Southern Region Small Fruit Consortium – Progress Report

Title: Antifeedants, repellants, organic controls and clarified injury status for plant-feeding bugs, scarab beetles and thrips on caneberries

Progress Report

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Research Project

Personnel:

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Objectives:

1) Determine efficacy of antifeedants and repellants, and sublethal doses of a pyrethroid, against a two complexes of blossom and berry feeders, (1) tarnished plant bug and stink bugs, (2) Japanese beetle and green June beetle and (3) thrips,
2) Determine relative susceptibility of several primocane-bearing brambles toward tarnished plant bug and Japanese beetle.
3) Develop illustrated guide to TPB and SB injury to varying berry developmental stages.

Justification:
Japanese beetles in primocane-bearing brambles pose special problems because the flowering/fruiting phenology and pesticide preharvest intervals (Pfeiffer 2007). Control of berry-feeding pests is difficult in brambles because of preharvest intervals of many materials, coupled with losses of pesticide registrations. A key pest here is Japanese beetle, which feeds on ripe berries. A material frequently used for Japanese beetle is carbaryl, but this is not appropriate in this setting because of the 7 day PHI. Tarnished plant bug is also injurious to brambles since they will feed on both flowers and fruit, as do stink bugs. The purpose of this study was to evaluate several materials that might be usable in this system, where short PHIs and low human toxicity are required.

Methodologies:
Objective 1:
In 2009, bioassays and field experiments were preformed in order to depict how six treatments applied affected Japanese beetle activity on primocane-bearing raspberries.

<u>Laboratory Studies</u>:
The bioassays consisted of dipping Prelude raspberry leaves into the different treatments (MGK, Requiem, Battalion, Assail, Altacor, and Neemix/Trilogy mix), then placing them in a Tupperware container with one Japanese beetle and a moist cotton ball for 48 hours. The percent defoliation after 48 hours was recorded to assess the treatment's antifeedant, toxicity or deterrent capability. Leaves were photographed for optical analysis of leaf area removal (analysis of these images in continuing). The number of beetles on the

leaves after 6, 18, 24 and 48 hours was recorded to determine the treatments' degree of repellency. Also, the number of beetles alive after 6, 18, 24, and 48 hours was recorded to assess the treatments' toxicity.

Field Studies:
The field experiments consisted of applying five treatments (Altacor, Assail, Battalion, MGK and a Neemix/Trilogy mix) to 1.2 meter (4 ft) plots of 8 different raspberry varieties. Japanese beetles were counted within each plot to assess the treatments' deterrent and/or repellant qualities. The raspberries were harvested and separated between marketable and unmarketable. Then, the percents marketable from each treatment were compared. Damaged leaves from each treated plot will also be evaluated to find the percent defoliation that corresponds to each applied treatment.

Objective 2:
Japanese beetles were counted on plants of the following varieties: Anne, Autumn Bliss, Caroline, Dinkum, Fall Gold, Heritage, Himbo Top Prelude. These counts were made in the chemical test trial as part of the experimental design.

Results:

Objective 1:
Laboratory studies:
Preliminary defoliation results for the bioassay are presented in Table 1. When comparing the percent defoliation of the bioassay, leaves treated with Requiem, Battalion, Assail, Altacor and the Neemix/Trilogy mix had significantly less defoliation than the control leaves. Leaves treated with MGK, a pyrethroid/Neem mix, did not have significantly different defoliation from the control.

Table 1. Percent defoliation on raspberry plants following insecticidal treatment.

Treatment	% damage
Control	10.0 a
MGK	5.3 ab
Requiem	4.7 b
Battalion	3.8 b
Assail	2.2 b
Altacor	2.0 b
Neemix/Trilogy	1.4 b

After six hours, the number of living beetles in the Assail containers was significantly less than the number alive in the control containers (Table 2). No other treatment differed from the control. After 18 hours, there were significantly fewer beetles alive in the Battalion and Assail containers. After a day of exposure, there were significantly fewer beetles alive in the Battalion and Assail containers than in the control containers. After 48 hours, again, battalion and Assail were the only two treatments that had a higher mortality than the control. There was a 56 percent mortality in the beetles exposed to Battalion and a 68 percent mortality in the beetles exposed to Assail.

Table 2. Percent living Japanese beetles after 6, 18, 24, and 48 hours.

Treatment	% alive 6 hrs	% alive 18 hrs	% alive 24 hrs	% alive 48 hrs
Control	100 a	100 a	100 a	100 a
Neemix/Trilogy	100 a	100 a	96 a	96 a
Requiem	96 a	96 a	92 a	88 a
Altacor	96 a	88 ab	88 a	80 a
MGK	92 a	88 ab	84 a	76 a
Battalion	84 ab	64 bc	52 b	44 b
Assail	64 b	52 c	36 b	32 b

After 6 hours, there were fewer beetles on the leaves treated with Battalion, Assail, and MGK than the control leaves (Table 3). After 18 hours, there were fewer beetles on the leaves treated with Battalion, Assail, Requiem, and MGK than on the control leaves. A day after exposure, there were fewer beetles on the leaves treated with Battalion, Assail, and Assail than on the control leaves. Two days after exposure, there were fewer beetles on leaves treated with Battalion, Assail, and Requiem than on the control leaves.

Table 3. Percent of Japanese beetles located on the raspberry leaves after 6, 8, 24, and 48 hours.

Treatment	% on leaves 6 hrs	% on leaves 18 hrs	% on leaves 24 hrs	% on leaves 48 hrs
Control	88 a	88 a	88 a	92 a
Altacor	72 abc	84 a	84 a	68 ab
Neem/Trilogy	76 ab	80 ab	80 a	60 abc
MGK	40 bcd	40 c	64 ab	60 abc
Requiem	52 abc	48 bc	44 b	48 bc
Assail	36 cd	36 cd	32 bc	28 cd
Battalion	4 d	4 d	4 c	4 d

The tenth of August was the only date in which there was a significant difference in the grams marketable when looking at the treatment's effect (Table 4). On this date, plants that were treated with Battalion had higher yield than plants treated with the other treatments and the control plants.

Table 4. Grams of marketable raspberries collected from plant subjected to Japanese beetle feeding after insecticidal treatment.

Treatment	6-Aug	10-Aug	13-Aug	17-Aug	20-Aug	24-Aug	27-Aug	31-Aug	3-Sep	10-Sep	17-Sep	Year total
MGK	140	1250 b	1761	1781	2012	2196	1199	1589	1104	1463	733	15228
Battalion	197	1825 a	1536	2260	2235	2316	1186	1222	714	1003	411	14905
Neem/Trilogy	149	1184 b	1657	1578	1855	2215	1143	1591	1123	992	552	14039
Control	102	1115 b	1641	1632	1678	2091	1240	1611	999	1169	558	13836
Assail	146	1249 b	1665	1835	1825	2158	917	1127	864	865	450	13101
Altacor	102	1180 b	1349	1549	1461	1700	1155	1333	875	966	475	12145

On 8 July, there were fewer beetles present on the plants treated with Assail than on the plants treated with Altacor and the Neemix/ Trilogy mix (Table 5). There were significantly more Japanese beetles present on the plants treated with Assail than all other treated plots. When all observed dates were added together, there were significantly more beetles on plots treated with Assail than all other plots.

Table 5. Average number of Japanese beetles per 1.2m of raspberries following insecticidal treatment.

Treatment	8-Jul	15-Jul	22-Jul	5-Aug	Total
Assail	29 a	18 a	48 a	14 a	109 a
MGK	13.5 ab	15 a	16 b	10.5 a	55 b
Control	14.5 ab	10.5 a	13 b	6 a	44 b
Battalion	11.5 ab	3.5 a	14 b	2.5 a	31.5 b
Neemix/Trilogy	3 b	6.5 a	11 b	9.5 a	30 b
Altacor	3 b	5.5 a	11 b	6.5 a	26 b

Objective 2:
The seasonal percent harvestable fruit were higher for Autumn Bliss and lowest for Himbo Top and Caroline. JB numbers were higher in Prelude and Fall Gold, and lowest in Dinkum, Caroline, Heritage and Himbo Top.

Objective 3:
Stink bugs were photographed and videotaped feeding on raspberry leaves, sepals, and berries. Initial observations of stylet insertion between drupelets was confirmed (Fig. 1). An example of a video clip generated can be viewed at the following URL: (http://www.virginiafruit.ento.vt.edu/greensbyellowrasp.wmv)

Plans for future research: Analysis of digital photographs of injured raspberry leaves is continuing. This will allow more precise quantification of feeding injury. Stink bug stylet penetration of berry receptacles using stains for stylet sheaths will be assessed in the coming season, to confirm the exact spot of stink bug fruit feeding.

Impact Statements:

Control of Japanese beetle in primocane-bearing brambles: In earlier studies the pyrethroids Battalion, and to a lesser degree Capture, provided the highest degree of control of Japanese beetle. In the current study, equivalent control was provided by Battalion, Assail, Altacor, and a combination of Neemix and Trilogy, two OMRI-certified materials.

Varietal differences among brambles: Himbo Top, Dinkum, Caroline and Heritage were less attractive to adult Japanese beetles. Prelude was preferred by adult beetles. This might aid planting decisions, although population differences in larger blocks will need to be evaluated.

Studies on stink bug feeding: Studies on stink bug feeding have provided a basic level of understanding of how injury occurs. This work will continue in the coming year.

Contribution to student training: This project contributed to the training of a graduate student involved in the fruit IPM program, Ms Laura Maxey.

Dissemination of information: In addition to this project report, information has been and will be shared through several venues. Results were shared with other fruit entomologists at an annual fruit workers' conference (Cumberland-Shenandoah Fruit Workers Conference, Winchester VA, an annual meeting of fruit specialists from VA, NC, SC, WV, PA, NJ, NY, and USDA). Material from this project will be included in presentations this winter other venues. Control and biological information has been updated in the NABGA (now NARBA)-sponsored Virginia Tech Bramble IPM web sit (Pfeiffer et al. 2009a, available in both conventional desktop or PDA-ready formats (http://www.virginiafruit.ento.vt.edu/NABGAIPMSite/NABGAIPMHome.html)). Results will also be shared at meetings with small fruit producers, as well as reported in a listserv for bramble-related issues maintained at Virginia Tech and supported by the North American Bramble Growers Association. Data will be used to update extension recommendations (Pfeiffer et al. 2009b). A numbered extension publication (Maxey et al. 2009b) was published this year. A pdf version is attached.

References (* resulting from this study, ** modified based on this study):

*****Maxey, L. M., C. A. Laub and D. G. Pfeiffer. 2009a. Effects of geranium exposure on Japanese beetle feeding on 'Prelude' raspberries, with a short video message on stink bug feeding behavior. Proc. 85th Cumberland-Shenandoah Fruit Workers' Conf., Winchester, VA. Dec. 4-5.

*Maxey, L. M., D. G. Pfeiffer, C. Laub, T. P. Kuhar. 2009b. Japanese beetle pest management in primocane-bearing raspberries. Va. Coop. Ext. Pub. 2909-1411. 6 p.

Pfeiffer, D. G. 2007. Thrips in caneberry crops. The Bramble 22(2): 4-6.

**Pfeiffer, D. G., and J. M. Williams. 2009a. Bramble Production and IPM News Web Site.   http://www.virginiafruit.ento.vt.edu/NABGAIPMSite/NABGAIPMHome.html (updated daily)

** Pfeiffer, D. G., K. S. Yoder and C. Bergh. 2009b. Commercial Small Fruits: Disease and Insects. p. 2-1 – 2-14. *In*: 2009 Pest Management Guide for Horticultural and Forest Crops. Va. Coop. Ext. Pub. 456-017. Revised annually since 1988. (available in PDF (http://www.ext.vt.edu/pubs/pmg/hf2.pdf - updated annually, or html http://www.virginiafruit.ento.vt.edu/SprayGuide/SmallFruitSprays.html - updated as appropriate)

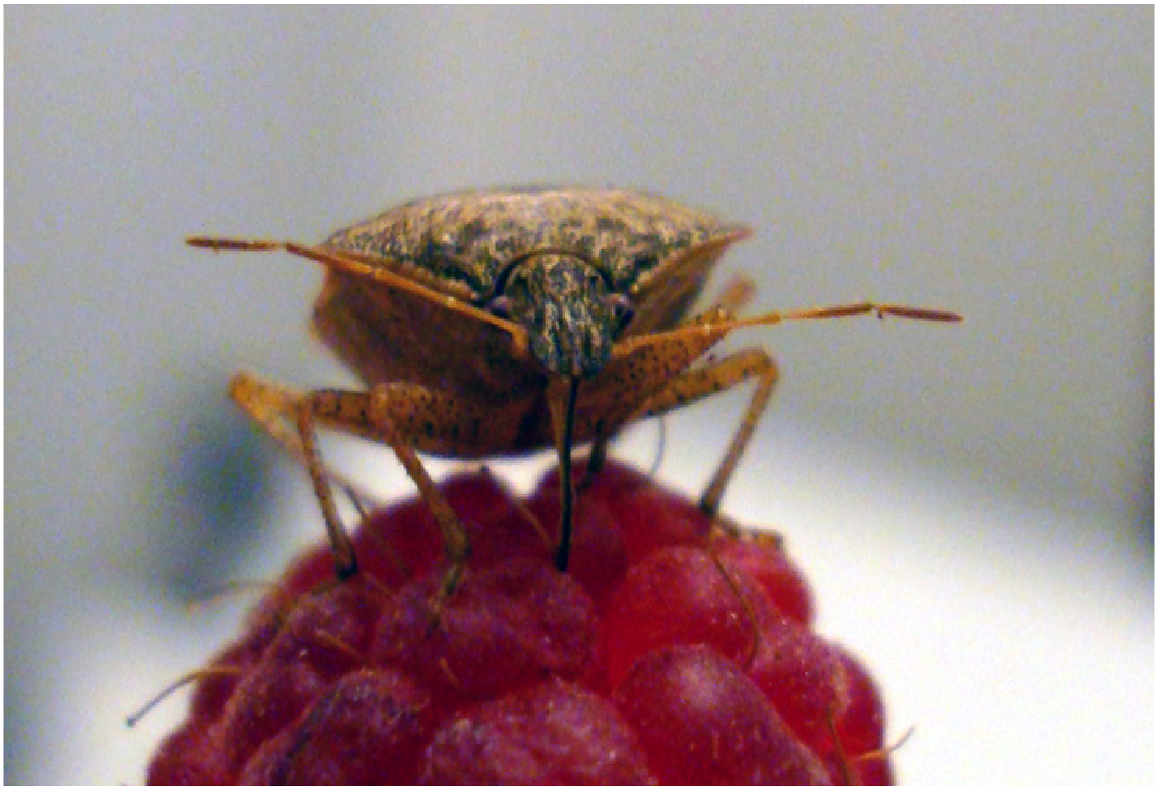

Fig. 1. Brown stink bug with stylets inserted between drupelets of raspberry.