CITRUS RESEARCH BOARD
PROJECT PLAN - RESEARCH GRANT PROPOSAL FOR FY2010-2011

Fiscal Year: 2010-2011
Anticipated Duration of Project: 4 years

This Project is: New (Year 1 of 4)

Project Leaders:
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Cooperating Personnel:
David Kellum, Entomologist, County of San Diego, 5555 Overland Ave., Ste 3101, San Diego, CA 92123; Phone: (858) 694-3076; E-mail: david.kellum@sdcounty.ca.gov

Cooperating growers, pest control advisors, companies working on organically approved pesticides, and other researchers working on citrus in CA, FL, and TX.

Technical Support: Alan Urena, Pam Watkins, Marianne Whitehead

Project Title: Optimizing Chemical Control of Asian Citrus Psyllid in California

Keywords: Asian citrus psyllid (ACP), Huanglongbing (HLB), chemical control, resistance management

Abstract:
We propose to conduct research on how to best control Asian citrus psyllid in California with the multiple objectives of reducing the spread of ACP into areas of California where it is not present, slowing the spread of HLB should it be found in California, delaying the appearance of pesticide resistant ACP strains, integrating biological control to the extent possible, and reducing the potential for secondary pest outbreaks. We will use knowledge that has been gained in other areas of the world that deal with ACP and HLB and will collaborate with key researchers in those areas to the extent that such collaboration would be productive and is feasible. We are open to industry input regarding specific sub-objectives and prioritization of research that can be accomplished each year of the project.

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Asian citrus psyllid (ACP) is now present throughout parts of southern California but has not yet established in commercial citrus groves and is not present in Ventura or Riverside counties. As much as possible, one hopes that chemical treatments applied in backyard situations and in commercial groves, if and when it is discovered there, will keep the insect contained but the breadth of the infestation in Los Angeles County is a concern. Huanglongbing has now been detected in the state of Sinaloa in Mexico and appears to be moving northward, with likely introduction into California at some point in the future, if it is not already present somewhere in the state due to the past introduction of HLB-infected asymptomatic plant material.

A fair amount of good work has been done in Florida and Texas on chemical control of ACP and those of us in California have borrowed heavily on this work in suggesting how we might manage the pest here. However, follow-up work is needed including but not limited to the following Sub-objectives 1-5: (1) Evaluate materials that have not been tested in Florida because they are not registered for use there (e.g., Baythroid, Carzol), have not been extensively tested elsewhere, or new materials that show promise in control of ACP; (2) Verify/evaluate the 200-250 ppm threshold for imidacloprid levels in young citrus flush proposed by Dr. Mamoudou Setamou (Texas A&M University) for effective control of ACP nymphs — this threshold is critical to the work Byrne et al. are doing in monitoring imidacloprid titers in backyard trees treated by CDFA and in research with both potted citrus and in commercial citrus groves; (3) Develop baseline data for ACP susceptibility to key pesticides before pesticide use is widespread in California and compare these data to resistance monitoring data from Florida (reported 34-fold ACP field resistance to imidacloprid in Florida with cross-resistance to thiamethoxam is a serious concern); (4) Test materials proposed for use in organic citrus – we need to find a material that is at least somewhat effective and is registered for organic use; and (5) other objectives as needed (i.e. we are open to other suggestions).

Objectives:

Our goal is to provide timely information important to the citrus industry as we continue to learn how to deal with ACP in California. The listed Co-PIs have different perspectives on the situation and it will be important that we continue to communicate on project objectives and priorities.

Objective: Conduct pesticide related research on Asian citrus psyllid needed to deal with this insect in an optimal manner in California.

Sub-objective 1. Screen pesticides not evaluated well elsewhere or new pesticides that appear to show promise in ACP control.

Sub-objective 2. Verify the 200-250 ppm imidacloprid threshold for effective control of ACP nymphs developed by Dr. Setamou.

Sub-objective 3. Develop baseline data for ACP susceptibility to key pesticides before pesticide use is widespread in California and compare these data to resistance monitoring data from Florida.

Sub-objective 4. Search for a material that is at least somewhat effective and is, or will be, approved for use on organic citrus.

Sub-objective 5. Other research objectives as needed. We are open to other priority research objectives once we have an ACP colony to work from. Co-PIs will have input on this at least quarterly (based on the schedule for required progress reports).

Milestones and timeline – These are listed below under Plans and Procedures.
Project's Benefit to the Industry:

To date, we have been dependent mostly on researchers in Florida, Texas, or South America for information on how to effectively control ACP. We need to develop the infrastructure and methodologies to start doing such work in California. Based on data largely from Florida (and data that is starting to come in from Texas), it appears that area-wide management of ACP can be surprisingly effective in reducing populations to low levels, especially if most citrus in an area is treated with effective materials, treatments are applied at approximately the same time, and treatments are timed at optimal times of the year in relation to flushing patterns and behavior of the psyllid. However, we need to develop the capability to expand on such research taking into account how ACP will behave in California and given the constraints on area-wide treatments and application methods in our state. In particular, we recognize the importance of a well-executed and coordinated area-wide management program in allowing for better management of pesticide resistance. This project is proposed as a service project to the industry to obtain critical data of this nature.

Research Collaborations:

The 5 listed Co-PIs are all presently working together on various projects involving management of ACP. It will be critical that we continue to communicate clearly on project sub-objectives and progress. We also need to continue to stay in touch with key collaborators (Michael Rogers, Univ. of Florida; Phil Stansly, Univ. of Florida; David Hall, USDA-ARS, Ft. Pierce, FL; Mamoudou Setamou, Texas A&M; Matt Ciomperlik, USDA-APHIS, McAllen, TX; others) working on ACP and HLB and progress that is made in other areas of the world and the U.S. We also need to stay in touch with the involved industries and to communicate our results rapidly to these industries. Co-PI Bethke will serve as our key liaison to the California nursery industry, Co-PI Grafton-Cardwell will be our key person charged with extension of results to the citrus industry (as well as Morse), and Co-PI Godfrey will coordinate communication with CDFA and federal ACP efforts through the various committees she serves on.

Plans and Procedures:

Where we can conduct the proposed research safely and are allowed to do so will depend a good deal on the future expansion of ACP in California. At present, two projects (Luck and Ray, Hoddle and Godfrey) are rearing ACP inside UCR’s Quarantine facility under permit from USDA-APHIS. Below are 3 possible scenarios regarding how we might proceed if this project is funded and based on the status of ACP on or after 11-1-10.

**Scenario 1:** ACP becomes widespread on commercial citrus in the Riverside area and on citrus at Agricultural Operations on the campus and the proposal is funded. **Action:** Develop a proposal to be reviewed by both the Riverside County Agricultural Commissioner and CDFA proposing to rear ACP safely inside greenhouse rooms 173 and 174 located outside and southwest of UCR’s Quarantine Facility. These 2 rooms are currently being retrofitted to contain ACP using CHRP funds as follows: air intake in the back is screened with Econet T screening so ACP cannot enter the room; a separate entryway is being built outside the front door to each room – the outer door will be fit with an air curtain that blows outward to keep ACP and other flying insects out of the screened entry cubicle; the inner door will not be opened until the outer door is closed and it contains a second air curtain that will blow inward to keep ACP inside the greenhouse room when that door is opened. Note that these facilities will be inspected by CDFA and the Riverside Agricultural Commissioner’s Office once the retrofitting is done. Also, we will not proceed with plans to rear ACP until both the Riverside County Agricultural Commissioner and CDFA have agreed to allow us to do so under established protocols. Our preference is to do the work at UCR but if necessary, we can proceed with Scenario 2 or 3.

**Scenario 2:** ACP is not present in the Riverside area or on citrus at Agricultural Operations on the campus and the proposal is funded. **Action:** Develop a proposal to be reviewed by San Diego Agricultural Commissioner Bob Atkins and CDFA to rear ACP safely at the Chula Vista location in that county inside contained temperature cabinets. Under funding from the California Avocado Commission we worked for several years at this location on an avocado lace bug project (ALB) (we could not do the work outside of the ALB Quarantine area in San Diego County). On June 30, we discussed Scenario 2 with Commissioner Atkins and Dr. David Kellum (Entomologist for San Diego Co.). Commissioner Atkins
indicated that he has experienced such good success with ACP control in San Diego County that he was reluctant to “jinx” the lack of repeat finds by doing anything different. However, he understood the need for the research we propose and would be willing to entertain a proposal for Chula Vista to serve as a potential site for such research depending on the situation 6 months or so from now.

**Scenario 3:** The proposal is funded but we decide to postpone most of the proposed research until ACP is widespread in the Riverside area and all affected parties have agreed for us to proceed as proposed under Scenario 1. In this case, very limited research might be conducted inside Quarantine (perhaps Sub-objective 2 above) and we would return research funds for the period of time the work is delayed (for example, if we could not start on the project until 3-1-11, after 4 months had passed in the CRB fiscal year, we would carryover 33% of project funds).

It is difficult to know how quickly ACP will spread in California. This grant is proposed so that as soon as ACP is present in the Riverside area and we have approval to proceed, we can rapidly initiate the proposed research. In this way, we are not bypassing the normal CRB new proposal system to put in a proposal at the last minute, when and if conditions change.

**Work Plan and Milestones**

Sub-objective 1. Screen pesticides not evaluated well elsewhere or new pesticides that appear to show promise in ACP control.

**Work Plan and Milestones:** 1). Develop protocols approved by the appropriate County Ag Commissioner and CDFA to rear ACP safely. 2). Develop a method of rearing ACP modeled after what we have seen in FL, TX, and is currently being done inside UCR’s Quarantine facility. 3). Develop a sound methodology for screening pesticides in a greenhouse environment – the citrus thrips – sumac system is one example of how this might be done. As in that system, a “mother colony” will be maintained in one greenhouse room where it is not exposed to pesticides and pesticide screening will be done in a separate “testing room”. 4). Screen candidate pesticides and report results on a regular basis (quarterly as required).

Sub-objective 2. Verify the 200-250 ppm imidacloprid threshold for effective control of ACP nymphs developed by Dr. Setamou.

**Work Plan and Milestones:** 1). Treat potted citrus plants that are attractive to ACP for feeding and oviposition with various rates of imidacloprid by watering the material into the soil, carefully avoiding leaching. 2). Test for imidacloprid levels in young flush tissue using ELISA. 3). Expose treated plants to ACP adults for oviposition when new flush feather growth has just started to appear (and perhaps sometime later to see if there are differences; we should also vary nymph life stage by transferring untreated nymphs onto treated foliage). 4). Monitor nymph mortality over time and report results. 5). Replicate as needed with different rates of imidacloprid.

Sub-objective 3. Develop baseline data for ACP susceptibility to key pesticides before pesticide use is widespread in California and compare these data to resistance monitoring data from Florida.

**Work Plan and Milestones:** 1). Collect ACP to initiate our mother colony from an appropriate location in California once permits and protocols are finalized allowing us to rear ACP and to transport live ACP from the collection area to the rearing location. 2). This mother colony will not be exposed to pesticides and will be used to develop baseline pesticide susceptibility data (clean plants will be moved into the room to infest them and then these plants will be transported to the “pesticide screening” greenhouse room listed under Sub-objective 1 – a protocol for doing this safely [perhaps inside a cage] will have to be developed). Initial bioassays will establish whether the levels of susceptibility in the mother colony are stable because we will not have information on the exposure history of the insects prior to collection. 3). Develop a sound method of screening ACP for pesticide susceptibility. Ideally, we would like to use a system similar to what is done in Florida (micro-applicator application of technical product dissolved in acetone applied to the dorsum of adult ACP) so that data from FL (and elsewhere) can be compared to CA data. 4). Screen pesticides important to ACP control in CA (pyrethroids – Baythroid, Danitol, Mustang; organophosphates – Lorsban, dimethoate, perhaps others; imidacloprid [compare a micro-applicator method to other methods of ACP exposure; compare data with adults versus nymphs]; Delegate; Movento enol; Altacor; others as needed) and report results.
Sub-objective 4. Search for a material that is at least somewhat effective and is, or will be, approved for use on organic citrus.

Work Plan and Milestones: 1). Continue to interact with companies that are developing materials envisioned for organic use and develop a prioritized list of materials to screen (based on evidence suggesting they are effective on some species of psyllid or related insects). 2). Develop a sound screening methodology (probably similar to that listed in Sub-objective 1). 3). Screen products that are registered for organic use versus those that are being developed for eventual organic registration and report results. Note: Hoddle, Morse & Godfrey submitted a Specialty Crop proposal 4-26-10 requesting $340,501 to conduct ACP research in organic citrus groves and screen pesticides, which might be used in an organic setting. We hope to hear whether that project will be funded in October and if it were, modification of this project would be in order.

Sub-objective 5. Other research objectives as needed. We are open to other priority research objectives once we have an ACP colony to work from. Co-PIs will have input on this at least quarterly (based on the schedule for required progress reports).

Other Funding Sources for this Project (current and/or pending):

At present, we have no other funds to support the research proposed in this project.

CRB Project 5500-179 (Assessment of systemic neonicotinoid insecticides for management of ACP to PIs Byrne and Morse) and Project 5500-182 (Optimization of imidacloprid application rates for the management of ACP on containerized citrus to Byrne and Morse [and Cooperator Bethke], 50% funding from the CA Citrus Nursery Board for this latter project) are both complimentary to this project and specifically Sub-objective 2. Note that neither of those projects is duplicative with this project (Sub-objective 2 requires that we have a colony of ACP to work with; validation of Dr. Setamou’s 200-250 ppm threshold is not proposed in either of Dr. Byrne’s current CRB projects).

Grafton-Cardwell’s CRB Project 5500-001 (Pest management infrastructure) is complementary to the proposed research (she is testing many of the chemicals we will test in this project on other pests) but until ACP spreads into the SJV to the extent that she is allowed to rear an ACP colony or can work on field populations, she is constrained from doing similar research as proposed in this project. Should she be able to work on ACP in the SJV, we anticipate dividing up future research to be done between this project and 5500-001. This is an additional reason why it is important she be part of the proposed research.

Hoddle, Morse, and Godfrey submitted a research proposal in April to the CA Specialty Crop Program (Management of ACP in organic citrus) and we should hear on funding approximately October. If funded, that project would be a nice complement to what is proposed above under Sub-objective 4 and the objectives of that project overlap to some extent with parts of Sub-objective 4. In the event the Specialty Crop proposal is funded, we would focus more effort on the other Sub-objectives and no budget revision is planned.

Technology Transfer:

We are committed to rapidly transferring significant results of our project to the industry. Each of the Co-PIs gives a number of talks each year to various segments of the citrus and nursery industries and regularly publishes results in popular and scientific journals. Whenever treatment recommendations are modified for ACP, web-based UC Pest Management Guidelines will be updated to reflect such changes. We also anticipate using Beth Grafton-Cardwell’s KAC Citrus Entomology web site (http://ucanr.org/sites/KACCitrusEntomology/) to post relevant information on the management of ACP as appropriate.

We don’t anticipate any intellectual property issues arising from this project at this point in time.
CRB Project Plan – Research Grant Proposal for FY 2010-2011
Optimizing Chemical Control of Asian Citrus Psyllid in California, J. G. Morse et al., 5500-11E

Literature Search:

All 5 of the Co-PIs have read through literature on ACP relevant to their expertise, 4 are members of the ACP-HLB Science & Technology Committee, and each of us has attended meetings where ACP research has been discussed and prioritized. Bethke provides expertise on the California nursery industry and pesticides that might be used in that setting to control ACP. Byrne provides expertise on imidacloprid uptake, ELISA monitoring, and pesticide resistance.

Budget Justification:

Morse is requesting 0.8 FTE (partial effort of 3 people) to work on this project. Under Scenario 1, we would need to maintain ACP host plant material, a mother colony of ACP, conduct pesticide trials, analyze data, prepare reports, and submit quarterly reports to the CRB. Some travel is needed as are supplies and expenses as we gear up our ability to rear ACP and conduct the proposed work in a safe manner after protocols have been submitted and approved.

$2,000 travel and S&E for Grafton-Cardwell is proposed so that she can stay in touch with research that is done in southern California and assist with extension of project information.

See the scope of work below regarding justification for Co-PI Bethke’s portion of the budget.

Scope of Work: UCCE Subcontract to Co-PI Bethke

Under Scenario 1 listed above, the Agricultural Technician will be charged with delivering host plants (orange jasmine, curry leaf, or citrus) to UC Riverside on a regular basis for maintenance of the ACP colony to be used in greenhouse pesticide trials. This activity will be done only after protocols for the movement of this plant material have been approved and assumes that UCR is within the ACP Quarantine zone (ACP host material cannot be moved outside the quarantine zone). This activity also assumes that protocols have been developed and approved by CDFA and the affected county Agricultural Commissioners (Riverside and San Diego) for such movement and for ACP work to be done at UCR. In addition to the above, the Agricultural Technician and Co-PI Bethke will participate heavily in pesticide trials at UC Riverside.

In contrast, if we are operating under Scenarios 2 or 3 as listed above, then part or all of the proposed research will be done in San Diego County, only after the location, method of rearing ACP, and protocols for doing such work safely have been approved by the appropriate persons (at a minimum, CDFA and the San Diego Ag. Commissioner). In this event, the Agricultural Technician will be charged with maintaining host plants and rearing ACP under the supervision of Co-PI Bethke and both he and she will conduct the proposed trials.

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## Project Budget Requested

**Morse: Department Account Number:** 440330 JGM  

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| **B. Travel and S&E for Grafton-Cardwell (extension, coordination)** | $2,000 |

| **C. Subcontract to UCCE San Diego (Co-PI Bethke)** |             |
| **Salaries**                             | Agricultural Technician, 0.75% time               | $20,703 |
| **Benefits**                             | Agricultural Technician, Benefits at 75.84%       | $15,700 |
|                                           | **Total Salaries & Benefits**                     | $36,403 |
| **Supplies and Expenses**                |                                                  | $2,600  |
| **Travel**                               |                                                  | $5,000  |
|                                           | **Total Requested, Bethke**                      | $44,003 |

**GRAND TOTAL REQUESTED**  

$110,000

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**Specifics regarding the contract:**  

- **Funding to Morse:** $63,997  
- **Funding to Grafton-Cardwell:** $2,000  
- **Subcontract to Bethke (UCCE San Diego Co.):** $44,003
SIGNATURES FOR MORSE, BYRNE, AND GRAFTON-CARDWELL:

Morse: _________________________________ Date: ________________________

Byrne: _________________________________ Date: ________________________

Grafton-Cardwell: ______________________ Date: ________________________

Department Chair: ______________________ Date: ________________________

Authorized UCR Representative: ________________ Date: ___________________

SIGNATURES FOR BETHKE:

Bethke: _________________________________ Date: ________________________

County CE Director: ______________________ Date: ________________________

Authorized UCCE: ______________________ Date: ________________________

SIGNATURES FOR GODFREY:

Godfrey: _________________________________ Date: ________________________

Unit Head: ______________________________ Date: ________________________