

A. Cover Page

1. Project Title: **2015 Demonstration of a combined new leaf sampling technique for nitrogen analysis and nitrogen applications approach in almonds**

2. Project Leaders:

- Dr. Gabriele Ludwig, Senior Manager Global, Technical and Regulatory Affairs, Almond Board of California, 1150 Ninth Street, Suite 1500, Modesto, CA 95354; (209) 343-3234; gludwig@almondboard.com
- Dr. Patrick Brown, University of California Davis, Dept. of Plant Sciences, 3019 Wickson Hall, Davis CA 95616 (530) 304 1390; phbrown@ucdavis.edu
- Blake Sanden, University of California Cooperative Extension Kern County, 1031 South Mount Vernon Avenue, Bakersfield, CA 93307; (661) 868-6218; blsanden@ucdavis.edu

3. Cooperators:

- Roger Duncan, Pomology & Viticulture Farm Advisor, University of California Cooperative Extension, Suite A. Corner of Service and Crows Landing, 3800 Cornucopia Way, Suite A, Modesto, CA 95358; (209) 525-6800; raduncan@ucanr.edu
- Dr. Gurreet Pal S Brar, Farm Advisor, Cooperative Extension Fresno County, 550 E. Shaw Avenue, Suite 210-B, Fresno, CA 93710; (559) 241-7526; gurbrar@ucanr.edu
- Dr. David Smart, Viticulture & Enology, Viticulture and Enology, 2005 Wickson Hall, Davis, CA 95616; (530) 754-7143; drsmart@ucdavis.edu
- Allan Fulton, Irrigation and Water Resources Advisor, Cooperative Extension Tehama County, 1754 Walnut Street, Red Bluff, CA 96080; (530) 527-3101, aefulton@ucanr.edu
- Dr. Jeff Dlott, President SureHarvest, 2901 Park Ave Suite A2, Soquel CA 95073 (831) 477-7797; jdlott@sureharvest.com
- Dr. Clifford Ohmart, VP Professional Services SureHarvest, 1528 Olympic Dr, Davis CA 95616 (530) 601-0740; cohmart@sureharvest.com

4. CDFA Funding Request Amount/Other Funding

\$261,717– CDFA FREP Request

\$9,000 Almond Board of California In-Kind Staffing

B. Executive Summary

The purpose of this project is to demonstrate the mid-April early leaf sampling and nitrogen (N) application protocol in almonds, which are produced throughout the Central Valley, to refine and drive widespread adoption of this new decision support tool. The Project Objectives, Approach and Evaluation reflect considerable deliberation by the Project Leaders and Cooperators on the most effective and efficient way to meet the project purpose.

1. Objectives, Approach, and Evaluation

Objectives: The objectives for this demonstration project are:

1. Demonstrate the effectiveness and nitrogen use efficiency (NUE) of the new mid-April early leaf sampling and nitrogen (N) application methodology in almonds (Silva et al. 2013).
2. Create a platform promoting widespread adoption of best nitrogen management practices by almond growers throughout the Central Valley of California.

Approach: Objective 1 will be accomplished through demonstration sites that compare standard nitrogen management to the newly recommended approach utilizing mid-April early leaf sampling and nitrogen (N) application methodology and evaluate nitrogen use efficiency (NUE). Demonstration sites will be located in the following counties:

- Tehama County
- Stanislaus County
- Madera County
- Merced County
- Fresno County
- Kern County

All project demonstration sites will be established in grower-cooperator orchards – either new sites secured specifically for this project or sites currently used for University of California Cooperative Extension (UCCE) research. All demonstration orchards will include standard and new nitrogen management treatments. Treatments will be replicated in orchards used for UCCE research. University of California Farm Advisors and/or Specialists will be responsible for field work and data capture at each project site. Data from all the project sites will be aggregated and analyzed by Dr. Patrick Brown's lab at UC Davis.

The “new” nitrogen management treatment will be based on the protocol developed by the UC Davis and the Almond Board of California (ABC) for early-season sampling and in-season nitrogen budgeting for almond orchards (Silva, S. S. et. al. 2013. <http://fruitsandnuts.ucdavis.edu/files/165544.pdf>). This is a nitrogen budgeting approach where the total amount of nitrogen fertilizer to apply for the year is determined by estimating crop yield for that year as well as on nitrogen inputs and credits including amount applied in fertilizer, amount applied in irrigation water, amount coming from organic matter addition and/or cover crops, nitrogen availability in the soil, and amount removed by the harvested crop. An initial estimate of total annual nitrogen fertilizer to apply is made based on a crop estimation done in January and the calculation of nitrogen inputs from all sources. A leaf tissue sample is taken in April to assess nitrogen nutrient status in the trees and another crop estimate is done based on visible crop load after fruit set. A revision of the total amount of nitrogen fertilizer to apply is

then made based on these two measures. Timing of fertilizer application will be based on tree demand as follows: 20% of estimated annual nitrogen fertilizer requirement is applied in early-spring; 30% applied during fruit growth state; 30% at kernel fill; and 20% applied at fruit maturity or early postharvest.

ABC has supported the development and release (February 2015) of an online nitrogen budgeting calculator decision support tool based directly on the UC early-season sampling and in-season nitrogen budgeting for almond orchards protocol. This online tool will be used to generate and update throughout the season orchard-specific nitrogen budgets. This online platform also generates Irrigated Lands Regulatory Program (ILRP) Nitrogen Management Plans (NMPs).

Demonstration sites will be assessed by measuring yield (lbs) per acre and size/quality of almond kernels. Other important data that could have an effect on yield will be recorded, such as soil type, pH, tree spacing, almond variety, tree rootstock, irrigation rates and timing, orchard floor management and pest management actions.

Objective 2 will be accomplished through biannual reporting to FREP, publishing interim and final project results in trade journals and the Almond Board of California's e-newsletter, grower field days at the project sites presenting interim and final project results, and integrating nitrogen management planning into workshops convened by the Almond Board of California's California Sustainable Almond Program (CASP) including training on the use of ABCs nitrogen budgeting calculator decision support tool that has been integrated into the CASP online self-assessment workbook technology platform.

Evaluation: Project success will be evaluated by:

- Analyzing and reporting on nitrogen use efficiency (NUE), crop yield, and quality in each of the demonstration sites
- Submission of bi-annual and final reports to FREP
- Number of growers attending field days and workshops focused on the project
- Number of Pest Control Advisors (PCAs), Certified Crop Advisors (CCAs), and other agricultural professionals attending field days and workshops focused on the project
- Number of almond growers, PCAs, CCAs and other agricultural professionals using ABCs nitrogen budgeting calculator decision support tool.

2. Audience

The audiences for the project are the almond growers of California as well as other important stakeholders such as Pest Control Advisors, Certified Crop Consultants, Regional Water Quality Coalitions, and the State and Regional Water Quality Control Boards.

C. Objectives

The purpose of this project is to demonstrate the mid-April early leaf sampling and nitrogen (N) application protocol in almonds, which are produced throughout the Central Valley, to refine and drive widespread adoption of this new decision support tool. The Project Objectives, Approach and Evaluation reflect considerable deliberation by the Project Leaders and Cooperators on the most effective and efficient way to meet the project purpose.

The objectives for this demonstration project are:

- Demonstrate the effectiveness and nitrogen use efficiency (NUE) of the new mid-April early leaf sampling and nitrogen (N) application methodology in almonds (Silva et al. 2013).
- Create a platform promoting widespread adoption of best nitrogen management practices by almond growers throughout the Central Valley.

Objective 1: Demonstrate the effectiveness and nitrogen use efficiency (NUE) of the new mid-April early leaf sampling and nitrogen (N) application methodology in almonds:

- Establishing a series of demonstration almond orchards in each of the following major almond growing regions including: Tehama, Stanislaus, Madera, Merced, Fresno, and Kern Counties.
- Utilize the new mid-April early leaf sampling and nitrogen (N) application protocol to develop seasonal nitrogen management plans. Nitrogen management will be based on the right rate of nitrogen addition determined by accounting for sources of nitrogen input and credits (e.g., irrigation water, nitrogen fertilizer, cover crops) and estimated yield for the season and potential rate adjustment based on mid-spring tissue sampling, applied with the right timing based on tree phenology and nitrogen demand, and in the right location to maximize orchard productivity and minimize leaching of nitrogen out of the tree root zone.
- Measuring the NEU, yield (lbs) per acre, and size/quality of almond kernels.
- Capturing, summarizing and reporting on all important variables from each demonstration site, such as nitrogen availability in the soil, leaf tissue sample analyses, crop estimates, rate and timing of nitrogen inputs from all sources, harvested crop yield, and amount of nitrogen removed in the crop.
- Capturing, summarizing and reporting on other agronomic variables that may also be important such as soil type and pH, tree spacing, rootstock, almond varieties, irrigation rates and timing based on evapotranspiration, pest management actions, and orchard floor management practices.
- Aggregate and analyze the data from all the demonstration sites and refine the early-season sampling and in-season nitrogen budgeting protocol if needed.

Objective 2: Creating a platform promoting widespread adoption of best nutrient management practices by almond growers throughout the region will be addressed by:

- Creating two project summary reports per year that include data summaries, to-date project progress, and comprehensive analyses of the demonstration sites.
- Ensuring important project results are in a form that is easily circulated and interpreted by the grower community and other industry stakeholders.
- Under the direction of FREP and in cooperation with UC Davis and UC Cooperative Extension (UCCE), facilitate timely field days at project sites for growers and other

important almond industry stakeholders such as PCAs, CCAs, regional fertilizer/chemical/amendment industry representatives, and staff from important agencies such as area Water Quality Coalitions, NRCS and Regional Water Quality Control Board.

- Presenting interim and final project results at the Almond Board of California's annual conference and at educational meetings sponsored by area Water Quality Coalitions as appropriate.
- Publishing interim and final project results in the Almond Board of California's electronic newsletter.
- Encouraging important trade publications like the Western Farm press to publish interim and final project results.
- Publishing final results in California Agriculture.
- Encouraging the use of the ABCs nitrogen budgeting calculator decision support tool as a guide determining the rate and timing of nitrogen fertilizer applications in orchards. This tool is housed in ABC CASP's online software platform. (<https://www.sustainablealmondgrowing.org/>) and is based on the protocols developed by the UC Davis and the Almond Board of California for early-season sampling and in-season nitrogen budgeting (Silva, S. S. et. al. 2013. <http://fruitsandnuts.ucdavis.edu/files/165544.pdf>). See **Figure 1** for a screenshot of the ABC nitrogen budgeting calculator.
- Train almond growers and Certified Crop Advisors (CCA's) in use of the nitrogen budgeting calculator decision support tool in California Sustainable Almond Program's (CASP) grower self-assessment workshops. Combine this training with demonstrating how the nitrogen budgeting calculator can generate Nitrogen Management Plans (NMP) required by the Central Valley Regional Water Quality Control Board to fulfill requirements of the Irrigated Land Regulatory Program aimed at reducing nitrate contamination of groundwater.

Figure 1. Screenshot of ABC’s nitrogen budgeting calculator landing page

California Almonds Sustainability Program

Home **Events** **Assessments** **N Calculator** **Reports** **Web Resources**

Tuesday, March 03, 2015 Welcome back **Demo a_user2!** (v1.6.3) [Provide Feedback](#) | [Need Help?](#) | [Logout](#)

Nitrogen Budget

[Provide Feedback](#) | [N Calculator Help](#)

Nitrogen Budget Work Flow

PRE-SEASON THROUGH EARLY SPRING

- Enter Kernel Yield Estimate
- Enter N Credits
- Enter Fertilizer App(s)
- Show N Management Plan Report

FRUIT GROWTH

- Revise Kernel Yield Estimate
- Revise N Credits
- Enter Early Leaf Sampling Results
- Enter Fertilizer App(s)

KERNEL FILL

- Revise Kernel Yield Estimate
- Review N Credits
- Enter Fertilizer App(s)

FRUIT MATURITY OR EARLY POST HARVEST

- Enter Actual Kernel Yield
- Enter Actual Irrigation N Credit
- Enter Fertilizer App(s)
- Show N Management Plan Report

Illustrations courtesy of D. Geisseler; CDFA Fertilizer and Research Education Program (FREP) for Almond Nitrogen Fertilization Guidelines

Year: 2014 **Orchard: Gratton Ranch** **Organization: ABC Orchards** **Business: ABC Orchards**

Timing

lbs N/Acre

Stage	Recommended (lbs N/Acre)	Applied (lbs N/Acre)
Early Spring	~45	0
Fruit Growth	~70	~15
Kernel Fill	~70	0
Fruit Maturity or Early Post-Harvest	~45	0

Cumulative

Total lbs N/Acre

Stage	Recommended (Total lbs N/Acre)	Applied (Total lbs N/Acre)
Early Spring	~45	0
Fruit Growth	~115	~15
Kernel Fill	~185	~15
Fruit Maturity or Early Post-Harvest	~230	~15

Kernel Yield
Irrigation N-Credit
Manure N-Credit
Compost N-Credit
Cover Crop N-Credit
Other N-Credits
Fertilizer Application
Leaf Factor

Save Budget
Close Budget
Delete Budget
Next > Tab

Enter pounds of kernels per acre for each growth stage. Click Refresh Calculations to update N budget values. Scroll down.

Reports

Show PDF Summary

Download CSV

Show Nitrogen Management Plan Report

D. Work Plans and Methods

1. Work Plan

Task 1 Establish Project Team: Establish project team made up of project leaders and cooperators. Task product – project team (completed Aug 2015)

Task 2 Project orientation meeting: Project team meets to discuss and refine as needed project goals, objectives, methods, data collection, data analyses and site selection. Task product – meeting notes and project schedule of tasks, timeline, and deliverables (completed Oct 2015)

Task 3 Initial project outreach: Announce project at Almond Board of California's annual meeting. Task product – presentation to large number of almond growers (completed Dec 2015)

Task 4 Site selection: Project sites in each region will be located in **grower-cooperator orchards, including some currently used for UCCE research.** Task product – project sites established (completed Dec 2015).

Subtask 1a: Establish project demonstration sites (completed Dec 2015)

Subtask 1b: Record data for project sites such as soil type, GPS location, pH, etc. (completed Dec 2015)

Task 5 January yield estimate: Using ABCs nitrogen budgeting calculator decision support tool generate nitrogen management plans based on historical yield records for the orchard make pre-season yield estimate for 2016. Task product – pre-season yield estimate and nitrogen management plans (January 2016; repeated Jan 2017 & 2018)

Task 6 Soil samples: 5 soil samples will be taken per demonstration field for depths 0-1.5, 1.5-3, 4-5, 6-7 and 8-9 feet and analyzed at the start of the season. Task product – measure of NO₃-N concentration in and below the root zone (completed March 2016)

Task 7 Early-spring nitrogen rate and timing: Based on January yield estimates and non-fertilizer nitrogen inputs, determine annual nitrogen demand and apply 20% of annual nitrogen fertilizer requirement. Task product – early-spring fertilizer application done (completed April 2016; repeated April 2017 & April 2018)

Subtask 7a: Nitrogen amounts from other sources: Determine amount of nitrogen (as NO₃) per acre coming from sources other than nitrogen fertilizer, such as soil, water, amendments and cover crops. Task product – annual nitrogen input from non-fertilizer sources (completed February 2016)

Subtask 7b: Apply 20% of estimated annual nitrogen fertilizer requirement (completed April 2016; repeated April 2017 and April 2018)

Task 8 Bi-annual report to FREP: Submit to FREP biannual report on to-date progress of project. Task product – Report to FREP (completed March 2016; repeated March 2017 & March 2018)

Task 9 Leaf tissue sampling: Collect composite leaf tissues samples from all demonstration sites, send to lab and obtain results. Task outcome – leaf tissue sample results (completed April 2018; repeated April 2017 & April 2018)

Task 10 April yield estimation: Estimate crop yield based on fruit set. Task product – early season yield estimation (completed April 2016; repeated April 2017 & April 2018)

Task 11 Fruit growth fertilizer application: Based on April yield estimate and April leaf tissue analyses estimate annual nitrogen demand, revise annual nitrogen demand determined in Task 7 if necessary, and apply 30% of annual nitrogen fertilizer requirement. Task production – Fruit growth fertilizer application (completed May 2016; repeated May 2017 & May 2018)

Task 12 Kernel fill fertilizer application: Apply 30% of annual nitrogen fertilizer demand determined in Task 11. Task product – Kernel fill fertilizer application (completed July 2016; repeated July 2017 & July 2018)

Task 13 Yield determination: Determine yield for each demonstration site either through the use of gondola load cells and crackout or hand crackout in randomized complete block design replicates. For whole field demonstration sites the commercial harvest total from huller will be used. Task product – yield data (completed September 2016; repeated Sept 2017; 2018?)

Task 14 Fruit maturity/early post-harvest fertilizer application: Apply 20% of annual nitrogen fertilizer demand determined in Task 11. Task product – fruit maturity/early post-harvest fertilizer application (completed October 2016; repeated Oct 2017; 2018?).

Task 15 Biannual report to FREP: Write and deliver biannual report to FREP presenting to-date progress and results. Task product – biannual report to FREP (completed Oct 2016; repeated Oct 2017 & Oct 2018)

Task 16 Data analyses: Compile and analyze data for each demonstration site. Dr. Patrick Brown's lab will aggregated and analyze the data from all the demonstration sites. Task product – data analyses (completed December 2016; repeated Dec 2017)

Task 17 Project outreach: Working with FREP and UCCE facilitate grower field days at project demonstration sites in each region. Task product – grower field days (completed June 2016; repeated June 2017 & June 2018)

Task 18 Ongoing project site maintenance: Project cooperators carry out all the necessary practices to maintain the trees in the project demonstration sites, such as irrigation, pest management, and orchard floor management. Task product – site maintenance (ongoing task)

Task 19 Final report to FREP: Compile and analyze project data and interpret results. Incorporate results into a final project report for FREP. Task product – final project report to FREP (completed Nov 2018)

2. Methods

Project Site Selections: Project demonstration sites will be established in grower-cooperator orchards, including some currently used for UCCE research.

Project demonstration sites will be established in each of the following counties:

- Tehama County
- Stanislaus County
- Madera County
- Merced County
- Fresno County
- Kern County

All demonstration orchards will include standard and new nitrogen management treatments. The “new” nitrogen management treatment will be based on ‘Guidelines for early leaf sampling and in-season nitrogen budgeting’ (Silva et al. 2013) as implemented in the ABC online nitrogen budgeting calculator (<https://www.sustainablealmondgrowing.org/>). For sites currently used for UCCE research, treatments will be replicated using a randomized complete block design and data will be analyzed using analysis of variance (ANOVA).

A key goal is to demonstrate the effectiveness and increase grower adoption of using April leaf samples for estimating July leaf nitrogen status in combination with the existing nitrogen budgeting tool to increase the efficiency of nitrogen use under variable conditions, and to subsequently refine the method/tool if needed. Comparing the standard versus new nitrogen management treatments in different regions and conditions and conveying methods and results via demonstration will achieve this goal.

Sampling Methods:

- Soil samples will be taken from each demonstration site as follows:
 - 5 samples per demonstration site to depths 0-1.5, 1.5-3, 4-5, 6-7 and 8-9 feet will be taken at the start of the project (winter 2015-16) to establish salinity and NO₃ baselines and then at the end of each succeeding season to assess actual contribution to yield and/or leaching. 0-1.5 foot samples will be analyzed for full fertility/salinity: pH, SP, EC, Ca, Mg, Na, Cl, NO₃-N (saturated past extract), Olsen-P, AA-K, DTPA-Zn, Cu, Fe, Mn). The other depths will be analyzed for SP, EC, Cl and NO₃-N (saturated paste extract)
- Leaf tissue samples
 - Composite leaf tissue samples will be taken for all demonstration sites in mid-April and mid-July and analyzed for nitrogen, potassium, phosphorous, iron, zinc, copper and manganese.
- Yield Estimates, N Applications:
 - Yield estimate made in January based on historic yield trends for the orchard
 - Annual nitrogen inputs for the orchard will be estimated for nitrogen in irrigation water (determined through a well water sample) and any organic matter added to the orchard in compost
 - Calculate the preliminary fertilization rates based on the above information using the ABC online nitrogen budgeting calculator decision support tool

- Apply 20% of total annual nitrogen demand in March – April
 - Collect and analyze leaf tissues samples in April using the following protocols:
 - Sample leaves from 5–8 non-fruiting, well-exposed spurs per tree at approximately 43+/-6 from days after full bloom when the majority of leaves on non-fruiting spurs have reached full size. Collect leaves from 10-28 trees collecting a minimum of 50-100 leaves depending on plot acreage.
 - Revise yield estimate in April – May based on apparent fruit load and grower/researcher experience. Adjust nitrogen budget accordingly – also considering predicted July nitrogen tissue concentrations based on April samples.
 - Apply 30% of total annual nitrogen demand during full leaf expansion to shell hardening stage.
 - Apply 30% of total annual nitrogen demand during shell hardening to hull split
 - Apply 20% of total annual nitrogen demand during hullsplit to early post-harvest.
- Data from each demonstration site will be aggregated and analyzed; the results will be used to refine the early-season sampling and in-season nitrogen budgeting protocol if needed.

Data collection and analyses: The following data will be collected from each demonstration site:

- Location (GPS), soil type, pH, age of trees (planting date), variety, tree spacing, irrigation type, root stock
- Available soil nitrogen a start of project (before first early spring nitrogen fertilizer application)
- Amount and timing and type of nitrogen fertilizer applications
- Annual amount of nitrogen from irrigation water and any organic matter additions or cover crops
- Yield estimate in January and then April – May
- April leaf tissue sample results
- Estimated amounts of nitrogen fertilizer applications for the four applications during the season
- Per acre yield of almonds for whole field demonstration sites based on the commercial harvest total from huller. For randomized complete block design sites crop estimates from hand crackout.
- Nut quality – size, nitrogen protein content, and reject levels
- Evapotranspiration (ET_o times crop coefficient) from CIMIS station data
- Amount and timing of irrigation
- Where possible soil moisture depletion, Pest management activities, including pesticide use, including date of action

Dr. Patrick Brown's lab will aggregated and analyze the data from all the demonstration sites and if necessary refine the early-season sampling and in-season nitrogen budgeting protocol.

3. Experimental Sites (two types)

New Grower Orchard Demonstration Site (non-replicated)

Standard Nitrogen Management	New Nitrogen Management
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Existing Grower Orchard Demonstration Site used for UCCE Research (randomized complete block design – conceptual illustration, not actual plot map as randomization and potential additional treatments to differ by site)

Standard Nitrogen Management	New Nitrogen Management	Standard Nitrogen Management	New Nitrogen Management
New Nitrogen Management	Standard Nitrogen Management	New Nitrogen Management	Standard Nitrogen Management

E. Project Management, Evaluation, and Outreach

1. Management

Project Leaders: Dr. Gabriele Ludwig will be the overall project principal investigator, making sure communication is flowing among project cooperators and ensuring the tasks are being carried out and completed on time. ABC will oversee the project budget ensuring proper budget management. Blake Sanden will be the nitrogen demonstration site liaison/coordinator with the UCCE Farm Advisors carrying out the demonstrations at each regional project site. He will make sure that the fieldwork related tasks are being carried out on time and completed. Dr. Patrick Brown’s lab will aggregated and analyze the data from all the demonstration sites, modifying the early-season sampling and in-season nitrogen budgeting protocol, if necessary. Dr. Brown will serve as a resource person for the UCCE Farm Advisors and participate in outreach events on the early-season leaf sampling and in-season nitrogen management protocols.

Project Cooperators:

UCCE Farm Advisors Brar, Duncan, and Fulton will be responsible for the demonstration sites in their respective regions, including data collection, taking leaf tissue samples, nitrogen fertilizer rate determinations and application, soil sampling, yield measurements, and project site maintenance such as irrigation, and pest management. They will also oversee orchard floor management for their experimental sites, and if the demonstration site is on a grower’s farm,

ensure that the required site maintenance is being done in a timely manner. Dr. David Smart will be responsible for providing a project sites Madera County. Drs. Dlott and Ohmart will be responsible for education and outreach for the nitrogen budgeting calculator (software designed and engineered by SureHarvest) along with FREP staff, UCCE, and the Almond Board of California. They will also be responsible for report writing.

2. Outreach

FREP is responsible for all demonstration project field days and other outreach activities. Project Leaders and Cooperators will be available to participate in all outreach activities organized by FREP as well as being available for tours by any interested parties of any of the project sites to discuss interim results, lessons learned, and final results at the end of the project. Project Leaders and Cooperators will also work with FREP and UCCE to enhance the project's education and outreach by facilitating participation in events like the Almond Board of California's annual conference and promoting the project in CASP grower workshops.

F. Budget Narrative

The Almond Board of California (ABC) is submitting the proposal on behalf of the almond industry. ABC will be subcontracting the University of California (UC) because of the unique and highly specialized grower, PCA, CCA and other agricultural professional education, outreach and extension expertise and experience required to implement high-quality and county-specific demonstration of a combined new leaf sampling technique for nitrogen analysis and nitrogen applications approach in six major almond production areas. The early-season sampling and in-season nitrogen budgeting for almond orchards protocol was developed by Co-Project Leader Dr. Patrick Brown and his lab at UC Davis Lab in collaboration with Co-Project Leader Blake Sanden (see publication by *Sebastian Saa Silva, Saiful Muhammad, Blake Sanden, Emilio Laca, and Patrick Brown* at <http://fruitsandnuts.ucdavis.edu/files/165544.pdf>). ABC is subcontracting SureHarvest to demonstrate and train growers, PCAs, CCAs and other agricultural professionals on how to use the ABC Nitrogen Budgeting Calculator that SureHarvest designed, engineered and provides ongoing technical support on behalf of the Almond Board.

a. Personnel Expenses.

Dr. Gabriele Ludwig will provide 3% FTE (\$5,000) in-kind funds as the project Principle Investigator. ABC will also provide 5% FTE (\$4,000) in staff time for financial grant management.

b. Operating Expenses.

- **Supplies:**
 - \$3,000 per year in meeting supplies including room rentals and refreshments for the Almond Board of California to supplement FREP outreach events.

- **Professional/Consultant Services:**
 - *The Almond Board of California (ABC) will subcontract the University of California (UC) for demonstrating a combined new leaf sampling technique for nitrogen analysis and a nitrogen applications approach in almonds. UC Farm Advisors will establish one or more demonstration sites in each of Glenn, Yolo, Stanislaus, Madera, Fresno and Kern Counties. Dr. Patrick Brown's lab at UC Davis will aggregate and analyze the data collected from all the demonstration sites. SureHarvest will be subcontracted to participate in project education and outreach events where they will demonstrate and train growers, PCAs, CCAs and other agricultural professionals how to use the ABC online Nitrogen Budgeting Calculator that was designed and engineered by SureHarvest. The overall budget for UC contracted services including 10% overhead and SureHarvest services is as follows:*

	Per County per Year			
Demonstration Sites	YR 1 (7/15/15 - 7/14/16)	YR 2 (7/15/16 - 7/14/17)	YR 3 (7/15/17 - 7/14/18)	3-Year Per County Total
Flow meters	\$ 600			\$ 600
Irrigation Water Analysis	\$ 55	\$ 55	\$ 55	\$ 165
Leaf Tissue Analysis (April)	\$ 640	\$ 640	\$ 640	\$ 1,920
Leaf Tissue Analysis (July)	\$ 368	\$ 368	\$ 368	\$ 1,104
Soil Sampling (Full Fertility)	\$ 800	\$ 400	\$ 400	\$ 1,600
Soil Sampling (SP, EC, NO3-N, Cl)	\$ 1,728	\$ 864	\$ 864	\$ 3,456
CERES Aerial Imagery	\$ 1,000	\$ 1,000	\$ 1,000	\$ 3,000
Travel	\$ 2,000	\$ 2,000	\$ 2,000	\$ 6,000
Staffing	\$ 3,307	\$ 5,171	\$ 5,171	\$ 13,649
Demonstration Site SubTotal	\$ 10,498	\$ 10,498	\$ 10,498	\$ 31,494
6 Counties	\$ 52,490	\$ 52,490	\$ 52,490	\$ 157,470
	YR 1 (7/15/15 - 7/14/16)	YR 2 (7/15/16 - 7/14/17)	YR 3 (7/15/17 - 7/14/18)	3-Year Total
Dr. Patrick Brown's Lab	\$ 15,000	\$ 15,000	\$ 15,000	\$ 45,000
UC SubTotal	\$ 67,490	\$ 67,490	\$ 67,490	\$ 202,470
UC Overhead @ 10%	\$ 6,749	\$ 6,749	\$ 6,749	\$ 20,247
UC Total Subcontract	\$ 74,239	\$ 74,239	\$ 74,239	\$ 222,717
SureHarvest Subcontract	\$ 10,000	\$ 10,000	\$ 10,000	\$ 30,000
Subcontract Project Total	\$ 84,239	\$ 84,239	\$ 84,239	\$ 252,717

- *The Almond Board of California will use a USDA-approved lump sum contracting agreement and payment method that has been in place with the University of California for more than four years. This is a standard and accepted contracting, payment, and accounting system that has and will undergo USDA audits.*
- *SureHarvest's will be paid monthly based via invoices for services rendered on the project.*

The three-year overall project total is \$261,717.

	YR 1 (7/15/15 - 7/14/16)	YR 2 (7/15/16 - 7/14/17)	YR 3 (7/15/17 - 7/14/18)	3-Year Total
Supplies	\$ 3,000	\$ 3,000	\$ 3,000	\$ 9,000
Professional Services	Per County per Year			
Demonstation Sites	YR 1 (7/15/15 - 7/14/16)	YR 2 (7/15/16 - 7/14/17)	YR 3 (7/15/17 - 7/14/18)	3-Year Per County Total
Flow meters	\$ 600			\$ 600
Irrigation Water Analysis	\$ 55	\$ 55	\$ 55	\$ 165
Leaf Tissue Analysis (April)	\$ 640	\$ 640	\$ 640	\$ 1,920
Leaf Tissue Analysis (July)	\$ 368	\$ 368	\$ 368	\$ 1,104
Soil Sampling (Full Fertility)	\$ 800	\$ 400	\$ 400	\$ 1,600
Soil Sampling (SP, EC, NO3-N, Cl)	\$ 1,728	\$ 864	\$ 864	\$ 3,456
CERES Aerial Imagery	\$ 1,000	\$ 1,000	\$ 1,000	\$ 3,000
Travel	\$ 2,000	\$ 2,000	\$ 2,000	\$ 6,000
Staffing	\$ 3,307	\$ 5,171	\$ 5,171	\$ 13,649
Demonstration Site SubTotal	\$ 10,498	\$ 10,498	\$ 10,498	\$ 31,494
6 Counties	\$ 52,490	\$ 52,490	\$ 52,490	\$ 157,470
	YR 1 (7/15/15 - 7/14/16)	YR 2 (7/15/16 - 7/14/17)	YR 3 (7/15/17 - 7/14/18)	3-Year Total
Dr. Patrick Brown's Lab	\$ 15,000	\$ 15,000	\$ 15,000	\$ 45,000
UC SubTotal	\$ 67,490	\$ 67,490	\$ 67,490	\$ 202,470
UC Overhead @ 10%	\$ 6,749	\$ 6,749	\$ 6,749	\$ 20,247
UC Total Subcontract	\$ 74,239	\$ 74,239	\$ 74,239	\$ 222,717
SureHarvest Subcontract	\$ 10,000	\$ 10,000	\$ 10,000	\$ 30,000
Subcontract Project Total	\$ 84,239	\$ 84,239	\$ 84,239	\$ 252,717
Overall Project Total	\$ 87,239	\$ 87,239	\$ 87,239	\$ 261,717

G. Budget Worksheet in FREP template (attached)

H. Appendices

1. Project Leaders – CV’s for Project Leaders are attached.
2. Project Coordinators – letters of support from each Project Cooperator are attached.