Southern Region Small Fruit Consortium – Final Report

Title: Antifeedants, Repellants, and Organic Controls for Tarnished Plant Bug and Japanese Beetle on Caneberries

Final Report

Grant Code: 2006-02

Research Project

Personnel:

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Objectives:

1) Determine efficacy of antifeedants and repellants, and sublethal doses of a pyrethroid, against a two blossom and berry feeders, tarnished plant bug and Japanese beetle,
2) Determine relative susceptibility of several primocane-bearing brambles toward tarnished plant bug and Japanese beetle.

Justification:

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:

A chemical control trial was initiated in a new caneberry planting at Kentland Farm, a research facility of the College of Agriculture and Life Sciences at Virginia Tech. Two pyrethroids (fenpropathrin (Danitol) and deltamethrin (Battalion)), and a representative of novel chemistry, rynaxypyr (DPX-E2Y45) were applied to a varietal planting of primocane-bearing raspberries, and compared with an untreated control. In a block of two varieties of primocane-bearing blackberries (PrimJim and PrimJan), several organically approved materials were compared with another pyrethroid (bifenthrin (Capture) and an untreated control. These were Azadirachtin (AzaDirect), capsaicin (Hot Pepper Wax), thyme oil (Proud), and potassium bicarbonate (Agricure).

On 17 July, 5 and 29 August 2006, fenpropathrin (Danitol 2.4EC) (21 fl oz/acre), deltamethrin (Battalion 0.2EC) (12 fl oz/ acre), and rynaxypyr (DPX- E2Y45 53 WDG) (4 fl oz/ acre), were applied to a 2-meter section of row, with 4 replications. Plants were blocked on the following varieties of raspberries: Autumn Bliss, Dinkum, Fall Gold and Heritage. On the same dates azadirachtin (AzaDirect 1.2%) (2 pt/acre), capsaicin (Hot

Pepper Wax 0.00018%) (600 fl oz/ acre), thyme oil (Proud 3) (1 qt/25gal/acre), potassium bicarbonate (Agricure 85) (5 lbs/ acre) and bifenthrin (Capture 2EC) (6.4 fl oz/acre) were applied to PrimJim and PrimJan varieties of blackberries using a randomized complete block design, blocking on variety. All treatments were applied using a CO_2-powered backpack sprayer. Starting on July 18 the plants were carefully observed twice a week in an attempt to count all the beetles present in the marked off plots. The plots were observed twice a week until the number of beetles present dropped dramatically. Therefore, counts stopped on August 28, for the raspberries and on 15 September for the blackberries. The data were analyzed using analysis of variance followed by Fisher's HSD

I. Results:

Objective 1:

Raspberry: On 18 and 20 July, the Danitol and Battalion treatments significantly decreased the number of beetles present. E2Y45 was not difference from the control. This pattern, however, changed by August 5 with the number of beetles on the Danitol and E2Y45 treated plants significantly increasing compared to the control. The plants treated with Battalion did not have a significant difference in the numbers present compared to the control.

Blackberry: On 10 August there were significantly more beetles present on Agricure-treated plants.

Objective 2:

Raspberry: On 24 July, there were a significantly lower number of Japanese beetles present on the Dinkum and Heritage varieties than on the Autumn Bliss and Fall Gold Varieties. This difference could be partly due to the different varieties having different ripening times; however there seemed to be lower levels of foliar feeding on Dinkum early in the season as well.

Blackberry: There were significantly fewer Japanese beetles on the PrimJan varieties than on the PrimJan varieties; this was consistent throughout the season.

Table 1. Effects of three chemical treatments with an untreated control on numbers of Japanese beetles per 2 m of row in a raspberry planting at Kentland Farm (Montgomery County).

Treatment	Form/gal	18 Jul	20 Jul	24 Jul	27 Jul	2 Aug	5 Aug	7 Aug	10 Aug	14 Aug	17Aug	21 Aug
Danitol	4.1 ml	0.3b	1.8b	2.8	7.3	3.5	5.3a	0.0	0.0	0.0	0.3	0.3
Battalion	2.27 ml	0.3b	2.8b	3.3	10.5	5.8	2.3ab	1.3	0.0	1.3	0.3	0.5
E2Y45	756 mg	7.8a	9.3ab	8.3	5.8	3.3	4.3a	1.5	0.0	0.3	0.0	0.0
Control		7.8a	13.0a	5.3	3.8	5.0	0.8b	0.8	0.0	2.8	2.0	0.0

Means in a column followed by the same letter are not significantly different, $\alpha=0.05$ ($\alpha=0.10$ on 5 Aug) (Fisher's protected LSD test, following $((x+0.5)^{-0.5})$ transformation).

Table 2. Differences among four primocane-bearing raspberry cultivars in numbers of Japanese beetles per 2 m of row at Kentland Farm (Montgomery County).

Variety	18 Jul	20 Jul	24 Jul	27 Jul	2 Aug	5 Aug	7 Aug	10 Aug	14 Aug	17Aug	21 Aug	25 Aug	28 Aug
Autumn Bliss	5.3	10.3	8.0a	7.0	4.3	2.8	2.0	0.0	1.3	1.8	0.5	0.0	0.0
Dinkum	2.0	2.8	2.0b	8.5	5.5	3.8	0.0	0.0	1.3	0.0	0.0	0.0	0.0
Fall Gold	5.3	9.0	8.5a	8.3	5.3	3.5	1.3	0.0	1.3	0.5	0.3	0.0	0.5
Heritage	3.5	4.8	1.0b	3.5	2.5	2.5	0.3	0.0	0.5	0.3	0.0	0.0	0.0

Means in a column followed by the same letter are not significantly different, $\alpha=0.05$ (Fisher's protected LSD test, following $((x+0.5)^{-0.5})$ transformation).

Table 3. Effects of five chemical treatments with an untreated control on numbers of Japanese beetles per 2 m of row in a blackberry planting at Kentland Farm (Montgomery County).

Treatment	Form/gal	18 Jul	20 Jul	24 Jul	27 Jul	2 Aug	5 Aug	7 Aug	10 Aug	14 Aug	17 Aug	21 Aug	25 Aug	28 Aug
AzaDirect	6.3 ml	4.0	7.0	3.3	1.5	2.5	3.0	1.3	0.0b	0.3	1.0	1.3	0.5	0.0
HPW	118.3 ml	2.5	2.0	0.0	0.0	1.3	0.8	0.0	0.0b	1.5	0.8	0.5	0.3	0.5
Proud	37.8 ml	1.8	4.5	4.5	2.0	2.3	4.8	3.0	0.3b	1.0	2.5	3.0	0.8	0.0
Agricure	15.12 g	2.0	4.5	1.0	1.3	3.5	2.8	2.5	0.8a	0.5	0.3	0.0	0.0	0.3
Capture	1.3 ml	3.5	4.8	2.8	7.3	5.0	5.0	0.0	0.0b	1.0	0.8	0.0	1.0	0.0
Control		2.0	4.5	6.3	9.3	6.8	6.3	2.0	0.0b	2.3	2.5	1.3	1.3	1.0

Means in a column followed by the same letter are not significantly different, $\alpha=0.05$ (Fisher's protected LSD test, following $((x+0.5)^{-0.5})$ transformation).

Table 4. Differences among two primocane-bearing blackberry cultivars in numbers of Japanese beetles per 2 m of row at Kentland Farm (Montgomery County)

Variety	18 Jul	20 Jul	24 Jul	27 Jul	2 Aug	5 Aug	7 Aug	10 Aug	14 Aug	17 Aug	21 Aug	25 Aug	28 Aug	15 Sep
PrimJim	3.0	6.2a	5.8a	7.0a	6.8a	6.8a	2.7a	0.3	1.8	2.3a	2.0a	1.1	0.4	0.5
PrimJan	2.3	2.9b	0.2b	0.1b	0.3b	0.7b	0.3b	0.1	0.4	0.3b	0.0b	0.2	0.2	0.1

Means in a column followed by the same letter are not significantly different, $\alpha=0.05$ ($\alpha=0.10$ on 20 Jul, 21 Aug) (Fisher's protected LSD test, following $((x+0.5)^{-0.5})$ transformation).

Conclusions: In the raspberry planting, the two pyrethroids provided control of Japanese beetle. This control lasted 3 days but not for a week. A factor in this loss of activity includes not only aging of residues, but production of new, unsprayed tissue on these varieties that bear fruit during periods of Japanese beetle activity. Rynaxypyr does not appear to offer promise for Japanese beetle control. Later in the season, on one date, Japanese beetle numbers were actually greater on plants sprayed with Danitol and rynaxypyr. This should be examined in the future to determine if this was an artifact of clumped feeding with lower pesticide residues, or a real biological effect. Likewise, in the only significant difference in the blackberry planting, Japanese beetle numbers were higher on the treatment with Agricure (potassium bicarbonate). This was not a large difference. It should be reexamined with higher beetle numbers. It should be pointed out that pressure was lower than in the adjacent raspberries.

Of the three pyrethroids used in this study, bifenthrin is currently the only one with a label for Japanese beetle. Its lack of activity in the blackberry planting was surprising in light of the general efficacy of pyrethroids for this species, and the control provided by both Danitol and Battalion in the raspberry planting. This should be reexamined.

AzaDirect exerted no control against Japanese beetle in this study. However, since initiation of the trial was delayed with a wait for materials, Japanese beetle activity had already started in the planting with the first spray. Azadirachtin has multiple modes of action. Its role as a growth regulator would not be effective against adult Japanese beetle. It is also an antifeedant, and as such may have a greater effect if the material is applied before beetles start to feed and mark foliage with their aggregation pheromone. This should be considered in a future trial.

As stated above, preharvest intervals (PHIs) need to examined in order to determine a fit with bramble production; intervals longer than 3 days are unlikely to be practical for growers. The following table contains PHI values for the products used in these trials.

Preharvest intervals (days) of materials employed:

Registered on brambles:
Capture – 3 days
Proud – 0 d
Agricure – 0 d
AzaDirect - 0 d

Not registered on brambles (PHI from other labeled crops):
Danitol – citrus – 1 d; strawberry - 2 d; tomato - 3 d; pear - 14 d; grape - 21 d
Battalion – fruiting vegetables – 1d; cucurbits – 3 d; pome fruits - 21 d

Plans for future research: Further work is planned under each of the above objectives. Additional data are needed for some of the pesticides employed in 2006. The lack of control provided by Capture was surprising and should be reevaluated. AzaDirect should be applied before the onset of adult beetle activity. Both Japanese beetles and green June beetles should be caged on plants after application to reduce variability. Susceptibility of a wider range of cultivars will be evaluated. Another issue relates to the higher numbers of beetles on some treated plants after longer intervals. Whether there is any real attractiveness of sublethal residues should be considered. The basis of varietal differences in attraction to Japanese beetle observed in this study should be determined. After Japanese beetles subsided for the season, some other insects remained, such as wasps. Evaluation of these pests should be included.

Impact Statements:
Control of Japanese beetle in primocane-bearing brambles: Of the materials tested here, two pyrethroids provided control of this key pest (Battalion and Danitol). If brambles can be added to the label, these will be useful tools for producers.
Varietal differences among brambles: Dinkum and Heritage were less attractive to adult Japanese beetles. This might aid planting decisions, although population differences in larger blocks will need to be evaluated. Among the blackberries, PrimJan was consistently less attractive than PrimJan; this could be another factor in cultivar choice as well, with the same caution as with raspberries. In general, there were fewer Japanese beetles in the blackberries than in the raspberries.

Contribution to student training: This project contributed to the training of two students, primarily an undergraduate with an interest in fruit production, Ms Laura Maxey, and a graduate student involved in the fruit IPM program, Ms Anna Wallingford.

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) (the article to be submitted to the written proceedings is attached). An article was prepared for The Bramble (Pfeiffer 2006, also attached); this was a preliminary report, since data were still being gathered and analyzed). Control and biological information has been updated in the NABGA-sponsored Virginia Tech Bramble IPM web sit (Pfeiffer et al. 2006, available in both conventional desktop or PDA-ready formats (http://www.nabgaipm.shorturl.com)). Results will also be shared at meetings with small fruit producers, as well as reported in a 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. 2006).

References (* resulting from this study, ** modified base on this study):
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**Pfeiffer, D. G., K. S. Yoder and C. Bergh. 2006. Commercial Small Fruits: Disease and Insects. p. 47-58. *In*: 2006 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.ento.vt.edu/Fruitfiles/SprayGuide/SmallFruitSprays.html - updated as appropriate) (2005 – 1,909 visits to VCE PDF, 5,398 to html version: total 7,307)