Hudson Valley Stink Bug Management

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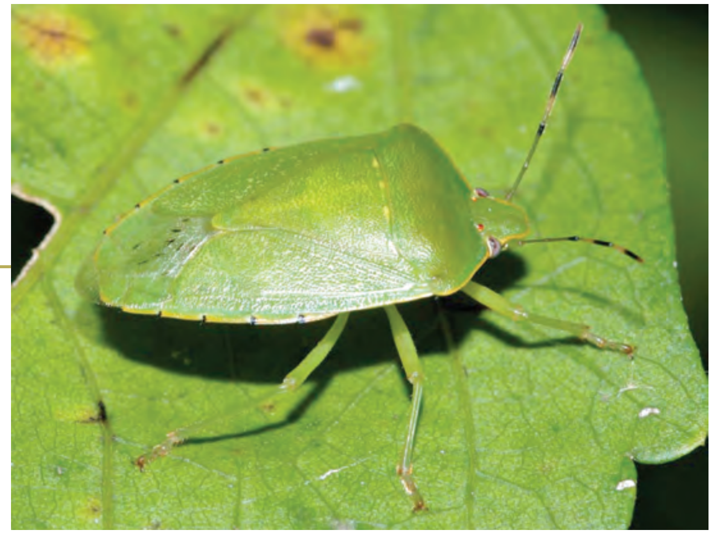

Figure 1. The green stink bug *Acrosternum hilare*. Photo by Susan Ellis.

Figure 2. The brown stink bug *Euschistus servus*. Photo by Russ Ottens, University of Georgia.

The Hudson Valley Region of New York is noted for both its abundance and diversity of plants and wildlife. In many respects this wealth of flora and fauna creates ecological niches for beneficial predatory and parasitic organisms that provides a foundation for agricultural bio-control. Yet this plant diversity flourishing along the hedgerows and fields of our orchards often harbors insects that can damage pome and stone fruit.

> **"Historic levels of orchard stink bug injury in combination with traditional scouting methods of observing adult presence and observations of fresh fruit damage are still our most reliable indicators to begin control measures for this insect."**

Stink bugs (Heteroptera: Pentatomidae) are native to the region. They are notable examples of migratory insects that live on a broad complex of plant hosts, erratically feeding on tree fruits. Principle hosts of the stink bug include mullein, mustard, dock, plantain, milkweed, mallow, morning glory, thistles, vetch, and velvet grass. These adult 'seed-feeders' enter our orchards during the dry periods of the season as host-plant seed pods dry out. Tree fruit becomes very attractive to the stink bug complex during drought conditions, leading to late season feeding damage in pear, apple and peach orchards. Their mouthparts are designed to pierce the fruit skin and draw out the cell contents of the fruit flesh, leaving behind dry cell walls that appear as corking when peeled.

As one might suspect stink bugs derive their name from the production of pungent and offensive chemicals released when they are disturbed. The green and brown stink bugs (*Acrosternum hilare* and *Euschistus servus* respectively) are found throughout New York State (Figures 1 & 2). They are cold hardy insects, perennial neighbors along the perimeter of the orchard environment. While relatively mild winters foster their overwintering success, sporadic weather patterns do not always provide favorable conditions for fruit feeding. Predictive models used successfully for other insects have not been successfully developed for use in predicting stink bug fruit feeding patterns. And pheromones, although available for stink bugs, are not effective at capturing significant numbers for predicting the occurrence of feeding and subsequent fruit injury. The insect tends to be very elusive. They have good vision and shy away from movement, making it difficult to scout for adults and effectively employ IPM treatment thresholds. In general we consider late season drought conditions the motivating influence prompting adult stinkbug movement into orchards to feed.

The brown marmorated stink bug, *Halyomorpha halys*, is a newly emerging pest on fruit in the northern mid-Atlantic region. Although it has yet to be observed in the lower Hudson Valley, it is a likely candidate for migration into the southern part of the state. E. Richard Hoebeke, a Cornell University senior extension associate in entomology, first identified the brown-marmorated stink bug in the United States from samples obtained in 2001 from Allentown, PA. He surmised that the insect had hitchhiked in cargo containers from Asia. Since then the brown-marmorated stink bug has been identified in parts of New Jersey, Maryland and Delaware.

Given their presence in the Mid-Atlantic region, the brown-marmorated stink bug may appear in the Hudson

Figure 3. The brown marmorated stink bug. Photo by David R. Lance, USDA APHIS PPQ.

Figure 4. Corky flesh immediately beneath the skin in stink bug injury.

Valley before too long. They stand out as having alternating light dark bands on the antennae and darker bands on the overlapping membranous portion at the rear of the front pair of wings. They have copper, bluish-metallic tinted depressions on the head and pronotum not exhibited in other species of regional stink bugs (Figure 3). In its native range of China, Japan, Korea, and Taiwan, the brown-marmorated stink bug feeds on a wide variety of host plants including apple, peach, figs, mulberries, citrus fruits and persimmons, along with ornamental plants, weeds, and soybeans. Its been observed feeding on tree fruits in the U.S., resulting in the characteristic "cat facing," on peaches that renders fruit unmarketable. It also can be a nuisance urban pest as it seeks protected overwintering sites in and around homes.

What does this all mean for tree fruit managers in the Hudson Valley? The first stage of management for this pest is determining the level of damage your farm has experienced over the past five years. Simply stated, if injury has been observed in years past, late season management of the stink bug complex should be conducted upon observation of adult presence in the tree canopy.

To determine injury from stink bug, it's important to note that stink bug feeding differs dramatically between stone fruit, apple and pear. 'Catfacing' injury to peaches by stink bug is very similar to that of the plant bug complex. Stone cells naturally occurring in pears are more pronounced in

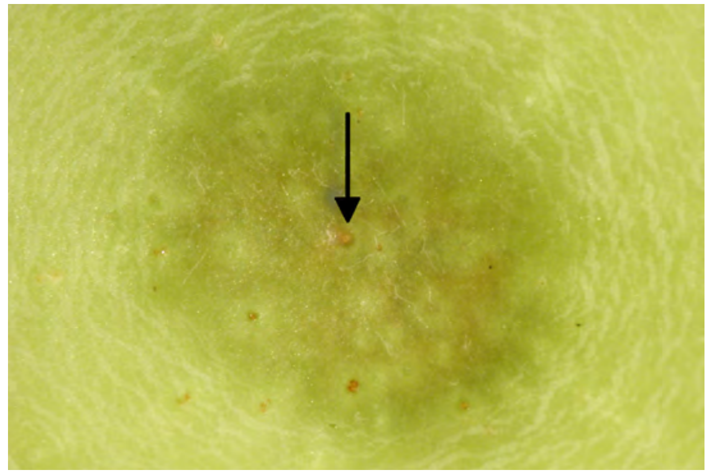

Figure 5. Small feeding puncture near the center of the depression.

fruit with stink bug feeding injury as cell contents are removed and thickened cell walls of stone cells remain. Yet on apple, fruit damage appears as shallow, circular, light brown to white spongy pockets in the fruit flesh, usually from 5-10 mm in circumference, and 5-8 mm in depth. Stink bug feeding and cork spot (bitter-pit) can easily be mistaken for one another.

Working at the USDA-Agricultural Research Station in Kearneysville, West Virginia, Dr. Mark Brown has conducted studies to discern the differences of fruit injury on apples in late summer and fall between the damage caused by stink bug feeding and the physiological disorder called cork spot. The damage caused by stink bug complex has been characterized and several apple cultivars have been evaluated for different levels of susceptibility to injury. Typical feeding injury tends to be on the stem end or sides of the fruit, as those parts of the fruit surface are easier for the insect to stand on, and most likely to be covered by foliage, providing protection to the feeding bug.

On apple, Brown demonstrated key differences between stink bug feeding and cork spot characterized by the depressions on the apple surface. The edge of the depression on the fruit surface from stink bug feeding is gradual rather than abrupt as observed in cork spot. The corky flesh is always immediately beneath the skin in stink bug injury and often separates from the skin, yet cork spot typically penetrates deeper toward the core (Figure 4). Stink bug injury always has a small puncture near the center of the feeding depression, requiring magnification to observe the feeding site (Figure 5). Occasionally, stink bug feeding may leave a 'feeding sheath' within the flesh protruding above the fruit surface (Figure 6).

To further emphasize the difference between stink bug damage and cork spot, studies were also conducted by Brown to determine the significance of calcium and boron levels related to stink bug injury. Applications of foliar calcium chloride was not found to affect the occurrence of corking damage related to stink bug feeding. Fruit flesh immediately below the skin in stink bug damaged fruit has been observed

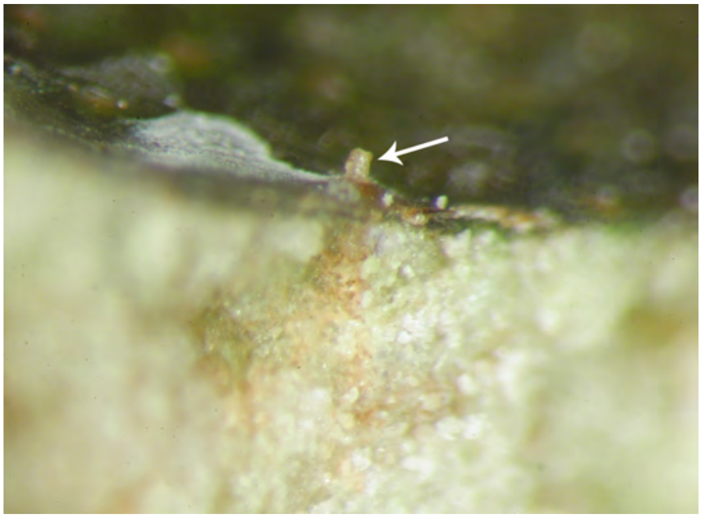

Figure 6. Feeding sheath on pear deposited after stink bug feeding is complete.

to have the same concentration of calcium and boron as fruit flesh from undamaged fruit.

To determine varietal susceptibility to stink bug injury, Brown evaluated 31 apple cultivars with fruit damage ranging from 0 to 28% injury from blocks of selected varieties at the Appalachian Fruit Research Station. Most stink bug damage occurred from 26 to 60 days before harvest. 'Braeburn', 'Jonica', 'Jonagold', 'Granny Smith' and 'Stayman' had consistently high stink bug injury levels at harvest, whereas, 'Imperial Gala', 'Lawspur Rome', and 'Red Fuji' had consistently low levels of stink bug injury.

Stink bugs are very difficult to manage for a number of reasons. They have a broad host range, including many crops and broadleaf weeds. They are highly mobile, frequently moving between weed hosts and fruit trees. They tend to be more active in the evening and during the night. Insecticide applications made during the day may not come in direct contact with the insect, subsequently reducing the effectiveness of the materials. Therefore sting bugs are not continually exposed to insecticide residues for long periods of time, as are most other managed orchard insect pests. Consequently, the management of stink bug points toward effective control requiring repeated applications of insecticides, especially along the borders of orchards during the period of 'adult in-flight' occurring late in the growing season.

Given the extent of stink bug injury we've observed to Hudson Valley fruit over the past few years, we became interested in how the use of late season insecticides for obliquebanded leafroller and apple maggot management might impact the stink bug complex. We were especially interested in the efficacy of the neonicotinyl insecticide group, as Assail 30SG, Calypso 4SC and Actara 25WDG have been used extensively for late season management of the insect complex.

Our study was conducted on apple in 2006 at Cornell University's Hudson Valley Laboratory Research Orchard. We used a mixed block of 18-year-old 'Ginger Gold', 'JerseyMac' and 'Liberty' apple, top-worked onto M-26 rootstock. The block was split into two management regimes to compare a commercially managed tree fruit block (West) and a sustainably managed block (East), the latter conceivably fostering higher stink bug populations from favorable ground-cover conditions. The 'West block' was mowed frequently with clean herbicide strips beneath the trees to the drip line. The 'East block' was un-mowed without late season herbicide applications and boarded by a row of peaches. Both blocks had identical commercial insecticide and fungicide programs until 1 July. From that point on they received eight different treatments on approximately 14-day intervals, applied to three-tree plots bordered on each side by cedar trees to reduce cross plot contamination. Plots were randomized in a complete block design including an untreated control.

Treatments began at 4^{th} cover on July 1, 5^{th} cover on July 17, 6^{th} cover on July 27, 7^{th} cover on August 14 and 8^{th} cover on August 28. Applications were made using a three-point hitch tractor mounted sprayer and pecan handgun using 300 psi. spray dilute to drip. Treatments included Actara 25WDG (thiamethoxam) at 5.5 oz./A; Calypso 4SC (thiacloprid) 5.5 fluid oz./A; Assail 30SG (acetamiprid) at 5.5 oz./A; Thionex 50WP (Endosulfan) at 4.0 lbs./A; Warrior® with Zeon™ technology (Lamda-cyhalothrin) at 5.12 fluid oz./A; Danitol 2.4EC (fenpropathrin) at 6.0 fluid oz./A; Carzol 92SP (formetanate hydrocloride) at 20.0 oz./A. Carzol 92SP is presently not registered in N.Y. for late season use on apple and was used for comparison purposes only. Fruit from Ginger Gold was harvested on the 9 and 18 of August. No visible signs of stink bug feeding were observed in the 'JerseyMac' or 'Liberty' varieties.

With regards to stink bug damage to fruit, there was no significant block effect observed between the East and West blocks. Significant differences between treatments and the untreated fruit were observed at the first harvest of Ginger Gold using ANOVA Fishers protected LSD shown in Table 1. There were however no apparent statistical differences between treatments. All treatments demonstrated reductions in feeding damage caused by stink bug with the possible exception of Assail treatments. Thionex 50WP, Danitol 2.4EC and Warrior® with Zeon™ Technology treated fruit exhibited lowest numeric damage levels from stink bug for both harvest dates.

Table 1. Evaluation of Insecticides for Controlling the Stink Bug Complex, Cornell University's Hudson Valley Lab, N.Y.-2006

Formulation Treatment	amt./Acre	Timing	% SB damaged fruit eval. Ginger Gold 1st harvest eval.	Ginger Gold 2nd harvest eval.
Carzol 92SP	20.0 oz.	4-8C	0.0 a	0.8 a
Thiodan 50WP	**4.0 lb.**	**4-8C**	**0.0 a**	**0.0 a**
Danitol 2.4EC	**16.0 fl.oz.**	**4-8C**	**0.2 a**	**0.0 a**
Warrior w/Zeon	**5.12 fl.oz.**	**4-8C**	**0.0 a**	**0.0 a**
Assail 30SG	5.5 oz.	4-8C	1.0 ab	2.4 a
Calypso 4SC	**6.0 fl.oz.**	**4-8C**	**0.4 ab**	**0.0 a**
Actara 25WDG	**5.5 oz.**	**4-8C**	**0.4 ab**	**0.0 a**
Untreated	-	-	1.8 b	0.8 a

1st Harvest on 9 August, 2nd Harvest on 18 August.
4C on 1 July, 5C on 17 July 6C on 27 July, 7C on 14 Aug., 8C on 28 Aug.

Formulation Treatment	amt./Acre	Timing	% External Lep. Damage Ginger Gold 1st harvest eval.	Ginger Gold 2nd harvest eval.
Carzol 92SP	20.0 oz.	4-8C	0.2 a	1.6 a
Thiodan 50WP	**4.0 lb.**	**4-8C**	**0.2 a**	**0.0 a**
Danitol 2.4EC	**16.0 fl.oz.**	**4-8C**	**0.2 a**	**0.0 a**
Warrior w/Zeon	**5.12 fl.oz.**	**4-8C**	**0.0 a**	**0.8 a**
Assail 30SG	5.5 oz.	4-8C	0.8 a	3.2 a
Calypso 4SC	**6.0 fl.oz.**	**4-8C**	**0.4 a**	**1.6 a**
Actara 25WDG	**5.5 oz.**	**4-8C**	**0.4 a**	**0.8 a**
Untreated	-	-	1.9 b	0.8 a

Formulation Treatment	amt./A	Timing	# mite or mite egg/25 lvs of 'Liberty' Phytoseiids	ARM
Carzol 92SP	20.0 oz.	4-8C	3.4 a	105.0 a
Thiodan 50WP	**4.0 lb.**	**4-8C**	**5.6 ab**	**134.4 a**
Danitol 2.4EC	**16.0 fl.oz.**	**4-8C**	**4.2 ab**	**80.0 a**
Warrior w/Zeon	**5.12 fl.oz.**	**4-8C**	**18.2 c**	**470.4 a**
Assail 30SG	5.5 oz.	4-8C	10.4 bc	409.6 a
Calypso 4SC	**6.0 fl.oz.**	**4-8C**	**20.8 c**	**384.0 a**
Actara 25WDG	**5.5 oz.**	**4-8C**	**12.6 abc**	**275.2 a**
Untreated	-	-	7.6 b	870.4 a

Conclusion

In conclusion, the stink bug complex is an infrequent pest to the orchard. Its sporadic nature makes it difficult to predict and subsequently difficult to manage. The physiological disorder 'cork spot' is very similar in appearance to the stink bug feeding site and may have been confused as such in years past. Determining the difference between the two is essential for initiating proper management programs for either fruit deficit. Technologies to assist growers in predicting stink bug damage levels are as of yet unavailable. Using historical levels of orchard injury in combination with traditional scouting methods of observing adult presence and observations of fresh fruit damage are still our most reliable indicators to begin control measures for this insect. Many of the materials available for late season management of apple maggot and obliquebanded leafroller can be used against the stink bug complex to achieve a degree of control. However, in years of prolonged drought prior to harvesting fruit in highly susceptible blocks, directed applications of various classes of materials such as Danitol 2.4EC or Thionex 50W would be required to obtain commercially acceptable quality.

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