AES/CE MAR 84

Workgroup walnuts

University of California
Division of Agricultural Sciences

Project Plan/Research Grant Proposal

Project Year 2008-9 Anticipated Duration of the Project _

Project Leader Steve Welter Location UC Berkeley

Cooperating Personnel Frances Cave, Bob Van Steenwyk, Carolyn Pickel, Joe Grant

Project Title Optimizing "meso-pheromone" emitters for codling moth management in walnuts

Keywords walnuts, codling moth, pheromone mating disruption

Commodity(s) walnuts Relevant AES/CE Project No.

Significance:

Hand-applied pheromone dispensers continue to be the dominant means by which pheromones are applied to control insect pests in tree crops. Codling moth has been effectively controlled worldwide in pears and apples using hand-applied dispensers applied at 160-400 units per acre. While this approach has been every effective, the height of the walnut tree makes placing this number of units into the tree canopy with a hydraulic lift too expensive and time consuming. As such, research within the past 4-5 years has focused on alternative units that require fewer units per acre.

Recent work with high-dose aerosol emitters ('puffers') using 1 puffer per 2 acres continues to look very promising for large plots and was evaluated at 4 locations in 2007. Codling moth damage was effectively suppressed in all orchards on average with early season damage noted in some locations (see Pickel and Grant reports). The push to develop a cost-effective strategy has produced a program that should be competitive at ca. $50-60 per acre. A similar, more expensive, strategy using 1 puffer per acre has been used effectively in Lake County for more than 10 years. However, 2 limitations remain for this program: 1) the perception of risk due to mechanical failure despite dramatic improvements in the quality of the dispensing units and 2) difficulties in achieving effective orchard coverage with plots less than 30-40 acres. Coverage becomes difficult with smaller plots as the edge-area ratio increases with small plot size and our inability to get sufficient plume coverage with 1 unit for every 2 acres in the smaller plots.

Efforts to develop a hand-applied dispenser that produced intermediate emission rates were successful in 2007 after evaluation of 7 different types of units in lab and field trials. Long-term studies showed excellent and consistent release rates for at least 107 days with dispensers aged for longer intervals yet to be analyzed. Using replicated trials, codling moth damage was significantly depressed to commercially acceptable levels in all of our walnut trials in both untreated organic orchards or in combination programs in a large field trial using pheromones and supplemental insecticides. The advantage of the meso-emitter is that fewer dispensers are applied per acre but the total amount of pheromone per acre is kept constant given the higher release rates per dispenser. A large scale preliminary trial in 2007 replicated 6 treatments which varied the number of dispensers per acre, yet attempted to keep the total amount of pheromone constant between treatments. The combination program using 18 or more units per acre produced superior results as a combination program compared to the insecticide alone program. While not statistically different, codling moth damage did not appear to be as effectively suppressed with only 12 units per acre. One treatment, which produced a lower

total emission rate per acre comparable to a 160 application of the Checkmate dispensers, still provided superior control of codling moth compared to the insecticide alone treatments.

Questions about total amount of pheromone required per acre using the "best" meso-emitter remain unanswered, yet will be a vital part of reducing overall program costs per acre.

Hercon Flakes

Based on results from 2007, the number of flakes adhering to the tree per acre using the ground applicator can be improved by adjusting the ejection speed of the applicator and the angle of the "canon". However, trade-offs between height of the application and ejection speed were also observed. Based on 2007 results, the ground applicator may be limited to smaller orchards with shorter canopies, whereas aerial applications may be required for the larger, mature walnut orchard.

The more promising results were obtained in wind-tunnel research looking at moth orientation to point sources with very low emission rates. Using very low emission rates which we hope to duplicate with the Hercon flake, codling moth was attracted over short ranges (<6 feet) and made direct contact with a low rate pheromone source. The hope is that the flake can be treated with low levels of an insecticide to develop a supplemental attract and kill. Traditionally, higher rates of pheromone were used to increase the attractiveness of a source (e.g. a trap lure), but the concentration was too high near the source and the moth would avoid the actual lure. Given the high number of flakes applied per orchard, we are hoping that a sphere of attraction of only 6 feet would be great enough to attract nearby moths yet still allow contact and hence death of the moth. If a plant volatile can be used to duplicate the contact observed with low rates of pheromone, then the flake applications could be used to supplement pheromone mating disruption treatments using a completely different tactic.

Objectives:

1. Validation of "best" meso-emitter treatment option from 2007 in multiple orchards under varying codling moth pressures at 18 dispensers per acre
2. Preliminary evaluation of the effect of total pheromone per acre at a fixed number of dispensing units per acre
3. Development of flake containing either a pheromone or plant volatile that will produce an attraction and contact by codling under field conditions.
4. Participation in areawide mating disruption of codling moth in walnuts using modified puffer program at 1 puffer per 2 acres (no funds requested)

Plans and Procedures

Modified pheromone emitters

Modified meso-emitters for the codling moth pheromone continue to be developed with Suttera with 2 major changes: a) an increase in either the effective releasing surface area of the unit, and 2) changes in the polymer regulating emission rates. Overall emission rates in 2007 per acre were ca. 500 mg per acre per day which exceeded our target rate of 400 mg per acre per day based on the 400 tie Isomate rope program. Thus the total number of units per acre will be adjusted proportionately.

Four plots will be established with 2 treatments: a) meso emitters at a single rate of 12-18 dispensers per acre plus standard insecticide b) meso-emitters alone c) standard insecticide treatment and an untreated control (1 acre). The meso treated plots will be 5-acre plots. Within each plot, codling moth traps will be placed baited with 1 mg codlemone or 10 mg codlemone lures. Damage will be assessed throughout the season to determine if and when problems should arise. Damage will be

determined using canopy assessments or at final harvest of the walnuts. Final number of meso-emitters used in these trials per acre will depend on final analyses of our 2007 release rate data.

Within a second set of trials, preliminary evaluation for the effects of total pheromone required per acre will focus on 18 dispensers per acre, yet use the different dispenser types evaluated in 2007 under field conditions. This trial will be conducted within a single orchard using 5 acre replicated plots and up to 4 levels of pheromone per acre. Given the preliminary nature of this research, plots will receive supplemental insecticides as needed to avoid outbreaks of codling moth in all plots. Differences between plots will be used to determine the relative contribution of the various pheromone treatments. This approach was used successfully in 2007 in our preliminary efforts to understand how the number of point sources influenced control. Similar indices of trap and damage suppression will be used.

Hercon Flake

Initial trials with the Hercon flake will most likely be limited to wind tunnel trials using plant volatiles (pear or apple) and pheromones. Sheets with different pheromone concentrations will be produced by the manufacturer and cut into smaller flakes for use in the wind tunnel so as to optimize the release rate. Moths will be exposed to different flakes within a wind tunnel at UCB, and their behaviors recorded including orientation to the plume, upwind flight, approach to the lure, and finally contact. Replication is with individual females. Existing colonies of codling moth at UCB have been used to optimize the flight tunnel and assay procedures. These same rates and odors will be evaluated for attraction and contact under field conditions using traps baited with the flake with adhesive only at the center of the trap to mimic a female.

Areawide Management Using Puffers – aid with grant headed by C. Pickel and J. Grant (see grant for details – no funds requested. Partial funding from IFAFS/RAMP will be contributed early in this project)

BUDGET – Management of codling moth - walnuts

Salaries		
	SRA II (45% time @ $5084 / mo)	$27,454
	Salary Subtotal	$27,454
Benefits (21.13%)		$5801
	Subtotal	$33,255
Travel (Seasonal rental, mileage,...)		$3,000
Equipment (hydraulic lift rental)		$1000
Supplies		
	Miscellaneous (traps, lures, colony materials)	$500
	Total	$37,755

Originator's Signature — Date 11/27/07

COOPERATIVE EXTENSION — County Director — Date

Program Director — Date

AGRICULTURAL EXPERIMENT STATION — Department Chair — Date 11/27/07

LIAISON OFFICER — Date