Improving water quality by reducing pesticide loadings in the Sacramento and San Joaquin River system through the wide scale use of environmentally sound farming practices in walnut production

Project Information

1. **Proposal Title:**

   Improving water quality by reducing pesticide loadings in the Sacramento and San Joaquin River system through the wide scale use of environmentally sound farming practices in walnut production

2. **Proposal applicants:**

   Lawrence Elworth, Center for Agricultural Partnerships

3. **Corresponding Contact Person:**

   Lawrence Elworth
   Center for Agricultural Partnerships, Inc.
   1 W. Pack Square, Ste. 401 Asheville, NC 28801
   828 285-9340
   lelworth@agcenter.org

4. **Project Keywords:**

   Ag/Urban Runoff
   Pesticides
   Water Pollution, Non-point Source

5. **Type of project:**

   Implementation_Full

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

7. **Topic Area**:

   Ecosystem Water and Sediment Quality

8. **Type of applicant:**

   Private non-profit

9. **Location - GIS coordinates:**

Latitude:

Longitude:

Datum:

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

San Joaquin and Sacramento water systems

10. **Location - Ecozone:**

    Code 15: Landscape

11. **Location - County:**

    Colusa, Contra Costa, Fresno, Kern, Kings, Madera, Merced, Sacramento, San Joaquin, Stanislaus, Sutter, Tulare, Yuba

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    3, 11, 18-20

15. **Location:**

    California State Senate District Number: 4-7,12,14,16,17

    California Assembly District Number: 5,8,10,17,25,26,29-32

16. **How many years of funding are you requesting?**

    3

17. **Requested Funds:**
    a) Are your overhead rates different depending on whether funds are state or federal?

       No

       If no, list single overhead rate and total requested funds:

Single Overhead Rate: 10%

Total Requested Funds: 502,040

b) Do you have cost share partners already identified?

No

c) Do you have potential cost share partners?

No

d) Are you specifically seeking non-federal cost share funds through this solicitation?

No

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

No

Have you previously received funding from CALFED for other projects not listed above?

No

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?**

No

Have you previously received funding from CVPIA for other projects not listed above?

No

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**

Yes

If yes, identify project number(s), title(s) and funding source.

x979015-01	**Implementing Pest Management System in CA Walnuts**	**US EPA Region IX**

Please list suggested reviewers for your proposal. (optional)

Ted Alway 509-548-4384 altiz@rightathome.com

Steve Balling	**Del Monte Research Center**	**925-944-7377**	**steve.balling@delmonte.com**
Bill Barnett	**541-387-5535**		

21. **Comments:**

Environmental Compliance Checklist

Improving water quality by reducing pesticide loadings in the Sacramento and San Joaquin River system through the wide scale use of environmentally sound farming practices in walnut production

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      No
   b) Will this project require compliance with NEPA?

      No
   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

      This project is primarily an education and training program to increase the use of environmentally sound practices to protect water quality for use by farmers and crop consultants. It is our understanding that this would not fall require CEQA or NEPA compliance.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR
   Xnone

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

Not Applicable

b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*If a permit is not required, leave both Required? and Obtained? check boxes blank.*)

LOCAL PERMITS AND APPROVALS

Conditional use permit

Variance

Subdivision Map Act

Grading Permit

General Plan Amendment

Specific Plan Approval

Rezone

Williamson Act Contract Cancellation

Other

STATE PERMITS AND APPROVALS

Scientific Collecting Permit

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land.
Agency Name:

Permission to access state land.
Agency Name:

Permission to access federal land.
Agency Name:

Permission to access private land.
Landowner Name:

6. **Comments.**

Land Use Checklist

Improving water quality by reducing pesticide loadings in the Sacramento and San Joaquin River system through the wide scale use of environmentally sound farming practices in walnut production

1. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   No

3. **Do the actions in the proposal involve physical changes in the land use?**

   No

   If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   Education and training activities to increase the use of environmentally sound farm practices and to improve water quality.

4. **Comments.**

Conflict of Interest Checklist

Improving water quality by reducing pesticide loadings in the Sacramento and San Joaquin River system through the wide scale use of environmentally sound farming practices in walnut production

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

Lawrence Elworth, Center for Agricultural Partnerships

Subcontractor(s):

Are specific subcontractors identified in this proposal? Yes

If yes, please list the name(s) and organization(s):

Pat Weddle Weddle, Hansen & Assoc.

Helped with proposal development:

Are there persons who helped with proposal development?

Yes

If yes, please list the name(s) and organization(s):

Susan Pheasant Center for Agricultural Partnerships

Comments:

Budget Summary

Improving water quality by reducing pesticide loadings in the Sacramento and San Joaquin River system through the wide scale use of environmentally sound farming practices in walnut production

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

Independent of Fund Source

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	n/a	280	15500	0	11000	2500	85200	0	12000	126200.0	12620	138820.00
		280	15500.00	0.00	11000.00	2500.00	85200.00	0.00	12000.00	126200.00	12620.00	138820.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	n/a	280	15500	0	10000	2500	117800	0	2000	147800.0	14780	162580.00
		280	15500.00	0.00	10000.00	2500.00	117800.00	0.00	2000.00	147800.00	14780.00	162580.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	n/a	280	15500	0	11000	2500	138400	0	15000	182400.0	18240	200640.00
		280	15500.00	0.00	11000.00	2500.00	138400.00	0.00	15000.00	182400.00	18240.00	200640.00

Grand Total=502040.00

Comments.

Budget Justification

Improving water quality by reducing pesticide loadings in the Sacramento and San Joaquin River system through the wide scale use of environmentally sound farming practices in walnut production

Direct Labor Hours. Provide estimated hours proposed for each individual.

Larry Elworth 20 days per year for 3 years. Susan Pheasant 15 days per year for 3 years. Pat Weddle 60 days per year for 3 years. Krishna Roy (Communications) 20 days per year for 3 years.

Salary. Provide estimated rate of compensation proposed for each individual.

Larry Elworth $10,500 per year for 3 years. Susan Pheasant $5,000 per year for 3 years.

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

None

Travel. Provide purpose and estimate costs for all non-local travel.

Larry Elworth 2,000 per year for 3 years. The purpose is to provide fiduciary oversight. Susan Pheasant 2,000 for years 1&3 and 1000 for year 2. The purpose is to administer survey, data analysis, and focus groups. Pat Weddle 6,000 per year for 3 years. Purpose is to attend regulatory meetings, walnut industry meetings, professional meetings, and site visits. Krishna Roy 1,000 per year for 3 years. Will provide trade press relations, dissemination of project results, and media communications. All travel will include air travel, lodging, meals, and mileage.

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

Office supplies $2500 per year for 3 years.

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

Project Manager (Pat Weddle) $30,000 per year for 3 years (60 days@$500). Will provide general project management including: inspection of work in progress, validation of costs, preparation of reports, giving presentations, and meeting attendance. Project Coordinator $20,000 per year for 3 years (50 days at $400 per day/per year). Will provide project design, coordination among sites, data aggregation, training and education. Crop consultants year 1 $25,200 (24 days @$350 per day[$5.04 per acre]), year 2 $51,800 (148 days@$350 per day[$3.45 per acre]), year 3 $78,400 (224 days@350 per day [$3.13 per acre]). Will provide field monitoring, implementaion, training, data collection, data interpretation & analysis. Communications $10,000 per year for 3 years (20 days@$500 per day/per year. Will provide trade press relations, dissemination of project results, media communication.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

None

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

Mangament and quality assurance, validation of costs, report presentation, meeting presentations, project design and planning, project evaluation, and troubleshooting.

Other Direct Costs. Provide any other direct costs not already covered.

Survey Administration $10,000 for year 1 and 3. Development of survey instrument, conducting of survey, analysis of results. Symposium year 3 $3000. Organization and preparation of proceedings. Educational meetings $2,000 per year for 3 years.

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

Year 1 $12,620, year 2 $14,780, year 3 $18,240. The overhead rate include rent and utilities, phone, legal and accounting fees, insurance, and all other general office expenses.

Executive Summary

Improving water quality by reducing pesticide loadings in the Sacramento and San Joaquin River system through the wide scale use of environmentally sound farming practices in walnut production

The Center for Agricultural Partnerships (CAP) will, through a cooperative effort with growers and their organizations, crop consultants, researchers and farm advisors, improve water quality and reduce risk to aquatic species in the Sacramento and San Joaquin River system through the adoption of environmentally sound farming practices. This will be accomplished by reducing loadings of pesticides from agricultural use, specifically chlorpyrifos and other organophosphates, through the widespread adoption of sprayable mating disruption in the production of walnuts, a key crop in the affected watersheds. The goal of the CAP project is the use of mating disruption on 25% of the walnut acreage susceptible to codling moth infestation (25,000 acres by the end of the third year) by: · Implementing a systematic process to further adoption of sprayable mating disruption on a wide scale in commercial walnut production over three years; · Documenting and disseminating economic, biological and decision making changes in the adoption of sprayable mating disruption at the farm, project, and industry levels; · Implementing and validating the effectiveness of kairomone-based lure as a key component in the use of sprayable mating disruption on a wide scale in commercial walnut production. This project provides an unprecedented opportunity to increase the use of environmentally sound farming practices that improve water quality and protect aquatic species in key California watersheds and to provide an example for similar changes in other important cropping systems in the affected river systems.

Proposal

Center for Agricultural Partnerships

Improving water quality by reducing pesticide loadings in the Sacramento and San Joaquin River system through the wide scale use of environmentally sound farming practices in walnut production

Lawrence Elworth, Center for Agricultural Partnerships

A. Project Description: Project Goals and Scope of Work

1. Problem Water quality concerns associated with the presence of pesticides from agricultural use have been identified as a high priority issue for California surface waters. In its "1998 California 303(d) List and TMDL Priority Schedule", the Central Valley Regional Water Quality Control Board identified the insecticide chlorpyrifos as a high priority for development of a Total Maximum Daily Load on 190 miles of the Merced and San Joaquin Rivers and 480,000 acres in the Delta waterways among the watersheds targeted. Chlorpyrifos has been widely used on a number of important crops grown extensively in the Sacramento and San Joaquin valleys including apples, pears, and walnuts. The Environmental Protection Agency's risk assessments indicate that chlorpyrifos poses human health risks from cholinesterase inhibition, high risk to birds, fish and mammals, and very high risks to aquatic invertebrates (USEPA, 2001).

Reducing the pesticide loading in surface waters is a highly effective means for improving water quality and protecting aquatic species. The most direct and effective means to reduce the loading of chlorpyrifos and other pesticides from agricultural use is to increase the implementation of new, environmentally sound pest management practices on key crops, such as walnuts, in the affected watersheds. The most promising environmentally sound option for reducing reliance on chlorpyrifos in walnut production is the wide scale use of pheromone mediated mating disruption. Given the wide geographic area over which walnuts are grown in the Sacramento and San Joaquin valleys, the innovative nature of the new technology, and the need for advanced information to effectively use the technology, achieving the water quality improvements from the new technology will require an extensive implementation effort.

The Center for Agricultural Partnerships (CAP) will, through a cooperative effort with growers and their organizations, crop consultants, researchers and farm advisors, increase use of sprayable mating disruption on 25% of the walnut acreage susceptible to codling moth infestation (25,000 acres by the end of the third year) by:

- Implementing a systematic process to further adoption of sprayable mating disruption on a wide scale in commercial walnut production over three years;
- Documenting and disseminating economic, biological and decision making changes in the adoption of sprayable mating disruption at the farm, project, and industry levels;
- Implementing and validating the effectiveness of kairomone-based lure as a key component in the use of sprayable mating disruption on a wide scale in commercial walnut production.

The foundation of the implementation effort is the involvement of growers and their pest management advisors throughout the project. Given the advantages that a sprayable mating disruption system offers to growers and the potential for reducing reliance on chlorpyrifos, this project provides an unprecedented opportunity to increase the use of environmentally sound farming practices that improve water quality and protect aquatic species in key California watersheds.

2. Justification

Reducing loadings of pesticides from agricultural use can most directly be accomplished by determining the key crop and key uses for the critical pesticides and then implementing practices that reduce reliance on the use of those pesticides. In the case of the Sacramento, Merced and San Joaquin river systems, walnuts are an important crop for which the key pest, codling moth, currently requires extensive application of chlorpyrifos. As this project proposal describes in detail, effectively protecting water quality and aquatic species through reductions in pesticide loadings can be accomplished through a large-scale project to increase adoption of mating disruption in walnut production.

California produces 99% of U.S. walnuts and 38% of the world production. There are 207,520 acres of walnuts in the state, over 90% of which occurs in the Sacramento and San Joaquin valleys. In addition, this region is where the most severe arthropod pest problems exist with highest damage pressure in the south valley.

Codling moth *(Lydia pomonella*) is the key pest of walnuts in California and the most economically important pest statewide. Codling moths over winter as full-grown diapason larvae under bark scales or under foliage debris on the ground near trees. As photoperiod lengthens and temperatures warm in the spring (mid-March) the moths emerge, mate and lay eggs on or near developing nuts. These eggs hatch over a period of 5 to 20 days depending on temperature. Young larvae bore through blossom ends and into nutlets where they develop into fully-grown fifth instar larvae. Larvae then drop to the trunk or ground and pupate while the damaged nutlet typically drops. Two more generations usually occur in California each summer. These later generations can be particularly damaging to harvested nuts. Summer larvae bore into the growing nut, damaging husk, shell, seed coat and kernel, and rendering the nut worthless for commercial use (USDA, 2001). In addition, infested nuts provide entry points for navel orange worm, *Myeloid transit Ella*, increasing the population of this pest in orchards, as well as pesticide applications and costs (IPM for Walnuts, 1987, Walnut Marketing Board, 2000a).

Approximately 60% of walnut acreage is susceptible to codling moth (CM) damage. Damage is generally most severe on early season cultivars, although it has been increasing steadily over the years on some late cultivars such as Chandler. Left uncontrolled, codling moth infestation can result in serious economic damage that exceeds 40% of the harvested crop. In addition to direct yield and quality losses, higher costs for sorting in the warehouse may result in additional economic penalties for growers. Codling moth feed on the walnut kernel thereby reducing edible yield. Since edible yield is a basis of payment on shelling varieties, any level of damage reduces the grower's payment for the crop. Low levels of damage reduce or eliminate any quality bonus payments to the grower. Additional financial penalties are imposed when insect damage exceeds 5%. Any lot of walnuts with insect damage greater than 8% is disqualified from in shell shipment and the associated premiums (S. Wulfert, 2001, Integrated Pest Management for Walnuts, 1987.) As a result, walnut growers are experiencing $16 – 40 million in losses from CM annually, with losses in recent years at the upper bound (Sibbitt 2001, Stewart 2001).

Codling moth (CM) management relies on one to three chemical treatments per year. The primary conventional pesticides organophosphate (OP) insecticides of which chlorpyrifos is the most widely used being applied to more than 40% of the walnut acreage annually. To protect

their crops from loss, walnut growers annually apply 1.5 to 2.2 lbs. AI/ac. of OPs to control CM in infested orchards. According to California's Department of Pesticide Regulation Pesticide Use Report Data Summary (2000) more than 145,000 pounds of chlorpyrifos were used on walnut production in 1999 alone. Grower costs for these sprays may exceed $100/acre per season. Use of these pesticides often requires additional pesticide inputs to control secondary pests, which erupt when their natural enemies are suppressed by the CM sprays.

While chlorpyrifos and other OPs have provided a valuable mainstay of pest management in walnuts, problems associated with their use have also multiplied. Of particular concern have been the detections of chlorpyrifos from agricultural use in the San Joaquin, Sacramento, and Merced rivers and Delta Waterways that have led to the scheduled development of a TMDL(s) by early 2002 (Lee, 2001). In addition, resistance to OPs has been widely documented (Varella, 1993, Knight, 1994.) Furthermore, OP pesticides disrupt parasitic or predatory natural enemies of secondary walnut pests, such as walnut aphid, dusky-veined aphid, web spinning mites which often results in additional pesticide applications (Ramos, 1985.) In short, the continued availability of the most widely used chemicals for control of the key pest of walnuts is in significant jeopardy due to biological and regulatory reasons.

Faced with these problems, the walnut industry finds itself in need of alternatives that are efficacious, cost-effective, environmentally sound, and that provide the basis for a stable pest management system. Some reduced risk chemical options are available for use in the control of codling moth, which have little or no mammalian toxicity and are less disruptive to natural enemies. However, none of these pesticides are individually capable of providing economic control of codling moth without the use of other pesticides.

The most promising option for improving water quality and protecting aquatic species is to reduce pesticide loadings from walnut production through the use of pheromone mediated mating disruption. As a volatile that interferes with the mating cycle of the target insect mating disruption poses none of the adverse human health or aquatic species risks posed by chlorpyrifos. This technology has already been instrumental in the reduction of use of OP insecticides in apples and pears (Brunner, 2001) and has shown significant efficacy for use against CM in walnuts (Welter, 2000). However, although pheromone mediated mating disruption (MD) is used successfully against codling moth in pome fruit it has not been widely incorporated in walnut production. The reasons for this lack of adoption include:

- Sprayable formulations of MD, more practical for large canopy trees, have not been widely tested, commercially available, or registered for use in walnuts.
- Hand applied formulations of MD products, which are well tested for efficacy must be applied in the tops of tree canopies to be optimally effective. This type of formulation is usually practical in low canopy pome fruit trees. However, due to the high cost of labor involved in the application, hand applied dispensers have been impractical for use in producing walnut orchards where tree height typically reaches 25 to 40 feet.
- Growers perceive alternative pest management technologies such as MD as high-risk and costly.
- Most walnut growers and their pest management advisors have little or no history or field experience with MD in walnuts and are typically adverse to the perceived risks posed by this relatively unknown technology.

- The economics of the use of MD technology are unknown in walnut production.
- OP insecticides are perceived by growers and their advisors as relatively cheap and effective and, as such, have been the default control tactic of choice.
- Commercial scale adoption of MD will, at least initially, require an increased level of orchard monitoring to ensure successful pest management. This increased level of orchard monitoring will add expense to a commercial pest management program through added labor, and more pest and environmental monitoring hardware and software costs (i.e. insect traps, temperature measuring equipment, etc.).
- New monitoring technologies which promise to improve monitoring efficiency have not been widely used or demonstrated in the field.

Two key pest management options for monitoring and managing codling moth can make it possible for the walnut industry to move to a more stable, environmentally sound and effective pest management system. One option is the use of sprayable pheromones or aerosol emitters. Both formulations are based on encapsulating small amounts of pheromone within tiny beads of various synthetic polymers. These beads are then applied to the tree canopy using traditional spray application equipment. The beads stick to the leaves and branches and once dry, begin emitting small amounts of pheromone throughout the tree canopy thus initiating the mating disruption process. In addition, aerosol emitters are also being made available for use. These emitters rely on a few point sources that release high levels of pheromones, which then distribute downwind to other parts of the orchard. The sprayable technology offers a significant advantages over hand applied technology in that it can be applied more easily in tall, large canopy walnut trees, requires less hand labor and is more compatible with existing orchard equipment and procedures.

The second option for improving the efficiency of mating disruption in walnuts is to incorporate a recently developed host plant, volatile-derived, bisexual kairomonal attractant (Trece DA2313) into trap monitoring for codling moth. This tool has significant advantages over pheromone baited traps used to monitor CM in conventionally sprayed orchards since those traps are not highly reliable as a monitoring tool in pheromone disrupted orchards (Welter, 1997). As a population monitoring tool for MD orchards, the use of DA2313 kairomone baited traps allows one to detect emergence, measure population level/intensity. In addition the trap offers the ability to delineate flight patterns of CM, where flight monitoring with pheromone was impossible or limited and capture rates attenuated due to permeation of pheromone through the orchard (Light, et al. 2000).

Field and registration research on both of these options of the pheromone has been completed so that they will be ready for implementation in 2002. Together they provide the means for walnut growers to implement mating disruption more effectively, efficiently, and economically over a wider scale than in the past. Applied as a system, the technologies also provide the means for growers to dramatically reduce reliance on chlorpyrifos thereby reducing the potential for water quality degradation at the source. Such an approach to water quality is the most effective and efficient means of achieving water quality benefits will also improving agricultural ecosystems and ensuring the economic viability of walnut production.

3. Approach

Widespread use of pheromone mediated mating disruption offers a significant opportunity to reduce loadings of insecticides in key California waterways while also providing walnut producers with the ability to solve pest management problems in an ecologically and economically sound manner. As with any new practice or technology, there is a technology (hardware) element and an information (software) element each of which is essential to adoption (Rogers, 1995). This is especially true of mating disruption, which involves a new paradigm of pest management changing from killing insects to reducing their ability to reproduce. Although both lead to net populations reductions, the new technology requires new information and decision-making to be used successfully. As such, the adoption of this innovative technology requires both efficacious technologies based on sound science and a systematic process for diffusing the innovations. CAP has developed an integrated process for increasing adoption of environmentally sound farming practices that is based on Rogers' insights into successful adoption of innovations and wide scale field implementation.

Rogers has identified, based on extensive research, the five most important characteristics in the rate of adoption of innovations:

- *Relative advantage*- technology must possess inherent qualities that provide improvement over current technologies
- *Complexity*- technology must be relatively simple to adapt commercially
- *Compatibility*- technology must be compatible with existing grower practices
- *Trialability*- technology must be easily evaluated on a small scale
- *Observability*-technology must demonstrate obvious results

Where relative advantage and compatibility are high, complexity is minimized and trialability and observability are maximized, adoption is most likely to be rapid. In addition, Rogers points out that the social system in which the innovation is adopted can also demonstrably increase the pace at which diffusion occurs.

Given that these characteristics are necessary for the rapid adoption of new technologies, a unique opportunity exists for an intensive effort to succeed in the widespread adoption of sprayable mating disruption in commercial walnut production. Water quality and environmental concerns combined with the pressures from insecticide resistance and the problems associated with secondary pest outbreaks create significant incentives for the industry to move to new practices. Sprayable mating disruption technologies afford significant advantages over existing materials because they pose virtually no risks and provide the opportunity to mitigate resistance and secondary outbreaks. By doing so, mating disruption offers the opportunity to reduce pesticide costs for those secondary pests. Sprayable mating disruption technologies are also compatible with existing orchard operations and less complex and labor intensive than hand applied dispensers. In addition, efforts by the walnut industry have provided a foundation of experience and a social system that are important to the adoption of new technology. The two remaining elements necessary for adoption must be provided through a carefully designed implementation project that allows growers the opportunity use and observe the results of the technology on a commercial scale.

This project is a cooperative effort of the Center for Agricultural Partnerships (CAP) with growers and their organizations, crop consultants, researchers and farm advisors to implement sprayable mating disruption on a wide scale in California walnut production. The goal of the

project is the implementation of sprayable mating disruption technology on 25% of the walnut acreage susceptible to codling moth infestation (approximately 25,000 acres by the end of the third year) through the accomplishment of the following objectives:

Objective 1 Implement a systematic process to further adoption of sprayable mating disruption on a wide scale in commercial walnut production over three years.
Objective 2 Document and disseminate economic, biological and decision making changes in the adoption of sprayable mating disruption at the farm, project, and industry levels.
Objective 3 Implement and validate the effectiveness of kairomone-based lure as a key component in the use of sprayable mating disruption on a wide scale in commercial walnut production.

CAP's methodology for this project focuses on determining and meeting the specific needs for implementation so that project activities are focused on the most effective means for encouraging and supporting adoption of the new technology. Integrated into the implementation is the documentation of changes at the field and project levels that provides a direct means for evaluating field and project results. In order to ensure successful adoption "trialability" and "observability"(Rogers' terms) are built into the project through the involvement of growers and their pest management advisors (PCAs). The involvement of PCAs further ensures that results are documented and provides a means for growers to receive the information necessary to make better decisions. PCA involvement makes it possible for commercial adoption to take place from the beginning of the project and provides the means to expand adoption rapidly by allowing participating growers to expand their use of the technology on larger acreage in succeeding years. At the same, the number of participating growers can be increased through the PCAs and their network. Leveraging this private sector involvement with the educational expertise of Cooperative Extension staff ensures that adoption can take place rapidly on a sound empirical basis in addition to ensuring that adoption is sustained commercially after the project ends.

The project will coordinate activities of crop consultants in three different regions in the state, since conditions under which walnuts are farmed in California vary considerably from north to south, east to west. Cooperating processors, crop advisors and farm advisors in each of the targeted regions will engage growers with whom they work in implementing and documenting use of sprayable mating disruption technology on expanded acreage in the 2nd and 3rd years.

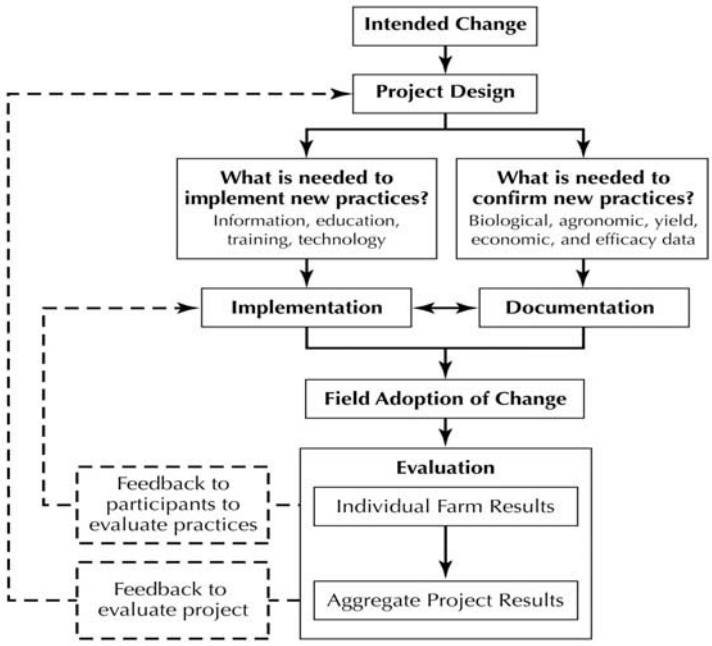
In the first year of the project, crop consultant coordinators in each of the regions will identify the initial growers who will be involved in using sprayable mating disruption and in whose orchards the kairomone lure will be validated. CAP and project staff will then convene focus groups of participating growers, as well as farm advisors, PCAs and researchers, as appropriate. In these discussions the groups will be asked to answer the following key questions:

1) Having decided to implement sprayable mating disruption, what specific information or support will participants need in order to *use* the new technology? As participants answer this question, education, training, or demonstration activities can be tied to what participants actually need. This focuses project activities on implementation and avoids burdening participants with excessive information.

2) What quantitative and qualitative information will participants need in order to determine whether the new technology is worthwhile? What biological, yield, economic and efficacy information will help growers decide whether or not the technologies worked? Asking this question ensures that important information for evaluating the technology is identified upfront and a system for collecting the information is put in place from the beginning.

Growers and PCAs are asked to collect *only* the information they will need in order to decide whether to adopt and/or continue use of the new technology. This not only ensures meaningful documentation and evaluation, it is also crucial in assuring adoption. The results of these focus group discussions will be supplemented by interviews with other participants to establish a baseline of pesticides use and decision-making practices, to customize any information needs, and to ensure that a field-based documentation system is in place. This process supports growers in their efforts to try the new technologies in their orchards, document results, see the advantages and gain confidence. At the same time the project will collect the information necessary to document the value to other growers so that the technologies can be understood and adoption can be rapidly expanded.

The integrated process used by CAP to increase the use of environmentally sound practices to achieve water quality benefits is shown by the diagram below:



CAP will coordinate oversight of the entire effort and work among the regions. Updates will be provided to participants through a newsletter on trap counts, pest pressure, and other information identified as important in the initial group discussions. In season, educational meetings will be organized in each region in cooperation with cooperating industry organizations, farm advisors and by the crop consultants. Communications within the walnut industry about the project and

its results will be carried out through newsletters, presentations, and electronic means by the participating organizations.

At the beginning of the first year, a baseline survey of the walnut industry will be conducted in cooperation with the Walnut Marketing Board and Diamond of California. The survey will 1) establish a baseline of current industry codling moth management practices and industry awareness of the new technologies; 2) determine the most appropriate communications messages, audiences and media to help increase industry-wide interest in new practices; and, 3) identify the best routes for increasing adoption within the industry as the project continues.

Implementation of the technologies will be done during the growing season by cooperating growers with the support of their crop consultants. Crop consultants will conduct field monitoring, provide training for the growers, and collect and interpret data to make it possible for the growers to master the new technology and the information necessary to successfully use it. To ensure consistency among grower and consultant efforts, the project coordinator will organize field implementation, analyze results, as well as facilitate the learning and sharing of results among participants in the different growing regions. In addition, Dr. Steve Welter will provide technical consultation on protocol design and field implementation. In year one, 10 to 20+ acre implementation sites will be established in each of three major regions throughout the Sacramento-San Joaquin valley. Collaborating PCAs and growers will adapt protocols, developed by UC and the pheromone companies, to the implementation sites. Treatment protocols will be designed based on site-specific considerations of historical pest pressure and any other site pertinent characteristics. Each implementation site will receive applications of sprayable pheromone for CM control and, depending on site-specific considerations, supplemental insecticide sprays, only as necessary to prevent unacceptable crop damage. Where possible, reduced risk insecticides will be used. Where sites are 20 acres or larger, the orchard may be divided into two comparable blocks. One block will receive the pheromone treatment protocol and the other a "standard" or conventional treatment. Pheromone baited traps and an equivalent number of DA2313 baited traps will be placed in each pheromone implementation site, both pheromone treated and, where available, the "standard" site. A documentation system will be carried out for each site and region and will measure multiple parameters including environmental conditions (i.e., weather,) spray records, trap counts, pest phenology, supplemental monitoring data and other pertinent information as determined to be important to implementation. Regional project crop consultant coordinators will tabulate the weekly data and provide weekly summaries to grower and PCA cooperators.

At the end of each growing season, crop consultants will compile biological, yield, economic and pesticide use results to review with each of the growers. They will be able to evaluate 1) quantitative changes such as yield, quality, production costs, net revenue, amounts of pesticides used and changes in pest and predator populations; and 2) the effectiveness of mating disruption technologies and how growers want to continue, expand, or modify their use. Since this project recognizes that new practices have to be economically viable, results will be presented for each cooperating grower in terms of net revenue as well as changes in direct costs.

Following harvest, participants will also meet as a group in each of the regions to review project activities, compare results, and set out plans for the coming season. Project staff will then

compile results from all of the farms, summarize the results and prepare an annual project report. The results of that report will be used in communications throughout the walnut industry, trade publications, and presentations at industry and grower meetings. Just as important, CAP will conduct press and media relations to the wider agricultural community and general public to increase awareness and support for improving water quality through environmentally sound agricultural practices.

In the second and third years, the crop consultants will expand the number of acres and growers involved in implementing the sprayable technologies. The intended outcome of the project is that 25,000 acres (one quarter of the acreage susceptible to codling moth infestation) will have implemented the sprayable mating disruption technology by the end of the project's third growing season. At the end of the project a series of focus groups will be used to assess farm and project level results. In addition, a final industry survey will be conducted to assess changes in the industry as a result of the project.

4. Feasibility

The walnut industry has a strong track record in working with innovative projects to improve environmental performance through innovative production practices. For example, the Walnut Marketing Board has initiated a cooperative program, the Walnut Pest Management Alliance with growers, the California Department of Pesticide Regulation, the University of California and Cooperative Extension and USDA-ARS researchers. Given the foundation that has been established, the pressures and incentives facing the industry, and the unique attributes that sprayable mating disruption offers, a well-designed implementation effort can achieve widespread adoption and significant water quality benefits. In short, an unprecedented opportunity exists to increase the implementation of effective technologies on an industry-wide scale that will reduce pesticide loading and improve water quality. .

CAP has extensive experience in the implementation of large-scale projects that solve important environmental and production problems in agriculture. The total acreage in six CAP field projects is more than 100,000 acres involving more than 70 grower groups, companies, universities and other organizations. The following projects indicate both CAP's ability to organize and conduct large scale projects and the feasibility of achieving significant environmental benefits from such large scale project in agriculture.

Central Coast Vegetable IPM Project (1997-2001)

In this project, Salinas Valley's five major vegetable companies (Bruce Church, D'Arrigo, Dole, Gene Jackson, Tanimura & Antle) along with input suppliers (SoilServe, Western Farm Service) and commodity boards (Celery and Lettuce Research Advisory Boards) have created a partnership with CAP through the leadership of the University of California Cooperative Extension Farm Advisor in Monterey County to use new, more biologically intensive methods of combating aphids and leafminers in lettuce and celery production. The project led to increased use of biological controls for aphids and leafminers among cooperating vegetable companies who account for 12% of the nation's lettuce, leading to a 30% reduction in organophosphate on that acreage.

Washington State Tree Fruit IPM Project (1997-2001)

Del Monte Foods, Snokist Growers, and the Washington State Horticultural Association, in cooperation with CAP, crop consultants, Washington State University Cooperative Extension, USDA Agricultural Research Service and chemical suppliers, are providing the means for implementing a more biologically intensive integrated pest management (IPM) system in the pear orchards of Washington State. The project resulted in increased ability of pear growers to control insect pests, thereby further reducing the need to use insecticides, through increased populations of beneficial species; made mating disruption a common tactic in nearly 3500 acres of Yakima District pear orchards; and led to total insect pest control savings to growers has averaged $100/acre with effective control, quality and yield and a reduction of more than 30% in organophosphate use.

Michigan Apple IPM Implementation Project (1998-2001)
Gerber Food Products, the Michigan Apple Committee, Michigan IPM Alliance, Michigan State University, growers and consultants have joined together in this project to develop a biologically and environmentally sound pest management regime. Using a common system of monitoring, CAP project staff is helping to develop the infrastructure to carry out large-scale scouting and implementation. The project has led to use of new pest management and monitoring system on 3,150 acres in 2000, a decrease in organophosphates by 49% and 24% in 1999 and 2000, and average cost savings of $48/acre with higher net revenues from better control and higher quality fruit.

Neuse Crop Management Project (1998-2002)
In an unprecedented cooperative effort, grower organizations (N.C. Soybean Growers, N.C. Small Grain Growers, Cotton Incorporated) have joined together with North Carolina State University and suppliers, such as Southern States Cooperative and Royster-Clark, to expand integrated pest management and nutrient management practices. Their efforts with corn, cotton, soybean and wheat growers will dramatically reduce nitrogen levels in the Neuse River Basin, one of eastern North Carolina's most important waterways. In the first year the project resulted in 12,081 acres under new weed IPM and nutrient management systems, a 13% decrease in soil applied herbicides, and 15% average reduction in nitrogen use on project acreage.

Midwestern Water Quality Project (2000-2002) To improve nitrogen management in corn production in south central Minnesota and improve water quality in the Minnesota River Basin, CAP has developed a collaborative project with commercial growers and their advisors, the Minnesota Corn Growers Association, University of Minnesota researchers, lenders and software developers. More than 40 farmers and consultants are using reduced nitrogen rates (fall and spring applications) and benchmarking of current nitrogen management practices and decision-making processes on 60,000 in the Minnesota River Basin.

North Carolina/Virginia Peanut Project (2000-2002) CAP has initiated a project with funding from USDA's Pest Management Alternatives Program for a project with North Carolina State University, independent crop consultants, and North Carolina peanut growers to implement and evaluate adoption of an IPM risk index for southern corn rootworm control. The project has recently been expanded to peanut growers in southern Virginia through the efforts of Virginia Tech staff. Work involving approximately 20 key farmers located throughout the primary peanut growing counties in both states is being conducted to a) benchmark current southern corn

rootworm management practices and the extent of risk index usage, b) document field level pest management decision-making processes, and c) obtain grower/consultant input to guide education and outreach activities.

5. Performance measures

Field results will be assessed in terms of the number of acres on which the mating disruption is used and the reduction in loadings through reduced reliance on chlorpyrifos and other organophosphate insecticides. Field results at the grower level will also be assessed in terms of changes in pesticide costs and net revenue, crop quality and yield. The field level results will be aggregated to determine overall project effects. The individual and overall project results will be compiled, analyzed, and reported in each of the three years.

Impacts on the overall walnut industry will be evaluated in terms of awareness of the benefits and results from mating disruption. Project effectiveness will be assessed in terms of participant perception of project activities as well as efficacy and benefits from adoption of new practices.

At the beginning of the first year, a baseline survey of the walnut industry will be conducted in cooperation with the Walnut Marketing Board and Diamond of California. The survey will 1) establish a baseline of current industry codling moth management practices and industry awareness of the new technologies; 2) determine the most appropriate communications messages, audiences and media to help increase industry-wide interest in new practices; and 3) identify the best routes for increasing adoption within the industry as the project continues.

At the end of each growing season, crop consultants will compile biological, yield, economic and pesticide use results to review with each of the growers. They will be able to evaluate 1) quantitative changes such as yield, quality, production costs, net revenue, amounts of pesticides used and changes in pest and predator populations; and 2) the effectiveness of mating disruption technologies and how growers want to continue, expand, or modify their use. Since this project recognizes that new practices have to be economically viable, results will be presented for each cooperating grower in terms of net revenue as well as changes in direct costs.

Following harvest, participants will also meet as a group in each of the regions to review project activities, compare results, and set out plans for the coming season. Project staff will then compile results from all of the farms, summarize the results and prepare an annual project report. The results of that report will be used in communications throughout the walnut industry, trade publications, and presentations at industry and grower meetings.

In the second and third years, the crop consultants will expand the number of acres and growers involved in implementing the sprayable technologies (10,000 A and 25,000 A respectively). . The intended outcome of the project is that 25,000 acres (one quarter of the acreage susceptible to codling moth infestation) will have implemented the sprayable mating disruption technology by the end of the project's third growing season. At the end of the project a series of focus groups will be used to assess farm and project level results. In addition, a final industry survey will be conducted to assess changes in the industry as a result of the project.

6. Data handling and Storage

Field results will be collected by the participating growers and compiled by PCAs in each of the regions. Results will be analyzed jointly by growers and PCAs to determine effectiveness and identify necessary changes. Those results will be aggregated by project staff to assess and demonstrate overall project results. Those results will be shared with project participants and disseminated to the walnut industry by Diamond and the Walnut Marketing Board through grower meetings, publications and organizational web sites.

7. Expected Products/Outcomes

- Establishment of a baseline of walnut producer and industry pest management and pesticide use practices
- Adoption of mating disruption on at least 25,000 acres over the three walnut growing regions
- Two field education and training meetings during each growing season in each of the growing regions
- Summary reports for individual growers and the project at the end of each of the growing seasons
- Annual reports summarizing project results.
- Focus groups and follow-up survey at end of project to assess extent and effectiveness of project.
- Final report summarizing entire project at end of third year
- Grower symposium on improved practices to protect water quality and aquatic species at end of project to sustain implementation

8. Work Schedule

Year one

Fall /winter, 2002-2003

- Work plan established by project staff and crop consultants
- Information needs and documentation system established through participant focus groups
- Baseline of participant practices established through interviews
- Baseline of industry practices established through industry wide survey
- Protocols established for scouting and implementation of sprayable pheromone and kairomone
- Industry made aware of project survey results through grower publications

Growing season, 2003

- Implementation of sprayable mating disruption for codling moth on 5000 acres of orchards over the three major growing regions
- Preparation of weekly field updates for participants
- Field education sessions in each region
- Growers informed about interim results through grower publications

Post-harvest, 2003

- Compilation and analysis of field results with participants and project staff
- Analysis of overall project results and refinement of project activities by participants

- Annual report prepared with aggregated results
- Dissemination of report in grower publications, presentations at grower meetings

Years Two and Three

Winter 2004 & 2005

- Work plan updated by project staff and crop consultants
- Project expanded through the identification of new growers and consultants
- Baseline of new participant practices established through interviews
- Protocols established for scouting and implementation of sprayable pheromone and kairomone

Growing season, 2004 & 2005

- Implementation of sprayable mating disruption for codling moth on additional orchards in the 3 major growing regions (10,000 A in Yr 2; 25,000 A in Yr. 3)
- Preparation of updates for participants
- Field education sessions in each region
- Growers informed about interim results through grower publications

Post-harvest, 2004

- Compilation and analysis of field results with participants and project staff
- Analysis of overall project results and refinement of project activities by participants
- Annual report prepared with aggregated results
- Dissemination of report in grower publications, presentations at grower meetings
- Project progress assessment through industry peer review

Post-harvest, 2005

- Compilation and analysis of field results with individual growers and project staff
- Analysis of overall project results and refinement of project activities by participants
- Industry impacts assessed through follow-up industry survey
- Participant impacts determined by exit interviews with growers and stakeholders
- Final report prepared
- Publication of report in grower publications, presentations on results at grower meetings
- Industry informed of project results and opportunities to sustain implementation through industry symposium

B. Applicability to CALFED ERP and Science Program Goals and Implementation Plan and CVPIA Priorities

1. ERP, Science Program and CVPIA Priorities.

This project meets the following priorities outlined in the CALFED Ecosystem Restoration Strategic Goals and Objectives:

"Goal 6: Water and Sediment Quality
Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed; and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people.

Objective 1: Reduce the loadings and concentrations of toxic contaminants in all aquatic environments in the Bay-Delta estuary and watershed to levels that do not adversely affect aquatic organisms, wildlife, and human health.**"**

2. Relationship to Other Ecosystem Restoration Projects.

This project is not directly related to other Ecosystem Restoration projects.

3. Requests for Next-Phase Funding.

This project is not a request for next phase funding.

4. Previous Recipients of CALFED Program or CVPIA funding

The Center for Agricultural Partnerships has not previously received CALFED Program or CVPIA funding.

5. System-Wide Ecosystem Benefits.

The adoption of mating disruption as an effective and environmentally sound pest management practice has shown that adoption on one crop provides an impetus for adoption on other related crops. Since mating disruption has been used successfully in pears (Barnes and Miller, 1992, Welter, 1999), almonds (Shorey and Gerber, 1996), and peaches (Rice, 1997) and hand applied MD dispensers have been used in walnuts (Welter, Cave and Singleton, 2000) there is awareness of mating disruption within the California grower community. With the advent of sprayable technology the potential exists to rapidly expand adoption in the target commodity and to other commodities in which mating disruption has been used in the past. As a result of this project the potential is high for adoption of these practices in other crops that use organophosphate insecticides, such as apples as pears, which are grown widely in the affected watersheds. Those changes can lead to further improvements for water quality.

6. Additional Information for Proposals Containing Land Acquisition.

This proposal does not include any land acquisitions.

C. Qualifications

Lawrence Elworth is Executive Director of the Center for Agricultural Partnerships, a 501(c)(3) non-profit organization that has extensive experience in the design organization, oversight and evaluation of major IPM implementation projects in 4 regions with grants totaling over $2.4 million. In this project, the Center builds on its experience in cooperative work with growers, crop consultants, commodity organizations, suppliers, university and extension staff in implementing economically viable and environmentally sound pest and nutrient management practices on more than 100,000 acres nationwide. In particular, CAP has successful experience in furthering the wide scale adoption of mating disruption in tree crops in Washington and Michigan. Based on his experience in coordinating public and private resources to support IPM adoption, Mr. Elworth, as principal investigator, will provide organizational and administrative guidance to the project.

Patrick W. Weddle is the founder and President of Weddle, Hansen & Associates, Inc. (WHA) an agricultural consulting firm specializing in the farm-site implementation of biologically

intensive integrated pest management. Weddle specializes in the design, development and implementation of strategies, tactics and policies to secure biologically rational and economically feasible systems of multi-tactic IPM. He has consulted extensively with farmers, industry, growers, environmental organizations and government agencies during his 28 year career. Weddle has taught classes in crop protection for the University of California, written extensively on IPM and related policies, delivered numerous lectures and papers on IPM implementation, testified before congress on IPM and food safety issues and has served on numerous professional, agency and industry committees. In addition, Mr. Weddle's firm has conducted research and consulting in eight foreign countries. WHA is a 1999 recipient of the California Environmental Protection Agency, Department of Pesticide Regulation, and IPM Innovator Award. Mr. Weddle will provide oversight, management and coordination for the project

Susan M. Pheasant, Director for Strategy, Planning, and Analysis at the Center will adapt baseline survey, interview, and focus group instruments developed for assessing decision-making and evaluating IPM adoption in Washington state apple (Brunner, Willett, and Mackey, 1997) and pear production, California lettuce and celery producers, North Carolina and Virginia peanut producers, Minnesota corn growers, and for Michigan apple production. She will supervise surveys, interviews, focus groups and data analysis and reporting.

Dr. Stephen C. Welter is Associate Professor of Entomology, Department of Environmental Science, Policy and Management; University of California, Berkeley. Dr. Welter is the coordinating research scientist for the Walnut PMA program and a leading researcher in insect-pheromone interaction and implementation of mating disruption technologies. Dr. Welter will serve as technical consultant to the project.

Walt Bentley and Carolyn Pickel are Areawide IPM advisors (University of California Cooperative Extension) in the Sacramento and San Joaquin valleys. They are coordinating the Walnut PMA project in cooperation with pomology farm advisors in walnut growing counties and will work with the CAP project to conduct educational meetings.

D. Cost

1. Budget (included in web application forms)

2. Cost-Sharing (there are currently no other funding commitments to this project for the propose funding period)

E. Local Involvement

The most important step in setting up an implementation project is time spent in the field with growers, consultants, commodity groups, farm advisors, cooperatives and other stakeholders to learn about the key problems facing the industry. Of particular importance has been the direct involvement of PCAs, the grower organizations, and farm advisors who have determined the

scope and substance of the project and its focus on sprayable mating disruption technology. In addition, the researchers who work with the walnut industry and the pheromone companies have shared the work that is going on with farmers this season so that the project activities are well designed. Finally, the communications network among growers of the Walnut Marketing Board and Diamond was identified as the primary mechanism, and is a significant in-kind contribution, for increasing awareness and understanding in the grower. The strength of this project is that it relies on the relationships and infrastructure that already exist in the cropping system so that useful changes can take place and be sustained after a project ends.

This project involves the collective efforts of the following people and organizations:

Walnut Marketing Board is the leading commodity organization for the California walnut industry. The Board promotes usage of walnuts through publicity, product promotions, and research and education programs. The Board will contribute to the project by disseminating project educational information and results to the industry through its publications and meetings.

Diamond of California, formed in 1912, is a cooperative owned by its 2000 growers. Diamond processes approximately 50% of California's walnuts and will contribute to the project by using its publications and grower meetings to disseminate project results and educational information to its grower members.

Ag Advisors, Inc is an independent consulting firm in northern California with approximately 25,000 acres of walnuts under pest management consulting services. Ag Advisors will serve as one of the initial crop consultants involved in the implementation process.

Pest Management Associates, Inc. is an independent consulting firm in the southern San Joaquin valley. Pest Management Associates will serve as one of the initial crop consultants involved in the implementation process.

F. Compliance with Standard Terms and Conditions

The Center for Agricultural Partnerships will comply with the appropriate State and Federal contract terms.

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