**Southern Region Small Fruit Consortium – Progress Report**

**Title:** Impacts and control of the stink bug complex on caneberries, with emphasis on brown marmorated stink bug, a new invasive species

**Progress Report**

**Grant Code: 2011-05**

**Research Project**

**Personnel:**

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**Objectives:**

1) Determine efficacy of pesticides of differing modes of action toward the stink bug complex,
2) Determine relative impact of feeding behavior of brown marmorated stink bug compared with native pentatomid species.

**Justification:**

Stink bugs have long been a problem in fruit crops, and have been addressed in the Virginia Fruit web site (Pfeiffer 2010a). Recently there has been a new invasive stink bug from China, which was first seen in Pennsylvania in 1996, though not submitted for identification until 2001 (Hoebecke and Carter 2003). This is now considered different and significant enough to warrant its own separate web page (Pfeiffer 2010b). It was recognized as feeding raspberries by Hamilton et al. (Hamilton et al. 2008), but at that time it was unclear whether this species would become common in the US. This is now the most commonly collected stink bug in our area (Nielsen and Hamilton 2009). It is usually present in low numbers for a few years before reaching very high populations. In 2010, it caused significant fruit injury in apple orchards in the mid-Atlantic region, as it has spread south through Maryland, West Virginia and Virginia. It has been intercepted in Florida (Halbert 2009), though is not yet in high populations in the Deep South. There are no adequate control methods for brown marmorated stink bug. The most effective materials have been pyrethroids, but even these fail to keep immigrating BMSB out of fruit plantings beyond 2-3 days. In addition to pyrethroids, some neonicotinoids have shown promise (Nielsen et al. 2008). One trial (Pfeiffer 2010b) in winegrapes at harvest used PyGanic (pyrethrum) and Belay (clothianidin) to knock bugs out of clusters at harvest. While promise was shown in this limited context, it is unexpected that these materials would provide sufficient control for a fruit crop.

**Methodologies:**

Stink bugs have long been a problem in fruit crops, and have been addressed in the Virginia Fruit web site (Pfeiffer 2010a). Recently there has been a new invasive stink bug from China, which was first seen in Pennsylvania in 1996, though not submitted for identification until 2001 (Hoebecke and Carter 2003). This is now considered different and significant enough to warrant its own separate web page (Pfeiffer 2010b). It was recognized as feeding raspberries by Hamilton et al. (Hamilton et al. 2008), but at that time it was unclear whether this species would become common in the US. This is now the most commonly collected stink bug in our area (Nielsen and Hamilton 2009). It is usually present in low numbers for a few years before reaching very high populations. In 2010, it caused significant fruit injury in apple orchards in the mid-Atlantic region, as it has spread south through Maryland, West Virginia and Virginia. It has been intercepted in Florida (Halbert 2009), though is not yet in high populations in the Deep South. There are no adequate control methods for brown marmorated stink bug. The most effective materials have been pyrethroids, but even these fail to keep immigrating BMSB out of fruit plantings beyond 2-3 days. In addition to pyrethroids, some neonicotinoids have shown promise (Nielsen et al. 2008). One trial (Pfeiffer 2010b) in winegrapes at harvest used PyGanic (pyrethrum) and Belay (clothianidin) to knock bugs out of clusters at harvest. While promise was shown in this limited context, it is unexpected that these materials would provide sufficient control for a fruit crop.

A field experiment was conducted on October 5 in a seven-year old raspberry planting at Kentland Farm (College of Agriculture and Life Sciences, Virginia Tech), Montgomery County, VA. This planting is on an elevated site above the New River in southwestern Virginia (37° 12.417’N, 80° 35.513’W, 616 m (2020 ft) elev.). Pesticides with different modes of action in insect neurotransmission were used. The organophosphate malathion acts on the acetylcholinesterase enzyme, the pyrethroid etofenprox is a sodium channel modulator and the neonicotinoid dinotefuran binds at a specific site on postsynaptic nicotinicacetylcholine receptor inhibiting insect neurotransmission. Etofenprox and dinotefuran were applied with the synergist piperonyl butoxide as a combined treatment. The pesticides were applied in 1.2 m sections of treatment plots in a completely randomized design with six treatments and four replicates. Cages containing 10 BMSB were placed, immediately after spray application over a raspberry stem in each treatment plot. Pesticides was applied using a $CO_2$-powered backpack sprayer and wand equipped with a 8008 VS stainless steel spray tip and calibrated to deliver 80 gpa at 40 psi. The cumulative percentage mortality was recorded 1, 2, 3 and 6 days after pesticides were applied. Insects were counted twice weekly on treated plants. After visual inspection, plants were jarred over a white sheet and insects collected. In addition, BMSB and a native stink bug (either brown stink bug, *Euschistus servus*, or green stink bug, *Acrosternum hilare*) were collected in the field and caged onto flowers or fruit clusters of treated plants at various intervals after spraying, in small nylon net bags. Three cages in each replicate were used for each target species. Caged insects were examined daily, and mortality and the degree of feeding determined. This will assess the degree of mortality, the degree of antifeedant activity, and the effect of aging of residues. Data will be transformed before statistical analysis.

**Objective 2:** Determine relative impact of feeding behavior of brown marmorated stink bug compared with native pentatomid species.

BMSB and a native stink bug species were collected in the field and caged onto developing raspberry fruit, placing three bugs in each net bag. Berries were examined every two days to determine and photograph injury. Bugs were replaced as needed. Receptacles were removed from plants and stained with an acid fuchsin dye to stain for salivary sheaths, to determine if bugs are feeding on the receptacle.

**Results:**

**Objective 1:**

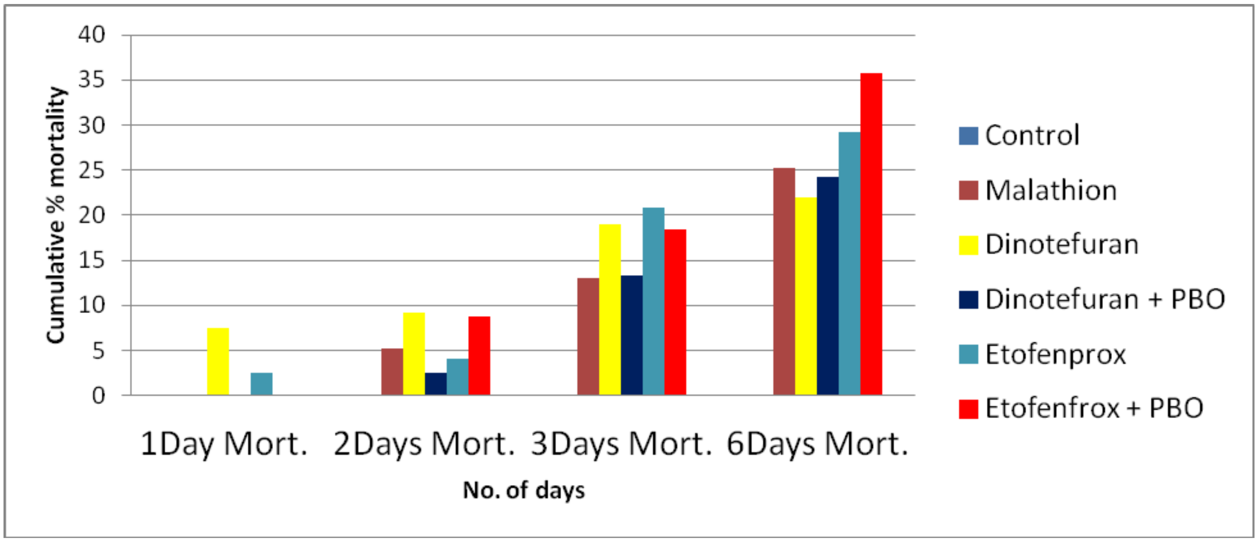



Fig. 1. 1, 2, 3 and 6 DAT cumulative percentage mortality of brown marmorated stink bug when treated with pesticides at standard rate.

Mortality data were assessed for 1, 2, 3 DAT but mortality was low. Some BMSB escaped from the cages, ranging from 1-5. Percentage mortality data for 6 DAT were analyzed as completely randomized ANOVA. The mortality data were compared among treatments using Tukey-Kramer HSD mean separation procedure at $P \leq 0.05$ level of significance.

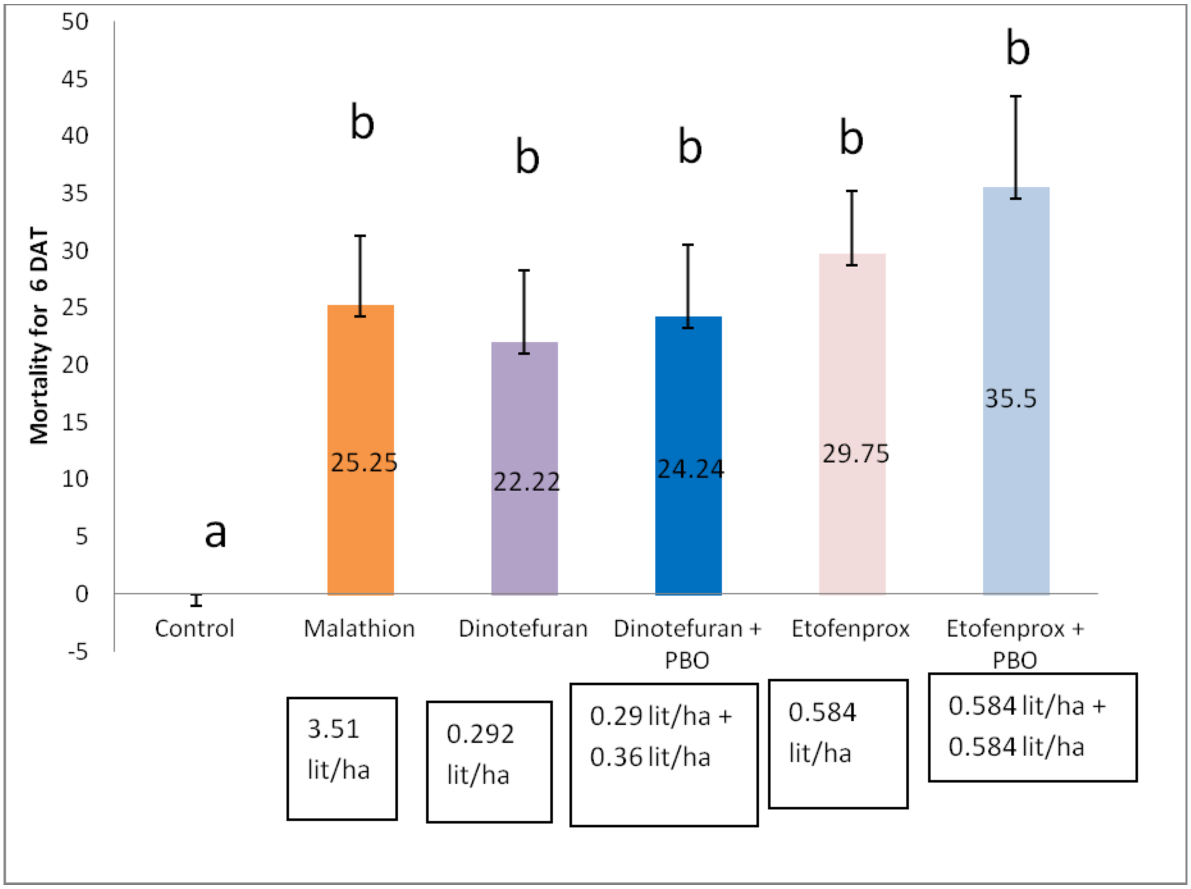



Fig. 2. 6 DAT mortality of brown marmorated stink bug when treated with pesticides at standard rate. Surviving brown marmorated stink bug treated with pesticides were significantly different from the untreated plots ($F = 4.7$, df = 5, $P < 0.039$). Bars with different letters are significantly different.

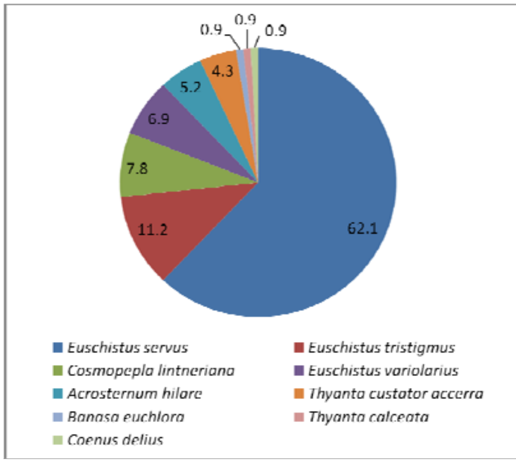
Conclusions

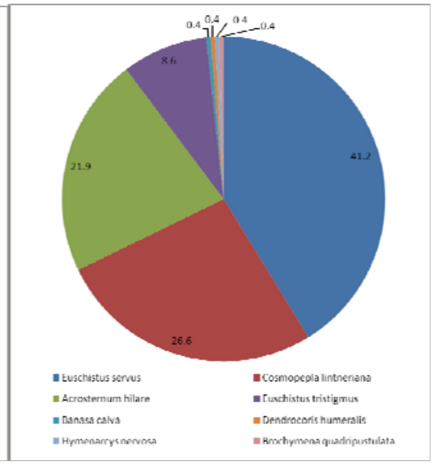
- There is no significant difference among the pesticides but there was significant difference between pesticides and control.
- There was no significant difference between pesticide treatment and combined treatment of pesticide and synergist.
- The mortality percentage is low but is still very efficient in using these pesticides because the data show the morality data for residual use of pesticides. During the field application, most of the bugs comes in direct contact with the pesticides and the mortality is expected to be higher
- Since there is no significant difference between dinotefuran and other pesticides, dinotefuran can be used to control BMSB. It is considered to be biologically friendly and natural enemies can be conserved

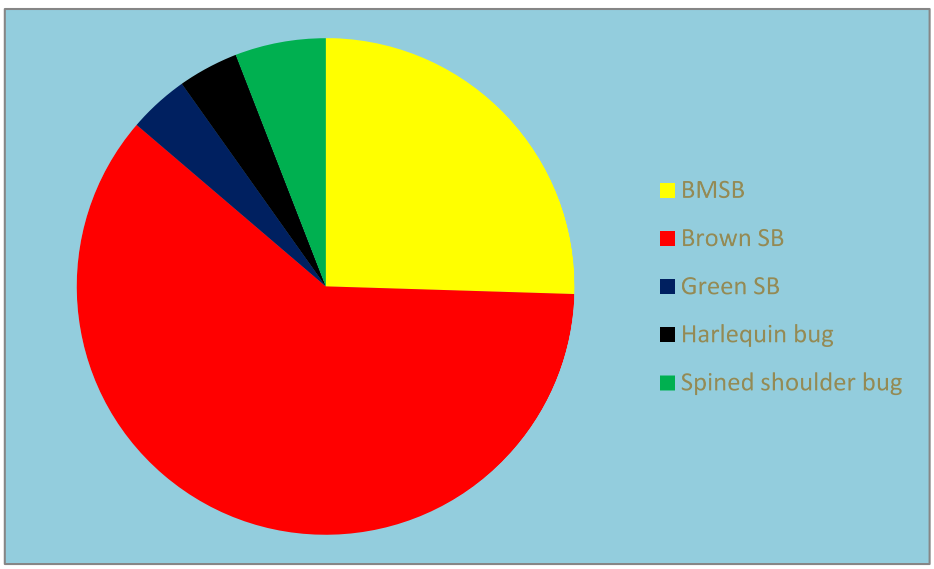
**Objective 2:**

Staining with acid fuchsin was unsuccessful; additional work on the protocol is needed because the white receptacles were highly absorbant and became entirely stained.

A complex of stink bugs was confirmed.  Numbers were compared with studies in 2008 and 2009.  BMSB was absent in the earlier collections, not yet established in the first two years of sampling; it now comprises 25% of the pentatomid community.




**Impact Statements:**

<u>Efficacy of insecticides toward brown marmorated stink bug (BMSB</u>:  All pesticides used caused significant mortality of BMSB.  These included the neonicotinoid dinotefuran, the pyrethroid etofenprox, and the organophoshate malathion.  It is significant that malathion caused mortality of BMSB, because this is a material that is widely available to home fruit and growers with small acreage.  The addition of the synergist piperonyl butoxide caused no significant increase in mortality from dinotefuran or etofenprox; however data indicate that further examination is warranted.

<u>Dissemination of information</u>: 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.

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. 2012). A numbered extension publication (Maxey et al. 2009b) was published this year. A pdf version is attached.

**F. References:**

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**Pfeiffer, D. G. 2010b.** Brown marmorated stink bug, *Halyomorpha halys* (Stål).

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