

CALIFORNIA AVOCADO COMMISSION
PROJECT PLAN - RESEARCH GRANT PROPOSAL

Proposal Budget Requested: **\$120,000**

CAC Fiscal Year 2008: November 1, 2007 – October 31, 2008

Anticipated Duration of Project: 3 years **

This project is: Ongoing (Year 4 of 3) **

** Due to taking the project in a new direction this last year (i.e. trunk injections of 4 active ingredients, acephate, dinotefuran, imidacloprid, and a proprietary avermectin), we are requesting one additional year of funding beyond that originally projected. Despite the additional objective, we are still on schedule (actually, ahead of schedule) to complete the work that was originally proposed.

Project Title:

Evaluation of systemic chemicals for avocado thrips and avocado lace bug management

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List of relevant published research

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Review of literature relevant to this research project:

There is surprisingly little literature linking pesticide residue levels within plant tissues with arthropod toxicity. This has largely been due to the lack of a convenient technique that is sensitive enough to detect low levels of pesticide within plant tissues. A common approach to testing the efficacy of an insecticide is to expose insects to treated plant foliage over time and then relate the insecticide application rate with the resulting mortality. This approach gives a measure of the insecticide efficacy over time, but provides no data on the titers of insecticide that are present at the time of each toxicity assessment. We have developed a system to provide a better understanding of the uptake of systemic insecticides in citrus (Castle et al., 2005), grapes (Byrne and Toscano, 2005; Byrne et al., 2005a), and avocados (Byrne et al., 2005b; Byrne et al., 2007). This has been made possible by the availability of commercial ELISA kits. While pesticide-specific ELISAs have been developed for many years, their primary purpose was in the detection of chemical residues in ground water as part of environmental monitoring programs (Gee et al., 1996). We have exploited the technology to quantify pesticide residues within different plant tissues. This has permitted us to measure residues of pesticides in tissues that have also been used for toxicity bioassays (Byrne et al., 2005b; Morse et al., 2005). We have defined insecticide threshold levels required for the effective management of two important avocado pests, the avocado thrips, *Scirtothrips perseae* (Nakahara), and the avocado lace bug, *Pseudacysta perseae* (Heidemann) (Byrne et al., 2007).

The first use of the ELISA strategy for correlating insecticide residues with insect mortality was in a study conducted on citrus (Castle et al., 2005). In that study, densities of *Homalodisca vitripennis*, the glassy-winged sharpshooter (GWSS), were monitored on citrus trees that were

treated systemically by chemigation with the neonicotinoid insecticide imidacloprid. On each occasion that the numbers of GWSS were determined, the concentrations of imidacloprid were also determined in the xylem fluid extracted using a pressure bomb. It was shown that suppression of GWSS populations was maintained when a concentration of 10 ng imidacloprid per ml of xylem fluid was reached.

Having established a working threshold for the GWSS, the ELISA was then used to optimize imidacloprid application rates in vineyards (Byrne and Toscano, 2006; Byrne et al., 2005a; Toscano et al., 2005; Weber et al., 2005). While this objective was completed in the Temecula Valley region (Byrne and Toscano, 2006), it was clear from the uptake data in Napa (Weber et al., 2005) and Coachella Valleys (Toscano et al., 2005) that the behavior of imidacloprid was not uniform in every vineyard. Soil type and irrigation practices had a dramatic effect on uptake.

There are several chemicals that belong to the neonicotinoid class of insecticides, and each has its own distinctive chemical properties. Water solubility varies greatly – the solubility of dinotefuran, for example, is almost 80-fold higher than the solubility of imidacloprid. Thus, the way in which these two insecticides move within a similar soil type can be greatly affected by irrigation (Toscano et al., 2005). Add to this the enormous variability that can exist in soil types, and the complexity of insecticide behavior in those soils becomes clear. It is important, therefore, to establish the efficacy of insecticide uptake for different plant systems under the prevailing agronomic practices, bearing in mind that two chemicals from the same class can behave differently. To illustrate this point, consider the results of the citrus (Castle, et al., 2005) and grape (Toscano et al., 2005) studies. Following the application of Admire to mature citrus trees, a period of between 4 to 6 weeks elapsed before residues of imidacloprid were at sufficiently high enough concentrations to kill glassy-winged sharpshooters feeding from the xylem fluid. The chemical properties of imidacloprid, particularly its water solubility, result in its slow uptake. In contrast, the neonicotinoid thiamethoxam is 8-fold more water soluble than imidacloprid, and its uptake into mature citrus trees was not only more rapid (its peak concentrations were reached within two weeks), but it reached higher titers even when applied at a lower rate. In grapes, uptake of both imidacloprid and thiamethoxam was very rapid due to the lower overall plant biomass. However, as noted in the citrus study, at lower rates of application, the uptake of thiamethoxam resulted in higher titers of insecticide within the xylem fluid (Toscano et al., 2005). It is important to note that despite the slow uptake of imidacloprid into citrus trees, once the threshold titers are reached, they can be maintained for up to 4 months (Castle et al., 2005). This seems to be a major advantage for imidacloprid – binding to the soil prevents a major influx of chemical into the plant at one point. Instead, a slow release of imidacloprid from binding sites within the soil allows for a more uniform uptake into a plant. If the uptake rates are favorable, a factor that is largely determined by the interaction between the watering and soil type, then prolonged protection can be afforded to the plant.

In 2007, we began evaluating trunk injection applications of acephate, imidacloprid, dinotefuran, and an avermectin (proprietary formulation which is under a confidentiality agreement with ArborJet) in trees that are about 25 years old. Trunk injections have shown excellent promise for the management of emerald ash borer, adelgids, and other invasive tree pests in the U.S. (Cowles et al., 2006; Harrell, 2006; Young, 2002). Incredibly, imidacloprid efficacy was retained for up to 1 year against hemlock woolly adelgids (Cowles et al. 2006).

Industry research priority:

Control of avocado pests. The identification of effective chemical control methods. The timing and method of pesticide spray application. Spray methods to minimize the impact of materials on honey bees.

Summary of research relevance to indicated industry priority:

The major objective of this study is to evaluate the potential role of neonicotinoid insecticides for pest management within avocado groves. We envisage their successful implementation by the industry in terms of overcoming operational difficulties currently associated with the application of foliar insecticides (the difficulty in achieving good coverage by helicopter application, potential environmental impact concerns associated with drift, etc.) and alleviating potential resistance problems associated with the currently available insecticides (Agri-Mek, Success, and Veratran D). The project will evaluate the uptake, distribution, and persistence of (1) soil-applied systemic neonicotinoids and (2) trunk-injected neonicotinoids and other chemical classes in young and mature avocado trees. We will monitor the efficacy of these treatments against the avocado thrips and the avocado lace bug using a combined bioassay and residue analyses approach (Byrne et al., 2006). In this way, we will be able to determine which application methods can deliver effective threshold levels of insecticide for each insect pest.

Justification for systemic insecticides:

The neonicotinoids represent a relatively new class of insecticide with a novel site of action that is not currently targeted by other insecticides used within California agriculture. Imidacloprid is the most widely used product within this class, and has remained resilient to resistance development. As with any class of insecticide, if resistance develops to one compound, it may also confer resistance to other members within the same class. Target-site cross-resistance between Success, Agri-Mek, or Veratran D and neonicotinoids is unlikely due to the disparate nature of the target sites of these chemicals. However, evidence is less conclusive whether there may be metabolic cross-resistance potential between two or all three of these chemicals. In California, imidacloprid is already used within many crop systems, and there are as yet no confirmed reports of resistance to this product, even in insects that have exhibited resistance to the more conventional products such as the organophosphates and pyrethroids. This includes aphids and whiteflies, which are notorious for their propensity to develop resistance. In fact, the availability of the neonicotinoids has marked a new age in whitefly and aphid control and resistance (not in California) has been limited to cases where the basic principles of resistance management have been abandoned for indiscriminate treatment regimes (Byrne et al., 2003). With judicious use, the neonicotinoids are an attractive option for pest management within California agriculture and we are, therefore, interested in continuing our evaluation of their efficacy at the field level as potential products for avocado pest management. Additional foliar treatments are needed for resistance rotation but they would be affected by the operational difficulties already encountered by growers with groves on steep hillsides. Systemic treatments via irrigation and trunk injections, however, would provide obvious operational advantages for growers in that these chemicals can be more easily applied at much shorter notice, and they are also an attractive means of reducing resistance risks by providing an additional mode of action for rotation with products already being used.

In 2007, we began evaluating trunk injection applications of acephate, imidacloprid, dinotefuran, and an avermectin (proprietary formulation which is under a confidentiality agreement with ArborJet) in trees that are approximately 25 years old. Trunk injections have shown excellent promise for the management of emerald ash borer, hemlock woolly adelgids, and other invasive tree pests in the U.S. (Cowles et al., 2006; Harrell, 2006; Young, 2002). Injection treatments require lower application volumes, allow improved placement of insecticide in the tree, and reduce environmental contamination. Given the poor uptake of soil applications of imidacloprid (Admire) into large avocado trees, it was important to determine whether uptake could be improved by eliminating potential binding impacts of the soil. Direct injection into the vascular system of the tree would provide valuable insight into the movement of imidacloprid within the tree. Because none of the insecticides are registered for trunk injection on avocados, it will be necessary to evaluate residues in fruit. In CAC-organized seminars, we have been frequently asked by growers what levels of insecticide might be present in fruit because of the systemic mode of application. In an effort to address this issue for the industry, we have added a fruit residue objective to our study.

Research Summary

General methods and procedures:

The overall aim of this research is to optimize the application conditions for systemic neonicotinoid insecticides in order to provide effective management of key avocado pests. The original focus of our research was soil-applied systemic neonicotinoids, but we now wish to broaden that focus to evaluate trunk injections and bark treatments, which have shown great promise in other tree systems (discussed earlier). All trials will be conducted within commercial groves so that the relevance of our results in terms of their benefit to the avocado industry can be more clearly seen. Given the poor uptake of soil applications of imidacloprid (Admire) into large avocado trees (Morse et al., 2006), it will be important to determine whether uptake can be improved by injecting the insecticide directly into the tree. This approach would eliminate potential binding of insecticide to soil particles and organic matter. We have established a collaboration with trunk injection specialists at ArborJet. In addition to evaluating their imidacloprid formulation (ImaJet), we have now begun to evaluate other compounds that are currently marketed or are being developing for future release. These include a proprietary avermectin, a second neonicotinoid (dinotefuran), and an organophosphate (acephate). We are seeking an additional 1 year of funding to evaluate trunk injections of these materials – note that trunk injections were not part of our original research proposal but at the Sept. 9, 2006 Avocado Society meeting at the Pechanga Resort, it was suggested that we add this research objective to our project and based on this input and follow-up discussions with CAC, we did so starting with our March 26, 2007 field trial in Temecula. We are having insecticide residues analyzed in fruit collected from trunk injected trees, as this will be a governing factor in the registration of trunk treatments for avocados should the toxicological activity against avocado thrips and avocado lace bugs prove favorable.

We will continue to use the procedures we have developed and used in our current project. We can measure residues of insecticide in leaf tissue using ELISA technology. Using that system in conjunction with Munger cell bioassays, we have completed the objective of defining threshold levels of imidacloprid needed to kill avocado thrips (young flush leaves) and avocado lace bugs (mature leaves) feeding on their preferred leaf tissue. During our current trial, we will establish

similar data for dinotefuran and will begin such data collection with avocado thrips and the proprietary avermectin.

Soil Column Studies:

Soil type can have a profound impact on the availability of neonicotinoids for uptake by the roots. We have developed a simple system to measure the binding capacity of soils for insecticides. To evaluate the binding potential of a soil at a new trial site, soil cores to a depth of 6 inches are collected, air-dried, sieved through a 2 mm mesh, and then loaded into glass columns. Each column is fully saturated with water, and 10 ml of a 1000 ng/ml solution of imidacloprid or dinotefuran (prepared from formulated products) are added to the top of the column. Then, successive 10 ml volumes of water are added to the top of the column to wash the insecticide through the soil profile. The reason for using a saturated column is so that as each 10 ml volume of water is added to wash the column, 10 mls will be displaced from the bottom of the column. These are collected into separate containers and the insecticide content in each measured by ELISA. The rate at which an insecticide moves through the column depends upon the soil texture and the organic matter content. Rapid flow through the column indicates that insecticide is readily displaced from binding sites within the soil. Under field conditions, this would indicate good uptake potential from the soil if this kind of solubility occurred close to the root zone.

Tree size:

The tree sizes selected for inclusion in this project represent the diversity of those typically found within California avocado groves, and include fruit-bearing trees at either end of the size spectrum for which avocado thrips treatments would be necessary to prevent fruit scarring. The young trees will be 6-8 years old and 8-10 feet tall that are typical of the many new plantings within the industry. The older trees will be 18-25 year old trees and 25-40 feet in height, typical of those with minimal thinning and pruning. The latter represent the greatest challenge to the successful deployment of soil-applied systemic insecticides in avocado groves. Irrigation practices can differ between groves. In the sites that we select for our studies, trees will be watered via sprinkler irrigation methods. Treated and untreated avocado trees will be irrigated according to established agronomic practices in the groves. Irrigation dates and all agronomic practices executed within the grove throughout the project period will be recorded for reference purposes.

Insecticide Treatments:

Admire Pro will be applied at a rate of 14 fl oz/acre. Venom 70SG (dinotefuran) will be applied at a rate of 60 g of product/acre. The soil-applied insecticides will be injected through the irrigation lines (chemigation) in large plot trials or via a sprinkler can in single-tree replicated experiments.

The application of insecticides for uptake through the roots is done in three steps: (1) irrigation for a period of up to 6 hours pre-application to thoroughly wet the soil in preparation for chemical treatment; (2) administration of chemical through the irrigation lines; (3) irrigation for a period of at least 6 hours post-application to wash the chemical through the leaf litter and into the soil. Pre-irrigation is an essential component for efficient preparation of the soil for chemical applications. By moistening the soil, it becomes more absorbent, and decreases the likelihood of

surface run-off (lateral movement) of insecticide during application that is likely to occur if the soil is dry and hard. Following application of insecticide, it is important to continue irrigation in order to move the insecticide below the surface of the soil where it will be unaffected by photolysis. This extra irrigation will ensure that the insecticide will penetrate through heavy leaf litter, which is a common feature of avocado groves.

Trunk Injections:

We are collaborating with ArborJet to evaluate several products that the company has formulated for trunk injection. These products include 2 neonicotinoids – imidacloprid (ImaJet) and dinotefuran (currently at the experimental stage in terms of formulation), an organophosphate (AceJet which has the active ingredient acephate) and an avermectin (we have been asked by ArborJet not to disclose the active ingredient of this chemical, but the chemical is related to the active ingredient in the commonly used foliar treatment Agri-Mek).

There are several application methods for trunk injections. Perhaps some of the antagonism against the use of trunk injections stems from some of the earlier technologies, which require an “IV-type” drip line to individual trees. Many in the industry felt this type of application would give the industry a bad press if the consumers were shown trees during the application process. Newer technologies eliminate the need for “IV-type applicators” and should alleviate many of the concerns about bad publicity surrounding the use of insecticides within groves.

In an effort to administer equal amounts of product to the trees, the trunk diameter of each tree within a treatment block will be quantified. Trees will be selected with diameters of similar range. The rates of application will be determined when we complete our current trial, in which we have a range of rates under investigation (summarized in Table 1).

Table 1. Summary of insecticides, rates of application, and post-treatment evaluations for our 2007 trial in Riverside County

Treatment	Active Ingredient	Application Method	Rate (g ai/tree)	Post-Treatment Evaluations
Admire Pro	Imidacloprid	Soil	2.28	Leaf Residues
IMA-jet	Imidacloprid	Trunk Injection	0.6	Leaf and Fruit Residues
			1.8	Leaf and Fruit Residues; ALB and Avocado Thrips Bioassays
Venom	Dinotefuran	Soil	1.89	Leaf Residues
AJ-F-08	Dinotefuran	Trunk Injection	0.6	Leaf and Fruit Residues
			1.8	Leaf and Fruit Residues; ALB and Avocado Thrips Bioassays
AJ-6600	Proprietary Avermectin Class Insecticide	Trunk Injection	0.6	Leaf and Fruit Residues; Avocado Thrips Bioassays
ACE-jet	Acephate	Trunk Injection	1.8	Fruit Residues; ALB and Avocado
			5.4	Thrips Bioassays
Controls	--	--	--	Leaf and Fruit Residues; ALB and Avocado Thrips Bioassays

Bark Treatments:

Trees that have a thin outer bark can absorb chemicals into the cambium where they are distributed throughout the tree via the xylem and phloem systems. Pentra bark is a product that is mixed with the pesticide to enhance absorption through the trunk. The mixture is sprayed around the lower section of the trunk in a final volume of 1 gallon. We would like to evaluate this application method as a possible strategy for avocado trees. This method of application may provide improved uptake of insecticides compared with the more localized treatments of trunk injections. In the state of Michigan, an SLN (special local needs permit) has just been approved for the use of dinotefuran and Pentra bark for the control of the Emerald Ash Borer. The technique has worked well for the management of that pest, and is attractive because of the lower volumes of water that are needed to treat large areas.

Insecticide Timings:

Our current trial was initiated at about 4-6 weeks before the Spring leaf flush occurred. Early indications suggest that the timing of trunk injections, and perhaps the timing of soil applications of dinotefuran, can play an important role in distribution of insecticide at the target zones. Bearing in mind that limited work of this nature has been done in the past, we will evaluate three timings for the trunk injections – these are tentatively (pending results of the 2007 study and further discussions with collaborators) (1) at 4-6 weeks before bud break, (2) when the foliar flush occurs, and (3) 2 weeks or so following the flush.

Insecticide Residue Studies:

Leaf tissue extraction. Residue measurements will be determined for leaf discs cut from avocado leaves. This will be done using leaves collected from various locations around the tree, thereby giving good information on the distribution of insecticides within the trees. Residues will also be determined in leaves used for avocado thrips and avocado lace bug bioassays, which will allow us to judge how effective insecticide residues are at killing these pests. For leaf residue analyses, 6 leaves will be sampled from each tree, and a leaf disc cut from each will be used to extract the insecticide for quantification. Leaf discs will also be cut from the bioassay leaves (12 leaves per treatment) in order to correlate avocado thrips and lace bug mortality with leaf residues. During our 2006 trial, we determined greater uptake into older leaves. Residues will, therefore, be compared in the Spring leaf flush with older leaves that were on the tree at the time of the applications (and which can be aged according to the number of growth scars present on the stems).

Residue measurements. Insecticide analyses on the leaf tissue extracts will be determined using ELISA, HPLC, and TLC techniques. ELISA (Enzyme-Linked ImmunoSorbent Assay) is a very sensitive tool for measuring insecticide residues. Antibodies have already been prepared against both imidacloprid, dinotefuran, and the proprietary avermectin and these are available in kit format from commercial sources. The QuantiPlate kit for imidacloprid (cat. #: EP 006; EnviroLogix Inc., 500 Riverside Industrial Parkway, Portland, ME 04103, USA) has a lower sensitivity of 0.2 ppb, while the Dinotefuran Plate Kit (cat. #: 9107001200USA; Horiba Ltd, 2 Miyano Higashi, Kisshoin, Minami-ku, Kyoto 601-8510, Japan) has a lower sensitivity of 1.5 ppb. Each assay takes under 2.5 hours to complete once the samples have been prepared. HPLC (High Performance Liquid Chromatography) is also a very powerful technique for the

quantification of insecticides in various matrices, including soil samples and plant tissue extracts. Differences in chemistry between neonicotinoids confer varied hydrophobicity, making it possible to discriminate insecticides and their metabolites or degradation products on specific columns known as reverse-phase columns. Movement through the C18 columns is governed by hydrophobicity, which allows accurate separation of closely related chemical species. These properties are also exploited by TLC (Thin Layer Chromatography). Used together, ELISA, HPLC, and TLC represent a very powerful set of analytical tools that can both identify the uptake of the insecticides as well as their stability and longevity within the plant.

For leaf residues, discs will be homogenized in methanol, and then allowed to extract over night. Aliquots of the supernatant are then dried, re-suspended in water, and the ELISA conducted.

Fruit Residues. Perhaps the most important information we will need to generate is residue data for fruit (i.e. do levels in fruit exceed allowable levels). We are assessing insecticide residues in fruit from all our current treatments that involve unregistered applications. Fruit analyses will mimic the protocol used by the IR-4 program for the determination of residues. Two sets of 6 fruit will be chosen from around each tree. These fruits will be quartered and opposite quarters sent to one of two labs for residue evaluation. The imidacloprid, acephate, and dinotefuran will be evaluated by Dr. Robert Krieger of UCR, who has been added as a Co-P.I. on this project, while the avermectin class insecticide residues will be determined by a commercial analytical laboratory.

Insect bioassays:

Insects. Avocado thrips will be collected from an untreated field site for use in the bioassays described below. Depending on whether or not it appears, *Neohydatothrips burungae* could become a pest on avocados; therefore, bioassays will be done with this insect assuming we are able to get a laboratory established from a pure field strain.

Avocado thrips bioassay. Bioassays will be conducted in Munger cells using freshly collected young avocado leaves. Prior to assembling the bioassay unit, discs will be cut from the leaf area immediately outside the cell chamber using a #4 cork borer (i.d. = 0.39 cm²), avoiding the main veins. Four discs will be cut from each leaf and immediately stored at -20°C until residues are measured. The leaves will be inserted into the Munger cells where a minimum of 10 second instar avocado thrips will be added. Mortality will be assessed at 48 hours.

Avocado lace bug bioassay. Bioassays will also be conducted in Munger cells using freshly collected mature avocado leaves. Prior to assembling the bioassay unit, discs will be cut from the leaf area immediately outside the cell chamber using a #4 cork borer (i.d. = 0.39 cm²), avoiding the main veins. Four discs will be cut from each leaf and immediately stored at -20°C until residues are measured. The leaves will be inserted into the Munger cells where of 5 small to medium sized nymphs will be added. Mortality will be assessed at 48 hours.

Statistical analyses:

All statistical analyses will be performed using GraphPad Prism® v4 (GraphPad Software Inc., San Diego, CA). Analysis of variance (ANOVA) will be used to test for significant effects of

tree size on insecticide uptake and distribution within trees. Repeated measures tests will be used to evaluate the significance of residue levels between different sampling dates.

Summary of Research Relevance to Systemic Pesticide Knowledge:

The techniques developed as part of this ongoing research have direct relevance to potentially every crop that is grown in California. Although techniques may need refinement for each plant system, the basic principle of measuring insecticide residues and correlating those with insect mortality in order to establish effective thresholds is the same for all. While it was necessary to modify the techniques when we studied leaf tissues rather than xylem fluid extracts, the overall methodology did not change drastically.

The techniques developed in this study are now being used to assess the impact of imidacloprid on parasitoids and predators. The greater sensitivity of the ELISA method, and the requirement for much smaller volumes, allow the user to quantify imidacloprid in tiny amounts of xylem fluid, nectar, and leaves.

Our research is novel in its approach to quantifying pesticide residues for use in the pest management decision-making process. One of the major spin-offs of this research is the possibility that growers could submit leaf samples (or later, fruit samples) from treated trees to our laboratory or others (should they develop this technology as we have) for pesticide residue testing. The grower would then be aware of the effectiveness of his chemical treatment, and would be able to decide whether further action was necessary for his pest management program.

Statement of Objectives and Projected Timetable of Events:

Our current trial in Temecula will see an end to our evaluations of soil treatments on large trees. In 2008, we will conduct further evaluations on mid-sized trees when we continue our assessments of trunk injections and bark treatments.

In this coming year, we also want to elaborate on the trunk injection study. Currently, we have established a pilot study with the cooperation of a Temecula grower who is donating fruit so that the study can be completed. The fruit cannot be marketed because there are no trunk injection pesticides registered for use on avocados.

Objectives:

1. Evaluate the uptake of systemic applications of neonicotinoids in small trees (6-8 years old, typical of the many new plantings in the industry) and large trees (18-25 years old, 25-40 feet in height, typical of those in commercial avocado groves in California) applied by chemigation, trunk injection, and bark treatments.
2. Determine the conditions affecting the uptake of neonicotinoids – insecticide timing and other systemic insecticides when administered via trunk injection or bark painting.
3. Determine the impact of leaf residues of these neonicotinoids against avocado thrips, avocado lace bug, and possibly, *Neohydatothrips burungae*, with the goal of establishing threshold levels of insecticide necessary for pest management.

4. Determine insecticide residues in fruit from trees treated by trunk injection and bark painting.

Expected Duration of Project:

With this proposal, we are entering a fourth year of the project. We are on schedule with our assessment of soil treatments of imidacloprid, but have added additional objectives to evaluate dinotefuran as a soil treatment, and trunk injections of imidacloprid, dinotefuran, acephate and an avermectin. The latter objective must be evaluated on a range of tree sizes for which we need to establish additional trials. In 2008, we also plan research on trunk bark treatments with Pentra bark.

PROPOSED PROJECT BUDGET

Budget Year 2008 (Nov 1, 2007-Oct 31, 2008)

Salaries and Benefits:

Assistant Researcher (Byrne), 60% time for 12 months	\$40,270
Benefits	\$12,484
Staff Research Associate (Robinson), 20% time for 12 months	\$8,398
Benefits	\$1,931
Staff Research Associate (Urena), 20% time for 12 months	\$9,646
Benefits	\$2,990
Subtotal, Salary	\$58,314
Subtotal, Benefits	\$17,405
Subtotal, All Salary and Benefits	\$75,719

Supplies/Expenses:

ELISA kits	\$12,600
Laboratory supplies	\$500
Field supplies	\$1,500

Fruit Residue Analysis

Fruit from our 2007 trial (not included in last year's budget)	\$12,000
Fruit from our 2008 trial	\$15,000
Subtotal, All Supplies and Expenses	\$41,600

Travel

Ca. 20 trips of 120 miles each to Temecula, vehicle rental	\$2,681
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Total **\$120,000**

Is satisfactory execution/completion of this research project contingent upon receiving support funding **in addition** to CAC funding? **No**

Funding from other sources:

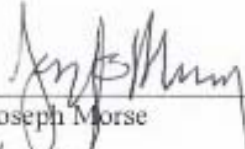
We are not currently receiving support from any other source for this project.

Evaluation of systemic chemicals for avocado thrips and avocado lace bug management

11/1/07 – 10/31/08

Approvals

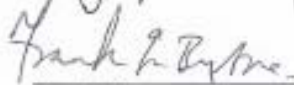
Project Leader



Joseph Morse

Date: 5-29-07

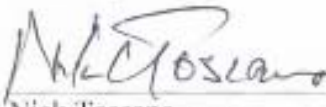
Project Leader



Frank Byrne

Date: 5-29-07

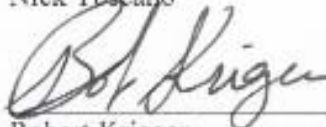
Project Leader



Nick Toscano

Date: 5/29/07

Project Leader



Robert Krieger

Date: 5/29/07

Department Approval



R. T. Carde, Chair, Entomology

Date: 5/29/07

CAC Approval

Mark Affleck, President/CEO

Date: _____

The Regents of the University of California



Mayela Castillo
Sr. Contract & Grant Officer

5/30/07