Report to the Agricultural Research Foundation
for the Oregon Processed Vegetable Commission

Development of an IPM Program for the Western Spotted Cucumber Beetle in Vegetable Cropping Systems

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Project Objectives

1. Develop and evaluate a Pilot IPM scouting program for the WSCB in snap beans
2. Determine the seasonal aggregation and movement patterns within diversified vegetable cropping systems
3. Evaluate the potential for "trap and kill" strategies as cultural control components of an IPM program for the WSCB in western Oregon vegetable cropping systems

Methods

Objective 1. This objective focused on evaluating the value of hiring part-time seasonal field scouts to sample bean fields for cucumber beetle adults and deliver information to participating growers. One field scout worked eight weeks, starting June 20 and ending August 12. Scouts were trained and supervised by the scout supervisor, housed in the OSU Department of Horticulture. The field scouts used a standardized sweeping technique and took ten samples of 20 sweeps per sample in each field. A portable GPS data logger was used to record individual sweep samples within fields. After every farm visit, the scout delivered written reports to a designated site on each participating farm. These reports gave field-specific data on beetle densities and possible aggregations, which could allow strip spraying the margins. Each participating grower chose their own "economic threshold" based on IPM data from 2004; thresholds ranged from 2 to 6 beetles per 20 sweeps. At the end of each workday, scouts downloaded data to computer at OSU and weekly scouting summaries were emailed to all program participants. All costs of operating the scouting program were recorded for an economic analysis of the program. Quality grade and spray reports from all scouted fields were obtained to examine economic loss from beetle damage.

To evaluate sweep net sampling efficiency in an effort to reduce scouting costs, a comparison of sample sizes (20 sweeps vs. 10 sweeps per sample) was conducted by "double sampling" in 42 fields. At each of the 10 sites in the field, a set of 20 sweeps per sample was taken and recorded, and then another sample of 10 sweeps per sample was taken. Average number of beetles per sweep was calculated for each sampling method for each field and regression analysis was used to examine correlation between the two sample methods.

Because earlier IPM work on the cucumber beetle in snap beans in the late 1980's reported a "time of day" effect on the number of beetles captured by sweep net sampling, we conducted time of day experiments to determine whether this factor was important for a scouting program. From Aug. 2 to 19, nine fields were sampled three times per day, 8 to 10 am, 12 to 2 pm, and from 4 to 6 pm.

Objective 2. As part of the field scouting objective described above, the field scout also took extra samples along the edge of bean fields, which were adjacent to sweet corn fields. In 2004, we had discovered that beetles aggregated along the margins of many bean fields which adjoined sweet corn fields. We speculated that beetles were "commuting" between bean and corn fields, feeding in the beans and laying eggs in the corn. In 2005, we identified three fields which contained high numbers of beetles along the field margins. To describe the population distribution in the field, we established 8 transect lines across the bean field running perpendicular to the bean/corn interface and took 10 samples of 10 sweeps per sample along each transect line.

We also observed seasonal aggregation patterns of beetles within different crops in the landscape to develop an understanding of how beetles move among crops, and which crops are preferred as overwintering sites. Collections of 50 beetles were made at various sites throughout the season and returned to the laboratory for dissection. Gender, egg development and parasitism were determined.

Objective 3. We continued our work in evaluating the effectiveness of our kairomone lures in attracting cucumber beetles to traps, and to developing mortality estimates of beetles landing on yellow fabrics treated with insecticides and extracts from a bitter watermelon contain high levels of cucurbitacin, a feeding stimulant. We also worked with a commercial pheromone company, AgBio, Inc., of Westminster CO to compare attractiveness with our laboratory-produced kairomone lure. To compare lure efficacy, we established an experiment in a squash field (var. = 'Golden Delicious" near Corvallis. Three treatments were used, including (1) no lure control, (2) OSU laboratory lure, and (3) the AgBio lure. Yellow sticky cards (7 x 10 inch) were mounted on metal poles approx. 30 inches above the soil and lures were mounted on top of the poles. Traps were spaced 90' apart in a line along the edge of the field next to a corn field. There were five replications of the three treatments for a total of 15 traps. Traps were placed in the field and removed after 24 hours. Traps were then reinstalled on 1-3 day intervals from Aug. 23 through Oct. 11.

To evaluate efficacy of the treated fabric traps in killing beetles, observations were made of traps installed in a squash field during September. Initially traps were observed with binoculars to record the rate beetles visiting the traps, and individual beetle "residence time" was recorded. Visual observation was later replaced by time-lapse photography techniques using computer-controlled cameras and by video cameras. Laboratory studies were conducted to evaluate the most effect rate of Entrust® insecticide to use on the fabrics.

Results

Objective 1. Scouting was conducted on a weekly basis, beginning just before flower initiation and continuing for 2 to 3 weeks. A total of 213 field visits were made to 125 bean plantings on 8 farms in the Stayton, Dever, Scio, and Corvallis areas. Of the 125 fields scouted, 61 fields were treated with an insecticide, 64 fields were not sprayed. Most fields were well below the economic threshold value of 6 beetles/20 sweeps reported by OSU researchers in the 1980's (Weinzierl et al. 1987) (Fig 1).

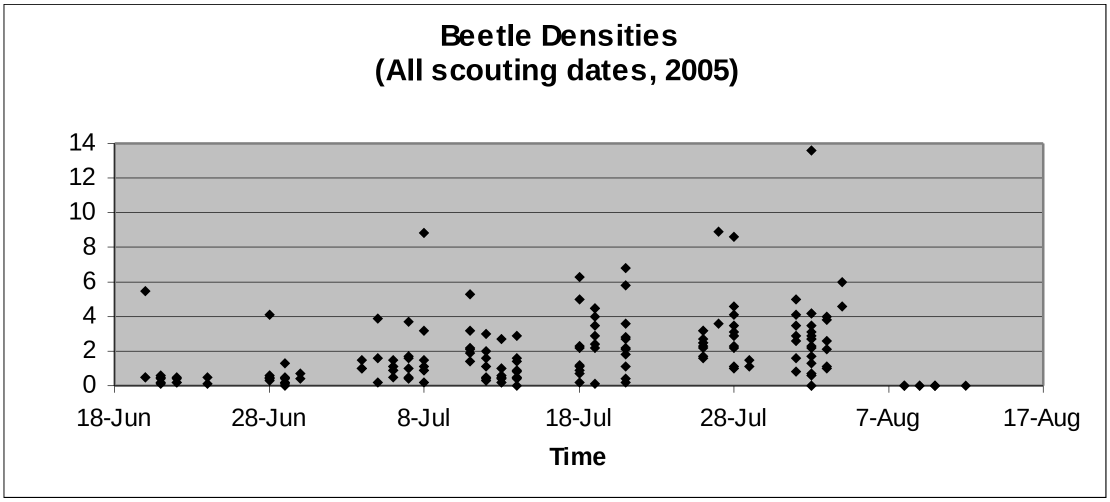

Fig. 1. Beetle densities bean fields in all scouting dates during 2005.

Economic loss from "bean bite" was calculated from the grade tickets, using "pre-equalization" prices from Norpac for each cultivar of bean grown in the project. Total economic losses to beetle damage per field were divided by the acreage of the field to obtain dollar loss per acre estimates. More than half of the fields scouted had no loss from bean bite, regardless of whether they were sprayed (Figs. 2 and 3) and few fields exceeded the cost of insecticide control (approx. $4/acre). There were no individual truckloads or fields of beans rejected by the processing plant for excessive beetle damage. Scouting costs were calculated to be approximately $2.20/acre, and included labor, transportation, and data management.

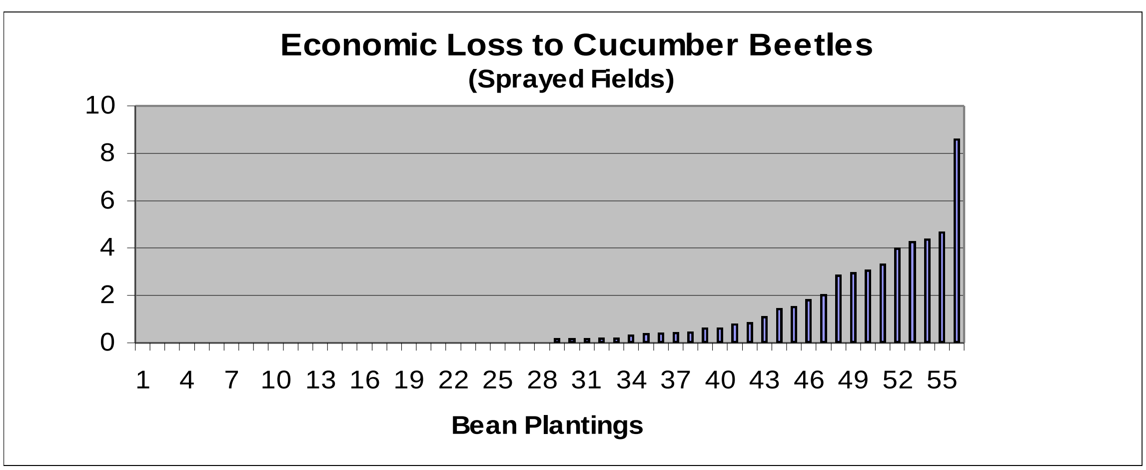

Fig. 2. Economic loss to cucumber beetles in sprayed fields, 2005.

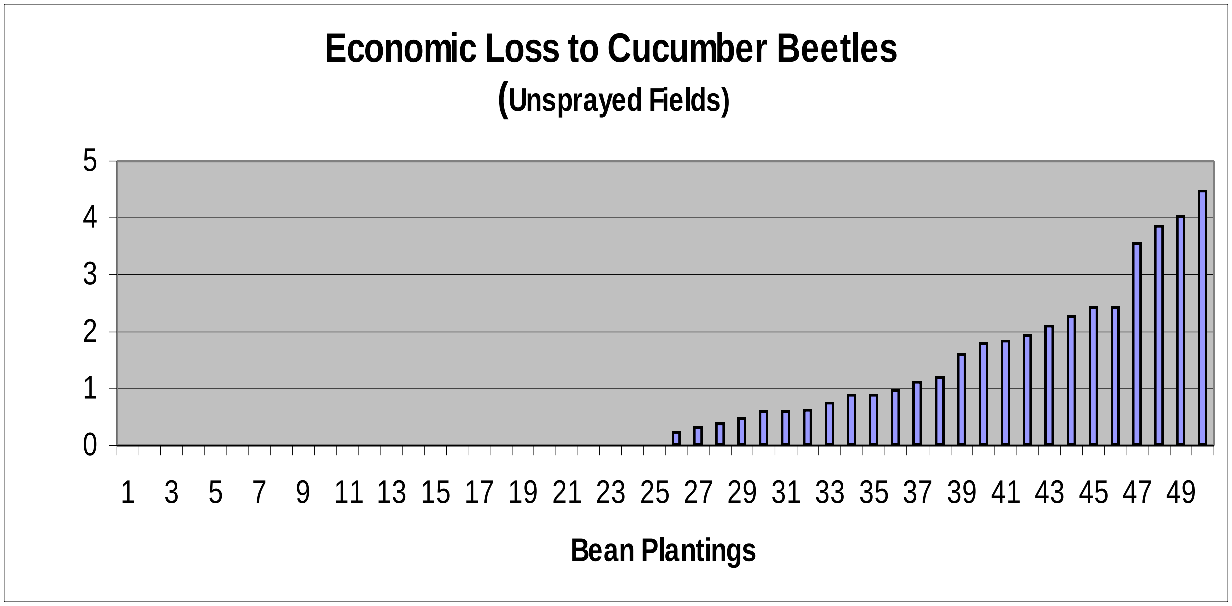

Fig. 3. Economic loss to cucumber beetles in unsprayed fields, 2005.

Sweep net sampling efficiency using a 10-sweep sample appeared to be similar to a 20-sweep sample (Fig. 4). Although the absolute accuracy of the 10-sweep sample is slightly less than the 20-sweep sample, it appears that a 10-sweep sample can be used to give reasonable estimates of beetle density. Reducing sample size can reduce the cost of scouting per acre.

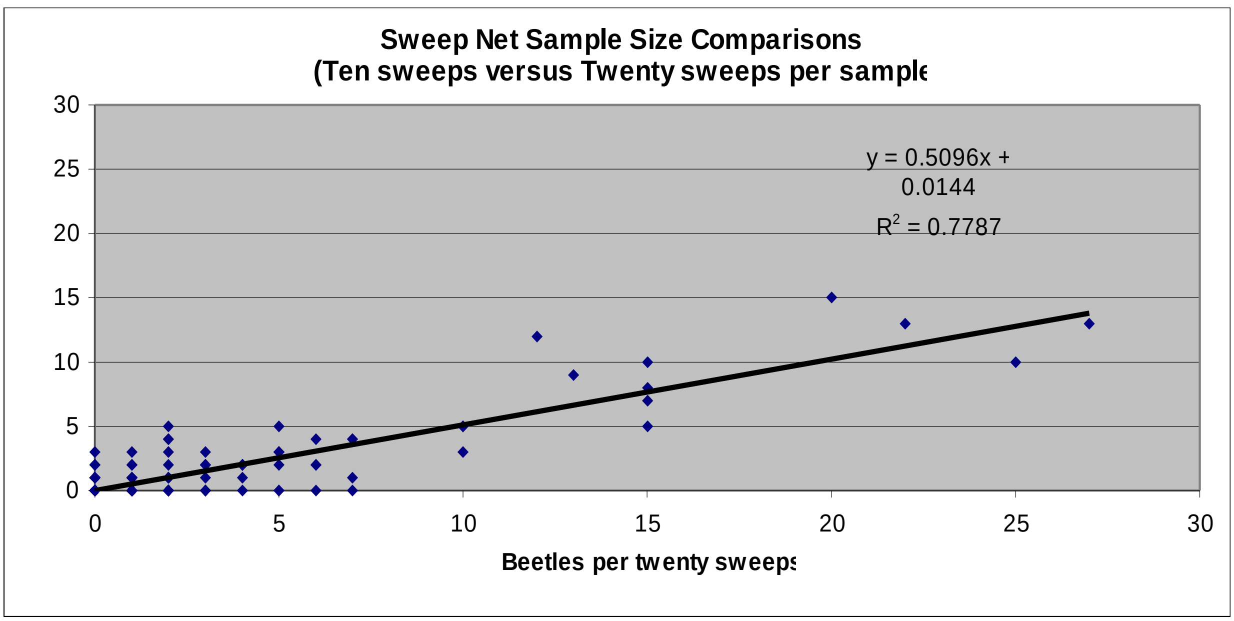

Fig. 4. A comparison of sweep net sample sizes (10 vs. 20 sweeps per sample).

In the study to examine the effect of time of day on sample estimates, it appears that time of day has little effect on the mean estimate of beetle counts based on sweep net sampling (Fig. 5).

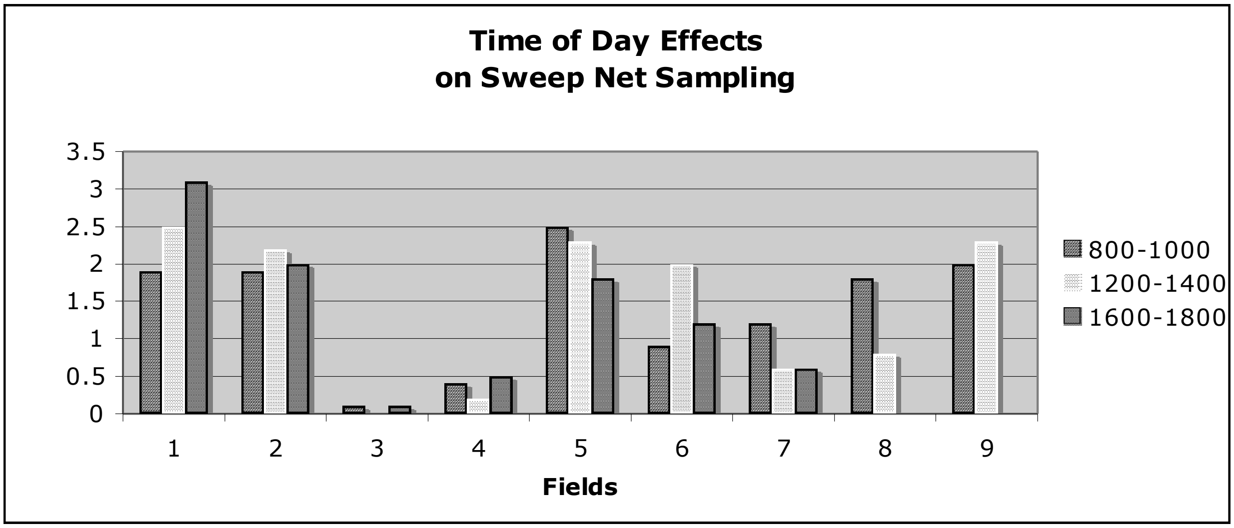

Fig. 5. Evaluation of time of day on sweep net catch of cucumber beetles in bean fields.

Objective 2. An aggregation of beetles in bean fields along the borders next to bean fields was documented in three fields in 2005 (Data for two fields shown in Fig. 6 and 7). High numbers of beetles were found within 25 feet from the edge of the field, with very few beetles found in the rest of the field. At least 50 beetles were collected from the aggregation area and from the remaining parts of the field. Most of the beetles in the aggregation areas were egg-carrying females; most of the beetles in the remaining part of the field were males and non-egg carrying females.

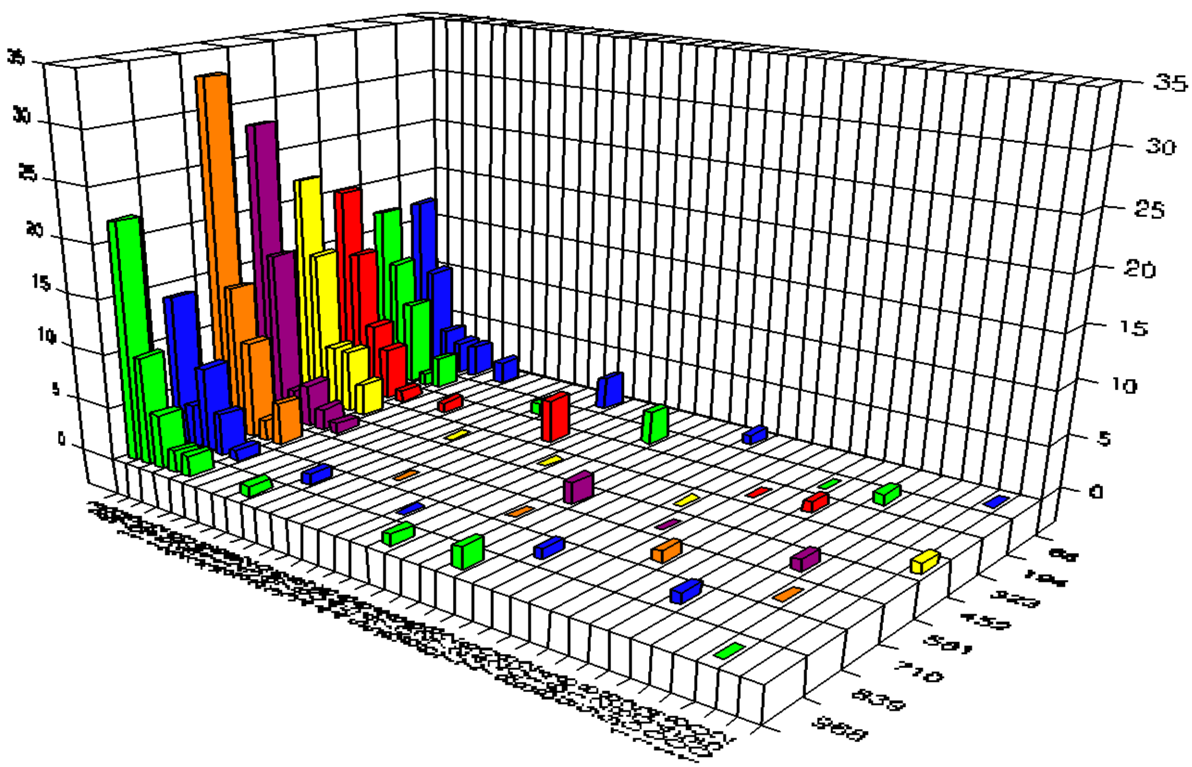

Fig. 6. Aggregations of beetles in the Chambers field in the Dever area. The left edge of the graph corresponds to the edge of the bean field next to sweet corn.

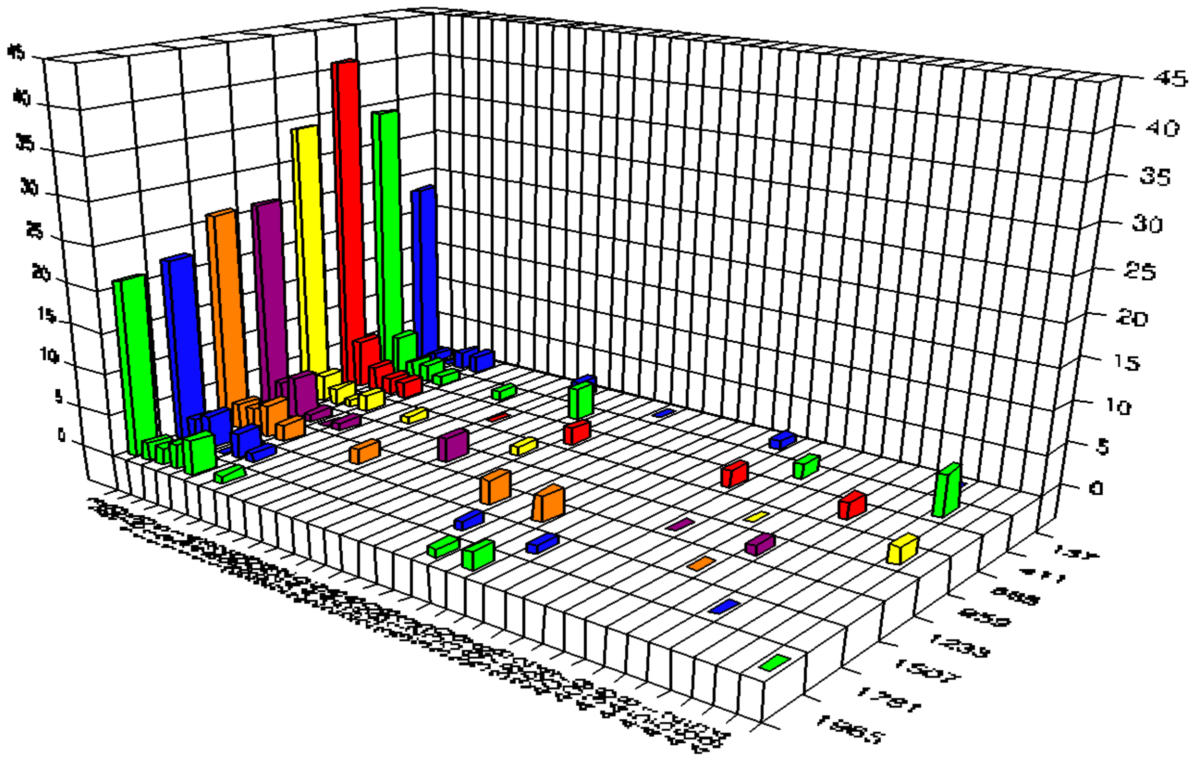

Fig. 7. Aggregations of beetles in the Keudell field in the Stayton area. The left edge of the graph corresponds to the edge of the bean field next to sweet corn.

Movement of beetles among crops in the landscape. Aggregations of beetles were found in volunteer radish seed fields on two farms (Chambers and Winn) and in sugar beet seeds fields at Chambers. This is the second year that beetles have been found in volunteer radish fields and the third year that beetles have been found in sugar beet seed fields. Not all beet fields contain beetles, however. One beet field on the Winn Farm was isolated from the rest of the farm by at least a mile, and it appears that this distance prevented fall colonization of the beetles from other fields. There is an apparent seasonal movement among crops, going from (1) adults moving out of overwintering sites in early March to lay eggs (likely in grass fields and early planted corn), followed by the colonization of bean fields in late June and July when the summer generation of adults emerges. These adults move into corn fields to lay eggs. Larvae develop in corn (and other crops), and by late August the second generation of adults emerge. Spinach, squash and other cucurbits appear to be favored crops for the adults at this time, and these adults also move into late season corn fields. Adults move into overwintering sites in late September and early October. Volunteer radish seed, sugar beet seed, and spinach fields appear to be preferred overwintering crops. Mated females and males were found in these crops in mid-November. An unanswered question is whether any eggs or larvae overwinter in addition to the overwintering adults.

Objective 3.

In the studies comparing the commercially produced kairomone lure (AgBio) lure with our standard OSU laboratory lure, the AgBio lure caught more cucumber beetles than the no-lure control panels, however this lure was not as effective as our laboratory-produced lure (Fig. 8).

Over the trapping period, the laboratory lure attracted an average of 121 cucumber beetles per trap day compared to 36 beetles in the no lure control. The lures remained attractive to beetles for more than 30 days in the field.

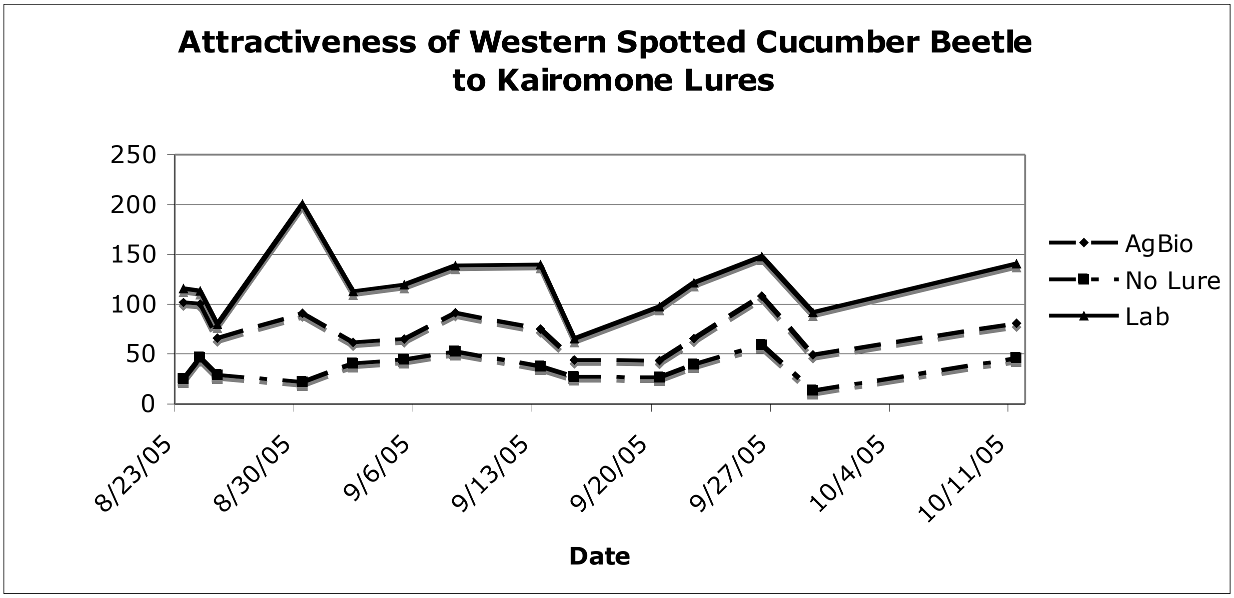

Fig. 8. Attractiveness and duration of a commercially produced kairomone lure (AgBio) compared to the OSU laboratory lure and a no-lure control treatment in a squash field near Corvallis, OR.

In the studies to evaluated the efficacy of the fabric traps to kill beetles, a problem emerged which prevented accomplishment of this objective. In laboratory studies to determine optimum rates of Entrust insecticide on the fabrics, we were unable to kill beetles, regardless of the exposure time on the fabrics. In prior work in 2004, we were able to kill beetle with more than one minute exposure to the fabric. In the 2005 work, however, exposures of up to ten minutes failed to kill beetles. Our only plausible explanation is that our supply of Entrust was purchased in 2004, and being a metabolite of a soil actinomycete with a limited shelf life, apparently lost it's toxic effect by the time we conducted these studies in October, 2005. In addition, we conducted our fabric residence time field studies using dried Hawkesbury melon power supplied by the USDA Biological Control of Insects Laboratory in Beltsville, Maryland. This material was several years old and although beetles were induced to feed on the fabric, residence time was low. This year we obtained seed of the bitter mutant Hawkesbury watermelon from the Beltsville Laboratory and grew 0.10 ha of melons at the OSU Vegetable Research Farm. Melons were harvested in late September and processed by washing, chopping in an apple grinder and pressing the juice in a wine press. When this fresh bitter melon juice was applied to the fabrics, beetles quickly covered the fabrics and remained feeding for more than five minutes. We have more than 200 gallons of this melon juice frozen for studies in 2006, and we will obtain a fresh supply of Entrust insecticide as well.