



the nutshell

The quarterly newsletter of the Northern Nut Growers Association

Volume 64, No. 4

www.nutgrowing.org

December 2010

The Inside Story

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Later instar (immature generation) of Brown Marmorated Stink Bug (*Halymorpha halys*) on hazelnut husk, September 2010. Photo credit: Mark Inzano, Plant Biology and Pathology Department, Rutgers University, New Jersey.

The Brown Marmorated Stink Bug: A New Pest of Hazelnuts?

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Introduction

The Brown Marmorated Stink Bug (BMSB) (*Halymorpha halys*) is quickly becoming a major pest to both farmers and homeowners throughout the east coast of the United States and surrounding areas. A native agricultural pest to Asia, BMSB was first identified in the United States in 1996 in Allentown, Pennsylvania. Slowly but surely, the appearance of BMSB on agricultural land and in homes where the insects over-winter has grown to include New Jersey, New York, and even Oregon and California (Wermelinger et al., 2008; Nielsen and Hamilton, 2009). In 2010, we observed this stink bug causing significant kernel damage to hazelnut plants growing at Rutgers University in New Jersey.

Background on the Brown Marmorated Stink Bug

The Brown Marmorated Stink Bug belongs to the order Hemiptera, or true bugs, which include aphids, cicadas, leaf hoppers and others. Adult BMSB are typically 15mm to 17mm in length and are most easily identified by their “shield-shaped body” and characteristic, brown and white marbled coloration, hence the use of the term “marmorated” (Fig. 1a & b). The adult’s antennae is segmented into brown and white

bands and a checkered row of alternating brown and white spots lines the lower abdomen. Eggs are typically laid from June to August and are off-white in color. The eggs are deposited on the underside of leaves and range in number from 20 to 30 eggs per cluster (Fig. 2). There are five instar stages of BMSB with nymphs identified by their red eyes and red, yellow, and black colored abdomen (Fig. 3). Both nymphs and adults feed continuously through the summer and fall seasons (Hamilton et al., 2008; Gill, et al. 2010). The BMSB over-winters in its adult stage in man-made structures, such as houses and sheds, but may also over-winter in leaf debris and other organic material that provides sufficient protection from the elements (Wermelinger et al., 2008). It should be noted that the BMSB has been observed to have a greater winter survival rate than its cousin, the southern green stink bug (*Nezara viridula*), based on its geographical distribution in the United States and in Japan (Nielsen et al., 2008). The “stink” of the BMSB is caused by scent glands underneath the abdomen that produce its unmistakable odor (Hamilton et al., 2008). Currently, it is not clear how many generations per year are able to be produced in the northeast (Gill et al., 2010).

Brown Marmorated Stink Bugs feed on a number of agricultural and ornamental crops. To date, over 300 different types of plants have been identified as host plants (Nielsen et al., 2008). When feeding, their mouthparts pump saliva down one maxillary stylet and suck up food through another (Mitchell, 2004). Injury is caused

by the breaking of the skin of the fruit, as well as the removal of the surrounding tissue when feeding (Brown and Short, 2010). The lesions caused by the insertion of the mouthparts can also provide an entry point for moisture and microbes such as fungal spores, resulting in kernel or fruit mold and other damage (Mitchell, 2004). Furthermore, the BMSB is able to switch hosts and survive by moving and feeding on a wide range of plants and fruits such as peaches, apples, soybeans, nuts, and even weeds. This behavior suggests that the BMSB is not only able to move to find the best available food source within a given area, but it may also be able to move from a pesticide treated area to another untreated area (Funayama, 2004). Due to its relatively new status as a pest in the United States, many aspects of its behavior and control still need to be studied in this environment.

In general, controlling BMSB has proven to be a difficult task. The elusive nature of the insect by use of camouflage and hiding, as well as its nocturnal activity, make population estimations difficult (Nielsen and Hamilton, 2009). Chemical sprays of pyrethroids are most often used in orchard settings, but the effects are short-lived (Funayama, 2004) and have a tendency to cause flare-ups of other pest problems as spraying also kills many natural predators (J. Goffreda, personal communication). Experiments with trapping using black lights and pyramid traps with pheromones have shown moderate success, but no completely adequate control techniques have been developed at

this time (Nielsen and Hamilton, 2009). As with any invasive species, the lack of natural predators seems to be one of the greatest reasons for the proliferation of BMSB in the United States thus far. Some success using spiders, lacewings, ants, and parasitic wasps has been noted, but additional research must be pursued in order to provide conclusive evidence as to their effectiveness (Wermelinger et al., 2008). Weather trends also seem to play a role in BMSB behavior. Wermelinger et al (2008) reported that, in Japan, warmer winters can result in the reduction of winter mortality rates of BMSB by an estimated 13% per each degree centigrade of warming above a certain threshold. Based on similarities in temperature and host plant species in parts of Asia affected by BMSB to those currently in the United States, it has been predicted that the distribution of BMSB will be able to increase over time (Nielsen et al., 2008).

Because of its status as a new invasive species in the United States, only a small amount of research has been done on BMSB and its effect on agronomic and horticultural crops. Integrated Pest Management (IPM) techniques including action and economic thresholds have yet to be developed for the new pest. Also, the reduction in applications of broad-range insecticides, widely used in the past to eradicate agricultural and ornamental crop pests, has led to BMSB becoming an unknown and possibly looming threat to growers in this country (Nielsen et al., 2008). The effects of BMSB in its native host range of Asia have been significant. Damage to various important food crops has

been reported and research has been ongoing for years in Japan and China to develop a reliable method to deal with the BMSB problem. Only time will tell how significant of a pest BMSB will become in North America.

Stink Bugs at Rutgers

The sudden dramatic increase in the number of stink bugs observed on hazelnut trees at the Rutgers Horticultural Research Farms over the summer of 2010 was alarming. Although small numbers of these insects have been observed on the hazelnut trees over the past few years, population sizes of the magnitude observed in 2010 had never been seen before. Large BMSB populations were first observed in the early summer of 2010 on trees at three different Rutgers research farms located in North Brunswick, Cream Ridge, and Adelphia, New Jersey. Although what we perceived as possible feeding damage was noted on the husks (or involucre) surrounding the developing nuts, no measures were taken to control the insect. This lack of control measures was due to the fact that BMSB had been observed in previous seasons and had been determined to pose little to no threat to overall yield or kernel health. In addition, we typically do not spray our hazelnut plants for insects or disease problems as we study their natural response to pests in our research plots. From our casual observance of the developing nuts, they appeared healthy over the season, matured, and were harvested as normal. Poorly formed nuts or an abundance of blanks in some selections was attributed, possibly incorrectly, to

the severe drought we experienced in 2010. Post-harvest nut evaluations, however, revealed that a considerable number of nuts appeared to have been damaged by BMSB feeding. The affected kernels were shrunken and withered in appearance with clear feeding sites consisting of a pronounced indentation surrounded by an area of necrotic tissue, which in many cases lead to mold and decay. A sample of hazelnut kernels with damage attributed to BMSB feeding is shown in Figure 4.

The potential for the BMSB to become a major pest of hazelnuts in the United States has yet to be determined. However, preliminary nut evaluations at Rutgers have shown that the insect is undoubtedly causing damage unlike that observed before on hazelnuts in this region. While a more detailed study is ongoing, early estimates of damaged kernels at the Cream Ridge Farm from stink bug feedings were between 15% to 20% of the crop across a large number and diversity of hazelnut selections sampled (50 nuts of over 30 breeding selections were cracked and evaluated with many more selections to be done this winter). Interestingly, damage at the research farm in North Brunswick, NJ (Hort Farm 3) ranged on average from only 5% to 10% of the crop sampled. It should be noted that no pesticides were applied at either location to control stink bugs or other pests. While the percentage of damaged kernels was not exceedingly high, over the past ten years of producing, collecting, and evaluating hazelnuts at these locations, similar damage has *never* been observed. The huge number

of insects found on the plants, and the kernel damage, and little known control measures, presents potential for this to grow into a major problem in future years.

It is not known if the BMSB is also feeding on the husks or leaves of the hazelnut plant and not solely the developing kernels, as the numbers of bugs on each tree reached extraordinarily high numbers in 2010. It seemed that most nut clusters were crawling with hundreds of stink bugs. However, fewer than 20% of the sampled kernels were damaged—a low number compared with the numbers of insects (including multiple stages of its lifecycle) present on the husks. It should also be noted that systematic counts of the insects per cluster were not made and a more detailed study needs to be undertaken to better understand how and when in the nut developmental stage are the stinkbugs feeding. Further, the cause for the rapid increase in BMSB population size from 2009 to 2010 is unclear. The severe drought and heat of summer 2010, lack of pesticide applications, and control

methods utilized on our farms, as well as a shortage of natural predators of this new pest are all possible explanations contributing to the sudden rise in number.

Our fear is that, with large overwintering populations in the winter of 2010/2011, next season may be even worse.

The issue of the BMSB in the eastern United States has proven to be a complex and increasing concern of economic importance to horticulture in the region: it is an invasive species with a voracious appetite that seems to be able to survive on numerous plant hosts, with no proven control methods. The long-term effects this insect could have on economic crops merit targeted scientific research. More specifically, the threat that BMSB poses to hazelnuts and other nut species needs to be evaluated and effective control methods need to be assessed and developed. As the production of hazelnuts and other nut crops continue to expand in the United States and worldwide, problems such as coping with an invasive species like the BMSB will arise. We hope that our

observations of BMSB on hazelnut will help spread the word and instigate further investigation of this potentially damaging new pest.

We will be following the BMSB populations much more closely in 2011 to help us better understand how this invasive pest will affect the development of hazelnut production in the northeastern U.S. and southern Canada, as well as in the current production region of the Willamette Valley of Oregon, where this pest has not yet caused significant economic damage. It is critical that researchers and growers work together to develop strategies that effectively deal with the problems associated with BMSB in a way that encourages a global dialogue and promotes sustainable management practices.

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Figure 1a. Brown Marmorated Stink Bug on hazelnut husk in June, 2010.



Figure 2. Egg cluster of Brown Marmorated Stink Bug on hazelnut leaf, in June, 2010.



Figure 1b. Close-up of Brown Marmorated Stink Bug on hazelnut husk in September, 2010, note characteristic "shield shape" and brown marbled coloration.



Figure 3. Later instar (immature generation) of Brown Marmorated Stink Bug on hazelnut husk in September 2010.



Figure 4. Example of damage to hazelnut kernels from nuts harvested at Rutgers attributed to the Brown Marmorated Stink Bug. Note the marks from feeding and associated mold growth. Quarter included to show scale.