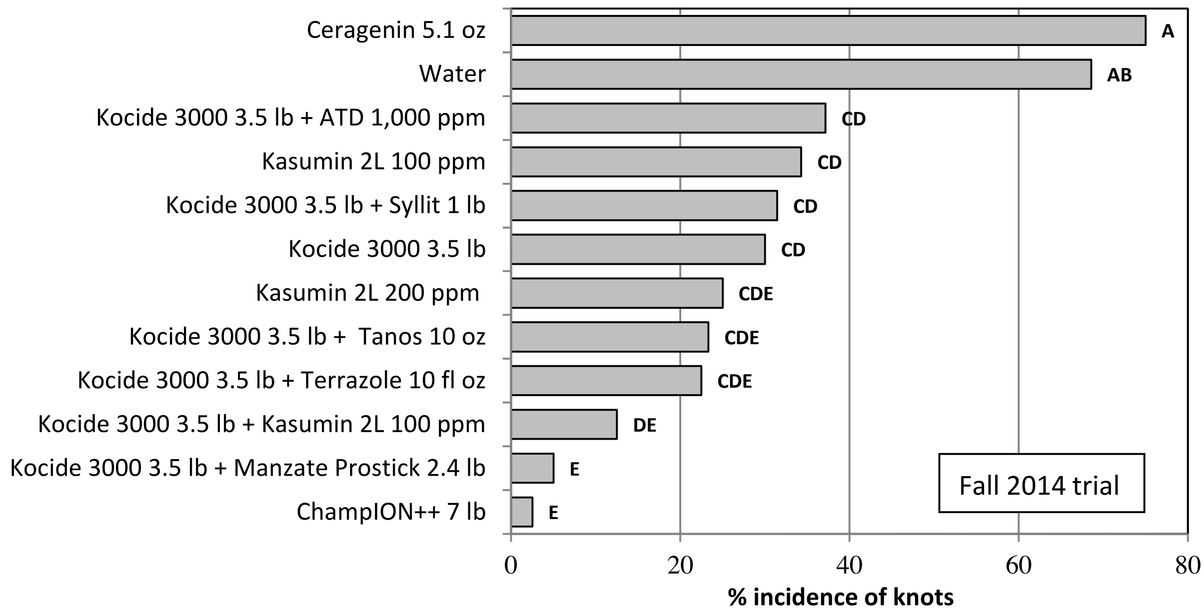
Olive branches of cv. **Arbequina** were injured with lateral wounds and foliar treated. After air-drying, wounds were spray-inoculated with a **copper-resistant** Psv strain at $1x10^8$ CFU/ml. Treatments with same letters are not significantly different based on a least significant difference mean separation test.

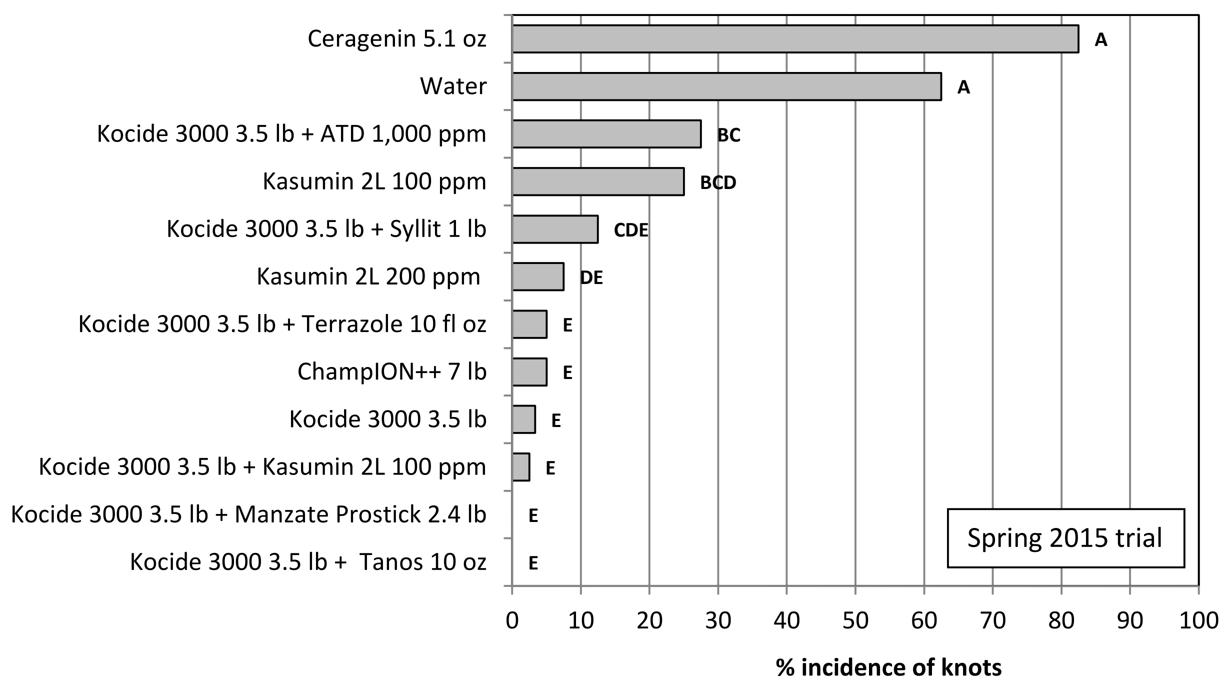
Fig. 6. Evaluation of new foliar treatments for management of olive knot of cv. Manzanillo caused by a copper-resistant Psv strain - Field trial at UC Davis.



Olive branches of cv. **Manzanillo** were injured with lateral wounds and foliar treated before being spray inoculated with a **copper-resistant** Psv strain at $1x10^8$ CFU/ml. Treatments with same letters are not significantly different based on a least significant difference mean separation test.

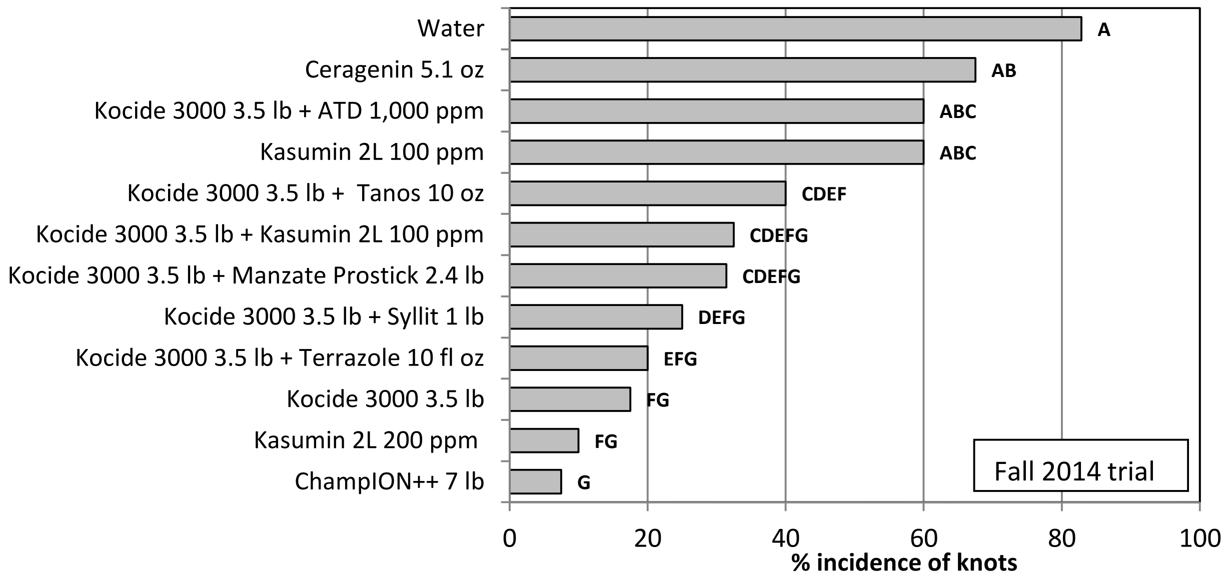
Fig. 7. Evaluation of new foliar treatments for management of olive knot of cv. Arbequina caused by a copper-sensitive Psv strain - Field trial in Yuba Co.

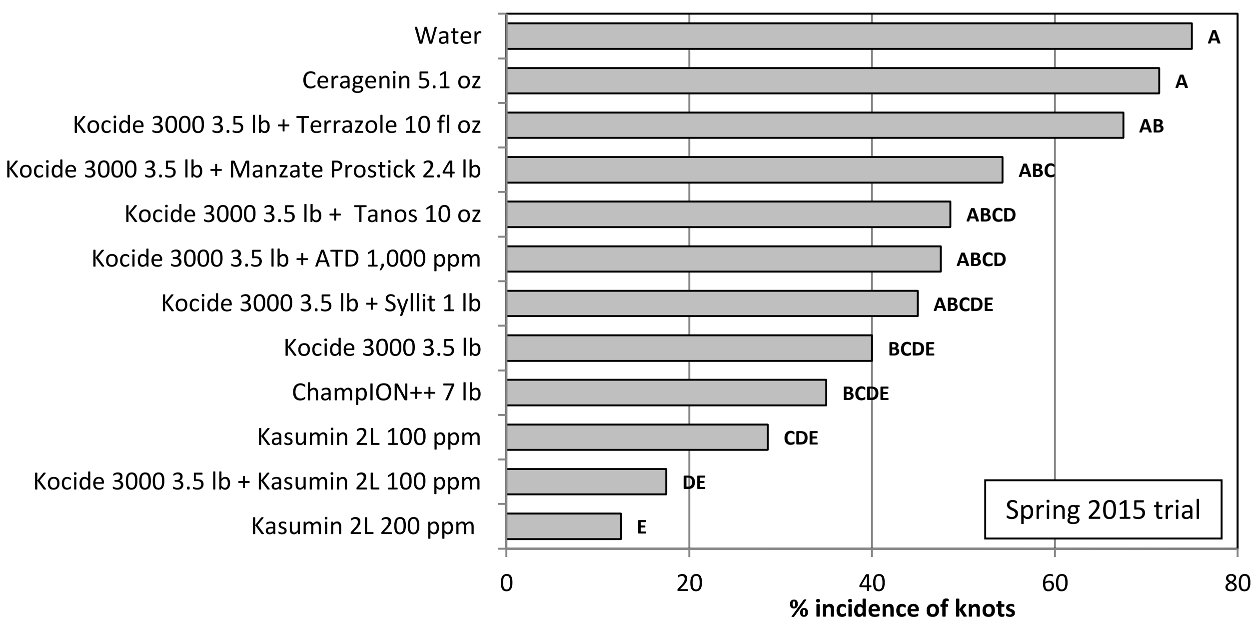




Branches were injured with lateral wounds in the fall of 2014 or spring of 2015 and spray treated. After air-drying, branches were inoculated with a **copper-sensitive** Psv strain at $1x10^8$ CFU/ml (fall 2014) or $2x10^7$ CFU/ml (spring 2015). Treatments with same letters are not significantly different based on a least significant difference mean separation test.

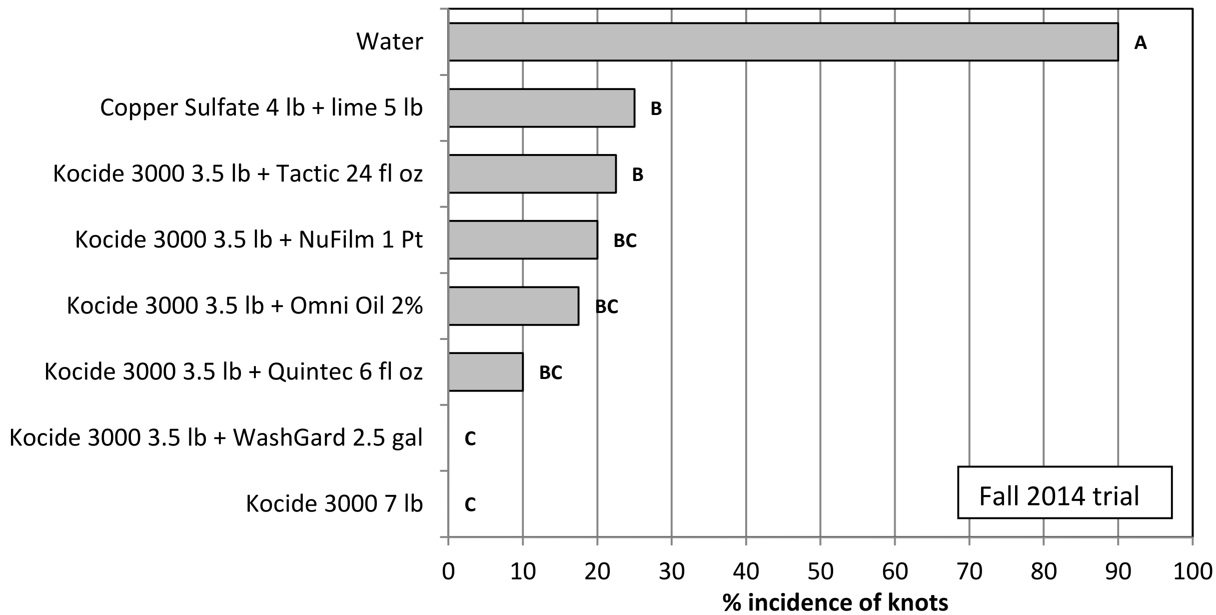
Fig. 8. Evaluation of new foliar treatments for management of olive knot of cv. Arbequina caused by a copper-resistant Psv strain - Field trial in Yuba Co.

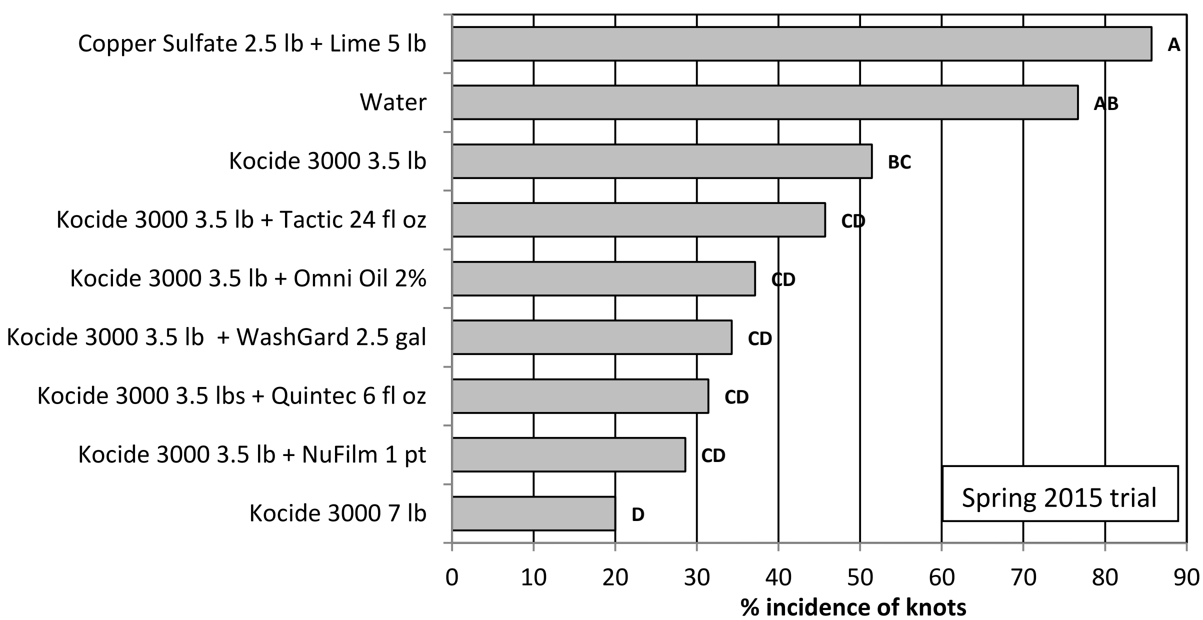




Branches were injured with lateral wounds in the fall of 2014 or spring of 2015 and spray treated. After air-drying, branches were inoculated with a **copper-resistant** Psv strain at $1x10^8$ CFU/ml (fall 2014) or $2x10^7$ CFU/ml (spring 2015). Treatments with same letters are not significantly different based on a least significant difference mean separation test.

Fig. 9. Persistence of copper treatments in inoculation studies with a copper-sensitive Psv strain on cv. Manzanillo olives in a field trial at UC Davis





Branches were injured with lateral wounds in the fall of 2014 or spring of 2015 and spray treated. This was followed by overhead irrigation for 30 minutes. After air-drying, branches were inoculated with a **copper-sensitive** Psv strain at $1x10^8$ CFU/ml (fall 2014) or $2x10^7$ CFU/ml (spring 2015). Treatments with same letters are not significantly different based on a least significant difference mean separation test.

Evaluation of Thermal Processing Variables for Reducing Acrylamide in Canned Black Ripe Olives

Shuaikun Tang[1], Roberto J. Avena-Bustillos[3*], Molly Lear[1], Ivana Sedej[2], Dirk M. Holstege[4], Mendel Friedman[3], Tara H. McHugh[3,] and Selina C. Wang[1,2*]

[1]Department of Food Science and Technology, University of California, Davis, One Shields Ave., Davis, CA 95616.

[2] Olive Center, University of California, Davis, One Shields Ave., Davis, CA 95616.

[3]Processed Healthy Foods Research, Western Regional Research Laboratory, Agricultural Research Service, U.S Department of Agriculture, 800 Buchanan St., Albany, CA 94710.

[4]University of California Analytical Laboratory, University of California, Davis, One Shields Ave., Davis, CA 95616.

Corresponding authors:

Dr. Selina C. Wang

One Shields Ave., Davis, CA 95616

Phone: (530) 752-0612

Email: scwang@ucdavis.edu

Dr. Roberto J. Avena-Bustillos

800 Buchanan St., Albany, CA 94710

Phone: (510) 559-5954

Email: roberto.avena@ars.usda.gov

Keywords. acrylamide reduction, black ripe olives, thermal processing, LACF lethality**.**

ABSTRACT

Acrylamide formed in plant foods at elevated cooking temperatures has been identified as a probable carcinogen. A wide variation and high acrylamide concentration in commercial canned black ripe olives has been reported. The objective of this study was to determine if different safe sterilization conditions during thermal processing can reduce substantially acrylamide levels in black ripe olives. Sterilization time and temperature for six thermal processes were adjusted and by heat penetration tests, process F_0 was measured and correlated to acrylamide formation and changes in quality attributes of black ripe olives.

Acrylamide concentration followed a positively correlated second order polynomial regression with process F_0. Similar process F_0, obtained by different processing conditions, gave similar acrylamide concentrations. Solids leaching from olives increased while pH decreased in brine at higher thermal processes. Skin color did not change, while increasing thermal processing reduced firmness of whole olives. Optimization of safe thermal processing conditions is a practical and efficient alternative to reduce acrylamide formation and improve quality of black ripe olives.

INTRODUCTION

Acrylamide [(CH_2=CH-CO-NH_2] is a conjugated reactive molecule that acts as a biological alkylating agent that is reported to induce numerous adverse effects in cells, animals, and possibly also humans. These include antifertility, carcinogenicity, neurotoxicity, and teratogenicity. Acrylamide has been identified as a probable carcinogen[1, 2]. The chemistry of acrylamide formation in food, and its *in vivo* reactions with essential enzymes, DNA, and neurons that cause the mentioned adverse effects are described in detail elsewhere[3-5].

Dietary acrylamide is largely derived from the heat-inducing Maillard-type reactions between the amino group of the amino acid asparagine and the carbonyl groups of glucose and fructose in plant-derived foods including cereals, coffees, almonds, olives, and potatoes during baking, frying or canning[3, 6-8]. Reported methods to reduce acrylamide levels include selecting commercial food with a low acrylamide content, selecting cereal and potato varieties with low levels of asparagine and reducing sugars, selecting processing conditions that minimize acrylamide formation, adding food-compatible compounds and plant extracts to food formulations before processing that inhibit acrylamide formation during processing of cereal products, coffees, olives, potatoes, and reducing multi-organ toxicity with the aid of antioxidative natural compounds, sulfur amino acids, and flavonoids[4, 9].

Acrylamide is formed in foods at elevated and typical cooking. Studies with laboratory-heated foods revealed a temperature dependence of acrylamide formation, though it is not detected in unheated or boiled foods[6]. Various levels of acrylamide have been found in black ripe olives. In a survey of black ripe olives in US market, a wide range of acrylamide (375-1925 µg/kg) was found[10]. Casado and Montaño[11] screened 11 black ripe olives from Spain and found levels of acrylamide also ranged broadly from 176 to 1578 µg/kg of olive pulp. Similarly, in our lab, we also found 288-1192 µg/kg acrylamide in seven black ripe olives samples (unpublished results). Charoenprasert and Mitchell[12] also reported relatively high concentrations of acrylamide in black ripe olives (226-1925 µg/kg).

It has been shown that acrylamide in black ripe olives is primarily formed during sterilization, and that sterilization time and temperature can significantly influence the formation of acrylamide[9, 11, 13]. Black ripe olives are processed through several lye immersion and water rinsing steps[12, 14] and canned or bottled and sterilized as a low-acid canned food (LACF) with a flesh pH around neutrality[14, 15]. LACF heat treatment require assurance of at least 12D reduction of *Clostridium botulinum* spores and minimum presence of other more thermal resistant spoilage spores, around 4D[16], where D refers to a one log cycle reduction (or 90% reduction) in the initial number of spores in the LACF[17].

California-style black ripe olives, as a LACF, usually require sterilization temperatures above 110°C[12]. In contrast Spanish- and Greek-style table olives are considered acidified foods (AF) and only require pasteurization temperatures below 65°C and/or additives for preservation and as a consequence acrylamide is negligible in these two olive styles[12]. Lowering the sterilization temperature and shortening the sterilization time could reduce the formation of acrylamide, while continuing to achieve appropriate commercial sterilization to assure low hazards of pathogenic *C. botulinum* and spoilage thermophylic bacterial spores survival. It is hypothesized that the wide variation of acrylamide in commercial canned black ripe olives is a consequence of different thermal processes used by industry due to different container sizes and ways to deliver the thermal processing in different retort types, as well as required heat sterilization established by thermal process authorities and regulatory agencies. Even though it has been reported that acrylamide in canned black ripe olives is caused by high temperature processing[11, 13], there is a lack of systematic studies to minimize acrylamide occurrences by reducing thermal processing during commercial sterilization. For LACF it is important to assure commercial sterility and then determine if it is still possible to reduce acrylamide concentrations as compared to common commercial canning practices. We examined the proposed simple and logical approach to reduce acrylamide content of olives.

The objective of this study was to determine if different safe sterilization conditions during thermal processing could reduce substantially the acrylamide levels in canned black ripe olives. We adjusted the sterilization time and temperature for six different processing conditions. From heat penetration data, process lethality was calculated and correlated to acrylamide formation and changes in physical quality attributes of black ripe olives.

MATERIALS AND METHODS

Reagents

For the olive preparation, sodium hydroxide solution (50%) was obtained from Loeffler Chemical Corp. (Atlanta, GA, USA) Sodium chloride (canning and pickling salt, food grade) was purchased from Morton Salt Inc. (Chicago, IL, USA). Ferrous gluconate (food grade) were purchased from VWR (Radnor, PA, USA).

For the acrylamide analysis, acrylamide (>99.9%) and methanol (HPLC grade, 99.9%) were purchased from Fisher Scientific (Pittsburgh, PA, USA). Acrylamide-d_3 standard solution (500 mg/L in acetonitrile) was purchased from Sigma-Aldrich (St. Louis, MO, USA). Reversed-phase cartridge columns (Sep-Pak^{TM} C18, 1 g and 6 cc) were obtained from Waters Corp. (Miford, MA, USA).

California-style black ripe olive preparation

Pilot-plant olive preparation method was modified from the work done by Charoenprasert and Mitchell[12] to mimic industrial California-style black ripe olive processing. The olives were harvested in October, 2014 and stored in 2% acetic acid solution since late October 2014 by the processor prior to the preparation. Thirteen kg olives were immersed in 1% sodium hydroxide solution (19 L) for 5 h for lye treatment, and then rinsed eight times before placed in fresh water for 19 h to remove the residual sodium hydroxide. During the washing step, air was constantly bubbled into the water to oxidize olives. This lye-wash cycle was performed twice. For the last cycle, the olives were soaked in lye for 2 h and washed for 20 h. The pH was measured after the final lye treatment to ensure the lye penetrated to the pit and pH was between 8 and 9.5. Then the olives were treated with 0.15% ferrous gluconate solution (19 L) for 3 h to fix the color. During the ferrous gluconate treatment, carbon dioxide was bubbled into the solution to neutralize olives. When the pH reached 7, the olives were rinsed to remove residual ferrous gluconate.

Blanching, canning and heat penetration testing

Cruess[18] indicated that tendency to "buckle" was greatly reduced when olives in cans were thoroughly heated in an exhaust box to 195°F before sealing. To prevent can buckling, blanching conditions under saturated steam conditions for whole olives should be around 2-4 min. This additional processing step eliminates tissue gases and bulging of cans without increasing acrylamide levels. Blanching of whole olives on single layers on S.S. trays moving in a continuous belt was done in the University of California, Davis FST food processing pilot plant custom built steam blancher for a residence time of 4 min, thus reaching the whole olives a maximum temperature of 200.6 ± 3.3°F from an initial temperature of 77.0 ± 2.0°F (n = 6).

Filling was done by hand. Fill weights (790 g) for 401x411 cans were 322.5 g (41%) whole olives and 467.5 g (59%) previously boiled brine (2-2.5% NaCl in water), allowing a ¼ inch headspace in cans to facilitate internal agitation during intermittent rotation of cans inside the rotary retort.

Temperature of the can content before sealing was recorded with a digital thermometer. Model 7500T DataTrace MPIII data loggers (Mesa Laboratories, Inc., Lakewood, CO, USA) were installed in each of six cans using S.S. bendable retainers to fix the 1” rigid probe tip at the geometric center of cans for measuring temperature during sterilization. Sealing was done with a Dixie Double Seamer model UVGMD-ALCC (Dixie Canner Co., Athens, GA, USA) using the vacuum setting provided for 401x411 cans. After sealing, cans were immediately sterilized.

A steam-heated discontinuous rotary retort (FMC Rotary Steritort, Madera, CA, USA) built in 1963 and refurbished in 2010 by the Precision Canning Equipment Co. from (Woodland, CA, USA) was used. This rotary retort requires 10-17 min to reach 215°F for venting, and another 2-8 min for coming up time (CUT) depending on processing temperatures. This retort can run up to 72 cans spaced in a balanced weight fashion. Retort was adjusted to constant processing temperatures in the range of 230°F-260°F for different processing times. After cooling, cans with data loggers were opened and data collected in a laptop computer through a DT Pro MPIII PC Interface with DT Pro Basic software.

Assessment of commercial sterilization of canned black ripe olives

Heat penetration data at six different thermal processing conditions were obtained during sterilization of canned black ripe olives with wireless data loggers inside 401x411 cans. This information was used to establish lethality values to assure safe (inactivated) *Clostridium botulinum* spores and reduction of other more thermo-resistant spoilage bacterial spores. Process lethality was calculated as process F_0 according to the evaluation of the integral alternative using the following equation that defines required or process F_0 lethality, either from microbiological or heat penetration data[17]:

$$F^{z}_{T_{ref}} = D_{T_{ref}}(\log(C_a) - \log(C_b)) = \int_{t_a}^{t_b} 10^{\frac{T(t)-T_{ref}}{z}} dt \qquad (1)$$

In this equation, by definition of F_0, Z = 18°F, T_{ref} = 250°F fin order to calculate F_0 as an integral equation with the DT Pro Basic software and Excel spreadsheet, where $T_{(t)}$ was temperature inside the cans during all the heating and cooling sterilization cycle from the start of the thermal processing (t_a) to the end of cooling (t_b), taken at 15 sec intervals (dt). Safe required F_0 thermal processing times for different retort temperatures and intermittent convection heating mode were applied according to process recommendations defined by Stumbo, Purohit and Ramakrishnan[16] and the state of California Department of Health Services[19] in Table 1.

For LACF it is required to design the thermal processing in a way to assure very low probabilities of survival of thermophilic spoilage bacterial spores and even lower probabilities of survival of *Clostridium botulinum* spores[16]. Sterilizing value F_0 is defined as the time in minutes equivalent at 250°F to destroy bacterial spores with a thermal sensitivity of Z = 18°F (indicating that there is a ten times increase in the rate of spores destruction when temperature is raised 18°F, or 10°C). Process F/required F_0 defines lethality of these spores by two ways (measuring microbial survival or measuring the sum of different lethalities as temperature rises and decreases during the heating and cooling processing) as indicated by Equation 1. Required F_0 is defined not only by microbiological control needs, but industry previous process results, unique processing equipment, or even subjective concerns on process safety factors[20]. Process F_0 is applied in laboratory tests or by canning industries and could become required F_0. The goal of commercial sterilization is to achieve Unit Lethality, when process F_0 is equal to required F_0, as lethality is defined as the ratio of process F_0/required F_0.

Acrylamide Analysis Sample preparation

Whole canned black ripe olives (~20 g) were drained and crushed in a mortar with a pestle. Sample pulp (2 g) was placed in a centrifuge tube and spiked with 0.5 μg d3-acrylamide as an internal standard. Water (4 mL) was added to the centrifuge tube. After 10 min shaking, hexane (1 mL) was added, followed by further shaking for 10 min. The samples were then centrifuged at 8,000 rpm in a Sorvall SS-34 centrifuge (Thermo Scientific, Waltham, MA) for 10 min to separate the aqueous and hexane layers. The aqueous layer was vacuum filtered using a 125 mL Buchner funnel. Nitrogen was then blown on the top of the filtrate to remove residual hexane.

A Sep-Pak C18 cartridge was activated with methanol (2 mL) followed by water (2 mL). The filtrate was then loaded on the cartridge and passed through without vacuum (about 1.5 mL/min). The eluate was collected and evaporated to a volume of less than 1 mL followed by addition of water to a volume of exactly 1 mL. Acrylamide determination was performed by LC-MS/MS.

LC-MS/MS analysis

The quantification of acrylamide and d_3-acrylamide was performed on a Sciex API 2000 triple-quadruple MS system (Perkin-Elmer, Shelton, CT, USA) controlled by Analyst 1.4.2 software (Applied Biosystems, Foster City, CA, USA). HPLC instrumentation consisted of a Perkin-Elmer Series 200LC system with a quaternary pump, autosampler, and in-line mobile phase degasser. The samples were separated using a Hypersil-Keystone Hypercarb column (50 × 2.1mm, i.d., particle size 5μ; Thermo, Waltham, MA, USA). The mobile phase was isocratic methanol/water (80:20, v/v) at 200μL/min for a total run time of 5 min. The column was operated at room temperature. Injection volume was 35 µL. The retention time of acrylamide and d_3-acrylamide was 1.56 min.

The mass spectrum data were acquired with positive ion atmospheric pressure ionization (APCI) utilizing the multiple-reaction monitoring (MRM) mode. The ion source settings were as follows: temperature was 350ºC; the curtain gas, collision gas, gas 1 and gas 2, 50, 6, 40 and 10 psi, respectively; the nebulizer current, 6 kV. The declustering potential, focusing potential, entrance potential, collision energy and collision cell exit potential were 55, 400, 1.6, 17 and 7.2 V, respectively. Transitions for acrylamide and d3-acrylamide were monitored at m/z (mass-to-charge ratio) 72 → m/z 55 and m/z 75 → m/z 58, respectively with dwell times of 250 µsec.

Quantitation

Quantitation was performed by internal calibration using the ratio of integrated area of acrylamide against d_3-acrylamide. The calibration solutions were injected before, in the middle of, and after the analysis of the samples. The calibration curve used weighted (1/x) second-order regression. The calibration range is 19.70 – 5,000 ng/ml with the correlation coefficient (R^2) 0.996.

Method Validation

The method was validated by determining the accuracy and precision of authentic acrylamide added (spiked) at 100 and 500 µg/kg (n=2). All the results are the averages of duplicates. Method precision was assessed by measuring the repeatability of the results of one sample (n=5).

Physicochemical Properties of Black Ripe Olives and Brine

Three cans from each thermal treatment were used for physicochemical analyses of black ripe olives and brine. All analyses were done in five replicates per can. After opening a can, olives were drained for 5 min and then both olives and brine were weighted. Approximately half of the olives were depitted, blended in a laboratory Waring blender (Waring Commercial, Torrington, CT, USA) and squeezed through a cheesecloth to obtain liquid for soluble solids and pH determination.

Soluble solids were determined with a digital refractometer LR-01 (Maselli Misure S.p.A., Parma, Italy). pH was measured using a Beckman Φ 40 Series pH meter (Beckman Coulter, Fullerton, CA, USA).

Tristimulus (L*, a*, b*) color values of whole olive skins were measured using a portable spectrophotometer model CM-508c (Konica Minolta Sensing Americas, Inc., Ramsey, NJ, USA) through a 3 mm diameter circular opening.

Texture analysis was performed on the TA-TX2 texture analyzer (Stable Micro Systems, Ltd, Godalming, Surrey, UK) with a puncture stainless steel probe (3 mm diameter, 25 mm long). Texture analyzer settings were as follows: operation mode – measure force in compression, pre test speed – 10.0 mm/s, test speed – 1.0 mm/s, post test speed – 10.0 mm/s, distance – 2.0 mm, trigger type – auto, trigger force – 0.20 N.

Olives were cut with a razor blade alongside without touching the pit to obtain a flat surface. The probe reached olives' skin on the opposite side from the flat surface. The described setup allowed testing the firmness of the olives. The recorded parameters were maximum force area (g.s), maximum force (g), and time (s). Temperature of olives immediately after texture analyses was measured with an Omega HH176 data logger thermometer with a precision fine wire thermocouple (Omega Engineering, Inc., Stamford, CT).

Statistical Analysis

Data were statistically processed by One-Way ANOVA using Minitab® Release 14.12.0 statistical software (Minitab Inc., State College, MA, USA) program. Means were compared by HSD Tukey's family error test at the significance level of $p \leq 0.05$. Treatment replicates varied from 2 to 15 depending on analysis accuracy and sample property variability.

RESULTS/DISCUSSION

Thermal processing evaluation of canned black ripe olives

The average temperature of the brine with black ripe olives inside the 401x411 cans, just before vacuum sealing, was 99.6 ± 10.2ºF. The initial temperature varied from 70 to 110°F in commercial runs for canned olives. The temperature reported in this study is within the range of commercial runs. The rotary retort heated by saturated steam used for sterilization of canned black ripe olives provided intermittent agitation for induced convection heating every time the cans rotated freely in the bottom of the internal retort body. Table 2 reports the relevant sterilization conditions for the applied six different thermal processes. Initial temperature was obtained from the wireless data loggers at the start of the thermal processes. Venting time and coming-up time varied depending on steam feeding rate and retort initial temperature. Processing time was calculated at different retort processing temperatures to achieve previously defined process F_0 which was determined by using preliminary heat penetration data obtained from wireless thermocouples inside 401x411 cans filled with whole black ripe olives and brine. The defined F_0 is in proportion to that commonly used by industry and in our food pilot plant batch discontinuous rotary retort.

Effect of thermal processing on acrylamide formation in canned black ripe olives

Table 2 reports the acrylamide concentrations measured in six different thermal processes. These acrylamide concentrations are within the range found in the screening study of commercial black ripe olives in the USA and Spain. The acrylamide concentrations in black ripe olives are relatively high compared to of the ones in other foods such as French fries (20-1325 μg/kg), baked foods (<364 μg/kg) and nuts (<457 μg/kg)[12]. Acrylamide concentration increased significantly as process F_0 reached up to 2.7 times (or lethality) the required F_0 values to assure a high degree of safety to commercial sterility, exceeding a high degree of assurance according to Stumbo and others[16] for the can size used in this study. Statistical analysis on treatments 230°F/175 min and 240°F/45 min showed very similar process F_0 (11.26 ± 0.04 -11.91 ± 0.19 min, respectively). The result shows that there is no significant difference between these two treatments in acrylamide concentrations (154.2 ± 27.9 – 156.2 ± 25.0 μg/Kg, respectively). These observations indicate that we can obtain the same safe F_0 process and similar acrylamide concentrations by different combinations of processing times and temperatures. Related observations by Montaño and others[21] reported that for similar thermal processes, or analogous cumulative lethality expressed by process F_0, acrylamide formation was lower for the processes carried out at higher temperature. However, because their study was not published it was not possible to compare our results to the actual process F_0 values or temperature/time processing conditions.

Table 1 reports four required F_0 that can be used for the design of thermal processing of canned black ripe olives, as a LACF. The optimum value is the lowest F_0 required for safety assurance. The olive canning industry can use these required F_0 values to estimate process F_0 for different can sizes and retort systems. As there are several combinations of processing time and temperature to obtain process F_0 equal to required F_0 for unit lethality, it allows industry to use the processes with highest retort temperature but minimum time that can practically be achievable for their retort systems and can sizes and be certain on the expected acrylamide level.

From results of this study it appears that the main reason there are wide-ranging reports of acrylamide in canned black ripe olives is because the olive canning industry may be using a large range of different process F_0. The State of California Department of Health Services advises to use a required F_0 of 13 min as an official required sterilization control process for olives, ripe, whole, pitted or broken pitted, in brine in 300x407 cans.

Mathematical fitting of the relationship between process F_0 and acrylamide concentration follows a second order polynomial equation with high correlation coefficient (R^2 =0.9932) as indicated in Figure 1. This non-linear regression is typical of biological and chemical phenomena such as the progression of disease epidemics or the growth rate of tissues. Extrapolation of this polynomial equation to process F_0 values of 32-34 min, usually obtained in canned olives at highest retort temperatures (255-265 °F), gives acrylamide concentrations values in the range of 1750-1950 μg/Kg, as found in samples of commercial canned black ripe olives in USA and Spain.

According to the observed relationship between F_0 and acrylamide formation in canned black ripe olives it is expected a concentration of 250 μg/Kg for this required F_0. This concentration is within the range of lowest acrylamide concentrations found in commercial canned black ripe olives by Charoenprasert and Mitchell[12] and by our group, 226 and 288 μg/Kg, respectively. It is important to consider that an acrylamide concentration of 250 μg/Kg formed by adhering to the current required F_0 established by the state of California Department of Health Services is not a serious health hazard considering the low consumption of canned black ripe olives compared with fried potato products and chips; crackers, cookies, cakes, and; bread, the three most important food sources of acrylamide in the USA diet (at 38%, 17%, and 14% of total acrylamide in the USA diet, respectively)[4].

Moreover, based on lower required F_0 reported by Stumbo and others[16], the olive canning industry could petition for the reduction of the current thermal processes to a new required F_0 of 10 min, as recommended by Stumbo and others[16] for LACF in 300x407 cans under convection heating for commercial sterility with high degree of assurance, without jeopardizing health safety. This can potentially reduce acrylamide concentration to 150 μg/Kg, that is, 60% of the lowest acrylamide concentration found in Manzanilla canned olives sterilized now at required F_0 of 13 min. Casado and Montaño[11] stated that by paying strict attention to sterilization conditions it could be possible to reduce the acrylamide concentration to <100 μg/Kg, at least for Hojiblanca variety ripe olives. However, the influence of time and/or temperature of sterilization on acrylamide formation was not covered in their study. We suggest that the canning industry invest in devising new optimized thermal processes suited for specific industrial conditions, either by hiring an external Thermal Processing Authority or using their in-house Thermal Processing Authority teams.

Other alternative approaches to reduce acrylamide in black ripe olives include sterilization of fresh olives either without brining or after 2-8 months of brining; not using calcium chloride in the brine solution; and decreasing air oxidation, and; carbon dioxide neutralization[12]. These four modifications to the traditional processing steps for black ripe olives can achieve reductions in the acrylamide concentration to 62, 44, 55, and 50%, respectively from control concentrations. However, reports on the effects on sensory properties of the three last options most likely will affect negatively the quality of canned black ripe olives. Casado and others[13] evaluated different additives (salts, amino acids and antioxidants) to reduce acrylamide in canned black ripe olives, and most of these additives turned out to be unsuccessful. Exceptionally, 25mM sodium bisulphate in this report reduced acrylamide concentration to 13% of control values without negative effect on sensory quality. However, sodium bisulphite is allergenic and requires a labeling warning by food safety regulations. Also in this study olives were sterilized after seven months of storage in the brine solution when it was reported by Charoenprasert and Mitchell[12] to have the lowest acrylamide formation during sterilization, compared to sterilization at one month storage. Irrespective of this fact, acrylamide values increased to the highest possible values, obtained if processed at one month of brining according to Charoenprasert and Mitchell[12], at the highest process F_0 values applied in this study. None of these alternatives can by itself reduce acrylamide, without negative effects on sensory quality and regulatory constraints, at the level that can be achieved by optimized thermal processing.

Effect of thermal processing on physical attributes of brine and whole black ripe olives

Soluble solids increase in brine at the highest thermal processing (process F_0 = 27.7 min) can be explained by leaching of pulp from whole olives due to the higher temperature. Otherwise, pH of the brine and whole olives decreased at the highest thermal process as shown in Table 3. Casado and others[15] also reported a pH decrease due to harsh thermal processing conditions of black ripe olives and hypothesized it could be related to organic acids formation from sugars degradation and/or degradation of Maillard reaction products, or saponification of pectin ester groups.

Color parameters of whole canned olives were not significantly different for the different thermal processing conditions (Table 4). Casado and others[15] reported loss of green color and increased darkening by increasing thermal processing, presumably due to Maillard reactions and autoxidation of phenolic compounds.

Firmness of whole olives was significantly reduced by increasing thermal processing (Table 4). Romero and others[14] also reported an decrease in firmness of canned black ripe olives at increasing process F_0, indicating that changes in firmness of ripe olives during sterilization follows first order kinetics, with activation energy values within the range reported for fruits and vegetables.

Conclusions

Optimization of thermal processing conditions is a practical and efficient alternative to reduce acrylamide formation and improve quality of canned black ripe olives. Modification of thermal processing conditions will require for the olive canning industry to file new processes with Food and Drug Administration (FDA). The proposed processes should be supported by specific heat penetration studies and thermal processing evaluation conducted by LACF thermal processing authorities.

ACKNOWLEDGMENT

We appreciate the support of Bell-Carter Foods, Inc. for providing brined whole Manzanilla olives for this study and Jane Yegge for technical information about industry practices for processing black ripe olives. We also appreciate the support of Mr. Mark Deniston, Associate Director, Process Engineering at IEH Incorporated for providing information on thermal processing recommendations for whole black ripe olive canning. ST and SCW thank Dajun Yu, Yuyi Cao and Karinna Estay for assistance with olive preparation.

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TABLES AND FIGURES

Table 1. Required F_0 (in minutes) for black ripe table olives as a low-acid canned food in 401x411 can size.

Sterilization condition/Retort temperature	**230°F**	**240°F**	**250°F**	**260°F**
Assure high degree of safety[1]	6.38	4.68	4.17	3.58
Commercial sterility with moderate degree of assurance[1]	6.93	6.93	6.93	6.93
Commercial sterility with high degree of assurance[1]	10.40	10.40	10.40	10.40
Dept. of Health Services, State of California[2]	_	13.0	13.0	13.0

[1]Stumbo and others, 1975[16].

[2]Dept. of Health Services, 1995.

Table 2. Thermal processing conditions and acrylamide concentration in black ripe olives processed in 401x411 cans in a discontinuous rotary retort.

Initial temperature (°F)	Venting time to 115°F (min)	Coming-up time (CUT) (min)	Processing temperature (°F)	Processing time (min)	F_0 process (min)	Acrylamide (µg/Kg)
91.9±1.1^{c}	10	12	230	90	6.32±0.02^{a}	63.7±15.9^{a}
92.0±0.4^{c}	11	13	240	45	11.26±0.04^{b}	154.2±27.9^{b}
106.6±3.1^{d}	11	13	230	175	11.91±0.19^{c}	156.2±25.0^{b}
74.6±0.3^{a}	17	24	250	10	13.15±0.24^{d}	284.9±49.8^{c}
80.9±1.6^{b}	14	21	250	15	17.97±0.19^{e}	539.7±38.5^{d}
111.4±2.5^{e}	14	22	260	5	27.66±0.43^{f}	1184.5±82.6^{e}

Thermal processing values are means of five determinations ± standard deviation. Acrylamide concentrations are means of six determinations ± standard deviation Different subscript letters indicate significant difference at $p<0.05$ by Tukey's difference tests.

Table 3. Soluble solids and pH of black ripe olives and brines with different thermal treatments.

Process F_0 (min)	Soluble solids (°Brix) Brine	Soluble solids (°Brix) Olives	pH Brine	pH Olives
6.32±0.02^{a}	2.72±0.11^{a}	3.99±0.09^{NS}	6.67±0.05^{c}	7.47±0.08^{b}
11.26±0.04^{b}	2.64±0.17^{a}	3.68±0.69	6.70±0.03^{c}	7.39±0.06^{a}
11.91±0.19^{c}	2.79±0.10^{ab}	3.70±0.09	6.55±0.06^{ab}	7.36±0.07^{a}
13.15±0.24^{d}	2.83±0.14^{ab}	3.48±0.11	6.53±0.04^{a}	7.40±0.02^{a}
17.97±0.19^{e}	2.62±0.06^{a}	3.33±0.08	6.59±0.03^{b}	7.38±0.06^{a}
27.66±0.43^{f}	2.97±0.21^{b}	3.51±0.36	6.67±0.06^{c}	7.64±0.13^{c}

Values are means of fifteen determinations ± standard deviation. Different subscript letters indicate significant difference at $p<0.05$ by Tukey's difference tests.

^{NS} No significant difference in olive pulp °Brix by different thermal treatments.

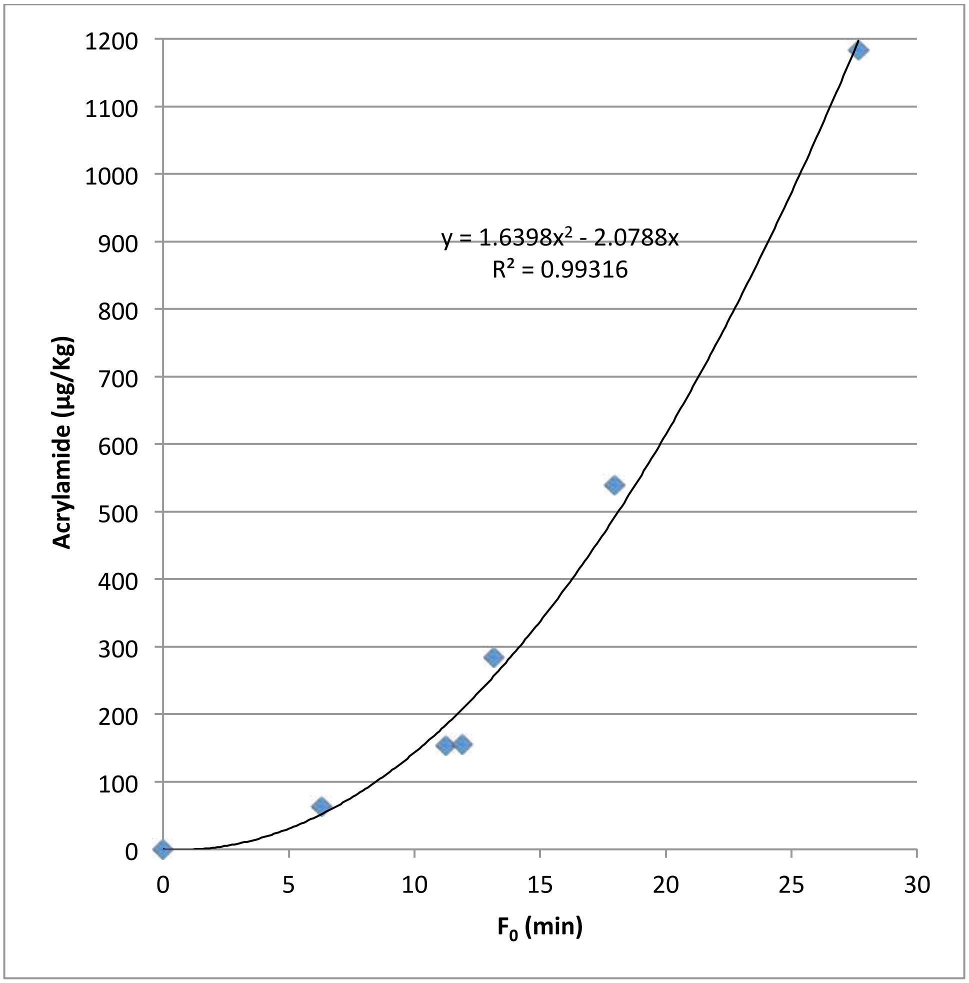
Table 4. Color and firmness properties of whole black ripe olives with different thermal processes.

Process F_0 (min)	**Color**			**Firmness**	
	L*	**a***	**b***	**Maximum force area (g.s)**	**Maximum force (g)**
6.32±0.02^{a}	26.6±0.27^{NS}	0.19±0.12^{NS}	0.29±0.07^{NS}	170.1±11.1b	141.8±11.6^{ab}
11.26±0.04^{b}	26.7 ±0.01	0.27±0.09	0.50±0.10	175.5±11.4^{b}	146.6±3.8^{b}
11.91±0.19^{c}	26.8±0.41	0.16±0.10	0.25± 0.18	160.6±4.9^{ab}	135.2±9.0^{ab}
13.15±0.24^{d}	26.9±0.28	0.30±0.06	0.33± 0.05	151.6±6.2^{a}	131.6±3.4^{ab}
17.97±0.19^{e}	26.7±0.43	0.14±0.06	0.30±0.08	149.8±8.2^{a}	135.9±8.0^{ab}
27.66±0.43^{f}	26.4±0.32	0.22±0.08	0.25±0.12	140.6±17.0^{a}	121.5±16.9^{a}

Values of color and firmness are means of fifteen determinations ± standard deviation. Different subscript letters in a column indicate significant difference at $p<0.05$ by Tukey's difference tests.

^{NS} No significant difference in color parameters on olive skins by different thermal processes.

462 Figure 1. Effect of thermal process lethality F_0 on acrylamide concentration in black ripe olives

463 

16 October 2015

From: Dani Lightle and Emily Symmes
Summary of 2015 COC project

Title: Evaluation of efficacy of attract and kill devices for olive fly control

Objective:
This project aimed to evaluate whether the attract and kill device (Magnet OLI, marketed by Suterra LLC) provided adequate control of olive fly when compared to grower standard control programs (GF-120 and/or Danitol). The study, as proposed, was 1) to evaluate field efficacy of the Magnet OLI using manufacturer's rates and recommendations; and 2) to evaluate, in the lab, how traps were affected after exposure to summer growing conditions. On September 11, 2015, Suterra LLC informed us that they were discontinuing registration of the Magnet OLI devices. Therefore, Objective 1 was mostly completed; however, Objective 2 was not begun.

Introduction:
Currently, many olive growers in the Sacramento Valley growing region are applying insecticides (primarily GF-120) as frequently as every other week during peak olive fly activity periods. Benefits to an alternative control measure such as Magnet OLI are delayed resistance build-up to GF-120 and low impacts on other natural enemies that control scale. Though attract-and-kill devices initially have high costs related to purchasing the devices and the labor to deploy them early in the season, the devices are advertised as effective for six months. If the devices are shown to be effective all season long, the initial investment will be offset by eliminating or reducing the number of sprays required for olive fly control, which lowers labor, fuel, and material costs.

Summary of Work Completed:
Three sites were identified in Glenn and Tehama counties:

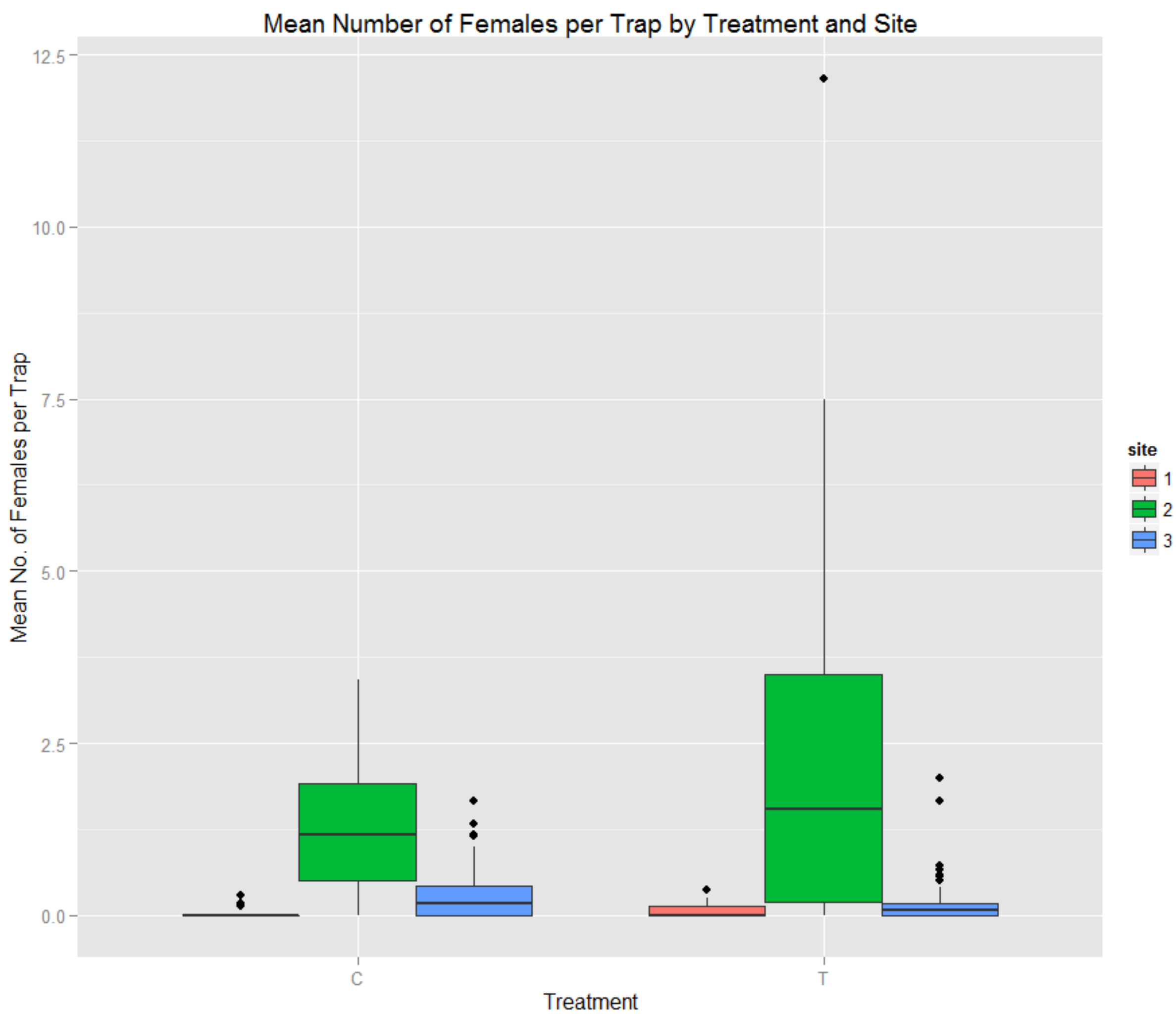
Site 1 – Manzanillo orchard, Bayliss (Glenn county)
Site 2 – Manzanillo orchard, Capay (Tehama county)
Site 3 – Seviallano orchard, Orland (Glenn county)

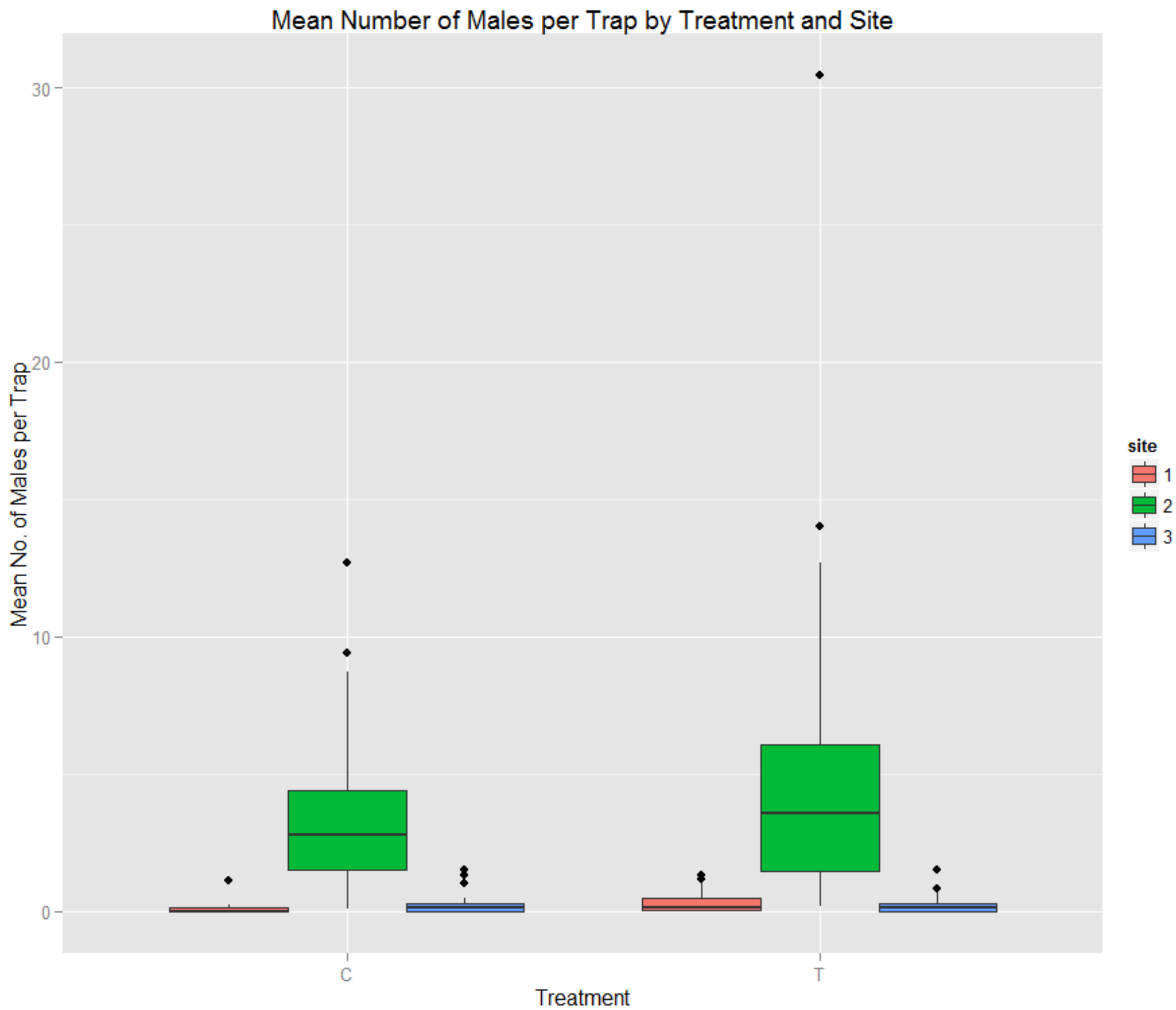
Each site consisted of a 10-acre block treated with the Magnet OLI devices at the label rate (42-45 traps / acre, depending on the tree spacing at each site). A 10-acre block acted as a grower standard control, and was managed by the individual grower at each site. Site 1 was established on May 11th; Site 2 was established on May 14th; and Site 3 was established on May 18th.

The control and treatment blocks at each location were monitored for olive fly populations using McPhail traps baited with Torula yeast, with one McPhail trap placed per acre. Traps were checked on a weekly basis and male and female olive flies were counted. McPhail traps were monitored until olive harvest. Olives were harvested on September 10th. From each treatment block, 1000 fruits were examined for olive fly stings, and an additional 500 fruits were held in rearing cages to monitor for emerging flies.

Results:

McPhail trapping:
Overall, there were more male flies captured than female flies. Additionally, there was a major influence of site on trapping numbers, with Site 2 hosting a very high olive fly population relative to Sites 1 and 3. However, there were no differences in the numbers of male flies or female flies trapped in the attract and kill treated plots (T) vs the grower standard plots (C), after accounting for differences between site.





Harvest damage:
There were no olive fly infested fruit found among the 1000 fruits examined from each treatment. Additionally, no flies have emerged from the olives held in rearing cages.

Olive Workgroup / Department of Botany and Plant Sciences, UCR

University of California
Division of Agricultural Sciences

PROJECT PLAN/RESEARCH GRANT PROPOSAL

Project Year: 2015

Anticipated Duration of Project: 1 remaining year of this 2-year project. We have harvested the Year 1 OFF- and ON-crop control trees and ON-crop trees treated with PGRs. Now we need the harvest for the year following treatment in order to determine the efficacy of the PGR treatments as foliar sprays to increase yield in the putative OFF-crop year.

Project Leaders: Carol Lovatt and Elizabeth Fichtner

Project Leaders' Contact Information:
CL-Professor of Plant Physiology, Botany and Plant Sciences-072, UC-Riverside, CA 92521-0124 Phone: 951-827-4663; Fax: 951-827-4437; Email: carol.lovatt@ucr.edu

EF-Farm Advisor, Orchard Systems, Cooperative Extension, 4437 S. Laspina St., Tulare, CA 93274, Phone: 559-684-3310; Fax: 559-685-3319; Email: ejfichtner@ucdavis.edu

Location: Lindcove Research and Education Center, Exeter

Project Title: Alternate Bearing in Olive - *Determining when fruit exert their negative effect on return bloom, whether the effect includes inhibition of floral development or only inhibition of bud break, and refining PGR treatments to break AB ON/OFF cycles*

Cooperating Personnel:
Lindcove Research and Education Center, Exeter

Keywords: Alternate bearing, ON-crop trees/year, OFF-crop trees/year, correlative inhibition, vegetative shoot extension growth, bud break, staminate flowers, perfect flowers, inhibition of floral development, plant growth regulators, fruit removal

Commodity(s): Table Olive

Relevant AES/CE Project No.: 4556H

Problem and its Significance: Alternate bearing (AB), production of a heavy "on-crop" (high yield, ON trees) followed by a light "off-crop" (low yield, OFF trees), occurs in perennial fruit and nut crops and in forest species (where it is called "masting"). AB is a serious problem of significant economic consequence to table olive growers, and probably oil olive growers (Sibbett 2000). Industry-wide, yield can vary from 46,300 tons one year to 195,000 tons the next (USDA NASS 2011 CA Olive Probability Survey Report). In ON years, trees produce a large number of small size fruit with reduced commercial value. In OFF years, trees produce large fruit but too few to provide a good income to the grower. For olive, the ON-crop takes longer to mature, attain size and accumulate oil. The delayed harvest further exacerbates AB.

There is a recurring need to mitigate the problem of alternate bearing. Alternate bearing is initiated by external factors (freeze; lack of chilling; low or high temperatures at bloom, pollination or fruit set; diseases etc) that cause poor flowering or pollination or excessive flower and fruit drop, resulting in an OFF-crop that is typically followed by an ON-crop, depending on how long it takes the trees to recover from the stress causing the loss of yield. Conversely, optimal conditions during bloom and fruit set such that normal crop thinning fails to take place result in an ON-crop, which is followed by an OFF-crop. Since climate is a factor initiating AB, the need for a corrective strategy reoccurs.

Summary of research results to date. The results of our earlier COC-funded research have provided the following information about alternate bearing in olive, confirming the report of Sibbett (2000) and providing significant new information.

- Summer vegetative shoot growth is inhibited in a manner directly related to total fruit number (crop load) (Sibbett 2000).
- Inhibition of summer vegetative shoot extension growth reduces the number nodes (sites) that can bear inflorescences the next spring (Sibbett 2000).
- Nonbearing shoots that do not set fruit in spring on OFF-crop trees produce the greatest amount of summer shoot extension growth and the greatest number of inflorescences the next spring.
- Fruit exert both a localized effect on the shoots that set them and a whole tree effect attributable to the total number of fruit on the tree.
- Bearing shoots, which are the majority of the shoots on ON-crop trees, produce the least amount of summer vegetative shoot extension growth and fewest inflorescences the following spring due to the combined inhibitory effects of fruit set on the shoots (localized effect) and all the fruit on the ON-crop tree (crop load effect).
- Nonbearing shoots, which are few on ON-crop trees, are subject only to the inhibitory effect of the On-crop on the tree and produce an intermediate amount of summer vegetative shoot growth and inflorescences at return bloom compared to nonbearing shoots on OFF-crop trees and bearing shoots on ON-crop trees (Table 1). **This is an important fact:** *For ON-crop trees, the return bloom and crop is produced by buds on shoots that did not set fruit; shoots that set fruit contribute little return bloom. Buds on nonbearing and bearing shoots on ON-crop trees are physiologically different.*
- Our results also suggest that fruit inhibit spring bud break in a manner related to crop load. Spring PGR treatments increased inflorescence number to a greater degree on nonbearing shoots than bearing shoots on ON-crop trees.
- Our results identified PGR treatments that significantly increase the number of inflorescences produced by nonbearing shoots on ON-crop trees 2-fold compared to nonbearing shoots on untreated ON-crop control trees and 40% greater than nonbearing shoots on untreated OFF-crop control trees. These same PGRs increased the number of inflorescences produced by bearing shoots on ON-crop trees 5-fold compared to bearing shoots on untreated ON-crop control trees. However, this degree of flowering was still only 1/3 to 1/4 of the maximum flowering attained by nonbearing shoots on OFF-crop control trees. **This is an important fact:** *It confirms that buds on nonbearing and bearing shoots on ON-crop trees are physiologically different.*
- Results of the fruit removal experiment that is part of this project (fruit are removed monthly through harvest October) revealed that the greatest amount of summer vegetative shoot extension growth occurs between June and July. Removing the fruit progressively later reduces shoot growth. **This is an important fact:** *In our current experiment, PGR treatments designed to stimulate vegetative shoot growth were applied in early June, earlier than we previously applied them, with a second application in early July.*
- Progressively later fruit removal reduced the number of inflorescences that developed per shoot, with bearing shoots producing significantly fewer inflorescences than nonbearing

shoots in each case. **The results provided two important facts:** *Fruit must be removed from ON-crop trees by mid-August to avoid a significant reduction in the number of inflorescences produced by nonbearing shoots on ON-crop trees. September fruit removal is too late to significantly increase bloom.*

- For nonbearing shoots on 2013 OFF-crop trees, 52%, 35% and 7% of buds at the first 8 node pairs, second 8 node pairs and basal 5 node pairs produced inflorescences in spring 2014 – the ON bloom. Surprisingly, 43%, 50% and 59% of the buds along the shoot remained inactive, respectively. In contrast, for bearing shoots on 2013 ON-crop trees, 75%, 76% and 71% of the floral buds had abscised from these shoot sections, respectively, one month before the 2014 bloom. For nonbearing shoots on the 2013 ON-crop trees, 89%, 67% and 63% of the floral buds along the shoot remained inactive (dormant) at spring bloom 2014, respectively. **The results provided three important facts:** *Bud abscission on bearing shoots is the main cause of low return bloom following the ON-crop year. The only source of return bloom following the ON-crop year is from nonbearing shoots; thus, it is critical to know if the buds on these shoots are viable floral buds that are merely inactive (dormant due the accumulation of hormones). PGR treatments must not only increase summer vegetative shoot growth during the ON-crop year, they must also increase floral bud retention and overcome floral bud dormancy to increase spring bud break and bloom.*
- By September 13, 2014, new growth on bearing shoots of OFF- and ON-crop trees had 50% fewer nodes to bear potential floral buds for next spring's bloom than nonbearing shoots on OFF- or ON-crop trees. Shoot extension growth of bearing shoots on OFF- and ON-crop trees stopped in June. For the new growth on nonbearing and bearing shoots on OFF- or ON-crop trees, 90% of the nodes developed buds and 98% of those buds were still on the tree through September 13, 2014. **The results provided one important fact:** *Floral buds do not abscise in summer, but abscise at a later time still to be identified. Identifying when floral buds abscise is critical to developing a corrective strategy.*

Objectives for Year 2: Objective (1) - to determine whether buds on bearing shoots on ON-crop trees are viable floral buds only inhibited from undergoing bud break or become nonviable floral buds due to inhibition of floral development by quantifying the expression of key genes in the floral development pathway. Objective (2) to test the ability PGR treatments applied as foliar sprays to break the AB cycle by increasing vegetative shoot length (node number) during the ON-crop year, increasing floral bud retention and increasing spring bud break to increase floral intensity and yield the year following the ON-crop to produce high back to back yields. ***NOTE:*** We applied the first part of the PGR treatments in summer 2014, the ON-crop year, and will apply the second part in February 2015. The final results are obtained with the harvest of 2015.

Plans and Procedures: *To meet Objective 1 of Year 2,* we will complete research quantifying floral gene expression to determine whether buds on bearing and nonbearing shoots on ON-crop trees are viable (floral gene expression is normal relative to nonbearing shoots on OFF-crop trees) or are not viable (floral gene expression is inhibited relative to nonbearing shoots on OFF-crop trees). We have a student who is conducting this research for his MS thesis. He has his own personal support. The buds necessary to complete this research have been collected. Samples have all been ground. All primer pairs necessary to complete the research are available and we have confirmed their validity by DNA sequencing of the PCR products and also by quantitative real time polymerase chain reaction (qRT-PCR) analyses of total RNA extracted from leaves, buds and flowers. Little genetic information is available for olive. We had to create degenerate primers. We are able to follow the expression (accumulation of mRNA) of genes that promote flowering [*FLOWERING LOCUS T* (*FT*) and *SUPPRESSOR OF OVEREXPRESSION OF CONSTANS* (*SOC1*)] and floral organ identity genes *PISTILLATA* (*PI*) and *AGAMOUS* (*AG*), the final gene in the pathway required for carpel formation. The expression of olive actin and ubiquitin serve as reference genes to normalize the data. He is nearly done but we need to do some additional sampling to fully understand the results of the inactive buds on nonbearing shoots on ON-tree. *To meet Objective 2 of Year 2,* we are testing the ability of the four best PGR treatments (identified in our branch-injection research) as foliar sprays applied in summer and spring to increase inflorescence number and yield following the ON-crop year. The goal is to produce strong blooms and good yields back to back. The PGR treatments being tested are: The following PGR treatments were applied during the first week of June and again the first week of July (to increase shoot growth as node number, floral bud number and floral bud retention) and will be applied again in February (to increase spring bud break): (1) ON-crop control trees; (2) ON-crop trees treated with 6-BA + low-biuret urea; (3) ON-crop trees treated with cytokinin X (a natural product) + low-buiret urea; (4) OFF-crop trees treated with cytokinin X; and (5) OFF-crop control trees. The PGRs were applied at 0.9 g/tree, low-biuret urea at 0.18 kg N per tree. In our previous proof-of-concept research in two different orchards, 6-BA and cytokinin X were as effective when used alone as when they were combined with an auxin-transport inhibitor in significantly increasing the number of inflorescences produced by nonbearing shoots on ON-crop trees the following spring; the increase in flowering by bearing shoots on ON-crop trees was increased but not significantly. We are testing the cytokinins with low-biuret urea for three reasons: (1) to supply N to support PGR-stimulated shoot growth; (2) 6-BA plus urea increases floral bud retention 2.5- to 3-fold during the ON-crop year of pistachio and increases yield to the same degree (this use is on the Valent BioSciences 6-BA label; if successful, it should be easy to add olive to the label); and (3) to increase the potential for either cyokinin to be available to olive growers sooner, we used them alone without the complication of a second hormone, the auxin-transport inhibitor. All foliar-applied PGR treatments, including the ON- and OFF-crop control trees, were replicated on 15 individual trees in a randomized complete block design. At bloom in 2015, we will quantify the number of floral shoots on five shoots with and without fruit on untreated ON- and OFF-crop control trees and PGR-treated trees at the Lindcove REC. During bloom in 2015, we will also sample flowers to determine treatment effects on the number of perfect vs. staminate flowers. Results obtained the branch-injected PGRs provided evidence that several PGR treatments increased the number of perfect flowers. This needs to be confirmed. Taken together, these data will help to identify the best PGR treatment/s and the optimal time to spray the foliage, and determine whether or not fruit thinning will be required in the future to mitigate AB in olive.

Expected outcomes: If olive responds to these PGR treatments like ‘Nules’ Clementine mandarin and ‘Hass’ avocado, we anticipate that foliar-applied PGR treatments applied in summer plus spring will increase fruit size of the olives on ON-crop trees (and possibly yield, which occurs with avocado but not citrus) and increase yield and the yield of large size fruit in the following year, such that 2-year cumulative total yield and 2-year cumulative yield of large size fruit is greater than that of untreated ON- and OFF-crop control trees. We anticipate that the results will indicate that trees should be treated annually.

Literature Cited:

Dag, A., A Bustan, A. Avni, I. Tzipori, S. Lavee and J. Riov. Timing of fruit removal affects concurrent vegetative growth and subsequent return bloom and yield of olive (*Olea europaea* L.). Scientia Hort. 123:469-472.

Sibbett, S. 2000. Alternate bearing in olive trees. California Olive Oil News. Vol. 3, Issue 12.

BUDGET REQUEST – Lovatt and Fichtner
Budget Year: 1 February 2015 – 31 December 2015

Funding Source: California Olive Committee

Salaries and Benefits:

Postdocs/RA's

Toan Khuong- Assistant Specialist @ $ 4,362/mo. variable time equivalent to 100% x 1 mo. 4,362
(Under my supervision, assists in treatment applications, bloom data collection, data sheets, monthly data management, monthly data entry, and monthly statistical analyses of the data.)

SRA's and Lab/Field Assistance

Lab Assistant I @ $15.07/hr. x 300 man-hrs. 4,521
(Preparation of treatment solutions, treatment applications, monthly data collection on the fate of buds, bloom data collection, harvest, and fruit size determination.)

Graduate Student Researcher (GSR); Student has his own personal support. 0
(Under my supervision, the GSR will conduct the research on floral gene expression to determine if floral buds are viable but inhibited from undergoing bud break or become nonviable due to inhibition of floral development (floral gene expression) for his MS thesis to be completed in December 2014.)

Subtotal Sub2 8,883

Employee benefits:

TK = $4,362 x 76.11%	3,320
Lab Asst I = $4,521 x 2.76%	125
GSR = 0	0

Sub6 3,445

TOTAL 12,328

Supplies and Expenses Sub3 6,720

Recharge commitment to the Lindcove REC: use of olive grove, water, fertilizer, and harvest etc calculated by Anita Hunt at Lindcove for 2014-2015.

Equipment Sub4 0

Travel Sub5 4,218

7 roundtrips to Exeter
(520 mi x 7 = 3,640 mi x $0.6014 = $2,189;
UCR vehicle rental 15 days x $47.268/day = $709
$10/person/night per Lindcove Trailer x 3 people x 8 nights (all trips are 2 days; bloom count is 3 days) = $240
Meals @ $45/1.5 days/person/trip x 3 people x 8 days (all trips are 1.5 days; bloom count is 3 days) = $1,080

SUBCONTRACT

Sub7 10,091

Elizabeth Fichtner, Farm Advisor, Orchard Systems, Cooperative Extension,
4437 S. Laspina St., Tulare, CA 93274
Department account number: AO1082 TOTAL 33,357

Carol J Lovatt

Originator's Signature Date 10/14/2014

COOPERATIVE EXTENSION

County Director: ______________________ Date ____________

Program Director: ______________________ Date ____________

AGRICULTURAL EXPERIMENT STATION

Department Chair: Michael L. Rosso Date 10/17/14

UC COC LIAISON OFFICER: ______________________ Date ____________

BUDGET SUBCONTRACT

Budget Year: 1 February 2015 – 31 December 2015

Elizabeth Fichtner
Farm Advisor, Orchard Systems, Cooperative Extension,
4437 S. Laspina St., Tulare, CA 93274

Funding Source:

Salaries and Benefits:

Lab Assistant I and Student Assistant I

(Y. Martinez, Student Assistant I and B. Dougherty, Lab Assistant I, hourly rate of $10.75 and $14.60, respectively. Core benefit rate of 5.5% as limited term employees. Total hours=300 hrs.

		8,023
Lab Helper from the Lindcove REC (40 hrs x $13.45/hr, includes EB)		538
Subtotal	Sub2	8,561
Employee benefits:	Sub6	0
	TOTAL	8,561
Supplies and Expenses Field supplies: bags, ribbons, digital calipers	Sub3	200
Equipment	Sub4	0
Travel (Mileage @ $0.55/mile travel to UCCE grower meeting in Butte Co.	Sub5	$330
	SUBTOTAL	9,091
UC ANR Overhead @11%	Sub6	1,000

$9,184 x 11% =

SUBCONTRACT TOTAL ______________ $10,091

Elizabeth Fichtner, Farm Advisor, Orchard Systems, Cooperative Extension,
4437 S. Laspina St., Tulare, CA 93274

Elizabeth J. Fichtner

Date ______10/16/2014_____

Originator's Signature

COOPERATIVE EXTENSION

County Director: Cathi Lamp Date 10-16-14

Program Director: ______________________ Date ______________

AGRICULTURAL EXPERIMENT STATION

Department Chair: ______________________ Date ______________

UC COC LIAISON OFFICER: ______________________ Date ______________

Progress Report

Project Title:

Propagating Dwarfing Olive Rootstocks and Establishing a Long Term Orchard

Project Leaders:

Louise Ferguson: Extension Specialist, Department of Plant Sciences, 2037 Wickson Hall, Mail Stop II, UC Davis, 1 Shields Ave., Davis CA 95616, (530) 752-0507 [Office], (559) 737-3061 [Cell], LFerguson@ucdavis.edu

John Preece: Curator, USDA National Clonal Germplasm Repository, Davis CA.

John.Preece@ars.usda.gov, (530)-752-7009

Dan Flynn: University of California Olive Center, Davis CA

JDFlynn@UCDavs.edu; (530)-752-5170

James M. Jackson: Principal Superintendent, Plant Sciences Field Facility, UC Davis CA

JMJackson@ucdavis.edu; (530)-753-2173 and (530)-681-2279

Progress through 9/24/2015

The trees planted in 2014 were maintained and staked and grown through the summer of 2015 to allow the trees to reach sufficient size for grafting. The 'Oblonga' trees were falling over more and in more need of staking (which was done) than the others. In spring of 2015, the border rows of 'Sevillano' pollinizers were completed by planting the last 41 trees. There were insufficient trees available in 2014 to complete the border rows.

Some of the rows of dwarf olives were incomplete, therefore additional cuttings were rooted and trees produced at the National Clonal Germplasm Repository nursery. The exception is that 'Dwarf D' has proven to be extremely difficult to root to produce plants for the wider spacing portion of the study. Therefore, in addition, cuttings of 'Little Ollie' were rooted and this cultivar proved to be easy to propagate. On September 29, the nursery produced plants will fill in the missing plants in the planting and 'Little Ollie' will replace the originally planned 'Dwarf D' at the wider spacing. This also gives a fifth genetically different rootstock to test for dwarfing of olive.

One of the 'Sevillano' trees died during the summer of 2015, but there were a few extra trees from the spring 2015 planting, and that tree will be replaced when the planting is completed on Sept. 29.

Sierra Gold Nursery has been contracted to graft the trees on September 28. Therefore, the planting will be completed and the trees grafted by September 30, 2015. This will give a cooler time of the year for the grafts to heal and take.

8 October 2015

To: California Olive Commission.
From: Charles H. Pickett
Re: Summary of project

Title: Biological Control of the Olive Psyllid
Grant period: 01/01/2015 to 11/30/2015.
Amount: $35,304.00
California Olive Commission.

Introduction

This project was initiated to cover costs during the latter half of 2015. It extends work that was initiated in 2012 with funding from the COC, and one year later funded for a three year period by a Specialty Crops Block Grant that ended June 2015. The goal of this project is to release a highly specific parasitoid into California to control the olive psyllid, an exotic, invasive pest of olive trees. The current funding from COC was to finish up studies needed to obtain a field release permit for the olive psyllid parasitoid,** *Psyllaephagus euphyllurae* **from the USDA APHIS and maintain continuity in this testing of non-target psyllids until the Specialty Crops Block Grant was renewed. The lead technician on the project is John M. Jones who broke his leg in a motorcycle accident. Therefore work was suspended for much of the year. It just continued in October 2015. We've asked for a no-cost extension through December 2016.

Summary of Work Completed in 2015

The project (and Mr. Jones) moved from the UC Riverside Quarantine facility to the UC Berkeley facility in September. Mr. Jones moved insects, plants, and materials up to UC Berkeley. Prior to his accident, John Jones started surveying the state to determine the current distribution of olive psyllid, the second objective to this project. In addition, some survey work that was completed prior to his accident. John inspected 13 locations in southern California during September, the off season for this pest, and found 2 with olive psyllid infestations; ususally one can't find any stage of psyllids during the summer months. This survey will resume next spring when populations are at their peak for the year. Work on testing additional non-target (native) psyllids at the UC Berkeley quarantine has resumed. Host plants for non-target insects are being cultured and the native psyllids will be collected this fall.

MARKETING

2015 MARKETING REVIEW

OVERVIEW

If you could describe the 2015 marketing program in two words it would be: Mediterranean Diet.

The Mediterranean Diet is one of the most celebrated diets and is a media darling. Capitalizing on it was the main focus for the COC marketing program.

PROGRAM OBJECTIVES

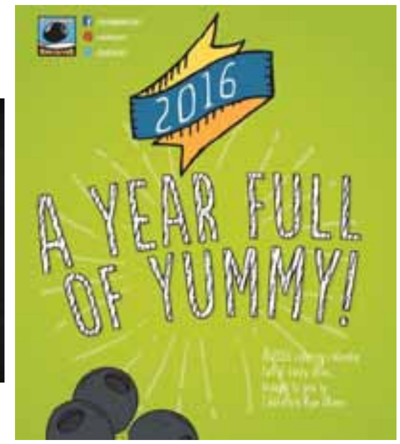
- Focus on the consumer audience, specifically Mom
- Reach target audience with a health-focused message through traditional and social channels
    - Consumer media
    - Bloggers
    - Social media (Facebook, Twitter, Pinterest)

2015 PROGRAM

Activities include:

- Paid media placements on "OK! TV" and "Daytime"
    - Reached 4 million viewers
- Mat release and infographic distributed to online news outlets
    - Reached a combined 90 million readers
- Blogger campaign targeting food, lifestyle, and nutrition bloggers
    - Reached near 1 million readers
    - 783K social impressions
    - 51 new healthy Mediterranean recipes and photos
- Nutrition blogger conference sponsorship where the COC engaged one-on-one with influential bloggers who are also registered dietitian nutritionists

- "8 Ways to Stuff an Olive" listicle distributed to online news outlets
  - Reached 61 million readers
- *'A Year Full of Yummy'* kids' coloring book download on CalOlive.org
  - 15,500 sweepstakes entries
- Social media engagement on Facebook, Twitter, and Pinterest



KEY NUTRITION MESSAGES

Olives, it's not just about the oil: California Ripe Olives are one of the most versatile items in the pantry. They are loved for their unique flavor, texture, and color, but can also be part of a healthy diet. Here's why:

1) **Olives naturally contain plant-powered polyphenols, one of the most important health promoting phytochemicals in the plant kingdom!**
   A number of studies have shown that plant-based polyphenols (including those from olives) have the potential to reduce inflammation and are linked to a reduced risk for certain chronic diseases.[1,2,3] Of more than 450 foods studied, black olives were among the top 50 polyphenol rich foods and ranked higher than extra virgin olive oil![4]

2) **Live longer, live better! Olives are an essential part of the Mediterranean diet and contain monounsaturated fat – the good fat!**
   Adherence to the Mediterranean diet, of which olives and olive oil are a key component, not only supports good health but has been associated with promoting

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(1) Pandey, K. B., & Rizvi, S. I. (2009). Plant polyphenols as dietary antioxidants in human health and disease. *Oxidative Medicine and Cellular Longevity*, 2(5), 270-278. Although several biological effects based on epidemiological studies can be scientifically explained, the mechanism of action of some effects of polyphenols is not fully understood.

(2) Charoenprasert, S., & Mitchell, A. (2012). Factors influencing phenolic compounds in table olives (Olea europaea). *Journal of agricultural and food chemistry*, *60*(29), 7081-7095. To date, there are not enough human studies of large sample size to determine the conditions under which olive phenolics will provide health benefits.

(3) Estruch, R., Ros, E., Salas-Salvadó, J., Covas, M. I., Corella, D., Arós, F., ... & Martínez-González, M. A. (2013). Primary prevention of cardiovascular disease with a Mediterranean diet. *New England Journal of Medicine*, *368*(14), 1279-1290. The generalizability of the findings is limited because all the study participants lived in a Mediterranean country and were at high cardiovascular risk; whether the results can be generalized to persons at lower risk or to other settings requires further research.

(4) Pérez-Jiménez, J., Neveu, V., Vos, F., & Scalbert, A. (2010). Identification of the 100 richest dietary sources of polyphenols: an application of the Phenol-Explorer database. *European journal of clinical nutrition*, *64*, S112-S120. Although polyphenol rich foods have been widely studied for health benefits, total polyphenol concentration may not fully explain associated health effects due to variations in activity of individual polyphenols.

longevity. Data from the Nurses' Health Study suggests that women who adhere to the Mediterranean diet had longer telomeres in their blood cells.[5] Telomeres are DNA sequences that get shorter when cells divide, so their length is thought to be a measure of a cell's aging.

Of the1.5 grams of fat in a 15 gram serving of olives, more than 75% is monounsaturated, which is not associated with the damaging effects of saturated fats, but is associated with increased longevity, decreased risk of heart disease, reduced risk of chronic disease, lower blood pressure, and improved brain function. [3,6,7]

3) **California black ripe olives are as good as they taste, and contain vitamin E, iron, vitamin A, and fiber[8]. They are packaged at their peak to preserve nutrients for year-round enjoyment.**
    - Vitamin E is an antioxidant which helps protect cells from oxidation and fight off free radicals produced during cellular energy production. A serving of olives has .25 milligrams of Vitamin E.
    - The ability of red blood cells to carry oxygen throughout the body is due to the presence of iron in the blood. A serving of olives has 0.50 milligrams of iron.
    - Vitamin A is needed for new cell growth, healthy skin, hair, tissues, and vision. A serving of olives has 60 IUs of Vitamin A, 1.2% of your daily value of 5,000 IUs.
    - Fiber promotes digestive tract health by helping to move food through the system at a healthier pace. A serving of olives has .50 grams of fiber.

4) **Black ripe olives are naturally gluten-free, and are also free of all major allergens including: wheat, soy, dairy, eggs, peanuts, and shellfish.**

5) **Olives are an ideal snack or meal complement for individuals who are on carb restricted diets. They are also Paleo-diet friendly!**

6) **A serving of olives contains 0 grams of trans fat and olives are naturally a cholesterol-free food!**

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(5) Crous-Bou, M., Fung, T. T., Prescott, J., Julin, B., Du, M., Sun, Q., ... & De Vivo, I. (2014). Mediterranean diet and telomere length in Nurses' Health Study: population based cohort study. *BMJ*, *349*, g6674. The project design precluded researchers from establishing a temporal association between dietary habits and telomere length; the single-measure test used prevented the estimation of associations between the Mediterranean diet and telomere attrition rate; and the participants predominately included women of European ancestry, and telomere dynamics may differ among other ethnicities.

(6) Hu, F. B. (2003). The Mediterranean diet and mortality-olive oil and beyond. *New England Journal of Medicine*, *348*(26), 2595-2596. This perspective view explores variations in diet and lifestyle that may or may not contribute to mortality rates, monounsaturated fats are a key component contributing to the health effects of the Mediterranean diet but other factors must be considered.

(7) Sofi, F., Cesari, F., Abbate, R., Gensini, G. F., & Casini, A. (2008). Adherence to Mediterranean diet and health status: meta-analysis. *Bmj*, *337*.

(8) USDA National Nutrient Database for Standard Reference 27. The meta-analysis supports a Mediterranean-like dietary pattern being significantly associated with a reduced risk of overall mortality and major chronic disease. Generalizability of the findings is again limited due to the Mediterranean diet not being homogenous, with variations in specific food categories and alcohol intake.

RESULTS

Target Goals	Actual Results
60,000,000 impressions	156,411,928 impressions
10% Facebook fan growth	12% Facebook fan growth
80% key message pull through	100% key message pull through

Facebook Insights

- 1,659 new fans
- Peak months of reach: April, August and December

2016 MARKETING PREVIEW

STRATEGIC APPROACH

- Focus on the quality of **California**
- Highlight **family traditions**
- Leverage connection to **Mediterranean Diet**

CAMPAIGN

Theme:

RIPE OLIVES. Grown in California. Enjoyed by families everywhere.

Why it works:

- Blends two "brand" attributes: California and Family
    - **Origin:**
        - California = Quality
    - **Usage:**
        - Versatility
    - **Health:**
        - Mediterranean Diet

Program elements include:

- Grower Recipes and Photography
- Video Production
- Test Kitchen Seminars
- Influencer Dinners
- Blogger Engagement
- Media Events
- Trade Advertising
- Trade Media Relations
- Social Media

EXPORTS

EXPORT SUMMARY

In 2015, the COC, based on its strategic plan, began implementing its export strategies.

To begin, the COC commissioned two studies. The first was entitled "Table Olives Country Support & Standards 2015." This report gives an overview of the U.S. competition with respect to other global table olive producing countries. The report shows the disparity and challenges the U.S. experiences when competing with other olive producing countries in the market place.

The second study entitled "World Table Olive Trade 2015" identifies major producing, importing, and exporting countries in the international table olive trading industry.

Lastly, the COC has begun applying for Market Access Program (MAP) dollars to assist the industry in identifying potential export countries.

For additional information, please contact the Committee office.

TRANS-PACIFIC PARTNERSHIP

After 5 years of negotiations, on October 5, an agreement was reached on the Trans-Pacific Partnership (TPP). The complex trade agreement seeks to significantly reduce or eliminate tariffs on our products and deter non-science based sanitary and phytosanitary barriers that have put American agriculture at a disadvantage. The eleven TPP countries in the Asia-Pacific region include Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam. Japan, Malaysia and Vietnam will eliminate tariffs on all fresh and processed fruits. Congress is not expected to vote on TPP until well into next year, and depending upon elections the approval may change. For more information, please contact the Commission office.

Source: USDA Marketing and Trade and USDA-FAS

TRANSATLANTIC TRADE AND INVESTMENT PARTNERSHIP

The Transatlantic Trade and Investment Partnership, known as T-TIP, is intended to be an ambitious and comprehensive trade agreement that significantly expands trade and investment between the U.S. and the EU. T-TIP specifically tries to increase economic growth, jobs and international competitiveness, as well as address global issues of common concern. It is considered to be a companion agreement to TPP. T-TIP will help unlock opportunity for American families, workers, businesses, farmers and ranchers through increased access to European markets for Made-in-America goods and services. This will help to promote U.S. international competitiveness, jobs and growth. The U.S. and EU economies are two of the most modern, most developed, and most committed to high standards of consumer protection in the world. T-TIP aims to strengthen that existing relationship in a way that will help boost economic growth and add to the more than 13 million American and EU jobs already supported by transatlantic trade and investment. T-TIP will be a cutting edge agreement aimed at providing greater compatibility and transparency in trade and investment regulation, while maintaining high levels of health, safety, and environmental protection. For more information, please contact the Commission office.

Source: Office of the United States Trade Representative

FOREIGN AGRICULTURAL SERVICE

The Foreign Agricultural Service (FAS) helps expand and maintain foreign markets for U.S. agricultural products by helping remove 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 up with cooperators like the COC to help US 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 Crop (TASC), and Emerging Market Programs (EMP). Each of these programs keep US products more competitive and counter subsidized foreign competition in the international market.

TABLE OLIVES

COUNTRY SUPPORT AND STANDARDS

2015

Schramm, Williams & Associates, Inc.

August 2015

Summary

This report includes information on the European and U.S. supports, country standards, and tariff levels affecting the world table olive market. The European Commission's description of support is general in nature and does not provide specifics with reference to the different sectors of the European table olive industry. The EC reports payment per hectare for agricultural production but does not provide payment by crop. However, we believe using other information table olive payment per hectare was achieved. There are several EC funded programs such as direct payments, rural development fundung, work programs, and producer organization support.

Information beyond the table olive grower is not available from the EC or member states. Historiacally, the EC has been known for its lack of transperancy with regard to funding different agricultural crops and alied processing industries. For example, the Producer Organizations, a type of cooperative, receives support from the EC and member states but there is no published information other than a total fundinmg.

Supports

The European table olive growers benefits from direct payments under the Common Agriculture Policy (CAP). We estimate that the Spanish table olive growers may receive approximately €41.2 million ($44.9 million) annually, the Greek table olive growers receives approximately €54.4 million ($59.3 million) annually, and the Italian table olive growers receives approximately €9.8 million ($10.68 million) annually in direct payments. In total, the European Union (EU) table olive growers receives approximately €105.4 million ($114.9 million) annually from direct payments. The table olive growers in Spain, Greece, and Italy also receive a sizeable amount of money under the Rural Development program within the CAP.

According to the Organization for Economic Co-operation and Development's (OECD) Producer Support Estimate Report, olive groves received over €10 million ($10.9 million) in 2014 in addition to direct payments.

The Moroccan table olive growers was recently the benefactor of aid from the United States under the Millennium Challenge Corporation. The fruit tree productivity program of the agreement was awarded $323 million and specifically targeted Morocco's olive orchards. The money devoted to olive orchards benefited both table olives and olives for oil.

Tariffs

The World Custom Organization's (WCO) harmonized tariff schedule contains three global harmornized schedule (HS) codes: 0709.92, 0711.20, and 2005.70. The United States has nearly 40 different HS numbers to track the imports and exports of table olives. A number of countries have been selected that represent key markets for table olives. The details on their tariffs are included in this report.

Standards

World wide there are six standards of table olives: two U.S. standards, two international organizations, and one from both Australia and South Africa. While Europe produces 31% of the world table olive, it does not have a table olive standard. Instead, the EU groups table olives into a general standard with other commodities that do not have specific grade standards. The EU is also a member of the International Olive Council, which is one of the two aforementioned international standards for table olives. In addition, Australia maintains protocols and guidelines for table olive processing.

International Trade

The World Table Olive Report 2015 was prepared by Schramm, Williams & Associates, Inc. in April 2015. Please refer to that report for more information regarding current import and export levels in the largest table olive markets

WORLD TABLE OLIVE TRADE

2015

Schramm, Williams & Associates, Inc.

April 2015, First Edition

Introduction

This report identifies major producing, importing, and exporting trading countries in order to determine international table olive trade. The report's statistics for most of the countries include calendar years 2005 to 2013. For the United States and most European countries, this report includes data for 2005 to 2014.

Scope of U.S. Trade

According to data provided by the United Nations, in calendar year 2013, global exports of table olives, including those transshipped[1], were approximately 970,000 MT (2.14 billion pounds)[2]. By contrast, the U.S. table olive industry exported less than one percent (0.3%) of global trade in 2013, 6,349 MT of table olives valued at $12.4 million. In 2014, U.S. exports increased 35 percent to 8,577 MT valued at nearly $15.3 million. This was mostly due to a surge of exports to Spain. Other than this occurrence, there is no record of such large exports to Spain in recent years.

U.S. imports for 2014 were 15 times the level of exports, 135,742 MT ($430 million). The majority, 95 percent, entered as processed olives (HS 2005.70), and nearly 45 percent (59,003 MT) of that were in the black sliced category. The United States is the largest importer of table olives in the world.

Major Table Olive Producing Countries[3]

Spain is the global leader in the production and processing of table olives. Annually, Spain produces over 530,000 MT of table olives.[4] The next seven largest table olives producers are: Egypt (400,000 MT), Turkey (380,000 MT), Greece (200,000 MT), Syria (147,000 MT), Algeria (132,000 MT), Argentina (130,000 MT), and Morocco (100,000 MT).[5] With the exception of Syria, detailed trade data of the aforementioned countries are included in this report.[6] While Syria is the fourth largest global producer, statistical trade data is difficult to obtain due to the ongoing internal military conflict. Although Algeria is the fifth largest producer of table olives, it is not involved in the export of table olives. Algeria, instead, is a net importer of table olives.

Major Table Olive Importers

The largest table olive importers after the United States are: Brazil, France, Italy, Russia, Germany, the United Kingdom, Australia, and Romania. Of the countries listed, Brazil is the only country who does not

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[1] Transshipped product refers to those table olives that are sent from the original producing country to an importing country who in turn exports the product to a third party regardless of whether the product was further processed.
[2] While the United Nations statistical database reports trade at 970,000 MT, provisional data from the International Olive Council reports trade for the 2013/14 crop year at 663,000 MT (1.46 million), excluding transshipments.
[3] The threshold used to determine the list of major table olive producing countries was those who produce over 100,000 MT of table olives on average annually.
[4] Average production estimates were calculated using data from International Olive Council.
[5] *Ibid*.
[6] The Spanish trade association, Asociación de Exportadores e Industriales de Aceituna de Mesa (ASEMESA), lists Iran as a major producer of table olives, but does not specifically list Argentina or Syria. ASEMESA estimates Iranian production for table olives at approximately 50,000 metric tons. The Foreign Agriculture Organization of the United Nations list total olive production for all uses between 35,000 and 40,000 metric tons. With global sanctions against Iran currently in place, it is difficult to determine whether trade is occurring or whether all Iranian production is consumed domestically. Should an agreement be found with Iran's nuclear proliferation talks and sanctions are removed, Iranian influence on the global table olive market should be monitored.

predominately import from Spain. Brazil's major supplier is Argentina, followed by Peru who is a distant second.

There are several markets that appear to have trade in table olives in quantities that may be worth investigating should future editions of the report be prepared.[7] These include: Bulgaria, Croatia, Czech Republic, Israel, Jordan, Netherlands, Peru, Poland, Romania, and Sweden.

Table Olive Transshipments

The transshipment of table olives appears to be exclusively European. Portugal, Italy, Belgium, Germany, and France export in large measure to other European countries. France is not a significant producer of table olives but is large importers along with Germany and Belgium. These three also export table olives to European countries as well as to others in the region. Both Portugal and Italy are significant producers of table olives, but each export in quantities that exceed their production less their domestic consumption.

Spain, who is the largest exporter of table olives, has only in the last two years been importing table olives in significate amounts. In 2013 and 2014, Spain imported 27,000 and 32,000 MT of table olives, respectively. Most of this product, 60 percent, was from Portugal. The import level of the immediately preceding five years, 2008 to 2012, averaged just over 7,000 MT. How these imports are being used cannot be determined, thus Spain cannot with certainty be viewed as a transhipper of table olives in addition to their being a major producer and exporter. The product is likely to supplement Spain's domestic consumption, but there may be a comingling of imports with domestic product for export purposes.

Russian Sanctions

In early 2014, the United States and Europe, among other countries, instituted banking and travel restrictions against Russia as a result of Russian aggression along the border and in Ukraine's peninsula known as Crimea. In August of 2014, Russia responded with its own set of sanctions that targeted fresh fruits, vegetables and tree nuts among other items. While fresh table olives (HS numbers 0709.92 and 0711.20) were included in this ban, processed food items (table olives under HS number 2005.70) continue to be traded without restriction.

European Subsidies

This report does not include details on subsidies provided to the European table olive industry by the European Commission and the European Union member countries. It is, however, prudent to mention that subsidies remain a significant factor in Europe's production of table olives and thus affects trade.[8] Subsidies to table olive farmers in the form of direct payments can no longer be determined due to reforms. Direct support payments for all farmers are governed by the Common Agricultural Policy

[7] It should be noted that three of the four most populated countries China (1.36 billion), India (1.25 billion), and Indonesia (250 million), together only import about 2,000 MT of table olives.   Indonesia's population is just behind the United States in ranking but only imports 40 MT of table olives annually. None of the three, who represent 40 percent of the globe's population, are commercial producers of table olives.

[8] The U.S. International Trade Commission report entitled, "*Olive Oil: Conditions of Competition between U.S. and Major Foreign Supplier Industries*" (USITC Publication 4419) details EU government support programs that benefit olive groves throughout Europe.

(CAP), which was reformed in 2013.[9] Under the CAP there are several types of payment schedules. The largest is the Basic Payment Scheme (BPS), which replaced the Single Payment Scheme.

Table Olive Trade Reporting Sources

Several government sources were researched for this report: The United States International Trade commission (USITC); Eurostat, the European Commission's government database; and the United Nations (UN) Comtrade database.

The United Nations obtains statistical trade data by requesting individual countries to report what they have imported and exported. Due to this methodology, discrepancies sometimes occur when comparing what one country reports as imported product with what a partner country has reported as exports. These discrepancies can occur due to the exporting country reporting the destination, but the importing country not reporting the shipment as imported due to transshipments to a third country. The discrepancies can also occur if data is improperly reported to the United Nations by a reporting government or if transshipments of products are misreported.

Tariff Nomenclature

Below is a table of the World Custom Organization's (WCO) harmonized tariff schedule numbers for table olives. This report contains trade data for the three global HS codes, 0709.92, 0711.20, and 2005.70.

Global Tariff Nomenclature	
0709.92	OLIVES, FRESH OR CHILLED
0711.20	OLIVES, PROVISIONALLY PRESERVED, BUT UNSUITABLE IN THAT STATE FOR IMMEDIATE CONSUMPTION
2005.70	OLIVES, PREPARED OR PRESERVED OTHERWISE THAN BY VINEGAR OR ACETIC ACID (EXCL. FROZEN).

For the United States, there are nearly 40 different HS numbers to track the imports and exports of table olives. These include: fresh, processed (including dried or frozen), their color, container type and size, as well as whether the product is whole, sliced, broken, pitted among other forms. The table below detailed a list of all U.S. HTS descriptions for table olives.

U.S. Detailed Tariff Nomenclature For Table Olives	
0709.92.00.00	OLIVES, FRESH OR CHILLED
0711.20.18.00	OLIVES,NOT PITTED,GREEN IN COLOR,IN A SALINE SOLUTION GT 8KG,DRAINED WEIGHT,USED FOR REPACKING OR SALE
0711.20.28.00	OLIVES, NOT PITTED, GREEN IN COLOR, IN A SALINE SOLUTION, IN CONTAINERS GT 8 KG, DRAINEDWEIGHT, TO BE USED AS REPACKING OR SALE AS GREN OLIVES
0711.20.38.00	OLIVES, NOT PITTED, PROVISIONALLY PRESERVED, BUT UNSUITABLE IN THAT STATE FOR IMMEDIATE CONSUMPTION, NESOI
0711.20.40.00	OLIVES, PITTED OR STUFFED, PROVISIONALLY PRESERVED, BUT UNSUITABLE IN THAT STATE FOR IMMEDIATE CONSUMPTION
0712.90.15.00	OLIVES, NOT RIPE, DRIED, WHOLE, CUT, SLICED, BROKEN OR IN POWDER, BUT NOT FURTHER PREPARED
0712.90.20.00	OLIVES, RIPE, DRIED, WHOLE, CUT, SLICED, BROKEN OR IN POWDER, BUT NOT FURTHER PREPARED

[9] Agriculture and Rural Development, European Commission. *Direct Payments*, *available at*: http://ec.europa.eu/agriculture/direct-support/direct-payments/index_en.htm.

2005.70.02.30	OLIVES, GREEN, NOT PITTED, IN A SALINE SOLUTION, RIPE, CONTAIN GT 8 KG BUT LT 13 KG EACHIN AN AGGREGATE QUANTITY NT TO EXCEED 730 METRIC TONS ANY
2005.70.02.60	OLIVES GREEN IN COLOR NOT PITTED, IN SOLUTION, RIPE, IN CONTAINERS HOLDING 8 KG OR LESS, IN AN AGGREGATE QUANTITY NOT TO EXCEED 730 METRIC TON IN
2005.70.04.30	OLIVES, GREEN, NOT PITTED, IN A SALINE SOLUTION, RIPE,IN CONTAINERS EACH HOLDING LT 8 KGBUT LT 13 KG, DRAINED WEIGHT, NESOI, NOT FROZEN
2005.70.04.60	OLIVES GREEN IN COLOR NOT PITTED, IN SALINE SOLUTION, IN CONTAINERS HOLDING 8 KG OR LESS, NESOI
2005.70.06.00	OLIVES, GREEN, NOT PITTED, IN SALINE SOLUTION, IN CONTAINERS EACH HOLDING GT 8 KG,DESCRIBED IN ADDITIONAL US NOTE 4 TO THIS CHAPTE AND ENTERED PU
2005.70.08.00	OLIVES GREEN IN COLOR, NOT PITTED, IN CONTAINERS EACH HOLDING MORE THAN 8 KG, NESOI
2005.70.12.00	OLIVES, GREEN, NOT PITTED, IN SALINE SOLUTION, NESOI, NOT FROZEN
2005.70.16.00	OLIVES GREEN IN COLOR PLACE PACKED STUFFED IN SALINE SOLUTION CONTAINERS EACH HOLDING NOT MORE THAN 1 KG, IN AN AGGREGATED QUANTITY LT 2700 M TON
2005.70.18.00	OLIVES, GREEN IN COLOR, PITTED OR STUFFED, PLACE PACKED, IN SALINE SOLUTION, STUFFED, IN CONTAINERS EACH HOLDING NOT MORE THAN 1 KG, DRAINED, NES
2005.70.23.00	OLIVES, GREEN IN COLOR, PITTED OR STUFFED, PLACE PACKED, IN A SALINE SOLUTION, NESOI
2005.70.25.10	OLIVES, GREEN, WHOLE, PITTED, IN SALINE SOLUTION, IN CONTAINERS HOLDING MORE THAN 8 KG EACH, NOT FROZEN
2005.70.25.20	OLIVES, GREEN, WHOLE, STUFFED, IN SALINE SOLUTION, IN CONTAINERS HOLDING MORE THAN 8 KG EACH, NOT FROZEN
2005.70.25.30	OLIVES, GREEN, BROKEN, SLICED OR SALAD STYLE, IN CONTAINERS HOLDING MORE THAN 8 KG DRAINED WEIGHT, IN A SALINE SOLUTION
2005.70.25.40	OLIVES, GREEN, WHOLE, PITTED, IN CONTAINERS HOLDING LESS THAN 8 KG, IN SALINE SOLUTION, NOT FROZEN
2005.70.25.50	OLIVES, GREEN, WHOLE, STUFFED, CONTAINER LESS THAN 8 KG, IN SALINE SOLUTION, NOT FROZEN
2005.70.25.60	OLIVES, GREEN, BROKEN, SLICED OR SALAD STYLE, CONTAINERS HOLDING LESS THAN 8 KG, IN A SALINE SOLUTION, NOT FROZEN
2005.70.50.30	OLIVES, NOT GREEN IN COLOR, NOT PITTED, CANNED IN SALINE SOLUTION, CONTAINERS HOLDING MORE THAN .3 KG EACH
2005.70.50.60	OLIVES, NOT GREEN IN COLOR, NOT PITTED, CANNED IN SALINE SOLUTION, CONTAINERS HOLDING .3 KG OR LESS, NOT FROZEN
2005.70.60.20	OLIVES, NOT GREEN IN COLOR, WHOLE PITTED, CANNED IN SALINE SOLUTION, CONTAINERS HOLDING MORE THAN .3 KG EACH, NOT FROZEN
2005.70.60.30	OLIVES, NOT GREEN IN COLOR, WHOLE PITTED, CANNED IN SALINE SOLUTION, CONTAINERS HOLDING .3 KG OR LESS, NOT FROZEN
2005.70.60.50	OLIVES, NOT GREEN IN COLOR, SLICED, CANNED IN A SALINE SOLUTION, NOT FROZEN
2005.70.60.60	OLIVES, NOT GREEN IN COLOR, CHOPPED OR MINCED, CANNED IN A SALINE SOLUTION, NOT FROZEN
2005.70.60.70	OLIVES, NOT GREEN IN COLOR, OTHER INCLUDING WEDGED OR BROKEN, CANNED IN SALINE SOLUTION, NOT FROZEN
2005.70.70.00	OLIVES, NOT GREEN IN COLOR, OTHER THAN CANNED, IN AIRTHIGH CONTAINERS OF GLASS OR METAL, IN SALINE SOLUTION, NOT FROZEN
2005.70.75.10	OLIVES WHOLE PITTED, NOT GREEN IN COLOR, NOT CANNED, IN SALINE SOLUTION, NOT FROZEN
2005.70.75.15	OLIVES SLICED, NOT GREEN IN COLOR, NOT CANNED, IN SALINE SOLUTION, NOT FROZEN
2005.70.75.20	OLIVES CHOPPED OR MINCED, NOT GREEN IN COLOR, NOT CANNED, IN SALINE SOLUTION, NOT FROZEN
2005.70.75.25	OLIVES, INCLUDING WEDGED OR BROKEN, NOT GREEN IN COLOR, NOT CANNED, IN SALINE SOLUTION, NOT FROZEN, NESOI
2005.70.91.00	OLIVES GREEN PREP/PRES OTHERWSE THAN IN SALINE SOLUTION NT FROZEN CONTAINERS EACH HOLDING LESS THAN 13 KG,IN AN AGGREGATE QUANTITY GT 550 M TON A
2005.70.93.00	OLIVES, PREPARED OR PREPARED OTHERWISE THAN IN SALINE SOLUTION, NOT FROZEN, NESOI
2005.70.97.00	OTHER VEGETABLES, OTHERWISE PREPARED OR PRESERVE THAN BY VINEGAR OR ACETIC ACID, NOT FROZEN, NESOI

Source: U.S. International Trade Commission.

Tariff Levels

A number of countries have been selected that represent key markets for table olives, and are organized in a table that includes details on their tariffs. The tariff data is the most up–to–date applied tariffs data available.

Possible and Future Tariff Rate Adjustments

Under the 1994 Uruguay Round Agreement, each country committed to limit tariff rates for commodities to a specific level. These tariffs are also specific to each country and are known as bound tariff rates.[10] Tariff rates that are lower than a country's bound rate are called currently applied tariffs. These applied rates can be lowered or raised up to a country's bound rate without permission from other trading countries or the World Trade Organization.[11]

As the multilateral negotiations in the Doha Round continues, as well as free trade agreement negotiations with Trans–Pacific Partnership countries, and Europe (Transatlantic Trade Investment Partnership), the tariff table on page 139 of this report should be updated to reflect the applied tariffs as agreements are implemented.

Exchange Rates

Included in this report are both the quantity of imports and exports as well as the monetary value of these goods. In order to obtain the most precise statistics, the European Commission's database *Eurostat* was used to obtain trade information for most European countries. As such, the value for these countries will be in Euros. For convenience, the tables below provide information on the average exchange rates between the Euro and the U.S. dollar each year (2005 to 2014).

Yearly Average Exchange Rates	
Year	**1 Euro =**
2005	1.24502 USD
2006	1.25583 USD
2007	1.37035 USD
2008	1.47092 USD
2009	1.39423 USD
2010	1.32747 USD
2011	1.39243 USD
2012	1.28577 USD
2013	1.32797 USD
2014	1.32898 USD

Yearly Average Exchange Rates	
Year	**1 USD =**
2005	0.80429 EUR
2006	0.79678 EUR
2007	0.73061 EUR
2008	0.68321 EUR
2009	0.71895 EUR
2010	0.75464 EUR
2011	0.71876 EUR
2012	0.77806 EUR
2013	0.75316 EUR
2014	0.75354 EUR

Source: www.**oanda**.com

[10] The World Trade Organization. *Tariffs*, *available at*: https://www.wto.org/english/tratop_e/tariffs_e/tariffs_e.htm.
[11] *Ibid*.

STATISTICS

CALIFORNIA RIPE OLIVE DATA

The following information is the completed 2014-2015 Ripe Olive Data. This data includes:

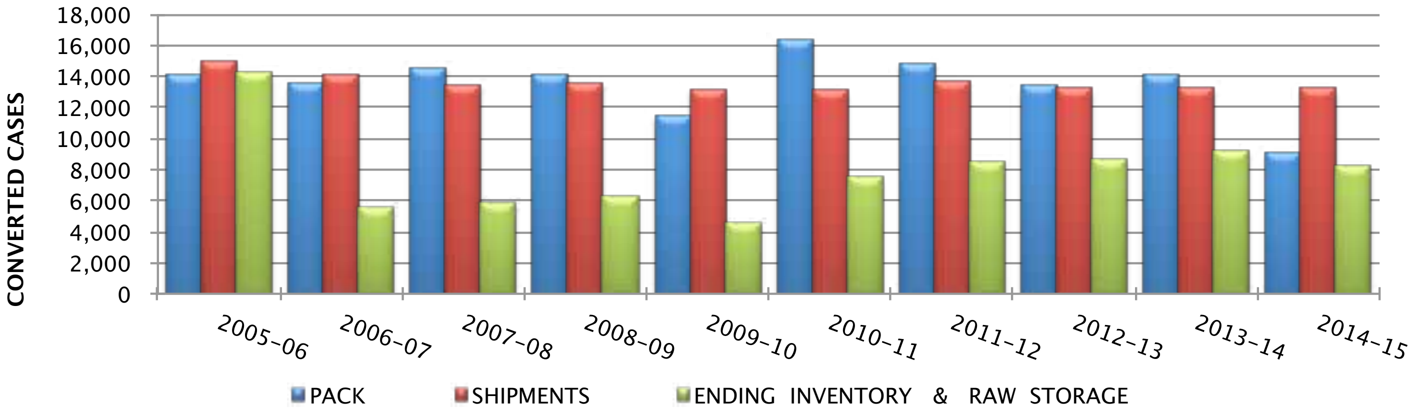
- Shipments, Pack, and Ending Inventory-All Styles
- Chart-Pack, Shipments, and Ending Inventory
- Pack, Shipments, and Carry Out-All Styles
- Chart-Pack, Shipments, and Ending Inventory-Pitted
- Pack, Shipments, and Ending Inventory- Pitted
- Chart-Pack, Shipments, and Ending Inventory-Sliced
- Pack, Shipments, and Ending Inventory-Whole, Broken Pitted, Ltd.
- Chart-Consumer and Food Service Shipments- % by Month
- Shipments by Month-Whole and Pitted
- Chart-Consumer and Food Service Sliced Shipments- % by Month
- Shipments by Month-Limited Styles
- Chart-Shipments by Size Grade-Whole and Pitted
- Shipments by Size Grade- Whole and Pitted
- Shipments by Size Container-All Styles
- Pack by Size of Container- All Styles
- Chart-Pack by Size Grade- Whole and Pitted
- Sizes Packed- Whole & Pitted

SHIPMENTS, PACK, AND ENDING INVENTORY SUMMARY
2012-13 TO 2014-15
(Converted cases 24/300 basis)

	Shipments			Pack			Ending Inventory		
	2014-15	2013-14	% Chnge	2014-15	2013-14	% Chnge	2014-15	2013-14	% Chnge
TOTAL	13,217,772	13,284,578	-0.5	9,090,482	14,112,613	-35.6	8,178,359	9,185,272	-11.0
MARKETS									
Consumer	9,990,132	10,034,595	-0.4	7,119,038	10,747,226	-33.8	6,585,126	7,623,328	-13.6
Food Service	3,227,640	3,249,983	-0.7	1,971,445	3,365,387	-41.4	1,593,232	1,561,944	2.0
STYLES									
Whole	11,941	12,100	-1.3	181,225	19,914	810.0	18,093	20,665	-12.4
Pitted	8,199,230	8,294,633	-1.2	5,552,897	8,922,768	-37.8	5,709,622	6,952,636	-17.9
Wedged	26,358	27,120	-2.8	30,576	24,514	24.7	33,519	29,356	14.2
Sliced	4,677,552	4,627,339	1.1	3,127,624	4,879,972	-35.9	2,217,742	1,913,425	15.9
Chopped	275,556	296,043	-6.9	685,033	265,023	158.5	175,894	231,266	-23.9
Broken Pitted	27,136	27,343	-0.8	13,127	422	3,010.7	23,489	37,924	-38.1
KEY ITEMS									
24/300 Pitted	7,786,839	7,903,235	-1.5	5,359,780	8,534,383	-37.2	5,462,797	6,576,627	-16.9
6/10 Pitted	394,223	372,933	5.7	186,662	373,331	-50.0	230,426	358,822	-35.8
6/10 Sliced	2,779,640	2,817,743	-1.4	4,729,288	2,921,940	61.9	1,296,906	1,116,131	16.2
24/300 Whole	9,671	9,132	5.9	181,225	14,941	1,112.9	16,036	16,017	0.1
6/10 Whole	2,270	2,968	-23.5	0	4,973	-100.0	2,057	4,648	-55.7
6/10 Wedged	24,965	25,299	-1.3	28,078	24,514	14.5	30,779	27,702	11.1
2.25 Sliced	822,458	841,789	-2.3	517,142	830,713	-37.7	329,702	344,337	-4.3
4.25 Chopped	245,018	262,606	-6.7	155,177	218,789	-29.1	139,714	171,880	-18.7

Source: COC/NASS

PACK, SHIPMENTS, AND ENDING INVENTORY - ALL STYLES



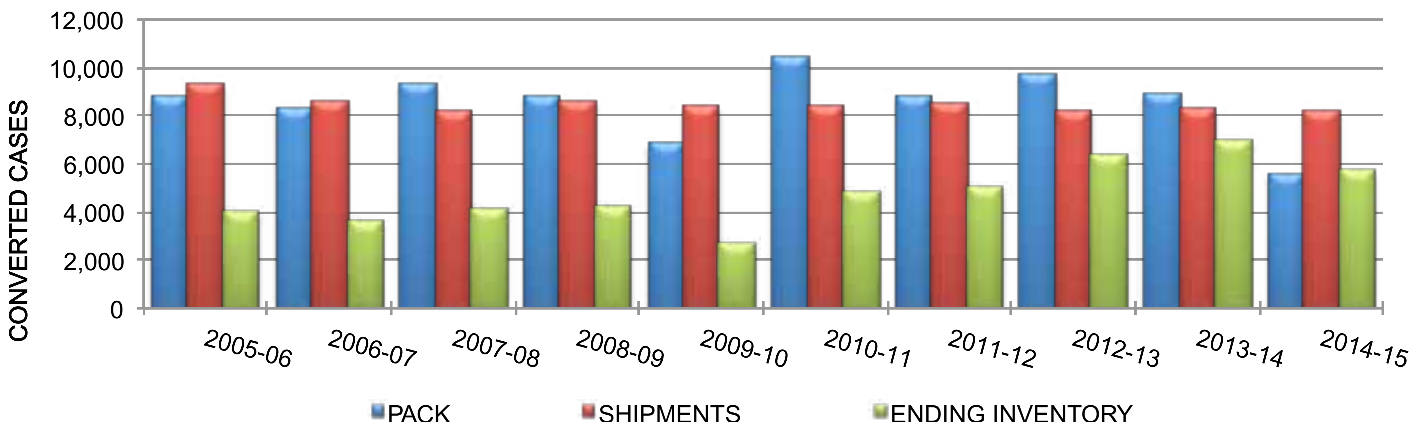
Source: COC/NASS

PACK, SHIPMENTS, AND CARRY OUT
CANNED RIPE & GREEN RIPE - WHOLE & PITTED
BROKEN PITTED - LIMITED
2005-06 TO 2014-15
(Thousands of cases 24/300 basis)

Season	Carry In		Pack	Shipments	Carry Out	
	Inventory	Storage			Inventory	Storage
2005-06	6,677.9	4,389.4	14,146.3	14,995.8	5,891.8	8,386.1
2006-07	5,891.8	8,386.1	13,474.3	14,087.5	5,158.8	371.8
2007-08	5,158.8	371.8	14,561.7	13,434.0	5,845.6	4,270.2
2008-09	5,845.6	4,270.2	14,153.2	13,581.0	6,272.7	757.4
2009-10	6,272.7	757.4	11,432.4	13,147.0	4,506.8	916.5
2010-11	4,506.8	916.5	16,350.6	13,072.7	7,474.2	12,322.0
2011-12	7,474.2	12,322.0	14,851.6	13,711.7	8,466.9	1,536.7
2012-13	8,466.9	1,536.7	13,353.0	13,229.1	8,592.3	2,431.7
2013-14	8,592.3	2,431.7	14,112.6	13,284.6	9,185.3	3,879.5
2014-15	9,185.3	3,879.5	9,090.5	13,217.7	8,178.4	1,529.4

Storage converted at 155 cases per ton.
Note: Inventory is finished goods; Storage is bulk olives.
Source: COC/NASS

PACK, SHIPMENTS, AND ENDING INVENTORY - PITTED



Source: COC/NASS

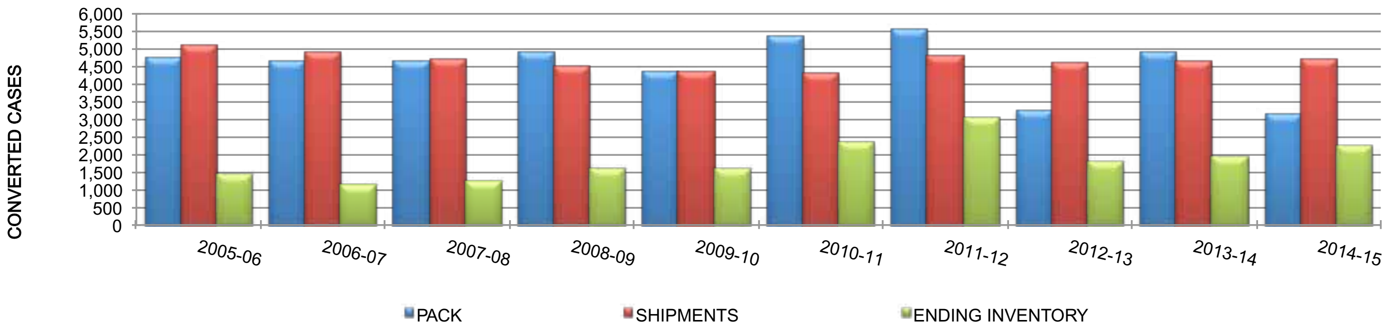
PACK, SHIPMENTS, AND ENDING INVENTORY
CANNED RIPE OLIVES - PITTED
2005-06 TO 2014-15
(Thousands of cases 24/300 Basis)

Season	Beginning Inventory	Pack	Shipments	Ending Inventory
2005-06	4,515.6	8,839.0	9,324.8	3,978.7
2006-07	3,978.7	8,330.3	8,601.6	3,647.3
2007-08	3,647.3	9,324.7	8,229.4	4,143.8
2008-09	4,143.8	8,794.1	8,604.7	4,275.0
2009-10	4,275.0	6,834.9	8,356.3	2,734.3
2010-11	2,734.3	10,473.4	8,381.4	4,795.2
2011-12	4,795.2	8,825.7	8,544.4	4,996.0
2012-13	4,966.0	9,720.2	8,235.7	6,409.6
2013-14	6,409.6	8,922.8	8,294.6	6,952.6
2014-15	6,952.6	5,552.9	8,199.2	5,709.6

Includes Green Ripe

Source: COC/NASS

PACK, SHIPMENTS, AND ENDING INVENTORY - SLICED



Source: COC/NASS

PACK, SHIPMENTS AND ENDING INVENTORY
CANNED RIPE OLIVES
WHOLE - BROKEN PITTED - LIMITED
2010-11 TO 2014-15
(Thousands of cases 24/300 Basis)

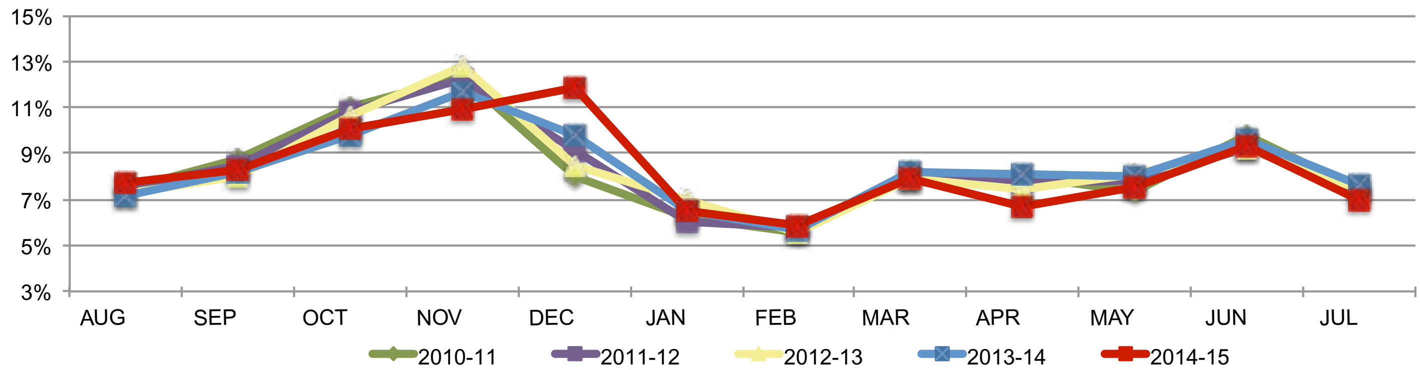
Style	Season	Beginning Inventory	Pack	Shipments	Ending Inventory
Whole*	2010-11	16.8	21	13.9	21
	2011-12	21	15.7	13.8	18.4
	2012-13	18.4	22.3	12.4	26.7
	2013-14	26.7	19.9	12.1	20.7
	2014-15	20.7	181.2	11.9	18.1
Broken Pitted*	2010-11	14.1	39.8	17.9	41.4
	2011-12	41.4	56.4	17.1	81.1
	2012-13	81.1	7.8	23.6	65.2
	2013-14	65.2	0.4	27.3	37.9
	2014-15	37.9	13.1	27.1	23.5
Wedged**	2010-11	46.1	0.0	28.1	17.5
	2011-12	17.5	31.0	29.4	18.1
	2012-13	18.1	40.2	24.6	33.2
	2013-14	33.2	24.5	27.1	29.4
	2014-15	29.4	30.6	26.4	33.5
Sliced	2010-11	1,565.2	5,357.9	4,290.3	2,355.6
	2011-12	2,355.6	5,529.5	4,772.5	3,056.9
	2012-13	3,056.9	3,250.9	4,601.6	1,784.5
	2013-14	1,784.5	4,880.0	4,627.3	1,913.4
	2014-15	1,913.4	3,127.6	4,677.6	2,217.7
Chopped	2010-11	130.2	458.5	341.1	243.4
	2011-12	243.4	393.3	334.7	296.4
	2012-13	296.4	311.6	331.2	273.0
	2013-14	273.0	265.0	296.0	231.3
	2014-15	231.3	185.0	275.6	175.9

* Includes Green Ripe

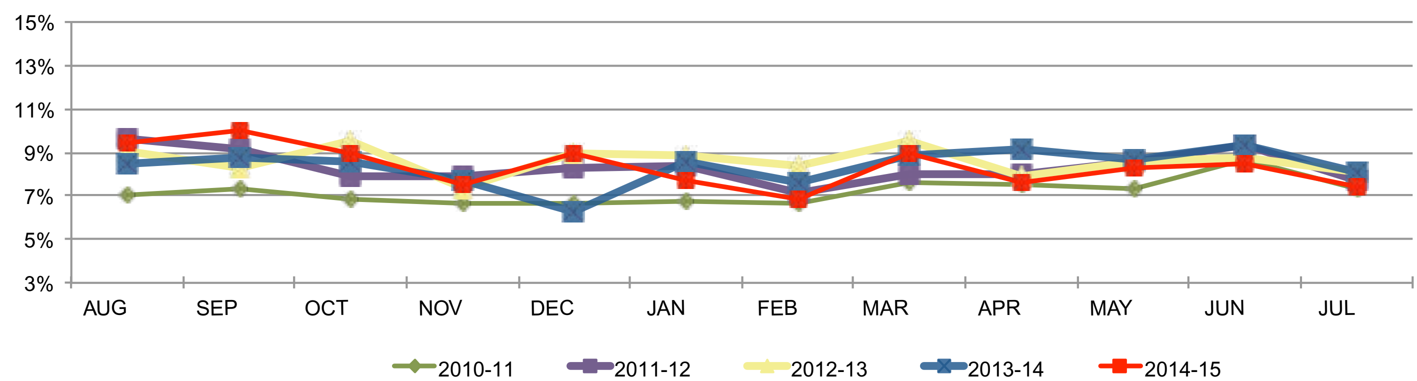
** Includes small amount of halved

Source: COC/NASS

Consumer Shipments - % Month



Food Service Shipments - % Month



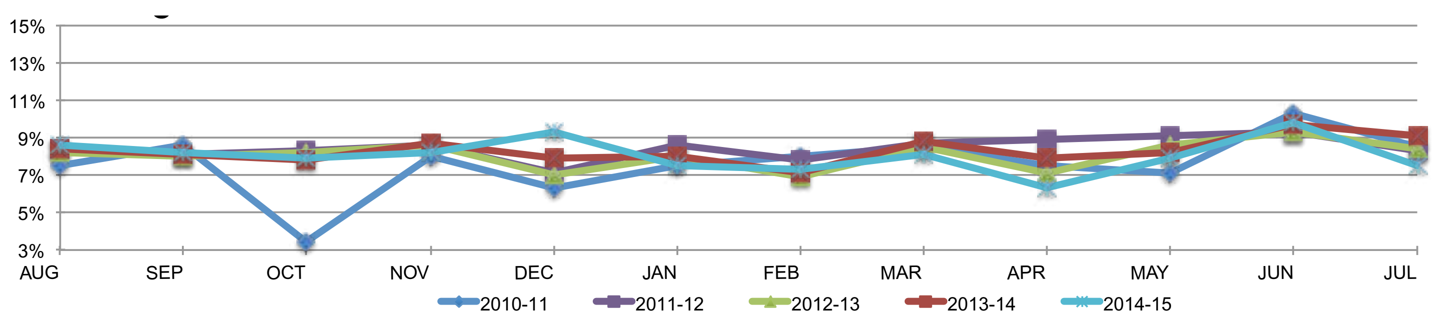
Source: COC/NASS

SHIPMENTS BY MONTH
CANNED RIPE & GREEN RIPE - WHOLE & PITTED
2004-05 TO 2014-15
(Thousands of cases 24/300 Basis)

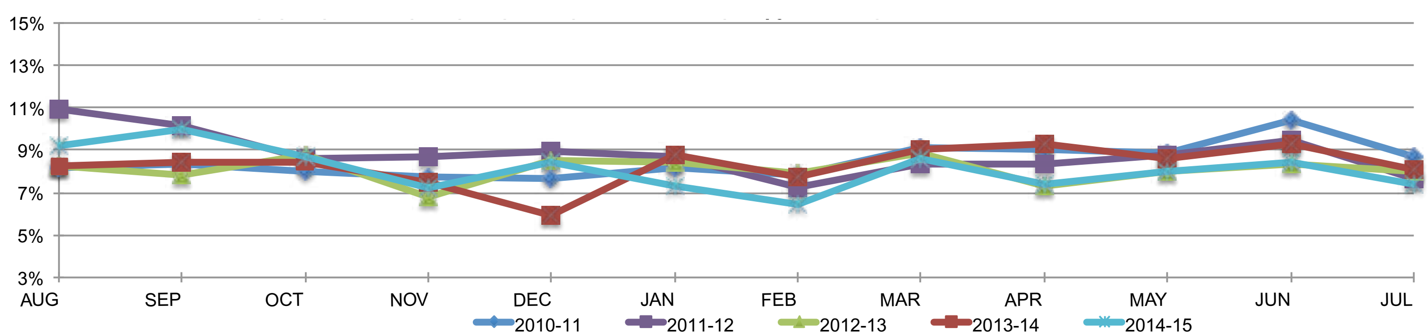
Month	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
August	719.3	804.2	561.8	693.2	620.1	610.1	637.7	583.8	567.9	618.7
September	772.0	828.9	592.2	825.8	724.1	723.1	722.8	642.1	652.0	664.3
October	981.8	879.8	921.6	925.6	982.0	947.5	962.5	896.9	835.4	853.2
November	1,303.6	1,038.5	1,192.2	1,125.9	970.0	1083	1091.8	1102.5	997.3	924.0
December	942.1	823.2	770.4	809.8	797.1	700.7	814.4	712.4	819.4	995.5
January	530.0	589.0	376.4	428.8	447.8	493.9	485.3	535.3	518.7	494.4
February	463.0	544.6	439.3	487.3	431.8	413.3	463.9	422.8	435.0	433.2
March	700.3	636.7	635.7	671.7	718.1	679.5	656.7	632.9	652.3	638.1
April	653.8	615.5	551.0	559.2	533.7	672.8	625.2	602.3	656.3	541.3
May	769.2	565.2	742.9	635.9	671.7	605.7	632.7	641.7	643.4	599.5
June	852.9	754.2	772.6	795.6	773.7	790.1	764.1	742.0	771.3	733.0
July	631.6	512.5	652.0	608.0	628.5	600.4	598.1	575.0	587.2	543.2
TOTAL	9,319.6	8,592.3	8,208.1	8,566.8	8,298.6	8,320.1	8,455.2	8,089.7	8,136.2	8,038.4
Green-W/ Ptd	37.2	33.8	42.9	54.4	75.7	75.7	102.8	158.3	170.4	172.8
TOTALS	9,356.8	8,626.1	8,251.0	8,621.2	8,374.3	8,395.8	8,558.0	8,248.0	8,306.6	8,211.2

Source: COC/NASS

Consumer Sliced & Chopped Shipments - % Month



Food Service Sliced Shipments - % Month



Source: COC/NASS

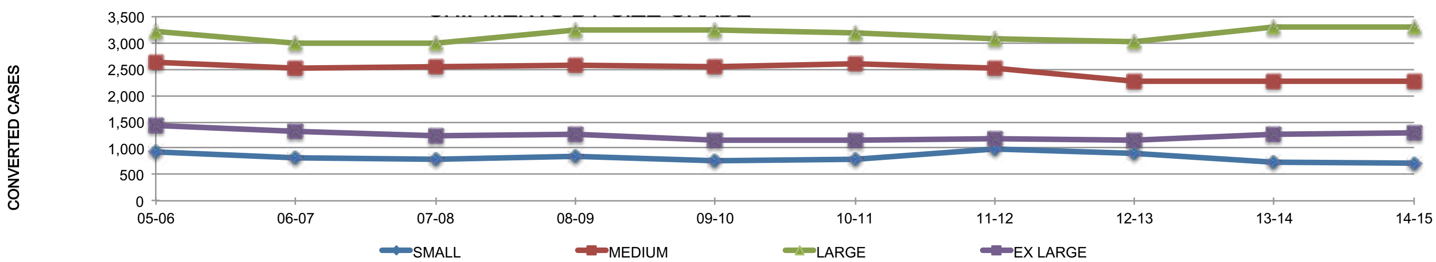
SHIPMENTS BY MONTH
CANNED RIPE OLIVES - LIMITED STYLES *
2005-06 TO 2014-15
(Thousands of cases 24/300 Basis)

Month	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
August	507.8	571.5	431.6	398.4	400.4	376.5	468.3	420.7	411.8	448.8
September	488.9	494.4	416.8	499.9	419.1	405.6	453.6	410.6	432.7	470.6
October	430.6	435.6	412.9	401.2	422.2	390.1	408.3	439.2	401.5	430.5
November	464.8	435.7	440.2	366.4	410.3	370.8	417.8	385.2	401.0	391.9
December	428.6	460.7	368.5	385.5	413.7	327.3	400.2	401.1	343.9	459.6
January	400.9	434.7	369.8	352.7	331.4	358.3	420.6	423.2	400.8	390.6
February	440.6	399.9	367.5	352.7	356.1	362.8	369.5	384.6	369.4	361.9
March	546.1	450.2	421.4	438.1	427.4	403.1	422.8	444.0	442.7	428.7
April	413.4	438.0	377.4	389.3	360.1	397.8	420.5	370.0	433.4	358.6
May	480.3	428.7	429.7	432.5	373.9	380.4	452.1	421.1	416.8	407.1
June	534.5	441.4	450.8	453.4	434.3	487.1	490.6	442.3	471.9	451.4
July	463.8	398.2	631.5	437.6	395.1	400.1	412.2	415.6	424.9	379.8
TOTALS	5,600.3	5,389.0	5,118.1	4,907.7	4,744.0	4,659.9	5,136.5	4,957.6	4,950.8	4,979.5

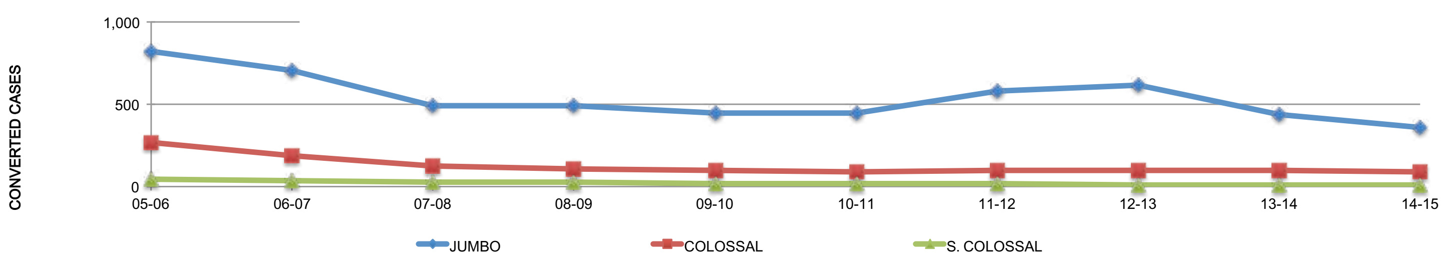
*Limited styles consist of Sliced, Chopped and Wedged

Source: COC/NASS

Shipments by Size Grade



Shipments by Size Grade



Source: COC/NASS

SHIPMENTS BY SIZE GRADE
CANNED RIPE & GREEN RIPE - WHOLE & PITTED
2005-06 TO 2014-15
(Thousands of cases 24/300 Basis)

Size Grade	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Small	931.3	823.6	798.9	834.4	765.1	795.9	975.7	909.4	747.5	716.8
Medium	2,627.8	2,524.3	2,549.6	2,569.6	2,551.6	2616.1	2525.5	2,276.1	2,283.1	2,273.8
Large	3,206.8	2,985.3	2,990.1	3,258.8	3,248.8	3186.7	3078.3	3,031.6	3,293.9	3,291.2
Ex Large	1,421.4	1,330.4	1,231.4	1,254.3	1,160.3	1151.2	1173.8	1,148.5	1,262.1	1,296.3
Ex Lg Sev	0.2	0.0	0.7	20.3	11.3	0	0	0	0	0
Jumbo	824.9	707.5	488.7	493.9	435.7	445.4	580.4	618.2	435.4	360
Colossal	266.0	189.5	124.2	110.0	92.1	85.2	93.9	94.7	102.6	90.6
Sup Col	41.3	31.7	24.4	25.6	15.9	15.6	13.9	11.4	11.8	9.7
TOTALS	9,319.7	8,592.3	8,208.0	8,566.9	8,280.8	8,296.1	8,441.5	8,089.9	8,136.4	8,038.4
G.Rp-Wh/Ptd	37.1	33.8	43.0	54.4	75.7	85.3	102.8	158.3	170.4	172.8
TOTALS	9,356.8	8,626.1	8,251.0	8,621.3	8,356.5	8,381.4	8,544.3	8,248.2	8,306.8	8,211.2

Source: COC/NASS

SHIPMENTS BY SIZE OF CONTAINER
CANNED RIPE & GREEN RIPE - WHOLE & PITTED
BROKEN PITTED - LIMITED USE STYLES
2010-11 TO 2014-15
(Thousands of cases 24/300 Basis)

Container	Styles	2010-11	2011-12	2012-13	2013-14	2014-15
No. 10 (600 x 700)	Whole	3.9	4.0	3.1	3.0	2.3
	Pitted	423.3	431.1	389.7	372.9	394.2
	Bkn Pitted	-	-	-	-	-
	Wedged	26.0	27.5	23.1	25.3	25.0
	Sliced	2,643.1	3,122.8	2,922.0	2,817.7	2,779.6
	Chopped	27.6	27.8	25.3	31.0	26.5
	Grn Ripe Ptd	-	-	-	-	-
Foodservice Total		3,123.9	3,613.2	3,363.2	3,249.9	3,227.6
No. 300 (300 x 407)	Whole	10.0	9.7	9.4	9.1	9.7
	Pitted	7,931.5	8,090.3	7,824.0	7,903.2	7,786.8
	Bkn Pitted	17.9	17.1	23.6	27.3	27.1
	Wedged	-	-	-	-	-
	Sliced	170.7	171.5	220.2	301.7	369.1
	Chopped	2.7	1.3	1.9	2.4	4.0
	Grn Ripe Wh/Ptd	85.3	102.8	158.3	170.4	172.8
Buffet (211 x 304)	Whole	-	-	-	-	-
	Pitted	26.5	23.0	22.1	18.5	18.2
	Bkn Pitted	-	-	-	-	-
	Wedged	-	-	-	-	-
	Sliced	619.3	607.4	633.4	666.1	706.4
	Chopped	75.8	241.1	7.3	0.0	0.0
2-1/4 OZ (211 x 200)	Wedged	2.1	1.9	1.6	1.8	1.4
	Sliced	857.3	870.8	826.1	841.8	822.5
4-1/4 OZ (211 x 200)	Chopped	0.0	304.1	296.8	262.6	245.0
Consumer Total		9,799.1	10,441.0	10,024.7	10,204.9	10,163.0
TOTALS		12,923.0	14,054.2	13,387.9	13,454.8	13,390.6

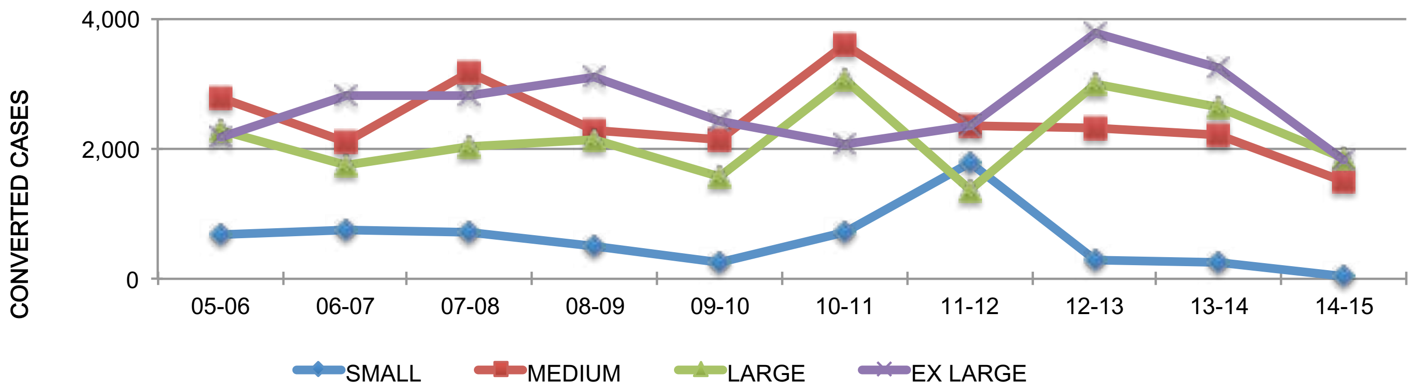
Source: COC/NASS

PACK BY SIZE OF CONTAINER
CANNED RIPE & GREEN RIPE - WHOLE & PITTED
BROKEN PITTED - LIMITED USE STYLES
2010-11 TO 2014-15
(Thousands of cases 24/300 Basis)

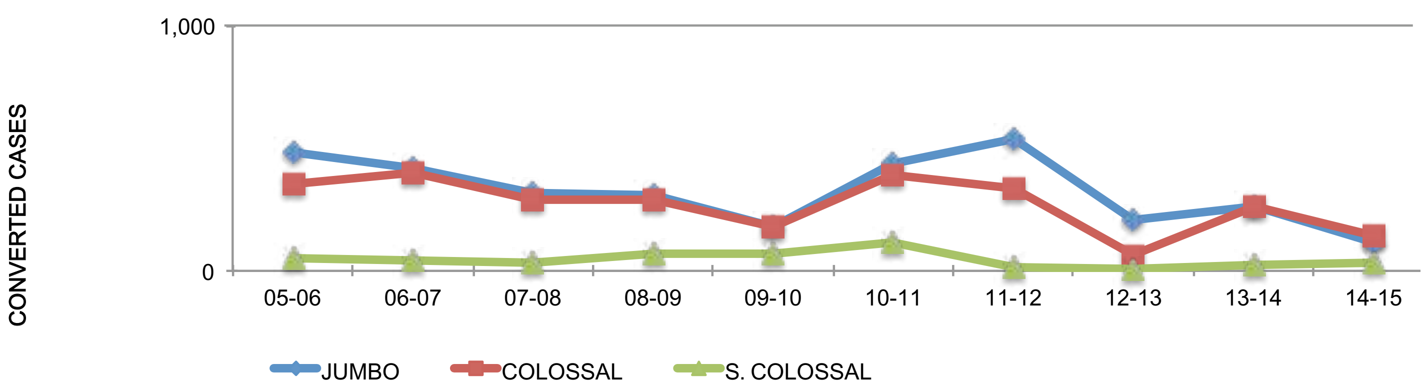
Container	Styles	2010-11	2011-12	2012-13	2013-14	2014-15
No. 10 (603 x 700)	Whole	3.4	2.7	3.4	5.0	0.0
	Pitted	556.1	403.1	458.3	373.3	186.7
	Bkn Pitted	0.0	-	-	-	-
	Wedged	0.0	28.7	36.7	24.5	28.1
	Sliced	3,223.3	3,845.4	1,752.0	2,921.9	1,729.3
	Chopped	35.9	17.6	47.5	40.6	27.4
	Grn Ripe Ptd	-	-	-	-	-
Foodservice Total		3,818.7	4,297.5	2,297.9	3,365.3	1,971.5
No. 300 (300 x 407)	Whole	17.7	13.0	18.8	14.9	181.2
	Pitted	9,892.5	8,395.0	9,237.6	8,534.4	5,359.8
	Bkn Pitted	39.8	56.4	7.8	422.0	13.1
	Wedged	-	-	-	-	-
	Sliced	193.3	303.9	143.4	365.3	372.5
	Chopped	2.6	0.0	3.6	5.6	2.4
	Grn Ripe Wh/Ptd	54.7	106.0	72.3	33.1	87.0
Buffet (211 x 304)	Whole	-	-	-	-	-
	Pitted	24.8	27.5	24.3	15.1	6.5
	Bkn Pitted	-	-	-	-	-
	Wedged	-	-	-	-	-
	Sliced	911.9	624.8	532.6	762.0	508.7
	Chopped	-	-	-	-	-
2-1/4 OZ (211 x 200)	Wedged	0.0	2.3	3.5	0.0	2.5
	Sliced	2,196.9	755.4	823.0	830.7	517.1
4-1/4 OZ (211 x 200)	Chopped	420.0	375.8	260.4	218.8	155.2
Consumer Total		13,754.2	10,660.1	11,127.3	11,201.9	7,206.0
TOTALS		17,572.9	14,957.6	13,425.2	14,567.2	9,177.5

Source: COC/NASS

Pack by Size Grade



Pack by Size Grade



Source: COC/NASS

CUMULATIVE PACKED BY SIZE
CANNED RIPE & GREEN RIPE - WHOLE & PITTED
2005-07 TO 2014-15
(Thousands of cases 24/300 Basis)

Size Grade	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Small	677.9	758.8	703.7	484.8	264.2	717.8	1,792.8	302.5	254.9	29.0
Medium	2,789.8	2,099.9	3,149.2	2,269.5	2,131.6	3,596.4	2,345.6	2,306.8	2,204.3	1,490.8
Large	2,292.7	1,750.0	2,023.8	2,131.2	1,566.1	3,063.7	1,365.0	2,995.2	2,629.1	1,833.6
Ex Lg	2,156.2	2,768.2	2,775.5	3,050.1	2,421.1	2,078.1	2,333.9	3,760.8	3,249.9	1,822.1
Ex Lg Sev	25.8	55.7	28.2	34.9	7.7	28.3	1.7	0.0	0.0	0.0
Jumbo	478.1	417.4	315.9	305.0	183.2	445.5	536.8	210.0	264.9	112.5
Colossal	353.0	401.1	289.0	286.6	187.4	391.5	331.6	64.8	263.0	143.8
Sup Col	52.0	43.1	29.4	73.2	72.2	118.4	12.3	8.0	23.6	34.0
TOTAL	8,825.5	8,294.2	9,314.7	8,635.3	6,833.5	10,439.7	8,719.7	9,648.1	8,889.7	5,465.8
GR-W/Ptd	36.4	60.3	29.9	175.5	25.0	54.7	106.0	72.3	33.1	87.0
TOTALS	8,861.9	8,354.5	9,344.6	8,810.8	6,858.5	10,494.4	8,825.7	9,720.4	8,922.8	5,552.8

Source: COC/NASS

CROP AND PRICES

The following information is the crop and prices for the California Ripe Olive Industry. These reports include:

- Producing County Report: In Tonnage
- 2014-2015 Producing County Report: In Commercial Acreage
- California Olives Received: Sevillano, Manzanillo, and Other Varieties
- Olive Grower Prices and Deliveries (In Canning and Limited Size Tons)
- California Olive Receipts By Variety Delivered to Regular Handlers
- Grower Deliveries to Handlers By Size Grade

PRODUCING COUNTY REPORT: IN TONNAGE *

2014 Harvest

County	SEVI	MANZ	OTHER	**Grand totals**
Butte	20	67	76	**163**
Colusa	-	-	-	**-**
Fresno	40	612	-	**652**
Glenn	1,007	10,583	7	**11,597**
Kern	-	-	-	**-**
Madera	1	42	-	**43**
San Joaquin	-	-	-	**-**
Shasta	7	19	19	**45**
Tehama	2,259	12,893	311	**15,463**
Tulare	381	8,737	39	**9,157**
Grand Total	**3,715**	**32,953**	**452**	**37,120**

2015 Harvest

County	SEVI	MANZ	OTHER	**Grand totals**
Butte	21	366	173	**560**
Colusa	-	-	-	**-**
Fresno	95	2,729	-	**2,824**
Glenn	1,534	16,636	15	**18,185**
Kern	-	-	-	**-**
Madera	17	292	-	**309**
San Joaquin	-	3	-	**3**
Shasta	213	109	15	**337**
Tehama	4,946	12,131	236	**17,313**
Tulare	1,038	36,982	43	**38,063**
Grand Total	**7,864**	**69,248**	**482**	**77,594**

Source: COC/NASS

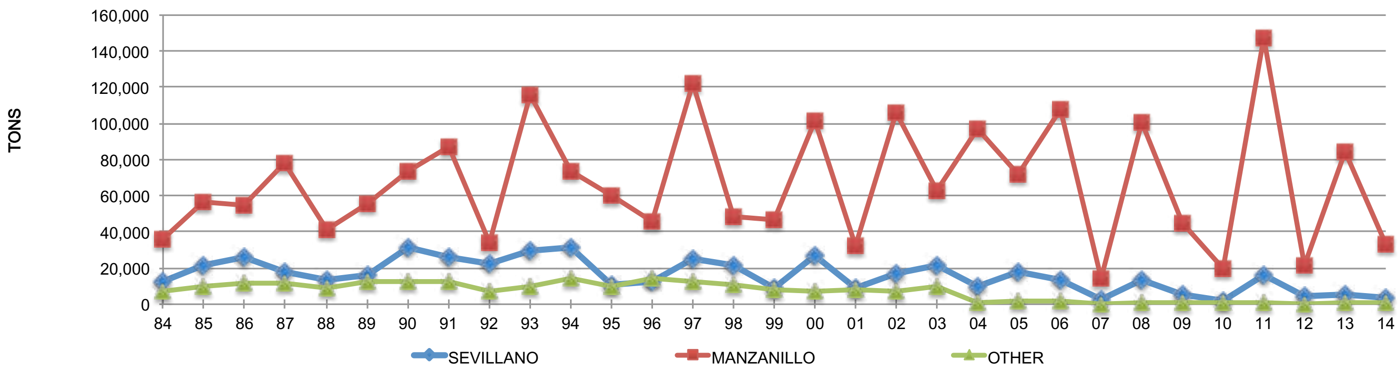
*Tonnage is reported based on actual production of the current year. Tonnage from varieties, within counties may vary from year to year.

2014-15 Producing County Report: in Commercial Acreage

County	SEVI	MANZ	OTHER	**Acreage**
Butte	17	219	147	**383**
Colusa	-	-	-	**-**
Fresno	22	466	2	**490**
Glenn	453	2,976	18	**3 ,447**
Kern	-	-	-	**-**
Madera	23	188	-	**211**
San Joaquin	85	33	59	**177**
Shasta	-	12	-	**12**
Tehama	1,323	2,644	125	**4 ,092**
Tulare	292	10,135	60	**10,487**
Grand Total	**2,215**	**16,673**	**411**	**19,299**

Source: COC

CALIFORNIA OLIVES RECEIVED: SEVILLANO, MANZANILLO, & OTHER VARIETIES



Source: COC/NASS

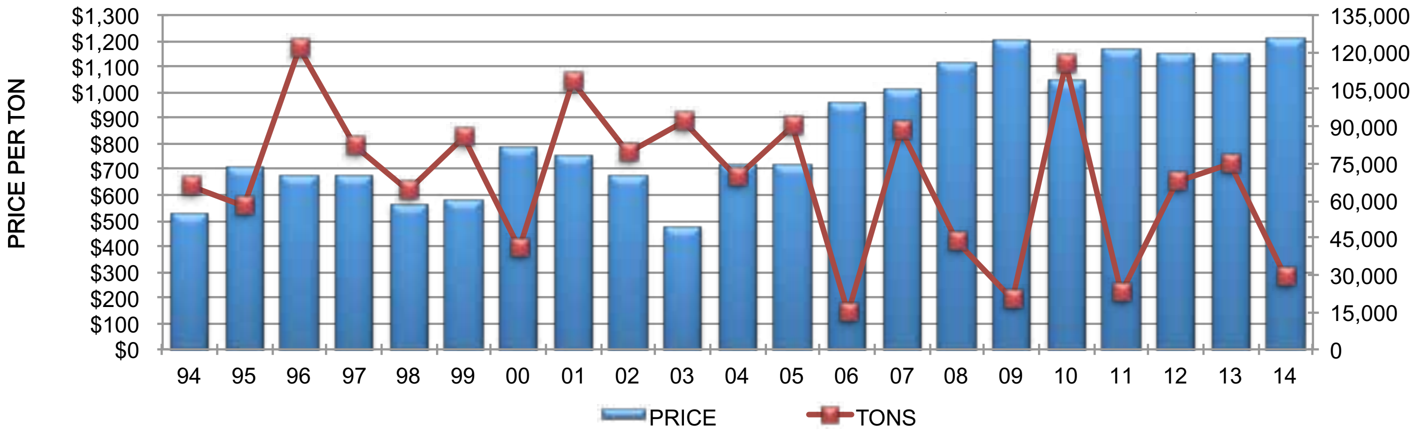
CALIFORNIA OLIVES - GROWER PRICES
1995-96 TO 2014-15

YEAR	Canning Size		Limited Size	
	Tons	Avg. Price $	Tons	Avg. Price $
1995-96	57,414	706	8,369	401
1996-97	122,012	676	28,065	262
1997-98	82,150	676	10,235	288
1998-99	64,161	564	12,830	218
1999-00	85,639	580	36,474	277
2000-01	41,260	781	5,114	331
2001-02	108,143	754	15,297	297
2002-03	79,113	672	9,893	306
2003-04	92,240	478	10,467	254
2004-05	69,737	720	16,126	276
2005-06	93,627	715	21,135	261
2006-07	14,769	961	1,501	249
2007-08	88,072	1,008	19,906	378
2008-09	43,360	1,109	5,891	381
2009-10	20,043	1,197	1,068	375
2010-11	114,930	1,040	36,754	378
2011-12	23,147	1,165	2,082	370
2012-13	68,044	1,150	6,062	334
2013-14	75,305	1,150	10,363	385
2014-15	29,078	1,207	5,648	419

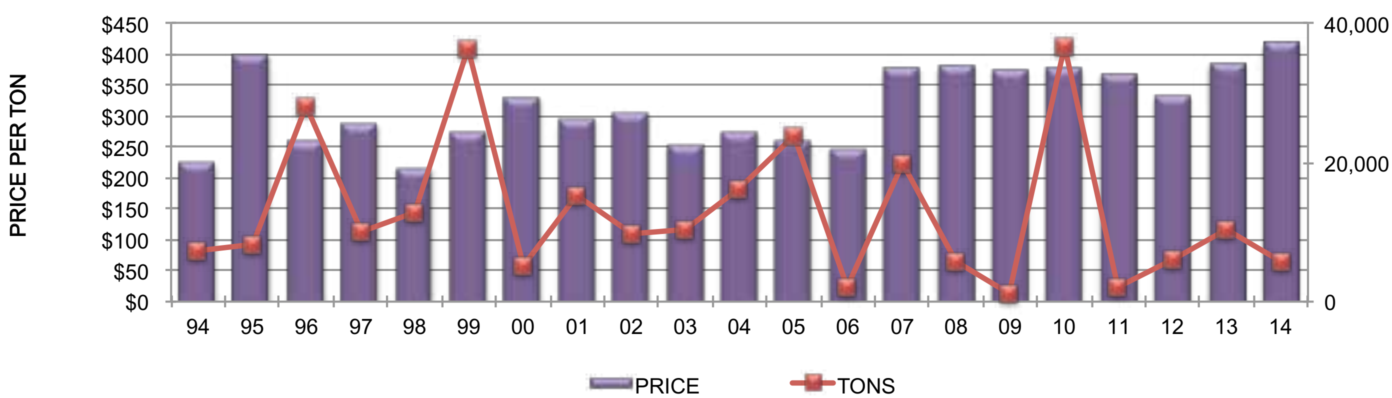
Source: Olive Growers Council (OGC)

Average Price- Independent canner price not including standard bonus, extra bonus, or hauling allowance.

OLIVE GROWER PRICES & DELIVERIES
(in CANNING SIZE TONS)



OLIVE GROWER PRICES & DELIVERIES
(in LIMITED SIZE TONS)



Source: OGC/NASS

CALIFORNIA OLIVE RECEIPTS BY VARIETY
DELIVERED TO REGULATED HANDLERS
2005-06 TO 2014-15
(in Tons)

Variety	Season	Canning	Limited	Undersize	Culls *	TOTAL
SEVILLANO	2005-06	11,832	854	384	725	13,795
	2006-07	2,136	145	133	99	2,513
	2007-08	11,052	1,308	566	517	13,443
	2008-09	4,923	211	187	127	5,448
	2009-10	1,589	140	172	24	1,925
	2010-11	12,956	2,029	868	660	16,513
	2011-12	3,957	347	187	211	4,702
	2012-13	8,737	636	325	255	9,953
	2013-14	4,804	233	157	255	5,449
	2014-15	3,223	287	136	67	3,713
MANZANILLO	2005-06	80,734	19,968	4,008	3,581	108,291
	2006-07	12,530	1,339	193	268	14,330
	2007-08	76,092	18,405	3,403	2,329	100,229
	2008-09	37,581	5,374	960	891	44,806
	2009-10	18,453	928	164	473	20,018
	2010-11	101,234	34,465	6,612	5,082	147,393
	2011-12	19,192	1,735	302	637	21,866
	2012-13	59,307	5,425	674	2,105	67,511
	2013-14	70,501	10,132	1,461	2,787	84,881
	2014-15	26,084	5,388	667	812	32,951
OTHER VARIETIES	2005-06	1,060	313	55	75	1,503
	2006-07	103	17	2	4	126
	2007-08	928	193	25	65	1,211
	2008-09	856	306	104	23	1,289
	2009-10	857	183	28	22	1,090
	2010-11	739	260	33	45	1,077
	2011-12	314	47	6	10	377
	2012-13	427	223	37	27	714
	2013-14	363	77	10	10	460
	2014-15	254	163	28	9	454
TOTAL	2005-06	93,627	21,135	4,447	4,380	123,589
	2006-07	14,769	1,501	328	370	16,968
	2007-08	88,072	19,906	3,994	2,911	114,883
	2008-09	43,360	5,891	1,250	1,042	51,543
	2009-10	20,899	1,251	364	519	23,033
	2010-11	114,930	36,754	7,514	5,787	164,985
	2011-12	23,463	2,129	495	858	26,945
	2012-13	68,471	6,284	1,036	2,387	78,178
	2013-14	75,668	10,442	1,628	3,051	90,789
	2014-15	29,561	5,838	831	890	37,120

* Includes ungraded fruit

Source: COC/NASS

GROWER DELIVERIES TO HANDLERS BY SIZE GRADE
2005-06 TO 2014-15
(in Tons)

Size Grade	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Small	19,423	1,800	18,392	6,006	1,432	34,193	2,121	8,544	10,979	4,825
Medium	23,076	2,852	19,962	7,868	2,637	28,647	3,247	13,780	17,804	8,246
Large	20,317	3,614	21,970	11,544	5,417	25,507	5,158	16,634	22,791	6,399
Ex Lg	19,939	4,483	17,812	12,999	9,821	13,376	8,852	20,676	19,193	6,833
Jumbo	4,763	705	4,146	1,324	431	6,180	1,133	3,289	1,356	1,268
Colossal	4,965	890	4,146	2,345	596	3,427	1,633	3,097	2,169	1,001
Sup Col	1,145	424	1,644	1,274	566	801	948	1,445	1,033	568
Limited	21,134	1,501	19,906	5,891	1,251	36,754	2,129	6,285	10,442	5,838
Canning & Ltd Total	114,762	16,269	107,978	49,251	22,151	148,885	25,221	73,750	85,767	34,978

Source: COC/NASS

IMPORTS

The following data is from the U.S. Customs. This data reviews the imports in grower tons from 2005-2006 through 2014-2015.

U.S. CUSTOMS IMPORT DATA
IN GROWER TONS

CROP YEAR	WHOLE/PITTED FS & RETAIL	FS SLICED	FS WEDGED & CHOPPED	TOTAL CANNED	BULK (Aug-July)	TOTAL IMPORTS
2005-06	5,938	55,673	3,726	65,337	7,911	73,248
2006-07	7,045	58,821	3,396	69,261	19,368	88,629
2007-08	8,053	61,601	4,163	73,817	9,265	83,082
2008-09	7,625	50,259	2,093	59,977	15,742	75,719
2009-10	9,775	56,696	4,341	70,812	27,494	98,306
2010-11	8,928	57,458	3,945	70,331	29,212	99,543
2011-12	8,439	60,209	4,475	73,123	4,641	99,543
2012-13	8,898	58,345	3,757	71,000	15,629	86,629
2013-14	10,277	63,923	3,961	78,161	12,878	91,039
2014-15	10,262	58,157	2,608	71,027	21,033	92,060

Source: US Customs

Reference Sources:

California Olive Committee (COC)

U. S. Department of Agriculture (USDA)

National Agricultural Statistics Service (NASS)

Olive Grower Council (OGC)

U.S. Customs

www.calolive.org

2565 Alluvial Ave., Suite 182 • Clovis, CA 93611 • P: 559.456.9096 • F: 559.456.9099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