RAMP OUTCOME TRACKING MATRIX: Updated Nov 30, 2008.							
Investigators	**Project Title**	**Objectives**	**Research Activities**	**Education Activities & Products**	**Measurements**	**Impact "nuggets" / Success stories**	**Leveraged Resources**
SECTION I: Field Level Experimental: Yield/Damage/Thresholds							
Ellsworth (AZ cotton) 1 data analysis project; 4 Extension presentations (200 reached); 1 invited syposium presentation (34 reached); 1 article (Western Farm Press); 1 grower demo; 1-on-1 mtgs with PCAs and growers (4); Leveraged 25k (UA-MAC PhD asst.)	Development of dynamic, yield : density relationships for terminating chemical control in cotton	1. Analyze 4-yrs of Lygus chemical control termination data. 2. Establish rules and/or guidelines for decision-making with respect to Lygus control termination. 3. Establish grower-demonstrations to both test, verify, and validate decision rules. 4. Continue education on the basic threshold guidelines for Lygus in cotton and the '15:4' concept of waiting until nymphs are present before initiating chemical controls.	1. All data have been assembled into a common database and prepped for analysis. A rate series of a novel chemical control agent was used to establish varying densities of Lygus and showed excellent relationship between Lygus levels (esp. nymphs) and yield. 2. A graphical representation of the data was developed to simplify presentation of the dynamic rules that govern Lygus control termination decisions. 3. Conducted experimental manipulation of natural enemies in field study to simulate impact of chemical choice and Lygus control consequences, and used as grower demonstration.	1. Presented invited talk at PB-ESA symposium in 4/08 on Lygus control termination & plant compensation for damage. 3a. One grower demonstration in 2007 was conducted with reduced-risk compound and timing of Lygus control termination. 3b. One grower field day was held on-site of grower demonstration to teach about Lygus termination decisions. 3c. Contacts were made to set-up demonstrations, but Lygus levels were too low to initiate treatments in 2008 in grower fields. 3d. Presented NE manipulation study in grower field day, and showcased damaged plants due to pest resurgence in response to Lygus chemical controls; co-wrote press article and provided photos. 4a. Met with individual PCAs to discuss their Lygus controls decision-making. 4b. Presented results from Lygus demo in 4 grower meetings.	Lygus thresholds, control termination, and plant compensation were presented to ca. 34 scientists; Met with 4 PCAs and 1 grower to discuss Lygus mgt. and potential demonstrations. Reached over 200 growers/PCAs in grower mtgs & field day with information on Lygus management and control termination. Published article in Western Farm Press showed readership the impact of pest resurgence as consequence of inappropriate Lygus controls.	One grower managed 1200 A of cotton late season with a reduced-risk insecticide based in part on this research and the pilot guidelines. Two PCAs reported using nymphs exclusively for timing Lygus chemical controls overturning a long-standing practice of spraying based on Total Lygus and/or adult Lygus counts only.	4-yrs of previous support from CI to help develop the experimental basis of this activity. MAC graduate student assistantship for 1 Ph.D. student doing related work showing whitefly pest resurgence in response to poor choices in Lygus chemical control (ca. $25K).

Parajulee (TX, cotton) 3 expts.; 1 preliminary model developed to predict boll suscept. based on HU; Leverage: 25k (CI, TX); 20k (CI Core)	Boll Susceptibility window for L. hesperus in TX cotton	a) Developing a heat unit based boll susceptibility threshold, b) Evaluating boll susceptibility differences among commonly adopted cotton cultivars, c) Evaluating the effect of nitrogen on boll susceptibility window in high production potential drip planted cotton.	a) Conducted field experiments to determine a heat-unit based boll susceptibility threshold. **Results are detailed in the 2008 Results Summary Report**. b & c) Conducted field experiments to determine a boll susceptibility differences among cotton cultivars and under 5 different nitrogen treatments. **Results:** Preliminary analyses suggest that the boll maturity did not significantly vary with cotton variety or nitrogen fertility rate.	We plan to prepare a publication based on data from these studies. We will develop management recommendations based on varietal differences as determined in part b. Nitrogen management recommendations will be developed based on plant growth phenology and boll susceptibility in relation to soil and leaf nitrogen, as determined in part c.		25K from Cotton Incorporated Texas State Support Committee and 20K from Cotton Incorporated Core Program
Bundy (NM, cotton) 1 exp.; 1 grower pres. (100 reached); 1 prof. pres.	Economic injury evaluations for Lygus in New Mexico Cotton	(a) Develop an Economic Theshold for Lygus hesperus on cotton in New Mexico. (b) Create an extension bulletin to communicate these thresholds to our clientele. (c) Disseminate new information via grower meetings, etc.	Data from the 2007 field research on Lygus infestation levels is currently being analyzed and compared to the results from the previous two years. Once completed, these data will be converted to a functional threshold for use by growers and consultants. This will be the first such information available in NM.	(a-c) an extension bulletin will be created to convey our results to growers/consultants; the impact of Lygus on NM cotton was presented to growers and consultants at 2008 NM grower's meetings; Lygus survey was presented at state meeting. (a) data are currently being incorporated into manuscripts (2-3) for submission to entomology research journals.	Data presented at beltwide cotton conference. Data on Lygus presented at NM State Cotton Grower's Conference (75-100 attended). Data will be further disseminated later in as extension bulletins (1-2), and research journals (2-3).	Personnel support from NMSU IPM Laboratory

Parajulee (TX, cotton) 3 exp.; 3 prof. pres; 2 consultant pres.; 1 publication in progress; Leverage: 20k (CI-Core)	Compensation of Lygus and fleahopper-induced fruit loss in cotton	a) Quantifying compensation of *Lygus*-induced fruit loss in pre-flower and early flower cotton under limited-irrigation production, b) Quantifying compensation of *Lygus*-induced fruit loss in pre-flower and early flower cotton under high input drip irrigation production system, c) Comparing the compensation potential of cotton in limited versus full irrigation after cotton fleahopper-induced square loss Note: These three sub-projects will collectively provide information to growers in determining the level and timing of Lygus/FH infestation that they can tolerate without having to treat with insecticides if we know the amount of compensation plants can attain for a given level of fruit loss.	Research began in 2007. We established 4 treatment regimes for each set of the study. Bugs were released for 3 consecutive weeks before or after initiation of flowering. Plant mapping was conducted weekly until crop cut-out. Percentage fruit loss for each experimental scenario was calculated. Yield and lint quality data were used to relate to the percentage fruit loss. **Results:** Our analysis indicates that while one needs to consider plant compensation potential, input variables (fertility, moisture), and environmental stress in making insect management decisions, protection of 30% fruit shed during early squaring and 25% during early flowering may not be necessary for the Texas High Plains.	Presentations based on these data made at: a) High Plains Association of Crop Consultants Annual Meeting, March 6, 2007, Lubbock, TX, b) Southwest Cotton Technology Conference, February 6-7, 2008, San Antonio, TX., c) Entomological Society of America Pacific Branch Annual Meeting, March 28-April 2, Napa, CA, d) High Plains Association of Crop Cosultants Annual Meeting, March 4-5, Lubbock, TX. One keynote speech will be delivered at an International Conference in Egypt in November partly based on these data. A peer-reviewed manuscript is planned for publication by early 2009 based on 2007 and 2008 data.		Invited for a panel discussion on *Lygus* management at the 2008 consultant conference. Also, invited as a keynote speaker at an International Conference in Egypt.	20K from Cotton Incorporated Core Funding Program
Goodell, Hutmacher & Godfrey (CA Pima cotton) About 150 "MiteFax" newsletters distributed	Strengthening research and extension for Pima cotton	1. To improve the quality of extension material for Lygus management in Pima cotton; 2. to improve the relevance of outreach to motivate change in Lygus management decision making	Currently reviewing existing materials and updating guidelines for monitoring and decision-making for Lygus in Pima cotton; will evaluate new methods for delivery and extension interactions	Used "MiteFax" to provide weekly status reports of Lygus in Pima to growers. Ultimately will provide information to growers on influence of cropping landscape on risk to cotton and management of Lygus. Future activities include survey of users and stakeholder response to new approaches	No measurements conducted in 2008.	Weekly publication of Lygus monitoring data from Pima cotton was well recevied by farming community	

Rosenheim (Ellsworth collaborator) (CA, AZ cotton) 1 exp, CA/AZ; 2 prof. pres; Leverage: 15k (grad student fellowship)	Incorporating the key predator *Geocoris* into thresholds for *Lygus* control in cotton	**Objective 1**: To quantify the influence of *Geocoris* spp. on *Lygus* egg, nymphal, and adult survival and on cotton fruit production. **Objective 2**: To modify existing control recommendations to incorporate knowledge of *Geocoris* spp. densities.	We have completed 2 seasons of field experimentation to quantify the effect of *Geocoris pallens* (a key predator of *Lygus* eggs and nymphs) and *Zelus renardii* (a key predator of *Lygus* adults) on the suppression of *Lygus* and the square retention and yield of cotton. **Results:** Despite the fact that *Zelus* is a predator of *Geocoris*, control of *Lygus* is most effective when both predators are combined. *Geocoris* populations appear to be limited by cannibalism. The intensity of cannibalism increases strongly, and the rate of *Geocoris* egg laying decreases strongly, as *Geocoris* densities increase.	Much of the field work is now completed for these objectives. We are presently processing samples from the 2008 field season. We will soon move to analyses and preparation of reports. Results were presented orally at two national meetings (Entomological Society of America and Ecological Society of America)			Graduate student (Yao Hua Law) support half-time on this grant and half-time on fellowship monies from the van den Bosch Endowment and from the Department of Entomology (UCD); total leveraged funds $15,000.
Palumbo (AZ vegetables) 1 exp.; 2 grower / PCA pres. (92 reached)	Lygus economic status and control in low desert vegetables and vegetable seed production	Objective 1: To deteremine the damage potential of Lygus and other seed feeding heteropterans on brassica seed crops. Objective 2: To monitor Lygus activity and document associated damage on lettuce and other leafy vegetables.	A field experiment was conducted in a broccoli seed crop with a cooperative grower. Aphids and false chinch bug were present during the trial and information was collected on insecticide efficacy and impact of FCB feeding on seed quality. *Lygus hesperus* were not observed during the trial. We may replicate the trail in 2009. A separate trial is being planned for Lygus efficacy on lettuce this spring.	(1) Participated in a PCA workshop for *Brasscia* seed growers and PCAs sponsered by Sakata Seed Co. in Yuma. Discussed the impact of FCB and Lygus on seed yield and quality, and alternative management options. As part of my presentation at Fall Vegetable Workshop in August discussed how to diagnose Lygus damage toromaine lettuce.	(1) 20 attended meeting (3) 72 attended meeting	Seed growers have adopted a simple sampling methodolgy for detecting Lygus and FCB in brassica seed crops.	

Godfrey (CA dry beans) 3 exp.; 2 field days (60 reached); 2 grower pres. (85 reached); publication of revised UC Pest management guidelines for dry beans; another UC IPM publication in progress.	Refining pest management guidelines for Lygus in dry beans	(a) evaluate the relationship between lygus bug numbers and dry bean production - yield and quality, (b) study the effects of application timing and intensity on dry bean production - yield and quality, (c) evaluate the effects of bean architecture on lygus bug sampling efficiency using the standard sweep net method, (d) modify existing thresholds as warranted based on results, (e) modify UC Pest Management Guidelines	Field research to study lygus numbers and timing of infestations on bean yield and bean quality was completed this year. Work was done on black-eye cowpeas on the UC Shafter Research and Extension Center and on lima beans of the UC-Davis Agronomy Farm. Yields were collected in early-mid Sept. Samples cleaning and bean quality evaluation in progress. Similar to 2007, lygus bug pressure was very high at the Davis location and low-moderate at the Shafter location.	Two field days were held to relay results to growers and affiliated personnel. Study details and goals were elaborated and field plots were viewed. A preliminary summary of results was provided. I particiapted in two grower meetings on dry bean production during the winter. The UC Bean Pest Management Guidelines have been modified. A Bean Year-Round IPM Program is under development.	(a) grower field days were held at both locations with each field day attended by 25-35 interested parties, (b) winter grower meetings (two) each had about 40-45 attendees.	Under the severe lygus bug pressure seen at the UC-Davis Agronomy Farm even the most intense treatment regime failed to produce beans of acceptable quality.	UC-Davis Agronomy Farm and at the UC Shafter Research and Extension Center land resources and personnel input

Bundy (NM chiles) 1 exp.	Plant bug injury to chile peppers	(a) Determine timing of plant bug injury to chiles. (b) Develop detailed descriptions of plant bug damage to chiles. (c) Determine impact of Lygus feeding on chile pepper yield. (d) Develop a threshold for Lygus on chile in NM. (e) Develop an extension bulletin to communicate thresholds. (f) disseminate data via growers meetings, etc. (g) Data will contribute to a separate RAMP project on source potential for landscape spatial assessments.	(a-b) Field research on plant bug injury to chile began in 2008. Chiles were grown using common field practices in southern New Mexico. Chile ages evaluated included buds, and 3 ages of chile pods: newly formed, 1 inch, and 2 inch. Lygus of two ages (5th instar nymphs and adults) were starved for a 24 hour period and caged on the various treatments for one week. One half of the fruiting structures were removed and taken to the laboratory for evaluation. Lygus were removed from the remaining plants, and the pods were allowed to continue development until maturity. A detailed evaluation was performed on the fruiting structures to include external and internal evidence of feeding, quality, pod size, etc. These data, once finalized, will give us the first detailed description of Lygus injury to chiles.	(a-f) An extension bulletin will be created to present findings to the public.	Data will be presented to NM Chile Growers.	Personnel support from NMSU IPM Laboratory

Goodell, Molinar, Jimenez (CA eggplant) 1 exp.	Developing pest management guidelines for Lygus in eggplant	This project will provide fresh market eggplant with rational Lygus action thresholds. Currently, fieldmen use a combination of visual count (bugs seen per plant) and blossom drop. These farm based thresholds will be the starting point for evaluating thresholds. These will provide the basis for a UC Pest Management Guideline. As part of the Guideline, a Year Round IPM plan will be delivered. Year round IPM plans are developed cooperatively with research, extension and industry members.	We created a cooperative relationship with a local eggplant grower. We planted several different crops (alfalfa, buckwheat, blackeye pea, lima bean, mustard,) in varied plot designs through an eggplant field. We performed weekly insect collections of the eggplant as well as the other crops. Lygus counts on the attractant crops and the eggplant are being analyzed.	No activities or publication developed in 2008	None	Close association with farmer cooperator has allowed insight into the organic eggplant production system, and the sense of risk aversion by the farmer.	Time investment of Local Farm Advisors with primary contact for eggplant production. UC IPM has committed writers and editors to developing the Pest Management Guideline for Eggplant

Naranjo & Ellsworth (AZ, Lesquerella) 2 exp.; 2 prof. pres (ESA & Cotton Pest Mgt. Seminar, 100 reached) and one poster (ESA)	Yield / Damage : Density Relationships for Lygus spp. in Lesquerella	1. Determine the timing of plant bug injury to lesquerella 2) Determine the nature and extent of plant bug injury to lesquerella 3) Determine the impact of plant bug feeding on yield and oil quality of lesquerella, 4) Test a series of nominal thresholds along with an untreated check 5) Quantify the relationship between plant bug density and lesquerella yield and quality and use this information to determine economic threshold 6) Develop efficient sampling plans based on the sweep net.	Observational studies were continued to quantify and characterize the feeding behavior of *Lygus hesperus* on lesquerella plants. **Results are detailed in the 2008 Results Summary Report.**	Informally presented results at Lygus networking group at Entomological Society of America meeting in 2007; Presented poster at ESA meeting in 2008. As a new crop, we expect this information will be made available to new growers (including seed contracts) as this crop enters the southwestern landscape, using bulletins & Arizona Crop Information Site (ACIS). Also, this will help provide information on source potential for landscape spatial assessments. Interactions between lesquerella and other hosts for Lygus were presented and discussed to >80 cotton entomologists at the 2008 Cotton Pest Management Seminar.	The ESA meeting is attended by over 2000 scientists, extension specialists and industry representatives.	USDA-ARS' on-going investment to develop this crop. In-kind provision and management of experimental crop areas. ARS personnel support.

Naranjo & Ellsworth (AZ, Guayule) 2 exp.; 2 prof. pres (ESA & Cotton Pest Mgt. Seminar, 100 reached) and one poster (ESA)	Yield / Damage : Density Relationships for Lygus spp. in Guayule	1. Determine the timing of plant bug injury to guayule 2) Determine the nature and extent of plant bug injury to guayule 3) Determine the impact of plant bug feeding on yield (biomass and latex quantity) of guayule, 4) Test a series of nominal thresholds along with an untreated check 5) Quantify the relationship between plant bug density and guayule yield (biomass and latex quantity) and use this information to determine economic threshold 6) Develop efficient sampling plans based on the sweep net.	Observational studies were continued to quantify and characterize the feeding behavior of *Lygus hesperus* on guayule plants. **Results are detailed in the 2008 Results Summary Report.**	Informally presented results of studies to other scientists at Lygus networking group at Entomological Society of America meeting in 2007; present poster on the topic at the ESA meeting in 2008. TAs a new crop, we expect this information will be made available to new growers (including seed contracts) as this crop enters the southwestern landscape, using bulletins & Arizona Crop Information Site (ACIS). Also, this will help provide information on source potential for landscape spatial assessments. Interactions between guayule and other hosts for Lygus were presented and discussed to >80 cotton entomologists at the 2008 Cotton Pest Management Seminar.	The ESA meeting is attended by over 2000 scientists, extension specialists and industry representatives.	Leveraged physical and field resources of the UA-MAC and Yulex Corporation who maintain the world's largest planting of guayule. ARS personnel support
SECTION II: Field Level Experimental: Insecticide Efficacy/Selectivity						

Godfrey, **Parajulee, Kerns** (TX, cotton); 2 exp.; several grower pres.; 1 electronic newsletter (1,400 reached); 1 proceedings publication Leverage: $3.5k FMC, 1k Dupont	Evaluating efficacy of registered and experimental insecticides for *Lygus* management in cotton, TX	a) Evaluating residual activity of selected insecticide chemistry to *Lygus hesperus* in cotton, 2) Evaluating insecticides from different modes of actions in *Lygus* management in Texas High Plains cotton	Two insecticide efficacy tests were conducted in 2008 and an insecticide residual test was conducted in 2007. Insecticides evaluated in 2008 included cypermethrin, flonicamid, acephate, thiamethoxam, oxamyl and novaluron. **Results:** At low population desities, all of the insecticides proved effective, but at high populations thiamethoxam appeared weaker than the other treatments. Lygus on the High Plains appear to be highly sensitive to a broad range of insecticides. Based on the insecticide residual study conducted in 2007, high rates of cypermethrin, flonicamid and oxamyl provide the longest residual control, approximately 80% at 7 days. Acephate and bifenthrin exhibited moderate residual activity, 80-100% mortality at 3 days. Endosulfan appeared to be short lived	Several producer talks were given to disseminate this information to cotton farmers. This information were also disseminated through an electronic newsletter to over 1,400 subscribers.	1 Beltwide proceeding manuscript is published; 1 M.S. thesis is being developed on this objective.	NA	3.5K from FMC and 1K from Dupont. MS Student support?

Godfrey, Parajulee, Kerns (CA, cotton) 2 exp.; 1 field day (25 reached); 1 grower mtg (25 reached)	Evaluating efficacy of registered and experimental insecticides for Lygus management in cotton, CA	(a) evaluate the efficacy of registered and experimental insecticides on lygus bug populations, (b) determine the optimal lygus bug life stage for control with various insecticides, (c.) determine the effects of registered and experimental insecticides on populations of non-target arthropods (natural enemies) within the cotton system, (d) evaluate any potential indirect effects, i.e.., flaring, of secondary pest populations following application of registered and experimental insecticides, (e) determine the plant response via plant mapping to lygus bug with registered and experimental insecticides, (f) monitor impacts of treatments and treatment regimes on cotton yields.	Field studies are ongoing on the UC-West Side Research and Extension Center and the UC Shafter Research and Extension Center to address this objective. Lygus bug populations have been extremely high, nearly unprecidented levels, this season at this location. 3 applications were made. Procedures have been followed as planned. Lygus bug and natural enemiy populations were quantiifed approximately every 3 days. Plant mapping was done following the second application and immediately before harvest. Analysis and results forthcoming, but it appears that under this level of pressure none of the treatment regimes provided acceptable control.	A Field Day was held at the Shafter location to showcase the ongoing cotton research at this location. One in-season meeting for growers was also held.	The Shafter field day was attended by ~25 interested parties; a similar attendance was seen at the in-season grower meeting.	Research and Extension Center land resources and personnel input (UC West Side and Shafter), Cotton Incorporated State Support funding

Ellsworth (AZ, cotton) 1 exp.; 1 demo plot (15 reached); 1 field day (35 reached); 1 historical data analysis & report that may influence registration of metaflumizone. Leverage: 40k (CI, in part); 10k (ACGA, in part); 27k from ag chem industry. IMPACT: adoption of carbine	Determination of deployment options for reduced-risk and other effective chemistry for Lygus control in cotton	1. Conduct small plot testing of new reduced-risk chemistries alone, in combination, and in rotation with other chemistry. 2. Conduct semi-commercial scale plot evaluations and grower demonstrations of reduced-risk chemistries.	1. 17 treatments and an UTC were examined in a small plot context; 3 experimental compounds, including one that has never been tested against Lygus before, in comparison to reduced-risk chemistries and conventional standards. 2a. Three large-scale demonstrations were planned but not implemented because of lack of Lygus pressure. 2b. One controlled demonstration was set-up to show the consequences of inappropriate Lygus controls with broad-spectrum materials and the resulting severe secondary pest outbreak of whiteflies which defoliated the cotton.	2a. A grower field day highlighted the attributes of reduced-risk chemistry, and showed graphically the impact of poor choices on whitefly outbreak potential. We also showed great promise in metaflumizone, flonicamid, and one brand new compound in controlling Lygus. Mite secondary pest outbreaks were also evident in many broader spectrum treatments and this was taught to growers with live examples during the field day. 2b. Historical data on metaflumizone performance was assembled, summarized and written up for a 3rd party request to meet EPA's requirement for Public Interest Documentation (PID).	Ca. 35 growers and PCAs toured field experiments during field day. One-on-one tours of controlled demonstration were done with 15 PCAs, growers, and industry representatives. The PID is expected to reach dozens of regulators and hundreds or more of stakeholders. If ultimately registered for use in cotton against Lygus, this PID as well as these efficacy data will have been paramount.	Carbine adoption increased, replacing acephate. Secondary outbreaks were rare as a result. Growers have sprayed less than twice for all insect pests of cotton over the last 3 seasons, averaging just 0.56 sprays against Lygus, less than 45% of the 13-yr average.	$40K (in part) from CI, and $10K (in part) from ACGA in 2008; $40K (in part) from CI for 2009 and $16.3K (in part) from ACGA ; ca. $27K from agrochemical industry as well as 80 A (ca. 15 lbs) of Carbine insecticide for grower use.

Godfrey (CA dry beans) 2 exp.; 2 field days / demos (60 reached)*; 2 grower mtgs (85 reached)*; UC Bean Pest Management guidelines revised based on RAMP work.	Evaluating efficacy of registered and experimental insecticides for Lygus management in dry beans	(a) evaluate the efficacy of registered and experimental insecticides on lygus bug populations, (b) determine the optimal lygus bug life stage for control with various insecticides, (c.) determine the effects of registered and experimental insecticides on populations of non-target arthropods (natural enemies) within the bean system, (d) evaluate any potential indirect effects, i.e.., flaring, of secondary pest populations following application of registered and experimental insecticides.	Studies are being conducted to examine lygus bug populations at specified intervals following application of registered and experimental insecticides. 3 applications were made (only two in the cowpeas) to correspond with critical periods in bean crop phenology. The field portion of the studies are completed. Preserved samples are still being processed for lygus (adults, small nymphs and large nymphs) and beneficial insect populations. Populations of other bean arthropod pests were monitored to determine effects on nontarget populations. Work was done on black-eye cowpeas on the UC Shafter Research and Extension Center and on lima beans of the UC-Davis Agronomy Farm. Similar to 2007, lygus bug pressure was very high at the Davis location and low-moderate at the Shafter location.	2 field days were held to relay results to growers. Study details and goals were elaborated and field plots were viewed. A preliminary summary of results was distributed. I particiapted in two grower meetings on dry bean production during the winter. The UC Bean Pest Management Guidelines have been modified. Finally, a Bean Year-Round IPM Program is under development.	(a) grower field days were held at both locations with each field day attended by 25-35 interested parties, (b) winter grower meetings (two) each had about 40-45 attendees.	Selective experimental insecticides tests for Lygus control in Californa dry beans reduced Lygus populations (particularly nymphs) while having less impact on natural enemies than pyrethroid insecticides.	UC-Davis Agronomy Farm and at the UC Shafter Research and Extension Center land resources and personnel input.
McGuire	Development of a selective biopesticide for Lygus	This project objective has been dropped.	McGuire changed positions after the grant application was submitted and will not be participating in this project. This was an unfunded study and will not now be included in our outcomes.				

Naranjo & Ellsworth (AZ, cotton), 1 exp.; 1 grower field day; pres. at 4 grower mtgs; 3 prof. pres. (total of 200 reached). Leverage: Co-sponsorship by participating companies (e.g., BASF, Chemtura, FMC, Valent). IMPACT: data will likely play a key role in registration of metaflumizone, an important new tool for Lygus mgt.	Evaluation of the selectivity of reduced-risk approaches to Lygus control	1. Evaluate the effects of new (flonicamid, metaflumizone) and existing (acephate) insecticides for selective control of Lygus bugs in cotton relative to an untreated control. 2. Determine the population dyanmics of 20-25 species of native natural enemies relative to insecticide regime. 3. Determine the population dyancmis of Lygus bugs relative to insecticide regime. 4. Measure predator:prey ratios relative to insecticide regime 5. Analyze community level effects of insecticide regimes on natural enemies	**Results:** Community analyses of data from a replicated large plot field study indicate that both flonicamid and metaflumizone selectively impact Lygus and other problematic plant bugs such as cotton fleahopper while having little or no impact on a wide diversity of predaceous arthropods that can contribute significant levels of suppression to other pests such as the sweetpotato whitefly. These findings provide growers and consultants with effective options for the management of Lygus bugs. In addition, along with transgenic Bt cotton for selective control of caterpillars, IGRs and other selective insecticides for management of whitefly, these compounds have the potential to equip producers with a complete arsenal of selective options that will contribute to more biologically-based management of all key pests of cotton in the region.	Preliminary results were discussed with other scientist at a Lygus networking group at Entomological Society of America meeting in 2007; these data were summarized and presented in 4 grower mtgs, 1 grower field day, 1 Beltwide PCA/grower forum, 1 cotton entomologist scientific forum, and 1 PB-ESA talk. In addition, historical non-target data were summarized and reported to a 3rd party in preparation of an EPA PID which was submitted in the fall.	Over 200 growers/PCAs, and over 200 scientists were reached with this information in various venues.	These non-target data and other information reported in previous project (above) will likely play a role in the registration of metaflumizone in cotton for Lygus control, and will provide AZ with a 2nd selective agent for the control of Lygus, minimizing risks of resistance, 2° pest outbreaks and pest resurgence.	Co-sponsorship by participating companies (e.g., BASF, Chemtura, FMC, Valent) Peter - verify. USDA-ARS' on-going investment to develop improved systems for IPM of Lygus bugs. In-kind provision and management of experimental crop areas. ARS personnel support.
SECTION III: Landscape Level: Patterns, Processes and Mechanisms							

Blackmer & Naranjo (Bancroft) 1 series of lab expts.; 2 prof. pres (Int'l Congress of Entm & ESA Lygus Network)	Influence of biotic and abiotic factors on Lygus movement	(a)Evaluate effect of wind speed on takeoff and oriented flight relative to insect age, gender, and mating status. (b) Evaluate the effect of varying temperatures on flight performance, while holding relative humidity constant. (c)Evaluate the effect of varying relative humidity on flight performance while holding temperature constant. (d) Determine whether light intensity influences frequency and length of flights. (e) Determine whether population density and host suitability influences flight behavior. (f) Disseminate information at national and regional meetings. (g) Publish results in refeered journals	(a)New flight mills were constructed and software developed to monitor and record data from the flight mills. Studies to examine the relationship of flight performance to temperature at fixed humidity are currently underway. **Results are detailed in the 2008 Results Summary Report.** Collectively, these studies will help to characterize the flight behavior of Lygus bugs relative to important environmental variables and will be of value to other members of the proposal team that are developing simulation models of Lygus movement on local and regional scales.	Presented preliminary results of some of the flight assay data at the International Congress of Entomology, Durban South Africa in July of 2008. The meeting was attended by scientists, extension personnel and industry representatives from over 70 countries. Preliminary results were discussed with other scientists at a Lygus networking group at Entomological Society of America meeting in 2007.	USDA-ARS' investment in flight assay equipment; ARS personnel support.

Hagler, Blackmer, Naranjo (AZ cotton) series of 5 mark-repature exp.; 1 prof. pres (ESA 2008)	Intercrop movement of Lygus and natural enemies among cotton, lesquerella, guayule, alfalfa and weeds	Use protein markers and an ELISA detection system for a mark-capture study to evaluate Lygus and natural enemy movement within and between cotton, lesquerella, guayule, and alfalfa	Completed 2nd year of field study. (a) Conducted 5 separate, 1 week mark-capture trials from April thru August, 2008. Examined dispersal of Lygus and naturual enemies within and between a cotton, lesquerella, guayule, and alfalfa agroecosystem (b) Assayed 25,760 individual insect samples for 3 separate protein marks (n=77,280 ELISAs). Data are being analyzed to estimate diffusion coefficients representing the spread of Lygus bugs and natural enemies within the 4 crops. Data from larger scale trapping transects will allow estimating of movement beyond crop boundaries and movement between crops will be analyzed using transition matrices. The results will provide useful data to on-going regional simulation model development by other project members.	(a) Present invited symposium talk at 2008 ESA National Meeting. Several presentations are planned for 2009. Pete Goodell has organized a symposium at the International IPM Symposium, Portland, OR, to highlight the various applications of the protein marking procedure. In addition, several departmental seminars are planned for 2009.	RAMP research activities have gained the interest of other researchers. Sean Swezey and Charlie Pickett are interested in using the marking technology to study Lygus and natural enemy dispersal in organic strawberry. Preliminary research was conducted in an organic strawberry field near Watsonville, CA in August, 2008. Met with Larry Eddings (Pacific Gold Farms), the World's largest producer of organic strawberry. He is very interested in having us conduct research	The protein marking procedure is being used by 3 different groups/projects (States) on the RAMP grant (Hagler, AZ; Parajulee, TX, Rosenheim, CA).	Leveraged physical and personnel resources at the USDA-ARS, ALARC. Shared funding resources from in-house CRIS project. In-kind provision and management of experimental crop areas by the USDA-ARS, ALARC. Extramural grant funding is being sought by Swezey et al. for additional strawberry work.

Rosenheim, Hagler (CA cotton) 3 field exp.; 2 prof pres (ESA 2008 & Ecological Society of Amer.); Leverage: $343,500 (USDA-NRICGP); $46,710 (UC Statewide IPM); 69k (CI); 25k (USDA-EPA Star grad student fellowship [100k for 4 years]	Long-distance dispersal of Lygus and crop colonization from native plant overwintering sites	**Objective 1**: To quantify the long-distance dispersal potential of *Lygus hesperus*. **Objective 2**: To assess the relative importance of different plant communities (agricultural and natural) as sources of *Lygus* colonizing cotton fields.	We have now completed our third season of large scale dispersal studies of *Lygus* moving between alfalfa and cotton. We encountered key methodological problems in each of the first two years that we now appear to have surmounted. During the 2008 field season we implemented new marking procedures that are providing high levels of confidence in our ability to detect rare long-distance movement events. The 2008 trial, which we have scaled up to include assays of >10,000 insects, should provide a detailed picture of dispersal from cut alfalfa of *Lygus hesperus*, *Geocoris pallens*, *Nabis alternatus*, *Hippodamia convergens*, and adult *Chrysoperla* spp.	We are currently preparing for a vast quantity of sample processing. Over the next year we will move to data analysis and report preparation. Results of initial work have been reported orally at the national meeting of the Entomological Society of America and the Ecological Society of America.	Construction and analysis of this database are being supported by: USDA-NRICGP ($343,500), University of California Statewide IPM ($46,710), and Cotton Incorporated ($69,000). In addition, the graduate student who is spearheading this project (Frances Sheller) is supported on a USDA-EPA STAR Graduate Fellowship (total support: $100,000 over the 4-year duration of the award).

Goodell (CA cotton, alfalfa) 1 large-scale expt.; 4 grower mtg pres. IMPACT: growers have adopted alfalfa mgt practices to reduce movement of Lygus into cotton.	Documenting the value of alfalfa in the cotton ecosystem	1. Determine the role of alfalfa hay in mitigating movemetn of Lygus in a landscape; 2. evaluate the value of assessing the risk to cotton with varying abundance of alfalfa in the landscape.	No work conducted in 2008.	Presented results from previous years in production meetings (4).	None	On a college farm setting, alfalfa was completely cut in June causing massive movement into cotton. The managers are now firm believers in leaving some habitat to mitigate movement and utilized this approach for the remainder of the season.	None.

Corbett, Rosenheim (Bancroft) 1 model with graphical interface in the development stage	A landscape-scale, research-level, simulation model for *Lygus*	**Objective 1**: To develop a spatially-explicit, yet simple, simulation model for *Lygus* to explore general landscape-scale quations and to inform research efforts.	The model has been designed and fully coded. A graphical interface has been designed that provides a key tool for understanding the model output and for using the model as a teaching tool. We are currently in the process of developing literature-based parameter estimates and in exploring different scenarios of crop mosaics, crop phenologies, and crop qualities for *Lygus* population growth. Key estimates of long-distance *Lygus* movement will be derived from the experimental work on *Lygus* dispersal described above.	This model should provide an ideal tool for understanding the disastrous *Lygus* outbreaks that occurred in certain regions of California's San Joaquin Valley during the 2008 field season, and in designing the arrangement of different crops within a ranch to minimize the potential for future repetition of these outbreaks.

Goodell Bancroft, Rosenhiem and Godfrey (CA, cotton) 1 large field exp.; 1 grower pres.; weekly Lygus updates via MiteFax; 1 web-served GIS crop mapping program developed and made available online.	Influence of surrounding crops on Lygus infestation in cotton	The potential outcomes of this project to cotton growers are an improved understanding of the sources of Lygus and the areawide buildup of Lygus populations. This information should support pest management planning and decision-making, resulting in enhanced resource allocation at the farm level. Such information will be delivered through the well established UC Cotton Extension and UA IPM/ICM Teams who provide local programming for workshops and field days as well as incorporated into the UCIPM Pest Management Guidelines, available in both print and electronic formats.	We have developed a network of cooperation with numerous cotton growers/ PCAs. We performed weekly insect collections at cooperator's fields. We monitored plant phenology of the cotton and the surrounding fields. We recorded crop type for all fields within several miles of focal cotton fields being studied. By examining insect counts within cotton fields compared to exisiting phenology and cropping systems situations, we are demonstrating potential sources and sinks of Lygus.	(a) Presented current landscape information at Annual Cotton Growers Meeting. (b) Worked with a subset of the larger community to assess the threat to cotton by safflower plantings and helped identify possible management options. (c) provided weekly updates to MiteFax newsletter. (d) Developed a web served GIS program for easy landscape mapping of crops (http://arcims.gis.uckac.edu/imf/imf.jsp?site=LygusFresnoKings).	Working with community to develop a response to changing landscape created farmer awareness of the problem. With crop protection companies, we explored possible remedies for requesting new classes of insecticides for management of Lygus in safflower.	GIS support from Kearney Ag Center Geospatial Laboratory.

Parajulee (TX, cotton) 3 large scale field exp.; 1 grower / consultant mtg.; Leverage: 20k (CI-Core)	Influence of non-cotton hosts, host preference, and inter-crop movement of Lygus on landscape-level dynamics	a) Evaluate the influence of roadside alfalfa on Lygus population dynamics in adjacent cotton, b) Investigate the host preference of Lygus in a simulated field mosaic of cotton, sunflower, alfalfa, pigweed, and Russian thistle, c) Quantify the inter-crop movement of Lygus using protein markers	a) Sampled Lygus and artropod predators in 4 study sites in Lubbock County, Texas, each with relatively pure roadside alfalfa stands adjacent to cotton fields. Roadside alfalfa significantly influenced the Lygus densities in adjacent cotton, with most Lygus movement from alfalfa to cotton occurring around peak flowering stage of cotton. b) Host preference study (choice field test) suggested that Lygus colonize in alfalfa and Russian thistle given the choice of cotton, pigweed, sunflower, Russian thistle, and alfalfa. c) Mark release and recapture study showed that Lygus move between alfalfa and cotton in both directions, but more number of Lygus moved from alfalfa to cotton than from cotton to alfalfa during cotton blooming stage. **Results are detailed in the 2008 Results Summary Report.**	Population trends of Lygus in alfalfa and cotton were discussed by a panel at the annual consultant forum to educate crop consultants and growers on roadside non-cotton habitat management.	20K from Cotton Incorporated Core Funding Program for sub-objective c.

Carriere, Ellsworth, Dutilleul, Goodell and Parajulee Large scale field studies in 3 states (AZ, CA, TX). 1 grower field day; 1 extension mtg.; 1 news article; 1 prof pres; 1 tribal council mtg. Leverage: USDA-NRI (unspecified); ACRPC (unspecified); 15k (USDA-ERS PREISM); 45k (USDA-CSREES, Int'l cotton res ctr)	Development of landscape-level pest management guidelines to reduce Lygus infestations in cotton	1. Describe association between distribution and abundance of Lygus habitats (crops of weed patches) and Lygus infestations in cotton fields in Arizona, California, and Texas. 2. Assess temporal constancy of above associations within and between growing seasons. 3. Based on data collected over 3 years, test whether Lygus outbreaks can be predicted in cotton fields.	Continued Lygus and natural enemy sampling in c.a. 50 focal cotton fields and surrounding fields per region in CA, AZ and TX, including GIS mapping of surrounding Texas Progress: TX Samples from 2007 are all processed. Analysis: Carriere conducted preliminary analysis of 2007 data for CA and AZ. TX data were not forwarded in time for inclusion in the analysis, but have since been delivered. **Results are detailed in the 2008 Results Summary Report.**	Project was highlighted in local AZ newspaper, in farmer field day, in 1 invited seminar, and in an Extension meeting in AZ. Will present information to AZ agents at in-service meetings and to growers and pest managers at extension meetings and field days. We are developing software for spatially explicit analyses of RAMP data and will make this available to RAMP researchers via a web application in 2009. Texas: Area IPM Agents are involved in this survey project to insure a good relationship between survey workers and producers in those focal fields. We expect to conduct some field days in 2009.	The average area being sampled in each region of CA, AZ and TX is 878.6 miles or 1413.7 km. Invited to present at International IPM Symposium in Portland, OR, March 2009.	Some growers whose fields are used as focal fields really appreciate the type of work we are doing and type of information we wish to generate for their use. They welcome and encourage our workers to continue such work in their farms.	GIS work in AZ partly supported by USDA-NRI and Arizona Cotton Research Protection Council and a new USDA-ERS PREISM grant, Tim Richards, PI (ca. $15K directly). TX: $45K from USDA CSREES through International Cotton Research Center.
SECTION IV: Extension/Outreach/Education/Evaluation							

Fournier and Smith 3 websites with expanded RAMP info; Leverage: 12k (APMC IPM program)	Reaching Stakeholders with Project Outcomes: The Arizona Crop Information Site	(a) Develop a Lygus Project area of the ACIS website, to serve as a clearinghouse for project information, print resources, and presentations. (b) Establish email list for communicating with RAMP project partners. (c) Request educational products, publications, presentations, etc., from RAMP partners and post the website. (d) Inform end-users through existing ACIS email list; expand to include growers and PCAs from throughout the region.	n/a	(a) Expanded APMC Lygus RAMP project webpage to include reports, a section for publications and outputs, and access to Lygus survey. (b) Used email listserv to communicate among project partners. (c) Various educational products posted on the website. (d) As more products from research are available as publications, etc., we will post and inform end-users of these via email list. (e) Also posted information on Arizona Crop Information Site and Arid Southwest IPM Network website.	2 presentations, one article, all RAMP reports and a link to Lygus International Symposium abstracts on the Journal of Insect Science website posted on the Lygus-RAMP project page of APMC site.		Leveraged funds through the Arizona Pest Management Center for web and database development ($12,000)
Ellsworth 1 fld day (same as above, 60 reached)	On-farm demonstration and validation of Lygus reduced-risk technology and decision-making	(1) Conduct on-farm demonstrations to present reduced-risk technologies and decision-making concepts to growers and PCAs	n/a	A grower field day highlighted the attributes of reduced-risk chemistry and timing of Lygus control termination, using experimental small plot and semi-commercial large plot studies. (Plans are underway to conduct at least 3-5 Lygus demonstrations including chemical control termination in 2009 with area agents, PCAs, and growers.)	Ca. 60 PCAs, growers, and industry representatives were taught about reduced-risk technologies, non-target effects and Lygus management through this demonstration.	More growers became aware of and elected to use flonicamid as the reduced-risk alternative to acephate, endosulfan, or other broad spectrum chemistries	

Ellsworth & Goodell 1 field day (35 reached)	Teaching Lygus sampling techniques for cotton	(1) Conduct workshops, field days, mtgs, and one-on-one training of growers, PCAs, and others on proper detection and sampling techniques for Lygus in cotton. (2) Production of a video tutorial and pamphlet on the topic.	Goodell and Ellsworth discussed development of script for video tutorial as well as avenues for securing additional extramural support.	(1) Sweep technique was discussed and taught to over 35 growers/PCAs in field day; (2) developed proposal to the Cotton Foundation for development of educational materials (rejected 8/08); objective delayed to 2009
Ellsworth, Corbett, Goodell, Rosenheim, Carriere (Tronstad, collaborator)	Grower training in group processes using gaming simulations of landscape processes & risk management	This is a year 3-4 objective.		

Ellsworth, Goodell et al. 1 symposium delivered in 2007**;** 15 presentations by PIS on RAMP; 1 symposium in early planning stages for 2010.	Development of an international forum for Lygus scientific exchange	(1) Scientific exchange and outreach of the latest information about Lygus identification, biology, plant interactions, and management at the 2nd International Lygus Symposium; (2) bring together project participants as well as the greater scientific community concerned with the management of Lygus in multiple crops throughout North America and Europe. (3) Meeting will serve as forum for planning activities associated with this RAMP, e.g., the discussion and development of common protocols for implementing landscape sampling programs in three states. (4) Meeting will provide a platform for sharing results with scientific audience and for summarizing RAMP achievements.	n/a	This objective was accomplished during year one. 13 scientific presentations by RAMP participants on various aspects of their Lygus research were published in Journal of Insect Science. RAMP planning session at the Lygus Symposium allowed PIs and collaborators to formalize plans for collaborative experiments, project communications, outreach and evaluation related to the RAMP effort. Access to abstracts and information about symposium were made available online. A surevy was conducted to help develop plans for a 3rd International Lygus Symposium to be planned for 2010.	Meeting attended by 50-60; 13 abstracts published.	On August 5 and 6 in Portland, NAFA held Strategy Meeting for Lygus Bug Initiative for PNW and California. The purpose of this new multi-crop initiative is to identify a long-term IPM strategy that would develop and deliver science-based information and technologies to reduce lygus bug pest pressure and severity for these crops. The

Fournier, Ellsworth, Goodell, Parajulee, Bundy, Godfrey Conducted Lygus Evaluation at 9 mtgs in AZ, NM, CA and TZ with 116 responses. Leverage: 1k (UA CE)	Evaluation of project Extension components and adoption of proposed Lygus management practices	(1) Develop methodology and instrument(s) for measuring changes in knowledge and behavior of end-users with respect to Lygus management; (2) implement measures at ongoing meetings, workshops, field days, etc., throughout the project; (3) analyze data to determine changes in knowledge and behavior and use and vale of Lygus resources as they are developed.	n/a	(1a) Project team developed methodology for measuring project outcomes and changes in lygus knowledge and management behaviors across all 4 states in Year 1; Conducted 3 conference calls in 2008 to refine and plan survey implementation. (2) Conducted Lygus Evaluation at 9 mtgs in AZ, NM, CA and TZ with 116 responses; (3) Data from year one (all states) are being entered and will be subject to analysis this year to develop a lygus knowlege and behavior baseline for each	Conducted Lygus Evaluation at 6 mtgs in AZ, with 57 responses; at 1 mtg in CA with 9 responses; at 1 mtg in NM with 13 responses; and at 1 mtg in TX with 37 responses. 116 responses total.	University of Arizona CE funding for Cotton Team, $1,000.