

Title: Alternative management tactics for green June beetles in grape

Progress Report

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Research Progress Report for 2009

Name, Mailing and Email Address of Principal Investigator(s):

Principal Investigators:

Dr. Donn T. Johnson
University of Arkansas
Fayetteville, AR 72701
dtjohnso@uark.edu

Cooperators:

Dr. Allen Knutson
Texas A&M Research and Extension Center
Dallas, TX
a-knutson@tamu.edu

Fran Pontasch
Texas AgriLife Research & Extension Center
Stephenville, TX 76401
FMpontasch@ag.tamu.edu

Additional Cooperators for on-farm trials:

Gene Cowherd, grape grower, Purdy, MO
Doug Hausler, grape grower, Keels Creek Winery, Eureka springs, AR
Tom Post, grape grower, Post Winery, Altus, AR
Willow Point Vineyard Bridgeport, Wise County, TX
Bobby Smith, grape grower, La Buena Vida Vineyards, Springtown, TX

Objectives: The overall objective is to develop a management tactic that prevents green June beetles from damaging fruit. The specific objectives are:

- 1) To compare the attractiveness of different odor mixtures for mass trapping green June beetles outside grape plantings; and
- 2) To evaluate field efficacy of insecticides and biopesticides against the green June beetle for potential use in an attract-and-kill formulation.

Justification:

Feeding green June beetle adults cause significant fruit damage to grape cultivars maturing from mid-July to late-August in the southeastern United States (Fig. 1 and 2; Jackson 2009). Continued funding will allow us to improve the attractive bait for mass trapping green June beetles and complete efficacy studies of insecticides and biopesticides against the green June beetle. Hand removal of fruit feeding green June beetles or foliar application of Sevin insecticide are the only recommended management tactic against the green June beetles on most fruits. One goal is to identify several effective insecticide and biopesticide formulations with different modes of action registered against green June beetles. Eventually, we plan to minimize insecticide use against green June beetles by developing an attract-and-kill strategy. This strategy will use bait (like isopropanol) to attract green June beetle adults to a perimeter row of

vines sprayed with a feeding stimulant (sugar) and insecticide or biopesticides to kill beetles with minimal insecticide use per acre.

Methodologies and Results:

Objective 1. To continue comparing the attractiveness of different odor mixtures. 2009 activities

In Arkansas: This summer, we set out trap lines to mass trap green June beetles in four locations: Altus, AR (vineyard of Campbell Early, Burmunk, Zinfandel), Eureka Springs, AR (vineyard of Vignoles, Vidal, Cayuga White and Seyval), Fayetteville, AR (apples and brambles) and Purdy, MO (vineyard of Seyval, Vignoles, Chambourcin) (Table 1). We decided to use the cheaper bait of 91% isopropanol in all traps in 2009 since it was shown that isopropanol and TRE#8607 blend of volatile compounds attracted similar numbers of green June beetles (Johnson et al. 2009). Therefore, each yellow funnel Xpando trap was baited with a 20 fl oz beverage bottle filled with 91% isopropanol that evaporated via a 1 inch exposed cotton-wick (½ inch diameter) and funneled green June beetles into a 20 liter plastic capture box. Isopropyl alcohol was added to bottle in each trap as needed, generally 100-300 ml/week, to replace that lost to evaporation. Weekly or biweekly (depending on number of green June beetles captured), we recorded the number of green June beetles per trap as well as the number of green June beetles and percentage damage on ten clusters adjacent to each trap in Arkansas.

In Arkansas, the 2009 season total numbers of green June beetles per trap were less in Altus, Eureka Springs and Fayetteville, AR than in Purdy, MO (Table 1). Season total counts per trap in 2008 and 2009 at Altus, AR were comparable at 619 and 682 green June beetles per trap, respectively. However, in Purdy, MO there were 13,190 green June beetles per trap in 2008 compared to much fewer in 2009 at 2,699 green June beetles per trap. The Purdy, MO vineyard had the highest population of green June beetles in 2008 and 2009 of all sites trapped, but still had no green June beetles feeding on any clusters. In both years, mass trapping of green June beetles may have resulted in this low feeding damage by green June beetles, but it was more likely due to weekly insecticidal control of economically damaging levels of Japanese beetles in July and early August to prevent defoliation. The low numbers of green June beetles in flight in three of the four locations equated to very little green June beetle attack of grape clusters. The vineyard in Altus, AR was free of Japanese beetles but the grower had a high value crop of early maturing Campbell Early and Burmunk grapes with some green June beetle feeding on a few clusters by 14 July. On 14 July, the edge row of Campbell Early grapes was at 13 Brix (percent ratio of sugar-to-water mass) with no green June beetles present, whereas the adjacent interior ten rows of Burmunk were at 17.7 Brix with eight green June beetles all on one cluster out of 60 clusters inspected. Earlier that morning, the grower had seen a few green June beetles on clusters of Burmunk and applied a protective insecticide spray of Mustang Max to prevent any green June beetle feeding damage. On 27 July, the Burmunk block was harvested and the grower had completed the first of several pickings of Campbell Early. By 28 July, a nearby block of Venus table grapes at 13.6 Brix had six out of 200 clusters infested with green June beetles, Campbell Early (edge row) was still at 13 Brix and had 21 of 400 clusters infested with green June beetles with light damage. There were fewer green June beetle-infested clusters in the Burmunk and the nearby Zinfandel blocks. No green June beetle feeding was observed on grapes in Eureka Springs, AR but a few were on apples in the conventional apple block in Fayetteville, AR.

Table 1. Estimated number of green June beetles (GJBs) captured in yellow funnel traps baited with 91% isopropanol in three mass trapping locations in Arkansas and one in Missouri (2009)

Location	No. traps	Total number of GJBs captured per sample date						Season total GJBs
		13-15 Jul	20-23 Jul	28-29 Jul	3-6 Aug	21- Aug	27- Aug	
Purdy, MO	26	10,095	18,398	41,688				70,181
Altus, AR	14	311	3,452	1,200	3,983		595	9,541
Eureka Springs, AR	16		1,462		5,130			6,592
Fayetteville, AR	18	391	2,112	1,827		1,732		6,062
Sample date total for AR & MO	--	10,797	25,424	44,715	9,113	1,732	595	92,376

Table 2. Estimated number of green June beetles (GJBs) captured in yellow funnel traps baited with 91% isopropanol in two mass trapping locations in Texas (2009)

Location	No. traps	Total number of GJBs captured per sample date							Season total GJBs
		1-13 Jul	20 Jul	27 Jul	3 Aug	10 Aug	17 Aug	24 Aug	
Bridgeport	29	43	44	40	31	918	7,628	466	9,170
Springtown	32	2	10	17	50	1,204	1,541	416	3,240
Sample date totals for TX	--	45	54	57	81	2,122	9169	882	12,410

In Texas: Allen Knutson and Fran Pontasch collaborated on this project and provided their own traps, bait and labor. They set up 29 and 32 isopropanol alcohol baited traps, each with a 13 gallon plastic heavy-duty garbage bag capture container, adjacent to vineyards in Bridgeport and Springtown, TX, respectively. An adjacent block in Springtown and a third vineyard in Stephenville, TX were without traps and both served as controls. Japanese beetles were absent from all vineyards in Texas and none of these vineyards were at high risk from grape berry moth. Twelve vines, one near each of 12 traps, were selected and 10 grape clusters on each vine were visually examined and damage due to green June beetle feeding was rated as follows: N = clusters not infested by green June beetle; L = light damage where clusters were infested by green June beetle but not ruined; M = moderate damage but harvestable; or H = heavy damage where clusters were ruined by green June beetle and not harvestable.

Springtown Vineyard: green June beetles were first captured on July 13 and peak capture (mean of 48 green June beetles/trap) was recorded on August 17 (Table 2). A total of 3,240 green June beetle were captured in the 32 traps (mean of 101/trap) during July through late August. The Tempranillo grapes were harvested July 27, when trap captures were still very low, and these grapes escaped damage by green June beetle. Green June beetles were first observed attacking the Chambourcin grapes on Aug. 10 when light damage was observed. The following week, 10% of the sampled clusters (50) had moderate damage due to green June beetle (Fig. 1).

Sevin XLR was applied to this Springtown vineyard on August 9 and August 17, 2009. On August 24, 18% of the sampled clusters had moderate damage and 10% had heavy damage. Cluster damage in the control vineyard in Springtown was not recorded. The control block in this vineyard was harvested early before green June beetle populations could damage clusters.

Bridgeport Vineyard: green June beetles were first captured in the traps on July 1 (total of 3 beetles) and peak capture (mean of 263/trap) was observed on August 17, the same date as in the Springtown vineyard (Fig. 2). A total of 9,170 green June beetle were captured (mean of 286 per trap) during July through late August. Grape clusters damaged by green June beetle were first observed on July 20, when 2 of the 120 clusters inspected were damaged. Damage rapidly increased on August 10 when 43% and 19% of the sampled clusters had moderate or heavy damage due to green June beetle, respectively. The damage level was greatest on August 24 when 27% and 48% of the sampled clusters were moderately or heavily damaged by green June beetle, respectively. Two of the four sample areas of Viognier had no green June beetle damage while all clusters in the remaining varieties were damaged by green June beetle. Sevin XLR was applied to the Bridgeport Vineyard on July 18 and August 10. On August 16, Sevin XLR was applied around but outside the vineyard within close range of the green June beetle traps.

Texas AgriLife Research Vineyard (TAES): On August 1, the first green June beetle was captured in the single sentinel trap baited with the commercial TRE-green June beetle lure. The only other capture was on August 26 when 3 green June beetle were captured in this trap. However on 5 August, green June beetles were common in this vineyard with 23% and 9% of the 80 sampled clusters had moderate or heavy damage due to green June beetles. Sevin insecticide was applied for green June beetle on July 31 and August 5. On August 26, 27% and 31% of the 100 sampled clusters had moderate or heavy green June beetle damage, respectively.

Conclusions: In AR and MO, the alcohol-baited traps captured large numbers of green June beetle in July with a peak in late July. In TX, the alcohol-baited traps captured large numbers of green June beetle during July and August but peaked on August 17. It is not known if this pattern of trap captures is a response to changing density of green June beetle or the attraction of beetles to ripening grapes. Research is needed to better understand adult green June beetle adult emergence and flight activity during the summer in north Texas.

The Trece TRE-green June beetle baited trap captured a total of 79 green June beetle during the trial at Springtown. Seventeen (54%) of the alcohol baited traps captured more and 14 (45%) of these traps captured fewer total beetles than the Trece trap. At Bridgeport, the Trece trap captured a total of 13 green June beetle during the trial and all of the alcohol-baited traps captured more green June beetle than did the Trece trap. Although not a scientific comparison, these results suggest the alcohol-baited traps are as attractive as the commercial lure.

Although a total of 22195, 70181, and 3240 and 9170 green June beetles were trapped and killed at the AR, MO and two TX vineyards, respectively, these vineyards were treated with insecticide. Total moderate and heavy cluster damage due to green June beetle ranged from 28% to 75% in these two TX vineyards, despite two insecticide treatments and destruction of several thousand green June beetle in the traps. Cluster damage by green June beetle at the TAES (control) vineyard totaled 58%, more than at the Springtown vineyard (total 28 % damage) but less than the Bridgeport vineyard (total 75% damage). Only a single trap was monitored at Stephenville, so beetle density among the three vineyards can not be compared. These results suggest that mass-trapping did not adequately suppress green June beetle densities below

numbers that justified an insecticide treatment, as determined by the growers, and even when combined with an insecticide, significant damage occurred in both TX vineyards. Traps did eliminate large numbers of beetles, and while this may have reduced the damage level, it is impossible to estimate the magnitude of this reduction. As evidenced by cluster damage, traps captured only a portion of the green June beetle entering the vineyard. As an example, during the week of July 27-August 4, the owner of the Bridgeport vineyard hand collected 87 green June beetle from grape clusters while 31 green June beetle were collected during the same week in the traps surrounding the vineyard. The following week, the owner hand collected 4,181 and 918 green June beetles from grape clusters and traps, respectively.

The effect of mass trapping as a control practice is difficult to evaluate for several reasons. First, population size of green June beetle in the area surrounding a specific vineyard no doubt varies due to the distance to green June beetle breeding sites in pastures and hayfields and the area of these breeding sites. Vineyards near large pastures and hayfields would likely have more green June beetles than a vineyard distant from these breeding sites. We do not know what the size of the local population of green June beetle at each of the three test vineyards. Thus, although the TAES vineyard did not have traps, and served as a “control”, we can not assume the green June beetle density surrounding that vineyard was the same as the two mass-trapped vineyards. For this reason, it is difficult to compare green June beetle numbers and damage at these three vineyards and evaluate the impact of mass-trapping in a single season. Another unknown and related question is the distance green June beetle can fly. Also, some beetles escaped through holes in the garbage bag in TX. Escaping beetles were often found in the grass and soil beneath the trap, and these were included in the trap catch. However, it is possible that the number of trapped beetles was under estimated. Beetle loss did not occur in traps in AR and MO where we used a plastic capture box. Future studies should use heavier plastic bags or plastic capture box. It was also observed that flying beetles were attracted to bags of dead and dying beetles, possibly responding to the alcohol that may have dripped from the wick on to the collection bags in TX.

There is concern with any mass-trapping program that large number of traps may attract more pests into the crop than might otherwise occur, and since traps do not capture all pests, there may be a potential to increase pest density. The assumption is made that traps only attract green June beetle that are already flying into the vineyard, and not attracting green June beetle from long distances. Future studies should determine the effective range of traps in attracting green June beetle.

Future studies on mass trapping should also include efforts to reduce the cost of traps. The current trapping station costs \$12.50 each and includes a Japanese beetle yellow Xpando trap top (\$4.80 from Great Lakes IPM, Vestaburg, MI) that funnels beetles into a \$4 plastic capture box (> 20 liter) baited with a recycled beverage bottle that dispensed \$3.00 of 91% isopropyl alcohol per season via a \$0.50 cotton wick. Traps are very durable and could be re-used each year. The cost of Sevin XLR used in this study was about \$21.80 per acre at a rate of 2 quarts per acre. With additional research on trap design, a less expensive trap could probably be designed and constructed in a home shop. Toward this goal, Dr. Pszczolkowski (Missouri State University, Mt. Grove, MO) and Dr. Johnson (University of Arkansas, Fayetteville, AR) have received a Specialty Crops grant from the MO Department of Agriculture titled, Optimizing an inexpensive trap and lure for monitoring green June beetles.

One cooperator noted that the trapping study alerted him to the need to inspect his vineyard for green June beetle. This suggests traps might serve as a monitoring tool, rather than a control practice, to alert growers to movement of green June beetle into the vineyard and the need to apply or re-apply an insecticide treatment. Data on cluster damage (Fig. 1 and 2) shows that green June beetle damage can increase quickly within a week during early August and frequent vineyard inspection in late July is needed to be prepared to protect grapes with an insecticide treatment should green June beetles begin feeding on fruit in the vineyard.

Objective 2: In 2009, the low numbers of green June beetles in flight and feeding on grape clusters in vineyards or apple block in AR and MO noted above prevented completion of the efficacy evaluations as proposed. For 2010, we plan to complete this objective but it will require that we modify the methods. For about 20 insecticides and biopesticides, we will determine the treatment formulation concentration that kills 90% of green June beetles (if any) via a series of replicated screen cage studies of ten green June beetle adults feeding on ripe grapes sprayed with a specific dose of insecticide or biopesticide mixed in a 67% sugar solution (feeding stimulant). The dose for each formulation causing 90% green June beetle mortality in the cage studies will be evaluated in the field in a RCB design of sprayed three-vine plots. Each plot will have a cluster of damaged, ripe table grapes from the grocery store (> 20 Brix) wired to the grape vine and a 50 ml cotton-wicked vial of 91% isopropanol to attract green June beetles. We will record the percentage green June beetle mortality and cluster feeding damage by treatment and statistically compare treatment means. See the revised Materials and Methods for objective 1 in the Southern Region Small Fruit Consortium proposal titled, Alternative management tactics for green June beetles in grape (submitted on 31 October 2010).

Impact Statements

Funding from the SRSFC and IR-4 programs allowed us to begin to determine the efficacy of insecticides and biopesticides against green June beetles. It also allowed us to evaluate mass trapping as a strategy to reduce local populations of green June beetles around fruit plantings. Mass-trapping did not suppress green June beetle densities below numbers that justified an insecticide treatment, as determined by the growers, and even when combined with an insecticide, significant damage occurred in both TX vineyards. However, isopropanol-baited traps did eliminate large numbers of green June beetles from the local population. This may reduce the local population if continued for several years and eventually reduce the fruit damage level.

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Fig. 1. Percentage of grape clusters with moderate and heavy damage by green June beetles with Sevin XLR foliar applied to vineyard on August 9 and 17 in Springtown, TX (2009)

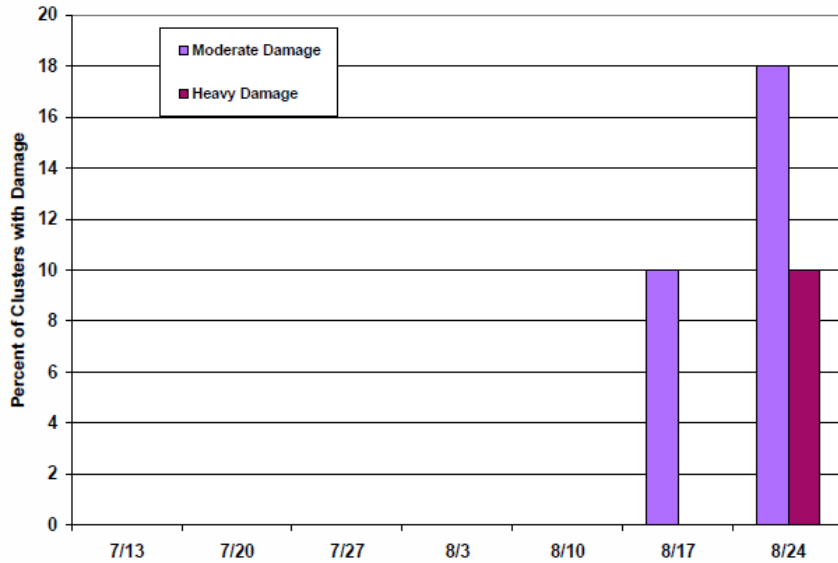
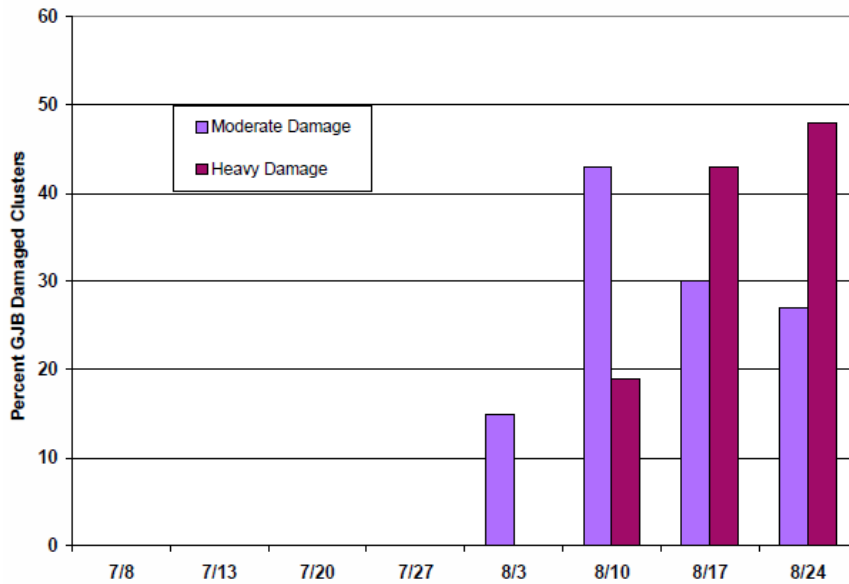


Fig. 2. Percentage of clusters with moderate or heavy damage from green June beetle with Sevin insecticide applied to vineyard on July 18 and August 10 in Bridgeport, TX (2009)



PUBLICATIONS RELATED TO PROJECT

Johnson, D.T., B.A. Lewis, R.J. Bryant, R. Liyanage, J.O. Lay, and M.A. Pszczolkowski. 2009. Attractants for the green June beetle. *J. Econ. Entomol.* 102: 2224-2232.
 Johnson, D.T., and B.A. Lewis. 2009. Efficacy of insecticides against green June beetle, 2008. *Arthropod Management Tests* 34: C13.

NEWS RELEASE:

Jackson, M. 2009. Texas green June beetles a menace to vineyards. *Southwest Farm Press* 9 September. Penton Media, Inc. <http://southwestfarmpress.com/news/vineyard-pests-0909/>