Native and Invasive Stink Bug Management

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Results of entomological research indicate that more than 500 species of arthropods feed on apple, 40 of which are present in the Hudson Valley, and may contribute to fruit yield reductions. As more species-specific insecticides are developed and employed, loss of broad-spectrum activity becomes more evident in the damage caused to apple by insect pests that were once controlled by older insecticides having greater broad spectrum residual. One such group of pests is found in the late season phytophagous stink bug complex (Heteroptera: Pentatomidae) comprised of three species. These include the green stink bug (GSB), *Acrosternum hilare* (Say), brown stink bug (BSB) *Euschistus servus* (Say), and the newly invasive brown marmorated stink bug (BMSB), *Halyomorpha halys.* The injury between species is indistinguishable, yet because the injury resembles hail marks and the physiological disorder known as cork spot, it has occurred at varying levels and likely misdiagnosed during packout. Reasons for a recent increase in injury are not completely understood, but changes in chemistries used for pest management (substitution of Delegate, Altacor and neonicotinoids for Lorsban, Penncap-M and other organophosphates), decreased levels of susceptibility, late season crop irrigation during periods drought and introduction of the newly invasive BMSB are believed to be contributing factors to increasing damage by the stink bug complex.

Recently, the stink bug complex has caused serious crop loss to cherry, peach, nectarine, apple and pear in NYS Hudson Valley Orchards. Control with insecticides is difficult as this pest is very sporadic, usually occurring mid to late season, right up to the harvest of stone and pome fruit. Over the past two years the stink bug complex invade orchards late in the growing season when choice of chemical controls is limited by pre-harvest interval restriction (PHI) considerations. Repeat sprays are often required because stink bugs continually migrate to and from the orchards, moving from weed hosts or woodlands. Migration often coincides with drought conditions and is concentrated near orchard edges, near abandoned or unmanaged land typical of the Hudson Valley and New England agricultural landscape. The insect will move into orchards to begin feeding on secondary host weed plants along the orchard edge and weed species in row middles and beneath trees that are flowering and producing seed. As these hosts dry, are killed by herbicides or mowed down, the stink bug moves to apple to begin feeding on fruit.

Research to verify stink bug occurrence and feeding damage on apple by Dr. Mark Brown, USDA entomologist (retired) has found that stink bug feeding injury differs from cork spot in three ways: 1) the edge of the depression on the fruit surface from stink bug feeding is gradual instead of abrupt as in cork spot; 2) the corky flesh is always immediately beneath the skin in stink bug injury, but may not be in contact with the skin in cork spot; and 3) a puncture is always present from stink bug feeding, yet may require the aid of magnification. Brown also found that orchards most likely to experience stink bug injury are those with poor weed control adjacent to woods and/or weedy borders. Stink bugs are very difficult to manage because they: 1) are highly mobile; 2) have a broad host range, including many crops and broadleaf weeds; 3) move frequently between weed hosts and fruit trees; and 4) are therefore not continually exposed to insecticide residues for long periods of time. As in the case of the brown marmorated stink bug, proximity of tree hosts to agricultural commodities play an important role in BMSB infestation levels.

Studies conducted by Drs. H. Hogmire and T. Lesky[3] (USDA) on trapping native stink bug to monitor for presence have indicated that although stink bug presence can be correlated between traps and presence in the tree, traps have not yet been developed as useful IPM tools in determining the timing of preventative measures. This also holds true for the invasive BMSB Tedders trap and newly developed lures used to monitor for presence. Thus the use of scouting observations, are still a more effective method to determine insect presence. The use of trap crops has been considered as a possible strategy to manage stink bug populations. Work done on cotton and soybean have pointed to the preference of soybean as a food source for the stink bug complex. Yet in a 2004 study conducted at Clemson University, the use of soy bean as a trap and kill crop did not significantly reduce damage to cotton by stink bug and does not appear to be a feasible alternative in controlling these pest species.

In a study conducted by USDA-ARS, G. L. Snodgrass et. al. in Stoneville, Mississippi, point to the differences in species susceptibility to insecticides efficacious to stink bug. The pyrethroid bifenthrin was equally toxic to brown and southern green stink bugs, whereas cypermethrin, cyfluthrin, and cyhalothrin were significantly more toxic to southern green than they were to brown stink bugs. They also found that bifenthrin was more toxic to brown stink bugs compared with southern green stink bugs by exposing adults in the laboratory to cotton bolls treated in the field. Organophosphate efficacy studies showed Methyl parathion > Acephate > Dicrotophos > Malathion; and pyrethroid evaluations showed Cypermethrin > Cyfluthrin > Bifenthrin > Permethrin. Yet many of the more efficacious products used on other commodities are not registered on apple in NYS. Newer chemistries with different target sites and modes of action have yet to be tested. Recent studies by Tracy Leskey at the USDA ARS in Kernysville, WV on efficacy of insecticides against the BMSB had shown similar disparity between insecticides. The best performance through residual bioassay studies in control of this species was provided by bifenthrin in the pyrethroid class, dinotefuran in the neonicotinoid class, endosulfan, a chlorinated hydrocarbon, chlorpyrifos, an organophosphate and methomyl in the carbamate class.

In Central Washington State, laboratory studies conducted on field-aged pesticide residues indicated that Asana 0.66 EC (esfenvalerate) was active as a one-day-old residue against native stink bug species but was not very active as a seven-day-old residue. Guthion (azinphos-methyl) was not effective against stink bug species as one-day or seven-day-old residues.

Native stink bug weed hosts include breadgrass, bushberries, curly dock, everlasting peas, milkweed, mallow, morning glory, mullein, mustard, plantain, thistles, vetch, velvetgrass, and other broadleaf plants. BMSB has been found to feed and reproduce on red-root amaranth or pigweed *Amaranthus retroflexus* along with sunflower, *Helianthus annuus*. The addition of enhanced broadleaf weed management, and timely seasonal mowing have been shown to reduce stink bug injury. Conversely, Dr. Mark Brown found late season mowing and poor weed management enhanced stink bug damage to apple. BMSB and the green stink bug are both arboreal, with increases of both species occurring simultaneously in the Hudson Valley in 2012. Both the BMSB and GSB were found to utilize the Tree of Heaven, *Ailanthus* altissima, throughout the growing season. Late in the season BMSB have been found to infest Catalpa, Black Walnut, Sugar Maple, American Ash as host plants and can be observed feeding on tree seeds. The BMSB movement off of woodland trees to late season tree fruit is believed to coincide with the development of the 2^{nd} generation adult and loss of viable or depleted resources in woodland host trees.