



**Lygus RAMP PI Meeting
Maricopa Agricultural Center
June 22 – June 23**

Participants: Peter Ellsworth, Al Fournier, Yves Carriere, Christa Eilers-Kirk, Virginia Barkley, Lucy Li, Peter Asimwe, Russ Tronstad, Steve Naranjo, James Hagler, Colin Brent, Lolita Mathew, Dale Spurgeon, Rodney Cooper, Pete Goodell, Jay Rosenheim, Larry Godfrey, Megha Parajulee, Stan Carroll

Purpose: This meeting brought together the majority of RAMP PIs and several collaborators and colleagues to review our progress on over 30 RAMP projects, identify challenges and pending objectives, and to strategize on successful completion of RAMP objectives.

Day 1: Presentations and Reports

I. 10:00–11:00 The Lygus RAMP, Why are we doing this? Peter Ellsworth

Peter presented a general orientation to the RAMP including some general information on project progress, modifications, and challenges that remain.

II. 11:00–Noon Project Evaluation and Impact Assessment. Al Fournier

Al covered the need to develop reports that emphasize results and outputs, reviewed our Internet and listserv resources, and reviewed our commitments outreach and our methodology for measuring change in our stakeholder groups. Both research and extension outputs and products are very important to documenting our success. Al described a new procedure for collecting data from PIs for RAMP Reports. The group discussed the use of an audience response system to enhance response rate for the Lygus Management Survey.

III. Noon–1:00p Lunch

IV. 1:00p–2:00p Plant/Pest/Pesticide Interactions. Steve Naranjo

Steve gave a presentation summarizing on our progress with respect to yield : damage relationships for various crops, and efficacy and non-target effects of Lygus insecticides. Attendees presented oral reports on their specific progress in this area (see project summaries). Larry Godfrey mentioned some resistance monitoring work he is initiating.

V. 2:00p–3:00p Individual Behavior & Local Movement. James Hagler

James presented on the progress made in understanding Lygus biology, behavior, and local movement as inferred from mark/capture studies, etc. Colin Brent (USDA, non-

RAMP member) also give a short presentation on his findings regarding Lygus reproductive behavior & biology. Attendees provided oral reports on their specific progress in this area (see project summaries). In addition to reports from project PIs, Dale Spurgeon, USDA, reported on his sampling efficiency work.

VI. 3:00p–4:00p Regional Ecology, Movement & Modeling. Yves Carriere

Yves gave a presentation on the status of the large 3-state regional ecology project. Attendees reported on their specific progress in this area (see project summaries).

VII. 4:00p–5:00p Game Training Simulation. Peter Ellsworth

This topic was deferred to Day 2 discussion. On Day 2, Peter provided a very brief presentation to graphically introduce this topic.

Day 2 Discussions

Game Plan: We held discussions in each of 4 theme areas with the following objectives:

- (1) Develop a clear understanding of our current progress in meeting RAMP objectives;
- (2) Discuss results and how they may relate to other RAMP components;
- (3) Identify unmet objectives and set goals for accomplishing them;
- (4) Identify expected outputs and applications of the research.

Expected outputs

Unanticipated RAMP outcomes / reportables

Budget points

I. Plant/Pest/Pesticide Interactions

- Bonus: Parajulee's lab is doing work on fleahoppers. Though not Lygus, fleahoppers have a similar niche. It would be appropriate to report some of these outcomes as part of the RAMP.
- Goodell: We are behind on the eggplant work. Carbine is registered in CA, but most growers are still relying on broad-spectrum insecticides. It may be a marketing issue. Objectives were to examine current decision-making in eggplant and do some experimentation on thresholds, then integrate what is learned into eggplant management guidelines they will publish.
- Goodell: Pima cotton work. There seems to be little adoption of Carbine in cotton. There is an educational need, although growers are few. They are publishing Pima PMG, now going through final review. Will have some lygus management information.
- Godfrey: has cotton trials and bean trials. They do field days to highlight the chemical trials. They are looking at the same suite of chemicals. Includes metaflumizone, indoxacarb (in beans) and novaluron (in beans). He is also working with Mueller on seed alfalfa trials. Any Lygus control work in seed alfalfa should be reported in the RAMP. Also monitoring resistance to pyrethroids, carbamates and OPs in 3 locations in cotton and alfalfa. Larry is willing to test Arizona Lygus in these trials.

- Parajulee: has a grad student doing work on Carbine & Orthene, looking at sublethal effects of Carbine: effects on feeding and fecundity. This was not a RAMP objective, but they will significant work done in this area. Product: papers will be produced on this work.
- Naranjo: Do not know the economics of lesquerella, but will have Lygus impact data. Because of the long growing season of guayule, it is hard to do trials to measure the impact of lygus. But they have made observations of lygus feeding gauyule, but are struggling with how to measure their impact on the quality and yield. Another problem is they don't always get a lot of lygus in guayule; their presence in guayule is seasonal, and may also depend on the age of the stand (or this could be a sampling problem). May do greenhouse studies, but field scale may not be tenable. Suggestion: modify the objective to determine if lygus can impact the yield.
- McGuire objective was unfunded, but was looking at interface between seed alfalfa and cotton, examining infection rates of Beauvaria. One problem is that Beauvaria is broken down by UV radiation. Dale thinks it may be a long shot, but worth looking at, particularly in alfalfa in the spring.
- Rosenheim: Geocoris in cotton, now in third field season of field experiments. 2 main results so far (1) Geocoris is suppressing populations through egg and small nymph predation; (2) also finding that cannibalism is density dependent, which may explain why Geocoris does not go beyond a certain density. So they contribute to population suppression earlier in the season, but when lygus are a big concern, their role is diminished. Working mainly with *Geocoris pallens* in cage studies. Unmet objectives: how to translate this information into a recommendation for growers. Additional field work may be needed to develop this.
- In lygus sampling: how detailed should we be making note of natural enemies? In Arizona, we are tracking most predators. Spiders are important predators, based on Hagler's lab work. What is the impact of miticides on spiders? We have a photo gallery of spiders on ACIS and Scott in Hagler's lab is working on something.
- Carriere: Could do principle response data on predators and correlate it to Lygus density from the regional field sampling. We have data that can be divided by year, by state, by region, includes pesticide data, lygus and predators. There is a lot of potential to analyze this data to better understand the dynamics.

Update: Third International Lygus Symposium plans. We will look at 2010 to have this meeting. Peter and I will send out an online survey to the Asilomar list this week, and will be looking for someone to step up and help organize the meeting. Could it be combined with another meeting? Doubtful, based on discussion the group had about this in 2007.

II. Individual Behavior & Local Movement

- Lolita, post doc with Jeff Fabrick. Evaluating molecular tools for lygus management. Using RNA to block specific lygus development genes or oviproduction. Current barrier is a lack of information on Lygus genes. They have a collaborator who has done some sequencing of *L. lineolaris*. They are working on *L. hesperus*. A transgenic approach. They have developed some markers. For this to work, it would depend on adequate production of double-stranded DNA in the host plant, which may be a limiting factor.

Monsanto has a patent on some lygus genes already. Peter may be doing some work on transgenic lygus work with Monsanto, but they are 6 to 10 years out from any marketable product, only at the beginning stages.

- Naranjo: Flight assays were discussed yesterday. This data is different from what would be seen in the field, but the value is in comparison of different individuals and factors in the lab. He is open to pursuing other kinds of questions that people may have based on fieldwork or field observations. Barrier: No one except for Jackie has the expertise to run the vertical flight chamber, which would be used to answer questions about lift, etc. Brent has an interest in this kind of data. There may be some potential that Felica Blackmer or Jesse Hardin have some experience in using it.
- Naranjo looked at development and reproduction on lesquerella and guayule (not a RAMP objective), but did not get any egg lay unless they added food packs. It seems lygus may need to feed as predators in order to successfully lay eggs.
- Goodell: pulling together their work in alfalfa management and putting it into a bulletin. This objective has not been met yet, but this will happen.
- Parajulee: looking at non-cotton hosts. One or two journal publications forthcoming. No unmet objectives.
- Hagler: Provided a good update yesterday and his biggest barrier is data analysis. Steve has some ideas on this. He plans to work on the data over the next few months. Yves has the expertise to evaluate the data, but his plate is pretty full with other RAMP objectives. The data from Hagler's study will be important to the simulation model and game, and is also related to the regional sampling analysis that Yves is already working on.
- AZ PIs should plan a meeting, perhaps this winter, to discuss where we are with biology and movement.

Regional Ecology, Movement and Modeling

- Rosenheim: Corbett developed a basic simulation model, but it was built without realistic data and does not have a user friendly interface. Corbett has stepped away, as have Jay Bancroft and now Frances Scheller. Rosenheim suggests that he will bring a post doc on to handle the next stage of actually running the model. Step 2 is use the model to learn things, to parameterize the model based on parameters developed from other RAMP projects. Of course, this project fits in closely with the gaming simulation. The model does not yet have information about edge effects or movement across crops. With 15 months left in the grant, is it reasonable to expect the completion of stage 2 of this project. Goodell's crew will have more time after the current field season and could dedicate some time to these objectives. It may be less challenging than identifying the right post doc, given the time frame. Could collaborate with Boswell, who have the field scale to do the work, and also have past data. We need to identify the team to move forward on this.
- Rosenheim: Mark-recapture work is being done by Frances in collaboration with James. Have 3 field seasons completed, cotton alfalfa interface, 1.5 to 5 km scale. We have focused on methodological and statistical issues, and now have the statistical tools to quantify the long distance dispersal events of lygus. It is methodologically challenging to find and analyze data on these rare long-migrating lygus. Also have data on natural

enemies. Do not have results yet. 2008 data looks clean. It may be tougher to get good info out 2006-07 data. **Frances is working on a manuscript on this project.**

- Parajulee: They will start a bit later this year, in July. They will be picking fields soon. Is it possible to get spray data? Yes for 2008 & 2009. Getting the 2007 data may be tougher at this point. Texas pesticide data may not be as useful and may be incomplete. They had very low insecticide use in 2008. Megha suggests that Yves not delay his analysis while waiting for pesticide data: it may take time. Megha committed to getting the pesticide data as soon as possible.
- Carriere & Kirk were asked how the pesticide data are being analyzed. Insecticides have been ranked, but because the total number of sprays and the ranking analysis are correlated Yves says it makes no difference how they approach the analysis. There may be a temporal factor that is confounding the analysis. It is an option to use spray date as a covariate.
- Goodell question: Is concerned that in AZ, there is overlap between the rings and he was told no overlap is acceptable. It has to do with the autocorrelation problem being larger in CA and the fields being larger.
- Canadian group at McGill University (Dutilleul) needs an additional **25k + IDC** to complete the project (including 2009 data analysis)– about 30k. The budget came up short in part because of the exchange rate. Dutilleul is developing the **software** and working with Yves on the analysis. Later will **publish a paper on the techniques and how to use the software.**
- Yves used flowering date in the analysis, as a covariate. This was based on heat unit models in CA. They also get info on planting date. In TX first flowering dates are pretty uniform. All 3 states provided data on flowering.
- Arizona had problems when a freezer went down, which added significant time to processing the samples. Goal this year is to have 2009 data to Yves this fall. They are being processed in real time, but only for lygus. Yves asked if all 2009 data could be provided in the fall, to ensure there is enough time to complete all the analyses before the end of the grant. Christa asked people to send her final maps as soon as they are ready, because there is work she needs to do on them.
- Host distributions. How many crop habitats can the analysis handle? The stepwise analysis will allow Yves to perhaps start with more than 4 host types. For example can we segregate spring melons from fall melons, which have different dynamics?
- Pete Goodell will make contact with Larry Willhoit to tap the CA pesticide use data as part of our impact analysis.

Game Training Simulation

- Peter explained the goal and concept behind the game training simulation. It is a game that would be used to train growers using mobile laptops. The goal would be to teach them how to make good crop placement choices based on what we learn through the RAMP. Growers will have a list of crops to choose from (these might vary locally). The grower would pick their crops and “plant” their fields, arranging their crops. We will build economics into this.
1. Run the simulation first with no lygus in the system to learn the economics.

2. Run it again with lygus in the system and calculate net profit for the grower and community when they make decisions in isolation.
3. Then we teach the concepts of lygus risk, movement, etc.
4. They communicate and perhaps cooperate
5. Then run the simulation again.
 - Outputs for each run would include economic profit based on different lygus levels for each individual and for the community.
 - Challenges: there is no simulation engine for this. We do not yet know what the parameters will be. Andrew Corbett has withdrawn from the project. He connected us to a company in Australia called Cadre. They have provided a proposal for developing this and the budget for this was \$67k. There may be some opportunities to haggle on the budget, perhaps.
 - Andrew was budgeted funds, 15k in year 2 and 15k in year 3, for the game training simulation. Separately, Andrew was budgeted a separate 60k over 4 years for the simulation model.
 - Recently, Andrew has expressed some concerns about the use of the simulation as a basis for the game, because it is not parameterized based on realistic data. He is interested in what will come out of the regional ecology project. Yves estimates that first 2 years of data analysis should be available by October, and this could be used by the team developing the game. We need to at least know what form the available data will be in. Based on 2007-08 data, at least we will know whether predictive models can be built from the regional sampling data.
 - Goodell suggested that after running the game, people could populate their own fields on with crops on a real world map. This would take into account their farm-specific limitations and constraints. It is beyond what we could do in the remaining time frame of this grant.

Budget Discussion

- Fiscal challenges as noted above.
- Everyone should review their budgets and identify if there are any resources that they can contribute back into these efforts. We need to know whether we will need to ask for a no cost extension. Al and Peter will send a reminder to everyone on checking their budgets.
- We should discuss potential future directions for a second RAMP. Think about the logical extensions of our current work. Perhaps a focus on natural enemies. By August of next year, we need to know what our plans and direction will be.
- In the Pacific NW, a group is putting together a RAMP on lygus control. Doug Walsh, Jim Barber, Frank Zalom are PIs. It may have been submitted this year. Focus on seed alfalfa, tree crops and strawberries.