BIOLOGY AND MANAGEMENT OF THE

Brown Marmorated Stink Bug

in Ornamental Landscapes

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EXTENSION

The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae; Figure 1) is a landscape and agricultural pest in the United States. It was introduced from Asia in the mid-1990s, and quickly spread to the entire United States because of its overwintering behavior. They seek dark and dry sites—such as a vehicle parked near trees—in the fall in which to overwinter. The Early Detection and Distribution Mapping System shows 95 positive reports throughout Georgia; it is established in the Piedmont region of the state. This pest is reported to feed on more than 170 plant species, including fruits, vegetables, and ornamental plants. The BMSB also is a nuisance pest as they aggregate and overwinter in man-made structures beginning in late fall.

Figure 1. Adult stage of the brown marmorated stink bug, *Halyomorpha halys* (Stål). Photo: Ken Childs, Bugguide.net.

Biology and Behavior

The BMSBs overwinter (diapause) as adults, and do not feed during this time. In spring, they emerge from overwintering sites and seek immediate nutritional resources from developing flowers and fruits before laying eggs. The BMSB undergoes three life stages: egg, nymph (five nymphal instars), and adult (Figure 2). A female lays eggs in a mass of about 28 eggs, and can lay between two and 15 egg masses during her lifetime. The light-yellow to light-green, barrel-shaped eggs are glued to the host's surface (leaf, fruit, stem; Figure 3). First instars have an oval- and tick-like appearance, with mottled orangish-red and black coloration, and remain aggregated around the egg mass (Figure 4). Subsequent instars disperse while seeking food. Second- to fifth-instar nymphs are black-and-white colored and have well-defined white bands on their legs and antennae (Figure 5). In the laboratory, the nymphs take about 43 days to grow before molting into adults. The adults are grey-brownish and shield-shaped, with two white bands on their antennae and mottled white-and-black stripes along the lower margins of the body (Figure 1). The BMSB differs from the brown stink bug, *Euschistus servus*, by the presence of white bands on antennae and legs (Figure 8). Adults can live up to 119 days. They are often found aggregated on host leaves (Figure 6).

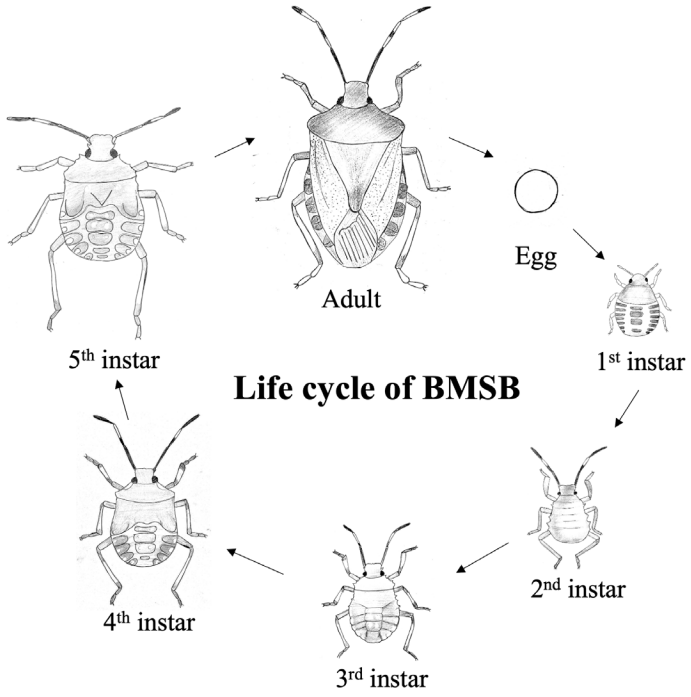

Figure 2. Life cycle of brown marmorated stink bug. Illustration: Fawad Khan.

There are two generations of BMSBs per year in Georgia. The nymphs from the overwintering adults mature into summer adults by late July or August, and the nymphs from the summer adults mature into overwintering adults in September or October. These adults seek overwintering sites in the fall. BMSBs are strong flyers and can fly long distances, as much as 3.7 miles in a month. In addition to flight, the fifth instar of BMSB can walk up to 65 ft in 4 hr.

Figure 3. Eggs of the brown marmorated stink bug. Photo: Yurika Alexander, Bugguide.net.

Figure 4. First-instar nymphs of the brown marmorated stink bug. Photo: Marcia Morris, Bugguide.net.

Figure 5. Nymphs of brown marmorated stink bug with prominent black and white bands on antennae and legs. Photo: Shimat V. Joseph.

Figure 6. Nymphs and adults of the brown marmorated stink bug aggregating on catalpa leaves. Photo: Shimat V. Joseph.

Host Plants and Damage

BMSBs can feed on plants from multiple families. In Georgia, more than 150 ornamental plant species are potential hosts of BMSBs. The invasive tree-of-heaven (*Ailanthus altissima*) is a preferred host for BMSBs in the landscape (Figure 7). Tree-of-heaven is the early host in pine-oak forests in the Piedmont region of Georgia. BMSB populations were observed where flowering dogwood tree (*Cornus florida*), yellow-poplar (*Liriodendron tulipifera*), Chinese privet (*Ligustrum sinense*), winged elm (*Ulmus alata*), sweetgum (*Liquidambar formosana*), maple (*Acer* spp.), oaks (*Quercus* spp.), walnut (*Juglans* spp.), crape myrtle (*Lagerstroemia* spp.), and honey locust trees (*Gleditsia triacanthos*) are present.

BMSB adults and nymphs attack a wide range of ornamental shrubs and trees. Table 1 shows the list of hosts infested with BMSBs.

Figure 7. Brown marmorated stink bug feeding on a tree-of-heaven.
Photo: Shimat V. Joseph.

BMSB feeding causes discoloration, distortion, and drying of the host tissue, although the extent of damage depends on the life stage, the number of infesting individuals, and the host plant's stage—e.g., flowering, fruiting, etc. BMSBs cause direct and indirect feeding damage to nursery and landscape plants. Direct feeding causes wilting of foliage (loss of rigidity), foliage stippling (dead brownish spots), bark discoloration (loss of color), and even death of some herbaceous plants. Indirect damage results from the transmission of diseases (like witches' broom disease) and may hinder normal plant growth.

Dispersal and Overwintering

BMSB adults seek man-made structures such as barns, storage structures, vehicles (recreational vehicles [RVs] and enclosed trailers), and people's houses and office buildings as sites for overwintering during the fall (Figure 9). They may also overwinter under dead and live tree bark. They prefer dry and tight sites for overwintering. The BMSB is regarded as a nuisance pest because it invades man-made structures. They find access into these structures through cracks and crevices of improperly sealed exterior doors and windows. Prematurely active adults walk and fly around inside the house, posing a nuisance during winter.

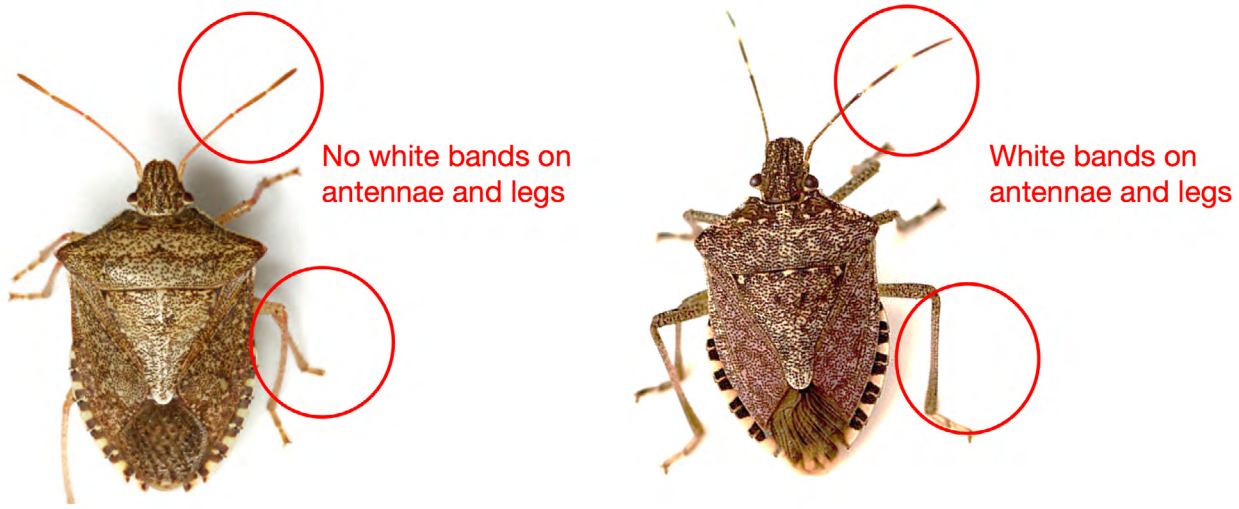

Figure 8. Comparison of brown stink bug (*Euschistus servus*, left) and brown marmorated stink bug (right).
Photo: Mike Quinn, TexasEnto.net, and Melinda Fawver, Bugguide.net.

The overwintering behavior of BMSBs also enhances their quick dispersal through human movement and trade. They hitchhike in mobile structures such as RVs, trailers, and shipping containers that are transported during winter, which enhances their quick dispersal across the United States.

Figure 9. Brown marmorated stink bug adults invading an office building while seeking a point of entry during the fall. Photo: Shimat V. Joseph.

Management

Ornamental plants in the landscape play a critical role in the biology of BMSBs because they offer breeding sites and food resources during the spring and summer. During the growing season, BMSB adults and nymphs can be monitored using commercially available traps, such as clear sticky traps or black pyramid traps baited with lures containing species-specific communication chemicals (semiochemicals).

In ornamental nurseries, high densities of BMSBs are found near the edges of the field and this behavior can be utilized for managing the pest. Predators such as ground beetles, jumping spiders, earwigs, crickets, and egg parasitoids—especially samurai wasp, *Trissolcus japonicus* (Hymenoptera: Scelionidae)—effectively reduce BMSB populations in the landscape. Insecticide applications should be considered if the population is high and apparent damage symptoms are observed. If insecticides are applied, repeated applications are warranted as the residual activity of effective insecticides (mostly pyrethroids, neonicotinoids, and organophosphates) do not last long enough for adequate BMSB control. Landscape trees and plants, or nursery stock closer to overwintering structures, are especially susceptible to an influx of adults in spring months.

Contact your county Extension agent for up-to-date recommendations for BMSB management by calling 1-800-ASK-UGA1.

Table. 1. Potential landscape hosts of the brown marmorated stink bug in Georgia.

Ornamental plants	Common name	Host reported in literature	Region	Reference
Abelia x 'Edward Goucher'	Edward Goucher Abelia	*Abelia* sp.		Sargent et al., 2010
Abelia x *Grandiflora*	Glossy Abelia	*Abelia* sp.		Sargent et al., 2010
Abelia x *Grandiflora* 'Sherwoodii'	Sherwood Dwarf Abelia	*Abelia* sp.		Sargent et al., 2010
Acer buergerianum	Trident Maple	*Acer x freemanii, Acer pensylvanicum*	USA	Bergmann et al., 2016
Acer palmatum	Japanese Maple	*Acer x freemanii, Acer pensylvanicum*	USA	Bergmann et al., 2016
Acer rubrum 'Franks Red'	Red Sunset Red Maple	*Acer rubrum*	USA	Bergmann et al., 2016
Acer rubrum 'October Glory'	October Glory Red Maple	*Acer rubrum*	USA	Bergmann et al., 2016
Acer saccharum	Sugar Maple	*Acer rubrum*	USA	Bergmann et al., 2016
Acer saccharum 'Legacy'	Legacy Sugar Maple	*Acer rubrum*	USA	Bergmann et al., 2016
Acer saccharum Spp. *Floridanum*	Southern Sugar Maple	*Acer rubrum*	USA	Bergmann et al., 2016
Amelanchier arborea	Serviceberry	*Amelanchier lamarckii*	Europe	Wermelinger et al., 2007
Berberis julianae	Wintergreen Barberry	*Berberis thunbergii var. atopurpurea* 'Rose Glow', *Berberis vulgaris*		Holthouse et al., 2021
Betula nigra 'Bnmtf'	Dura-Heat River Birch	*Betula nigra*	USA	Holthouse et al., 2021
Betula nigra 'Cully'	Heritage River Birch	*Betula nigra*	USA	Holthouse et al., 2021
Buddleia davidii	Butterfly Bush	*Buddleia* sp.		Hoebeke & Carter, 2003
Buxus sempervirens	Common Boxwood	*Buxus sempervirens*		Morrison et al., 2017
Calycanthus floridus	Sweet Shrub	*Calcanthus* sp.		Maistrello et al., 2016
Camellia hiemalis	Dwarf Sasanqua	*Camellia sinensis*	Turkey	Ak et al., 2019
Carpinus betulus 'Fastigiata'	Upright European Hornbeam	*Carpinus betulus*	France	Gariepy et al., 2015
Carpinus caroliniana	American Hornbeam	*Carpinus betulus*	Switzerland	Gariepy et al., 2015
Carya illinoinensis	Pecan	*Carya illinoinensis*	USA	Peverieri et al., 2019
Celtis laevigata	Sugar Hackberry	*Celtis occidentalis*	USA	Quinn et al., 2019
Cercis canadensis	Eastern Redbud	*Cercis canadensis*	USA	Bergmann et al., 2016
Cercis chinensis	Chinese Redbud	*Cercis canadensis*	USA	Bergmann et al., 2016
Cercis reniformis 'Oklahoma'	Oklahoma Redbud	*Cercis canadensis*	USA	Bergmann et al., 2016
Chaenomeles japonica	Japanese Flowering Quince	*Chaenomeles* sp.		Bergmann et al., 2016
Chaenomeles speciosa	Flowering Quince	*Chaenomeles* sp.		Bergmann et al., 2016
Cinnamomum lanceolata	Camphortree	*Cinnamomum camphora*	China	Yu & Zhang, 2007
Cladrastis kentukea	American Yellowwood	*Cladrastis kentukea*	USA	Bergmann et al., 2016
Cornus florida	Flowering Dogwood	*Cornus* sp.	Romania	Macavei et al., 2015
Cornus kousa	Kousa Dogwood	*Cornus* sp.	Romania	Macavei et al., 2015
Cotoneaster spp.	Groundcover Cotoneaster	*Cotoneaster* sp.		Bergmann, 2015
Cryptomeria japonica 'Yoshino'	Japanese Crytomeria	*Chryptomeria japonica*	Japan	Funayama, 2015
Eriobotrya japonica	Loquat	*Eriobotrya japonica*	Europe	Dumbadze et al., 2019
Fagus grandifolia	American Beech	*Fagus sylvatica*	USA	Holthouse, et al., 2021
Ginkgo biloba	Ginkgo or Maiden Hair Tree	*Ginkgo biloba*	USA	Bergmann et al., 2016
Halesia tetraptera	Silverbell	*Halesia* sp.		Bergmann et al., 2016
Hedera canariensis	Algerian Ivy	*Hedera helix*	Switzerland	Haye et al., 2014

Ornamental plants	Common name	Host reported in lit.	Region	Reference
Hedera canariensis	Algerian Ivy	*Hedera helix*	Italy	Haye et al., 2014
Hydrangea arborescens 'Annabelle'	Annabelle Hydrangea	*Hydrangea arborescens*		Cornelius et al., 2016
Hydrangea macrophylla	French Hydrangea	*Hydrangea arborescens*		Cornelius et al., 2016
Hydrangea macrophylla 'Pia'	Pia French Hydrangea	*Hydrangea arborescens*		Cornelius et al., 2016
Hydrangea paniculata 'Grandiflora'	Pee Gee Hydrangea	*Hydrangea arborescens*		Cornelius et al., 2016
Hydrangea paniculata 'Tardiva'	Tardiva Hydrangea	*Hydrangea arborescens*		Cornelius et al., 2016
Hydrangea quercifolia	Oakleaf Hydrangea	*Hydrangea arborescens*		Cornelius et al., 2016
Ilex cassine	Dahoon Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex cassine	Cassine Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex cornuta 'Anicet Delcambre'	Needle Point Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex cornuta 'Burfordii'	Burford Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex cornuta 'Dwarf Burford'	Dwarf Burford Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex crenata 'Hetzii'	Hetz Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex crenata 'Sky Pencil'	Sky Pencil Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex glabra 'Nigra'	Nigra Inkberry	*Ilex aquifolium*		Wiman et al., 2015
Ilex latifolia	Lusterleaf Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex myrtifolia	Myrtle Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex opaca	American Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex opaca 'Greenleaf'	Greenleaf Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex vomitoria	Yaupon Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex vomitoria Bordeaux™	Bordeaux Dwarf Yaupon	*Ilex aquifolium*		Wiman et al., 2015
Ilex vomitoria 'Nana'	Dwarf Yaupon Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex vomitoria 'Pendula'	Weeping Yaupon Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex vomitoria 'Schillings'	Schillings Dwarf Yaupon	*Ilex aquifolium*		Wiman et al., 2015
Ilex x *Attenuata*	Hybrid Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex x *Attenuata* 'Fosteri'	Foster's Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex x 'Emily Bruner'	Emily Bruner Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex x 'Mary Nell'	Mary Nell Holly	*Ilex aquifolium*		Wiman et al., 2015
Ilex x 'Nellie R. Stevens'	Nellie R. Stevens Holly	*Ilex aquifolium*		Wiman et al., 2015
Juniper chinensis 'Pfitzeriana'	Pfitzer Juniper	*Juniperus* sp.		Aigner et al., 2017
Juniperus chinensis 'Robusta Green'	Robusta Green Juniper	*Juniperus virginiana*	USA	Aigner et al., 2017
Juniperus chinensis 'Torulosa'	Hollywood Juniper	*Juniperus virginiana*	USA	Aigner et al., 2017
Juniperus virginiana	Red Cedar	*Juniperus virginiana*	USA	Aigner et al., 2017
Koelreuteria bipinnata	Chinese Flametree	*Koelreuteria paniculata*	USA	Holthouse et al., 2021
Koelreuteria paniculata	Goldenrain Tree	*Koelreuteria paniculata*	USA	Holthouse et al., 2021
Lagerstroemia indica 'Victor'	Victor Crapemyrtle	*Lagerstroemia* sp.		Bakken, 2014
Lagerstroemia x 'Tonto'	Tonto Crapemyrtle	*Lagerstroemia* sp.		Bakken, 2014
Liquidambar styraciflua	Sweetgum	*Liquidambar* spp.	USA	Nielsen & Hamilton, 2009
Liriodendron tulipfera	Tuliptree or Yellow-Poplar	*Liriodendron tulipifera*	Europe	Ion & Raluca, 2019
Lonicera nitida	Box Leaf Honeysuckle	*Lonicera* sp.		Wermelinger et al., 2007
Magnolia grandiflora	Southern Magnolia	*Magnolia grandiflora*	USA	Formella et al., 2020
Magnolia grandiflora 'Bracken's Brown Beauty'	Bracken's Brown Beauty Magnolia	*Magnolia grandiflora*	USA	Formella et al., 2020

Ornamental plants	Common name	Host reported in lit.	Region	Reference
Magnolia grandiflora 'Little Gem'	Little Gem Southern Magnolia	*Magnolia grandiflora*	USA	Formella et al., 2020
Magnolia soulangiana	Japanese Magnolia	*Magnolia grandiflora*	USA	Formella et al., 2020
Magnolia stellata	Star Magnolia	*Magnolia grandiflora*	USA	Formella et al., 2020
Magnolia virginiana	Sweetbay Magnolia	*Magnolia grandiflora*	USA	Formella et al., 2020
Mahonia fortunei	Chinese Mahonia	*Mahonia repens*		Holthouse et al., 2021
Malus 'Callaway'	Callaway Crabapple	*Malus* sp.	USA	Nielsen & Hamilton, 2009
Malus floribunda	Japanese Crabapple	*Malus* sp.	USA	Nielsen & Hamilton, 2009
Malus x 'Dolgo'	Dolgo Crabapple	*Malus* sp.	USA	Nielsen & Hamilton, 2009
Metasequoia glyptostroboides	Dawn Redwood	*Metasequoia glyptostroboides*	Russia	Zakharchenko et al., 2020
Nerium oleander	Oleander	*Nerium* sp.		Bergmann, 2015
Nyssa sylvatica	Black Tupelo	*Nyssa sylvatica*	USA	Cornelius et al., 2016; Bergmann et al., 2016
Parthenocissus quinquefolia	Virginia Creeper	*Parthenocissus quinquefolia*	Slovakia	Hemala & Kment, 2017
Pennisetum alopecuroides	Dwarf Fountain Grass	*Pennisetum glaucum*	USA	Nielsen et al., 2016
Pennisetum setaceum	Fountain Grass	*Pennisetum glaucum*	USA	Nielsen et al., 2016
Pennisetum setaceum 'Rubrum'	Crimson Fountain Grass	*Pennisetum glaucum*	USA	Nielsen et al., 2016
Pennisetum villosum	Feathertop Grass	*Pennisetum glaucum*	USA	Nielsen et al., 2016
Phoenix canariensis (Potential host)	Canary Date Palm	*Phoenix canariensis*	Australia	Horwood et al., 2019
Pistacia chinensis	Chinese Pistache	*Pistacia chinensis*	USA	Lara et al., 2017
Pittosporum tobira	Tobira Pittosporum	*Pittosporum tobira*	Russia	Musolin et al., 2018
Pittosporum tobira 'Wheeler's Dwarf'	Wheeler Dwarf Pittosporum	*Pittosporum tobira*	Russia	Musolin et al., 2018
Platanus occidentalis	Sycamore Or Planetree	*Planatus* sp.	Russia	Musolin et al., 2018
Platanus x *acerifolia*	London Planetree	*Planatus* sp.	Russia	Musolin et al., 2018
Prunus caroliniana	Carolina Cherrylaurel	*Prunus* spp.		Wermelinger et al., 2007
Prunus cerasifera 'Thundercloud'	Purpleleaf Plum	*Prunus* spp.		Wermelinger et al., 2007
Prunus laurocerasus 'Otto Luyken'	Otto Luyken Laurel	*Prunus* spp.		Wermelinger et al., 2007
Prunus laurocerasus 'Schipkaensis'	Schip Laurel	*Prunus* spp.		Wermelinger et al., 2007
Prunus mume	Japanese Apricot	*Prunus* spp.		Wermelinger et al., 2007
Prunus serralata 'Kwanzan'	Kwanzan Cherry	*Prunus* spp.		Wermelinger et al., 2007
Prunus subhirtella var. *Autumnalis*	Fall Blooming Cherry	*Prunus* spp.		Wermelinger et al., 2007
Prunus x 'Okame'	Okame Cherry	*Prunus* spp.	Europe	Wermelinger et al., 2007
Prunus x *yedoensis*	Yoshino Cherry	*Prunus* spp.		Wermelinger et al., 2007
Punica granatum	Pomegranate	*Punica granatum*	China	Yu & Zhang, 2007
Punica granatum var. *Nana*	Dwarf Pomegranate	*Punica granatum*	China	Yu & Zhang, 2007

Ornamental plants	Common name	Host reported in lit.	Region	Reference
Pyracantha koidzumii	Formosa Firethorn	*Pyracantha coccinea*		Wermelinger et al., 2007
Pyracantha koidzumii 'Low-Dense'	Low-Dense Pyracantha	*Pyracantha coccinea*		Wermelinger et al., 2007
Pyracantha x 'Mohave'	Mohave Firethorn	*Pyracantha coccinea*		Wermelinger et al., 2007
Quercus alba	White Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus coccinea	Scarlet Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus falcata	Southern Red Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus hemisphaerica	Laurel Oak or Darlington Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus laurifolia	Swamp Laurel Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus lyrata	Overcup Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus myrsinifolia	Chinese Evergreen Oak	*Quercus* spp.		Milnes et al., 2016
Quercus nigra	Water Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus nuttallii	Nuttall Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus palustris	Pin Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus phellos	Willow Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus shumardii	Shumard Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Quercus virginiana	Live Oak	*Quercus* spp.	USA	Lee & Leskey, 2015
Rosa species	Climbing Roses	*Rosa* sp.	Australia	Horwood et al., 2019
Salix babylonica	Weeping Willow	*Salix* spp.	Europe	Wermelinger et al., 2007
Salix matsudana 'Tortuosa'	Contorted Willow	*Salix* spp.	Europe	Wermelinger et al., 2007
Syringa vulgaris	Common Lilac	*Syringa* spp.		Wermelinger et al., 2007
Trachycarpus fortunei	Chinese or Fortunes Windmill Palm	*Trachycarpus* sp.		Bergmann, 2015
Ulmus parvifolia	True Chinese Elm or Lacebark Elm	*Ulmus americana*	USA	Bergmann et al., 2016
Ulmus parvifolia 'Elmer I'	Athena Lacebark Elm	*Ulmus americana*	USA	Bergmann et al., 2016
Ulmus parvifolia 'Elmer II'	Allee Lacebark Elm	*Ulmus americana*	USA	Bergmann et al., 2016
Viburnum awabuki	Awabuki Viburnum	*Viburnum prunifolium, Viburnum opulus variety americanum*		Nielsen & Hamilton, 2009
Viburnum odoratissimum	Sweet Viburnum	*Viburnum prunifolium, Viburnum opulus variety americanum*		Nielsen & Hamilton, 2009
Viburnum opulus 'Roseum'	European Snowball Viburnum	*Viburnum prunifolium, Viburnum opulus variety americanum*		Nielsen & Hamilton, 2009
Viburnum plicatum var. *Tomentosum*	Doublefile Viburnum	*Viburnum prunifolium, Viburnum opulus variety americanum*		Nielsen & Hamilton, 2009
Viburnum suspensum	Sandankwa Viburnum	*Viburnum prunifolium, Viburnum opulus variety americanum*		Nielsen & Hamilton, 2009
Viburnum tinus	Laurustinus	*Viburnum prunifolium, Viburnum opulus variety americanum*		Nielsen & Hamilton, 2009
Viburnum trilobum	American Cranberry Bush Viburnum	*Viburnum prunifolium, Viburnum opulus variety americanum*		Nielsen & Hamilton, 2009

Ornamental plants	Common name	Host reported in lit.	Region	Reference
Viburnum x *burkwoodi*	Burkwood Viburnum	*Viburnum prunifolium, Viburnum opulus variety americanum*		Nielsen & Hamilton, 2009
Viburnum x *rhytidophyllum*	Leatherleaf Viburnum	*Viburnum prunifolium, Viburnum opulus variety americanum*		Nielsen & Hamilton, 2009
Weigela florida	Weigela	*Weigela* sp.		Bergmann, 2015
Wisteria frutescens	American Wisteria	*Wisteria sinensis*	China	Yu & Zhang, 2007
Zelkova serrata 'Green Vase'	Green Vase Japanese Zelkova	*Zelkova* sp.	China	Lee et al., 2013
Zelkova serrata 'Village Green'	Village Green Japanese Zelkova	*Zelkova* sp.	China	Lee et al., 2013

References

Acebes-Doria, A. L., Agnello, A. M., Alston, D. G., Andrews, H., Beers, E. H., Bergh, J. C., Bessin, R., Blaauw, B. R., Buntin, G. D., Burkness, E. C., Chen, S., Cottrell, T. E., Daane, K. M., Fann, L. E., Fleischer, S. J., Guédot, C., Gut, L. J., Hamilton, G. C., Hilton, R., … Leskey, T. C. (2019). Season-long monitoring of the brown marmorated stink bug (Hemiptera: Pentatomidae) throughout the United States using commercially available traps and lures. *Journal of Economic Entomology, 113*(1), 159–171. https://doi.org/10.1093/jee/toz240

Aigner, B. L., Kuhar, T. P., Herbert, D. A., Brewster, C. C., Hogue, J. W., & Aigner, J. D. (2017). Brown marmorated stink bug (Hemiptera: Pentatomidae) infestations in tree borders and subsequent patterns of abundance in soybean fields. *Journal of Economic Entomology, 110*(2), 487–490. https://doi.org/10.1093/jee/tox047

Ak, K., Uluca, M., Aydin, Ö., & Gokturk, T. (2019). Important invasive species and its pest status in Turkey: Halyomorpha halys (Stål) (Heteroptera: Pentatomidae). *Journal of Plant Diseases and Protection, 126*(5), 401–408. https://doi.org/10.1007/s41348-019-00243-7

Bakken, A. J. (2014). *The biology and ecology of stink bugs and plum curculio Conotrachelus nenuphar in North Carolina tree fruit orchard* [Master's thesis, NC State University]. NC State University Libraries. https://www.lib.ncsu.edu/resolver/1840.16/10026

Bergmann, E. J. (2015). *Patterns of host use by brown marmorated stink bug,* Halyomorpha halys *(Hemiptera: Pentatomidae), in woody ornamental trees and shrubs* [Master's thesis, University of Maryland]. Digital Repository at the University of Maryland. https://drum.lib.umd.edu/bitstream/handle/1903/17245/Bergmann_umd_0117N_16644.pdf?sequence=1

Bergmann, E. J., Venugopal, P. D., Martinson, H. M., Raupp, M. J., & Shrewsbury, P. M. (2016). Host plant use by the invasive *Halyomorpha halys* (Stål) on woody ornamental trees and shrubs. *PloS ONE, 11*(2), Article e0149975. https://doi.org/10.1371/journal.pone.0149975

Bosco, L., Nardelli, M., & Tavella, L. (2020). First insights on early host plants and dispersal behavior of Halyomorpha halys (Hemiptera: Pentatomidae) from overwintering to crop colonization. *Insects, 11*(12), 866. https://doi.org/10.3390/insects11120866

Cornelius, M. L., Dieckhoff, C., Hoelmer, K. A., Olsen, R. T., Weber, D. C., Herlihy, M. V., Talamas, E. J., Vinyard, B. T., & Greenstone, M. H. (2016). Biological control of sentinel egg masses of the exotic invasive stink bug *Halyomorpha halys* (Stål) in mid-Atlantic USA ornamental landscapes. *Biological Control, 103*, 11–20. https://doi.org/10.1016/j.biocontrol.2016.07.011

Dumbadze, G., Gokturk, T., Jgenti, L., & Chelidze, N. (2019, November 22) *Distribution of brown marmorated stink bug (*Halyomorpha halys*), bioecological features and control mechanisms in Batumi (Georgia)* [Paper presentation]. 4th International Symposium on Innovative Approaches in Engineering and Natural Sciences, Samsun, Turkey. https://dx.doi.org/10.36287/setsci.4.6.152

Formella, A., Dorman, S. J., Taylor, S. V., & Kuhar, T. P. (2020). Effects of aggregation lure and tree species on *Halyomorpha halys* (Hemiptera: Pentatomidae) seasonal oviposition. *Journal of Economic Entomology, 113*(1), 203–210. https://doi.org/10.1093/jee/toz281

Fryer, J. L. (2010). *Ailanthus altissima*. Fire Effects Information System, Forest Service, U.S. Department of Agriculture. https://www.fs.fed.us/database/feis/plants/tree/ailalt/all.html

Funayama, K. (2015). Nutritional status of overwintering adults of the brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Pentatomidae), is affected by cone counts of Japanese cedar, *Cryptomeria japonica*, in northern Japan. *Applied Entomology and Zoology, 50*(1), 117–121. https://doi.org/10.1007/s13355-014-0312-9

Gariepy, T. D., Bruin, A., Haye, T., Milonas, P., & Vétek, G. (2015). Occurrence and genetic diversity of new populations of *Halyomorpha halys* in Europe. *Journal of Pest Science, 88*(3), 451–460. https://doi.org/10.1007/s10340-015-0672-0

Haye, T., Abdallah, S., Gariepy, T., & Wyniger, D. (2014). Phenology, life table analysis and temperature requirements of the invasive brown marmorated stink bug, *Halyomorpha halys*, in Europe. *Journal of Pest Science, 87*(3), 407–418. https://doi.org/10.1007/s10340-014-0560-z

Hemala, V., & Kment, P. (2017). First record of *Halyomorpha halys* and mass occurrence of Nezara viridula in Slovakia (Hemiptera: Heteroptera: Pentatomidae). *Plant Protection Science, 53*(4), 247–253. https://doi.org/10.17221/166/2016-PPS

Hoebeke, E. R., & Carter, M. E. (2003). *Halyomorpha halys* (Stál)(Heteroptera: Pentatomidae): A polyphagous plant pest from Asian newly detected in North America. *Proceedings of the Entomological Society of Washington, 105*(1), 225–237. https://www.biodiversitylibrary.org/page/16195502

Holthouse, M. C., Spears, L. R., & Alston, D. G. (2021). Urban host plant utilisation by the invasive Halyomorpha halys (Stål) (Hemiptera, Pentatomidae) in northern Utah. *NeoBiota, 64*, 87–101. https://doi.org/10.3897/neobiota.64.60050

Horwood, M., Milnes, J. M., & Cooper, W. R. (2019). Brown marmorated stink bug, Halyomorpha halys (Hemiptera: Pentatomidae), detections in Western Sydney, New South Wales, Australia. *Austral Entomology, 58*(4), 857–865. https://doi.org/10.1111/aen.12421

Ion, M., & Raluca, S. (2019). *Halyomorpha halys* Stål (Heteroptera: Pentatomidae): A new pest for the Oltenia area. *Annals of the University of Craiova–Agriculture, Montanology, Cadastre Series, 49*(1), 238–243. https://anale.agro-craiova.ro/index.php/aamc/article/view/946/894

Lara, J. R., Kamiyama, M. T., Hernandez, G., Nay, J., & Hoddle, M. S. (2017). Assessment of feeding acceptance and injury of Kerman pistachios, *Pistacia vera*, by brown marmorated stink bug (Hemiptera: Pentatomidae). *Journal of Insect Science, 17*(5), 106. https://doi.org/10.1093/jisesa/iex084

Lee, D.-H., & Leskey, T. C. (2015). Flight behavior of foraging and overwintering brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Pentatomidae). *Bulletin of Entomological Research, 105*(5), 566–573. https://doi.org/10.1017/s0007485315000462

Lee, D.-H., Short, B. D., Joseph, S. V., Bergh, J. C., & Leskey, T. C. (2013). Review of the biology, ecology, and management of *Halyomorpha halys* (Hemiptera: Pentatomidae) in China, Japan, and the Republic of Korea. *Environmental Entomology, 42*(4), 627–641. https://doi.org/10.1603/en13006

Leskey, T. C., & Nielsen, A. L. (2018). Impact of the invasive brown marmorated stink bug in North America and Europe: History, biology, ecology, and management. *Annual Review of Entomology, 63*, 599–618. https://doi.org/10.1146/annurev-ento-020117-043226

Macavei, L. I., Baetan, R., Oltean, I., Florian, T., Varga, M., Costi, E., & Maistrello, L. (2015). First detection of Halyomorpha halys Stål, a new invasive species with a high potential of damage on agricultural crops in Romania. *Lucrări Ştiinţifice, 58*(1), 2015. https://www.researchgate.net/publication/286263563

Maistrello, L., Dioli, P., Bariselli, M., Mazzoli, G. L., & Giacalone-Forini, I. (2016). Citizen science and early detection of invasive species: phenology of first occurrences of *Halyomorpha halys* in Southern Europe. *Biological Invasions, 18*(11), 3109–3116. https://doi.org/10.1007/s10530-016-1217-z

Martinson, H. M., Venugopal, P. D., Bergmann, E. J., Shrewsbury, P. M., & Raupp, M. J. (2015). Fruit availability influences the seasonal abundance of invasive stink bugs in ornamental tree nurseries. *Journal of Pest Science, 88*(3), 461–468. https://doi.org/10.1007/s10340-015-0677-8

Medal, J., Smith, T., & Santa Cruz, A. (2013). Biology of the brown marmorated stink bug *Halyomorpha halys* (Heteroptera: Pentatomidae) in the laboratory. *Florida Entomologist, 96*(3), 1209–1213. https://doi.org/10.1653/024.096.0370

Milnes, J. M., Wiman, N. G., Talamas, E. J., Brunner, J. F., Hoelmer, K. A., Buffington, M. L., & Beers, E. H. (2016). Discovery of an exotic egg parasitoid of the brown marmorated stink bug, Halyomorpha halys (Stål) in the Pacific Northwest. *Proceedings of the Entomological Society of Washington, 118*(3), 466–470. https://doi.org/10.4289/0013-8797.118.3.466

Morrison, W. R., III, Bryant, A. N., Poling, B., Quinn, N. F., & Leskey, T. C. (2017). Predation of *Halyomorpha halys* (Hemiptera: Pentatomidae) from web-building spiders associated with anthropogenic dwellings. *Journal of Insect Behavior, 30*(1), 70–85. https://doi.org/10.1007/s10905-017-9599-z

Musolin, D. L., Konjević, A., Karpun, N. N., Protsenko, V. Y., Ayba, L. Y., & Saulich, A. K. (2018). Invasive brown marmorated stink bug *Halyomorpha halys* (Stål) (Heteroptera: Pentatomidae) in Russia, Abkhazia, and Serbia: history of invasion, range

expansion, early stages of establishment, and first records of damage to local crops. *Arthropod-Plant Interactions, 12*(4), 517–529. https://doi.org/10.1007/s11829-017-9583-8

Nielsen, A. L., Dively, G., Pote, J. M., Zinati, G., & Mathews, C. (2016). Identifying a potential trap crop for a novel insect pest, Halyomorpha halys (Hemiptera: Pentatomidae), in organic farms. *Environmental Entomology, 45*(2), 472–478. https://doi.org/10.1093/ee/nvw006

Nielsen, A. L., & Hamilton, G. C. (2009). Life history of the invasive species *Halyomorpha halys* (Hemiptera: Pentatomidae) in northeastern United States. *Annals of the Entomological Society of America, 102*(4), 608–616. https://doi.org/10.1603/008.102.0405

Peverieri, G. S., Mitroiu, M. D., Bon, M. C., Balusu, R., Benvenuto, L., Bernardinelli, I., & Talamas, E. J. (2019). Surveys of stink bug egg parasitism in Asia, Europe and North America, morphological taxonomy, and molecular analysis reveal the Holarctic distribution of *Acroclisoides sinicus* (Huang & Liao) (Hymenoptera, Pteromalidae). *Journal of Hymenoptera Research, 74*, 123–151. https://doi.org/10.3897/jhr.74.46701

Quinn, N. F., Talamas, E. J., Acebes-Doria, A. L., Leskey, T. C., & Bergh, J. C. (2019). Vertical sampling in tree canopies for *Halyomorpha halys* (Hemiptera: Pentatomidae) life stages and its egg parasitoid, *Trissolcus japonicus* (Hymenoptera: Scelionidae). *Environmental Entomology, 48*(1), 173–180. https://doi.org/10.1093/ee/nvy180

Rice, K. B., Bergh, C. J., Bergmann, E. J., Biddinger, D. J., Dieckhoff, C., Dively, G., Fraser, H., Gariepy, T., Hamilton, G., Haye, T., Herbert, A., Hoelmer, K., Hooks, C. R., Jones, A., Krawczyk, G., Kuhar, T., Martinson, H., Mitchell, W., Nielsen, A. L., … Tooker, J. F. (2014). Biology, ecology, and management of brown marmorated stink bug (Hemiptera: Pentatomidae). *Journal of Integrated Pest Management, 5*(3), 1–13. https://doi.org/10.1603/IPM14002

Sargent, C., Dively, G., Hooks, C., Raupp, M., Sardanelli, S., Shrewsbury, P., Clement, D., & Malinoski, M. K. (2010). *Exotic pest threats: Brown marmorated stink bug.* University of Maryland Entomology Bulletin. https://apps.frederick.edu/library/vlo/Evalinfo/BMSBBulletin1_10-2010_000.pdf

University of Georgia Center for Invasive Species and Ecosystem Health. (n.d.). *Early Detection and Distribution Mapping System* (EDDMapS). Retrieved November 19, 2019, from https://www.eddmaps.org/

Venugopal, P. D., Martinson, H. M., Bergmann, E. J., Shrewsbury, P. M., & Raupp, M. J. (2015). Edge effects influence the abundance of the invasive *Halyomorpha halys* (Hemiptera: Pentatomidae) in woody plant nurseries. *Environmental Entomology, 44*(3), 474–479. https://doi.org/10.1093/ee/nvv061

Wermelinger, B., Wyniger, D., & Forster, B. (2007). First records of an invasive bug in Europe: *Halyomorpha halys* Stål (Heteroptera: Pentatomidae), a new pest on woody ornamentals and fruit trees? *Mitteilungen der Schweizerischen Entomologischen Gesellschaft, 81*, 1–8. https://www.researchgate.net/publication/228912610

Wiman, N. G., Walton, V. M., Shearer, P. W., Rondon, S. I., & Lee, J. C. (2015). Factors affecting flight capacity of brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Pentatomidae). *Journal of Pest Science, 88*(1), 37–47. https://doi.org/10.1007/s10340-014-0582-6

Yu, G. Y., & Zhang, J. M. (2007, September). *The brown marmorated stink bug,* Halyomorpha halys *(Heteroptera: Pentatomidae) in P. R. China* [Paper presentation]. International Workshop on Biological Control of Invasive Species of Forests, Beijing, China.

Zakharchenko, V., Karpun, N., & Borisov, B. (2020). Trophic connections of the brown marmorated stink bug *Halyomorpha halys* Stål in the conditions of the invasive area on the Black Sea coast of the Caucasus. *BIO Web of Conferences, 21*, 00007. https://doi.org/10.1051/bioconf/20202100007

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