Integrated Pest Management
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Spindle Worms in Elderberry Shoots

by Michele Warmund

Spindle worms, commonly known as the larval stage of the elder shoot borer (*Achatodes zeae*), will soon be apparent on elderberry plants in Missouri. They will be most noticeable as theyfeed on the tissue inside young elderberry shoots (about six to ten inches-long), causing these stems to bend over and wilt. Because of this feeding damage, these stems fail to flower and produce fruit.

Figure 1: The larval stage of the elder shoot borer (Achatodes zeae) inside a young elderberry shoot. Note the entry hole at the top left side of the plant tissue

The adult stage of the elder shoot borer is a moth that lays eggs in masses in canes at least one year-old usually in July and August. Eggs hatch the following spring. Larvae feed first within the unfolding leaves, with the damage often inconspicuous at this time. However, as the small larva bores into new shoots, a hole in the tissue is visible. When such a stem is dissected, a spindle worm is clearly visible. These larvae have a yellowish-white segmented body with shiny black spots and the head, thoracic and anal shields are also black (Figure 1). Spindle worms feed inside the stems, growing to about 1.5 inches-long at maturity. When larvae are fully grown in early summer, they leave the shoots and tunnel into dead canes to pupate, leaving small piles of frass (sawdust) on the ground at the base of the old wood.

To control *Achatodes zeae*, prune out infested green shoots or mature canes that have holes in them during the growing season. In winter, remove dead canes to reduce pupation. Always remove prunings from the area or burn them.

A different pest, *Desmocerus palliatus*, known as the elder borer beetle, also damages elderberry plants. These plain white grubs larvae bore into pencil-sized or older canes, where they feed. Damaged canes wilt, die, and remain on the plants as dangling, necrotic tissue. Adults are iridescent blue with prominent yellow markings and are classified as long-horned beetles (see http://bugguide.net/node/view/14265). Beetles are present during elderberry flowering, where they eat pollen and leaves, and then lay their eggs on leaves or canes near the ground. To control this pest, prune out infested elderberry canes and burn or remove them from the planting.

In This Issue

Beet: Vegetable with an Image Problem

by David Trinklein

Very few vegetables elicit less excitement from the average gardener than beet. No one boasts about having fresh beets from the garden by the fourth of July, or the magnitude of the beet crop this year. In short, beet suffers from an image problem. Once relegated to pickling or making borsht, beet's newfound health claims are causing American's to view it with a greater deal of respect, even if they most still do not like its taste.

Garden beet (*Beta vulgaris*) is a member of the Amaranthaceae family, subfamily Betoideae. It is thought to have originated from a wild species known as sea beet (*Beta maritima*) which is native to coastal regions of the Mediterranean Sea. Its common name is derived from the Old English *bête* which, in turn, was thought to be derived from the Latin *beta*.

Beets have been consumed by humans for over 5000 years. The first beets produced long, thin roots. Therefore, it most likely was the leaves of beets that were harvested and used as a pot herb. This tradition continued for centuries until the Romans began using the roots for their medicinal value, primarily to relieve fevers and cure constipation.

It was not until the second or third century A.D. that cooking and eating the beetroots was described in the literature. Presumably this referred to a fleshy root and not the long, fibrous root described above.

Fast-forward to 14th century Europe, where history suggests beetroot was first consumed in England. At that time, beet had roots shaped more like a carrot or parsnip, opposed to the sphere-like root of today's modern beet. The latter probably first appeared in 16th or 17th century Europe, but still needed several hundred years before it became a popular food source.

Beet was introduced to the United States by early colonists. History records that George Washington grew beets at Mount Vernon and Tomas Jefferson planted them at Monticello. By the 19th century, seed catalogs featured four different variety of beets. Today Burpee Seed catalog lists 17 different varieties available in colors including red, yellow, white and concentric or "candy striped".

During the eighteenth century, a German scientist discovered that beets contain sugar indistinguishable from that produced by sugar cane. The discovered was significant, since few "commoners" in Europe at that time could afford sugar from tropical sugar cane. Subsequent work to improve the sucrose content of beet led to the establishment of the sugarbeet industry. First grown in the U.S. in 1890, today sugarbeets account for a bit over 50 percent of the eight million metric tons of sugar produced annually in our country.

The earthy taste of beets which causes people to either love them or loathe them is due to a compound called geosmin. The human nose is very sensitive to geosmin and is able to detect it as the astonishingly low concentration of only five parts per trillion. Interestingly, geosmin is the same compound that causes certain fish such as carp to have an earthy or "muddy" flavor.

Beets have long enjoyed notoriety as a health food. It is now known this is because of phytonutrients they contain called betalains. The latter are plant pigments that have anti-oxidant, anti-inflammatory and general detoxification properties in humans. Unfortunately, the betalain content of beets undergoes steady decline as cooking time increases.

More recent is the discovery of the healthful effects of dietary nitrates (NO3) contained by beets. In the human body, dietary nitrates ultimately are converted to nitric oxide (NO) which relaxes and dilates blood vessels. The result is a significant decrease is systolic blood pressure that can be achieved by drinking beetroot juice. Whether it is grown for it vitamin-rich leaves or "earthy-tasting" storage root, beet is a home garden vegetable that is fairly easy to grow. It is a cool-season crop that prefers full sun and well-drained soil. Beets tolerate average-to-low fertility quite well. In fact, too much nitrogen will encourage top growth at the expense of root development.

Beets are frost-tolerant and should be planted early in spring so their primary growth occurs during cooler weather. After establishing a good seed bed, plant beet seeds ¾ inch deep and one inch apart in rows separated by 12 to 18 inches. Each beet "seed" actually is an entire ripened ovary that contains several seeds, so they should be thinned after they emerge from the soil to reduce competition.

Botanically, beet is a biennial. It produces an enlarged storage root during its first season of growth, and flowers and sets seeds during it second. If beets experience long durations (e.g., three weeks) of temperatures less than 45 degrees F., a flower stalk may develop the first year. If this happens the flower stalk should be removed.

Beets can be harvested as soon as they are large enough to eat which is when they reach an inch or more in diameter. Since the best flavor and root color develop under conditions of bright light along with cooler temperatures, "new" beets usually are more flavorful than those allowed to grow to full maturity. Beets that mature during warm weather have less sugar and poorer color.

Beet greens can be harvested sparingly during the growing season and consumed fresh or cooked. Remove only a few older, fully-matured leaves from each plant to allow the remaining leaves to continue to manufacture food and enlarge the beetroot.

Like most root crops, beets store well. Remove the tops and only store roots free of diseases or mechanical injury. At temperatures just above freezing and relative humidity in the range of 95 to 100 percent, beets can be stored for up to six months.

One cup of sliced, cooked beets contains only 75 calories. Beets are high in dietary fiber and are an excellent source of folate along with vitamins A and K. Additionally they contain significant amounts of manganese, copper, and potassium.

Beet Trivia:

- In ancient Rome, beets were considered to be an aphrodisiac. In many cultures still today, it is believed that if a man and woman eat from the same beet, they will fall in love.
- Beet juice has been used as a natural dye since the 15th century. In Victoria-era England, women used it to dye their hair. Today it is used to improve the color and flavor of such foods as catsup and tomato sauce.
- Research conducted in Great Britain revealed that cyclists who drank a pint of beet juice before embarking on a bicycle trip could petal 20 percent longer than those who drank a placebo.
- The water in which beets are cooked is said to be a natural remedy for dandruff.
- In Australia, hamburgers served at fast-food restaurants include a slice of beetroot, along with more traditional condiments.
- The world's largest beet was produced in the Netherlands and weighed in at 156 pounds.

Monitoring and Integrated Pest Management of the invasive Brown Marmorated Stink Bug in fruits and vegetables

by Jaime Pinero

The invasive Brown Marmorated Stink Bug (BMSB), *Halyomorpha halys*, [picture on the side- please cite source] is currently distributed in 43 US states and 4 Canadian provinces. It is a severe agricultural pest in 9 states (largely in the Mid-Atlantic) and a nuisance problem in 21 others.

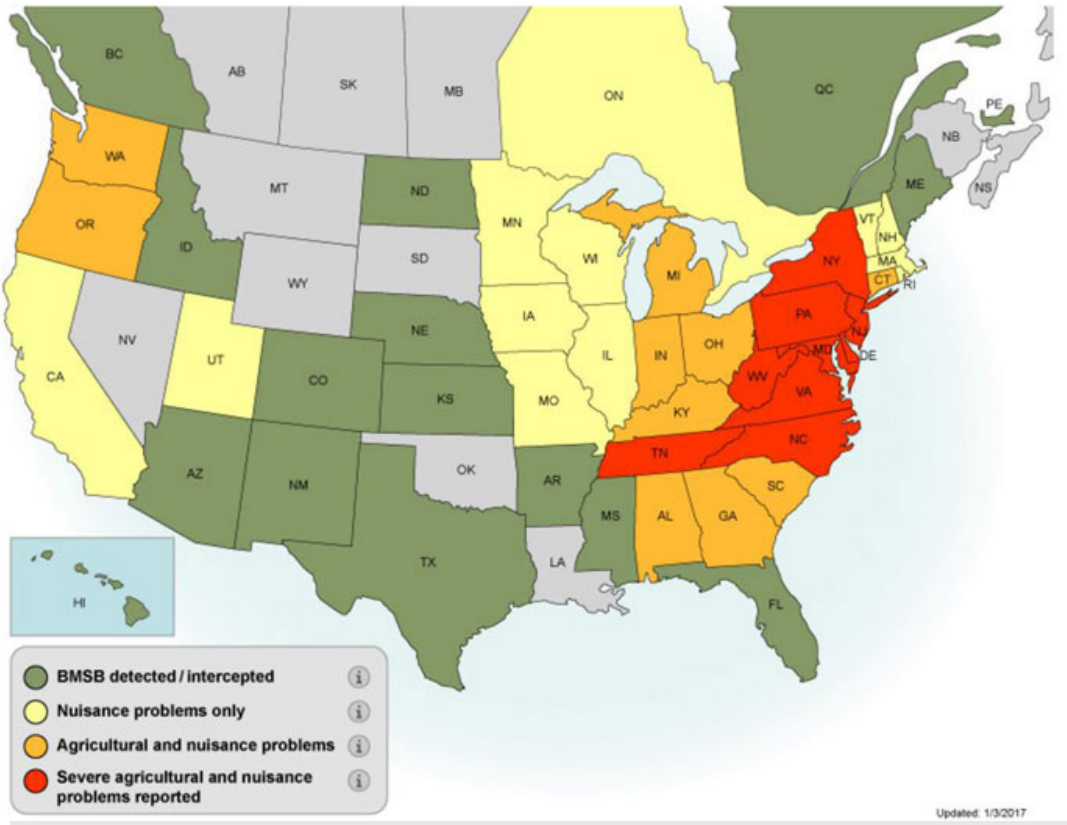
BMSB is considered to be a landscape-level threat. This means that adults frequently switch between cropped land (agronomic crops, fruits, vegetables, ornamentals) and wooded habitats. This article provides an update on monitoring and management of BMSB in specialty crops. Information provided here is summarized. The STOP Brown Marmorated Stink Bug website (http://www.stopbmsb.org) has been setup to provide current and relevant information on this pest.

BMSB has been reported to be in Missouri since 2013. While BMSB does not seem to have reached damaging populations yet, numbers have been increasing year by year as a result of breeding populations reported in Ferguson / St. Louis area in 2015, and the continued risk posed by dissemination via hitchhiking on vehicles. Therefore, farmers of specialty crops are encouraged to monitor for this invasive pest, especially if you live in St. Louis, Springfield, and Kansas City areas.

Credit: Steven Valley, Oregon Department of Agriculture, Bugwood.org

Where does BMSB spend the winter?

During the winter months BMSB enters a type of hibernation called diapause. During this time they do not feed and do not reproduce. Overwintering takes place in forested areas as well as inside houses and other buildings. In the spring, BMSB adults emerge from overwintering sites (houses, barns, storage buildings, and dead trees) and become active on nearby crops during warm sunny days. In the spring and throughout the summer, adults feed, mate, and lay eggs.

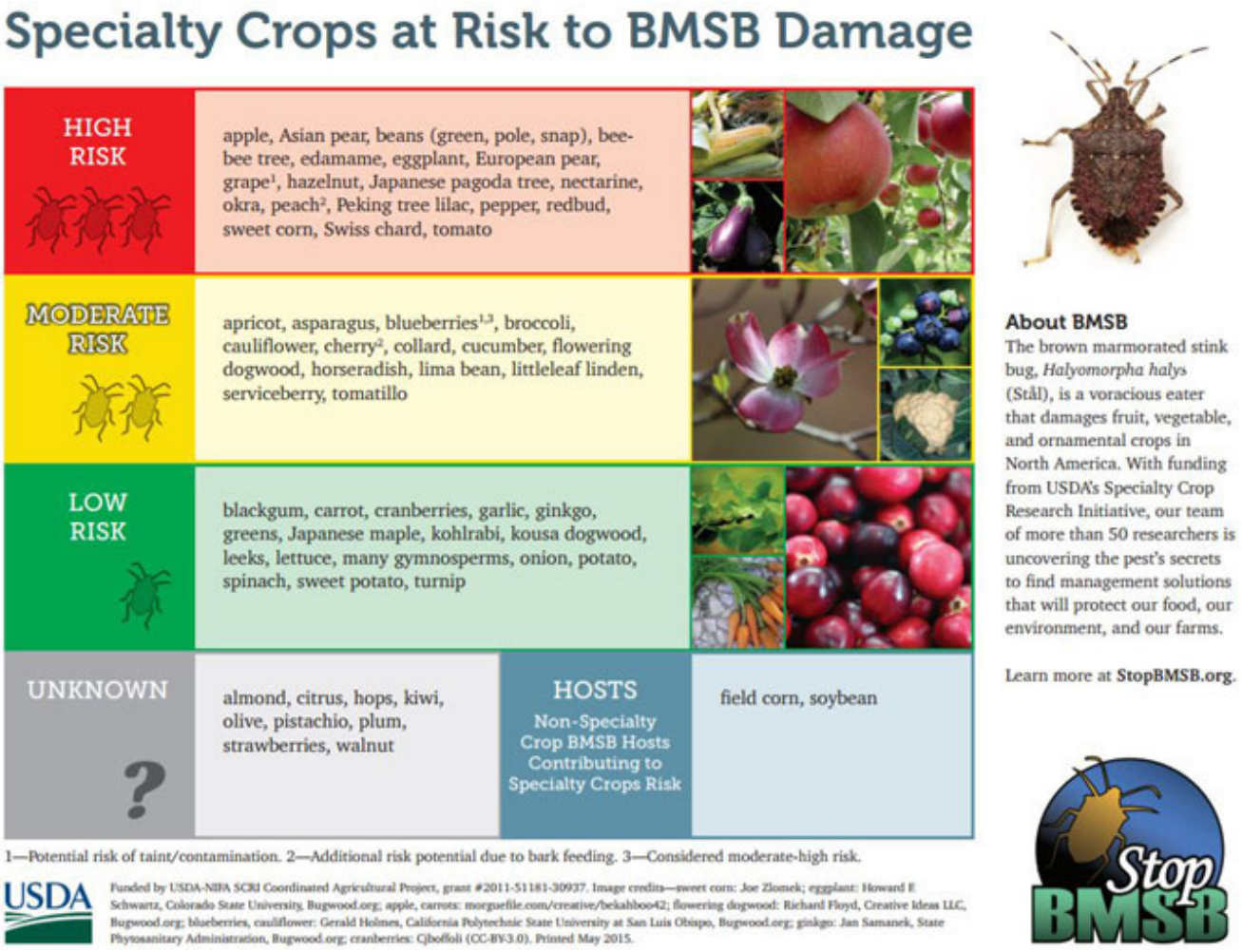


Distribution of the Brown Marmorated Stink Bug in the USA as of 1.3.2017
Credit: http://www.stopbmsb.org/where-is-bmsb/state-by-state/

(continued on pg. 5)

Agricultural crops being attacked by BMSB

Both adults and nymphs (immature stages) are known to cause feeding damage to crops. BMSM has a wide host range of over 300 plants. BMSB nymphs and adults feed by inserting their piercing-sucking mouthparts into fruit, nuts, seed pods, buds, leaves, and stems and appear to prefer plants bearing reproductive structures. Their mouthparts can penetrate very hard and thick tissue, such as the hazelnut hull. Feeding damage has been recorded in high value specialty crops including tree fruit (apples, peaches, pears), small fruit (e.g., raspberries, blackberries), vegetables such as tomatoes, sweet peppers, sweet corn, as well as agronomic crops such as soybeans (Fig. 2). In one study, researchers in the Mid-Atlantic reported that sweet corn, okra, and bell pepper had significant higher abundances of BMSB adults and nymphs compared with green bean, eggplant, and tomato.



Specialty crops at risk to BMSB damage
Credit: http://www.stopbmsb.org/where-is-bmsb/crops-at-risk/

Integrated Pest Management of BMSB

IPM recommendations for BMSB in specialty crops such as orchard fruit, small fruit, and vegetables have been developed by researchers across the country. Summaries of specific options that have been developed as of August, 2016, for grapes, orchard crops, and vegetables, are available at: http://www.stopbmsb.org/managing-bmsb/management-by-crop

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I. ECONOMIC THRESHOLDS.

An economic threshold is basically the density of the pest triggering a control method, usually insecticides. If left untreated, economic losses due to pest damage may occur.

In specialty crops such as apples, researchers in West Virginia and Maryland have just developed a provisional threshold of 10 BMSB accumulated in one pheromone-baited trap located within the orchard or at the orchard border. Once this threshold is reached two alternate-row-middle sprays with 7 days between reduced the number of BMSB-targeted sprays while maintaining good control.

FREE BMSB Identification Kits!

Researchers collaborating in the StopBMSB.org project have made identification kits available at no cost.

The kit includes one BMSB specimen in a bottle, stink bug ID guide, among other materials.

Click http://www.stopbmsb.org/about-us/contact-us/bmsb-kits/ to request your BMSB ID kit

Pest identification is key to IPM

II. MONITORING

Commercially available traps and pheromone lures for BMSB monitoring provide valuable information on presence/absence of BMSB and also help to decide if insecticide treatments are needed to manage this pest. Ag-Bio, Inc. (http://www.agbio-inc.com), Great Lakes IPM (http://www.greatlakesipm.com), Trece, Inc. (http://www.trece.com) and Sterling International are some of the companies that sell monitoring systems for BMSB.

Black pyramid traps. Stink bugs, including BMSB, are visually attracted to tree silhouettes. The trap recommended for monitoring is a black pyramidal trap, which represents trunk mimic, coupled with a capturing device. Researchers are trying to assess whether yellow sticky cards, which are easier to deploy, can be used for monitoring purposes.

Black pyramid trap

Pheromone lures: Various companies are now marketing the male-produced aggregation pheromone of BMSB. Research has shown than when this pheromone lure is combined with another lure termed 'MDT lure' which is also commercially available, the result is increased response by BMSB adults and nymphs, thereby increasing the efficacy of monitoring traps.

The pheromone lure that is being used in Missouri is called "Stink Bug Xtra Combo - Broad Spectrum 5-7 week lure". It has been reported to attract multiple stink bug species such as Brown, BMSB, Conchuela, Consperse, Dusky, Green (*Acrosternum*), Harlequin, and Red Shouldered stink bugs. Therefore, efforts need to me made to correctly distinguish BMSB from other similarly-looking stink bugs.

When should I start monitoring for BMSB? Learning about the life cycle of insect pests is important to design effective IPM tools and strategies, including timing of monitoring. BMSB spend the winter as adults. After emerging from overwintering sites in May and June, BMSB adults begin mating and laying eggs on various host plants. Monitoring for BMSB can start in late-May, and needs to continue until early- or mid-October.

III. CHEMICAL CONTROL

Insecticide sprays is the most effective control method for BMSB. It is important to select effective insecticides given that adult BMSB are hard to kill. Whenever possible, target the nymph stage, as nymphs are more sensitive to insecticides than adults. While insecticide recommendations vary according to availability on different crops, Actara, Brigade, Danitol, Mustang Maxx, and Lannate have shown good efficacy in trials; however, multiple applications may be needed with reinfestation. Specific insecticide recommendations can be found in the production guide for the various types of crops:

Tree-fruit and small fruit

Midwest Fruit Pest Management Guide 2017: https://ag.purdue.edu/hla/Hort/Documents/ID-465.pdfÂ

Vegetables

Midwest Vegetable Production Guide for Commercial Growers 2017: https://ag.purdue.edu/btny/midwest-vegetable-guide/Pages/default.aspx

ALWAYS follow label instructions and safety procedures, and check to make sure the chemical you are using is registered for use in your crop.

Notes on insecticide application:

- The overwintering generation of BMSB tends to be more susceptible to insecticides than the summer generation. Therefore, products with the best effectiveness against this pest should be used later in the season
- Insecticides should be rotated among products in different classes with different modes of action to delay the onset of resistance to pesticides.

IV. CULTURAL CONTROL

The goal of cultural control is to make the crop environment less suitable for insect pests or to manipulate the environment in such a way that insects are less likely to arrive on the cash crop. Most of the time, cultural control is used as a preventative measure. Research is being conducted in this area and no promising tactics have been identified, except for trap cropping.

Trap cropping is a behaviorally-based IPM method involving planting very attractive plants next to a higher value crop so as to congregate the pest in trap crops where they can be easily attacked by natural enemies and/or killed by insecticides. Recent research with BMSB has shown that a trap crop mixture composed of sorghum and sunflower may be an effective management tool for BMSB. For organic systems, given the lack of effectiveness of most organic (OMRI-listed) insecticides, then flaming and vacuuming can be used to kill the arriving pests. To access a webinar on organic management options for BMSB including trap cropping click here: http://articles.extension.org/pages/67200/brown-marmorated-stink-bugs:-invasion-biology-monitoring-and-management-webinar.

Funding for outreach on Brown Marmorated Stink Bug and monitoring efforts in Missouri was provided by the USDA/ National Institute of Food and Agriculture (NIFA) through the Extension Implementation Program, Award No. 2014-70006-22571 to the Missouri IPM program (University of Missouri & Lincoln University).

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Trap cropping: A simple, effective, and affordable Integrated Pest Management strategy to control squash bugs and squash vine borers

by Jaime Pinero

Relevance of squash vine borer and squash bugs as pests of cucurbit crops

The squash vine borer, *Melittia cucurbitae* - a clear wing moth, and the squash bug, *Anasa tristis* - a true bug, are two significant pests of cucurbit crops. These two insect pests can cause serious economic losses to cucurbit farmers if populations are left uncontrolled. Commercial vegetable farmers and gardeners often find themselves scratching their heads to find effective ways of controlling them. Insecticides can be an effective control option; however, harvest interruption due to pre-harvest intervals, and the potential impact on beneficial/pollinator species must be considered. Many of these insecticides will also be "restricted-use", requiring private pesticide applicator training and licensing. This article discusses trap cropping as an Integrated Pest Management (IPM) strategy to control squash bugs and squash vine borer with little or no insecticides applied to the cash crop.

Squash vine borer: The adult squash borer may be mistaken for a wasp. The front wings are a metallic green and the rear wings are transparent with black or brown margins and veins. The body is orange and black. The adult moths are active during the day, so they can be spotted relatively easily. Soon after emerging from cocoons in the ground around June (in mid-Missouri), squash vine borers lay eggs singly at the base of susceptible plants. Approximately one week after they are laid, the eggs hatch and the resulting borers, which are a type of caterpillar, drill into stems to feed. At this moment the plant is destined to die. The larvae feed through the center of the stems, blocking the flow of water to the rest of the plant. The larvae feed for four to six weeks, then exit the stems and burrow about one to two inches into the soil to pupate. They remain there until the following summer. There is one generation per year.

Adult squash vine borer, base of squash plant showing infestation by the borer (a type of caterpillar), and view of a fully-grown caterpillar.

Squash bug: Adults overwinter in sheltered places. In spring (around late May and June in mid-Missouri) they mate and lay small masses of shiny, oval, copper-colored eggs beneath leaves. Hatchlings are pale green. They grow and molt through various immature stages (nymphs). Older nymphs are gray with dark wing buds. Often a mixture of stages congregates together on the same plant. Upon the final molt, they emerge as winged, sexually mature adults. There are at least two broods per year.

View of squash bug adult, eggs, and nymphs at various stages of development.

What is trap cropping?

Just like most animals do, insects have a preference for certain types of foods. Given a choice, insects will likely select their preferred food. If no option is given, they will be happy feeding on the type of plants that are available. Trap cropping means using very attractive plants growing in the perimeter of the garden or cucurbit

field. These attractive plants pull the pest away from the cash crop. Insects congregated on trap crop plants can be more easily killed with insecticides or by other means. Research conducted by the Lincoln University (LU) IPM program since 2011 indicates that Blue Hubbard squash is very attractive to squash bugs and to squash vine borer, and therefore it is an excellent trap crop plant. In addition, Blue Hubbard squash is also very attractive to spotted and striped cucumber beetles, so farmers and gardeners can actually control four insect pests using Blue Hubbard as a trap crop.

Benefits of trap cropping

By using trap cropping, farmers can reduce inputs (fuel, labor, time, and insecticides) resulting in increased income while protecting pollinators and other beneficial insects. As an example, one producer from St. Peters has not sprayed any insecticides to his cucurbit cash crop since 2011. He only applies a small amount of insecticide to the Blue Hubbard seedlings shortly before transplanting them to the corners of his fields. He currently sells his cucurbit produce as insecticide-free.

Implementing trap cropping in gardens and small farms

With some planning, using trap crop plants can be easy and inexpensive. Blue Hubbard squash can also be used as a monitoring tool. For example, start growing Blue Hubbard squash transplants in mid- or late-April, and set one tray with Blue Hubbard squash seedlings out in the field. As soon as squash bugs (and/or cucumber beetles) are seen, then it will be time to transplant the trap crop plants to the field. The key is to transplant 2- week old Blue Hubbard seedlings (trap crop plants) to the field at the same time you sow the seeds of your cucurbit cash crop. If you grow your cash crop from transplants, then you will need to transplant the Blue Hubbard seedlings at least 2 weeks before your cash crop. The bottom line is that, to be most effective, Blue Hubbard squash plants need to be bigger than cash crop plants.

A second piece of advice is to kill the insect pests on the trap crop plants. Remember, having 1-2 squash bugs on your cash crop doesn't mean that you need to spray. Our research has demonstrated that for a small garden of 100 or so cucurbit plants, you can be successful at controlling squash bugs (and cucumber beetles) using 6-8 Blue Hubbard squash plants. The trap crop plants can be planted at the corners, at some distance (3-8 ft.) from the cash crop.

On a commercial farm, for cucurbits grown using plastic mulch and drip irrigation then we recommend you transplant 2-4 Blue Hubbard squash seedlings to both ends of each row.

View of two-week old Blue Hubbard squash seedlings ready to be transplanted to the field

For the IPM studies, 4 Blue Hubbard squash seedlings transplanted to the ends of each row at the same time as sowing the seeds of the cash crop have produced excellent results

Field view of Blue Hubbard squash plants (larger plants inside red box) used as trap crops planted at both ends of each row (Lincoln University George Washington Carver farm)

Blue Hubbard squash can also be grown in large pots. Some farmers have implemented trap cropping outside high tunnels to protect cucumbers by placing potted Blue Hubbard plants treated with a systemic insecticide early in the season, with good results. If temperatures at night are expecting to drop potentially injuring the Blue Hubbard squash seedlings, then pots can be moved indoors.

Removing / killing insect pests congregating on trap crop plants

Insect pests (e.g., squash bugs) congregating on trap crop plants need to be eliminated. Otherwise, they are likely to reproduce on those plants, and then they can move to the cash crop. Not killing the squash vine borer means that the trap crop plants will succumb. Therefore, for both squash bug and squash vine borer control insecticides applied to the Blue Hubbard squash are recommended. Whether using organic or synthetic insecticides, make sure to apply them thoroughly, especially near the base of trap crop plants.

View of squash bugs and cucumber beetles killed by a systemic insecticide applied to the roots of Blue Hubbard squash (trap crop).

Synthetic insecticides: Foliar applications of insecticides listed in the Midwest Vegetable Production Guide for Commercial Growers for use in cucurbit crops will result in effective control of squash bugs and squash vine borer. Some producers have opted for using small amounts of systemic insecticides (examples of trade names: Admire Pro®, Alias 2F®) applied to the trap crop plants only. When applied to the roots, systemic insecticides are absorbed by plant tissue, producing plants that will be toxic to insects that feed on them. Imidacloprid-treated plants will continue to kill insect pests for about 3-4 weeks, depending on weather conditions.

Organic insecticides: Pyrethrins-containing insecticides such as AZERA® and Pyganic® represent good options to kill cucurbit pests. Because squash bugs are hard to kill, then use the high label rate if you are targeting the adult stage. If sprays are targeting the nymphs (immature stages), then a low or medium application rate will be effective. Timing of application is important particularly in the case of the squash vine borer, as again, once the caterpillar hatch from eggs and bores into the stem, no control method will be effective.

During bloom, sprays should be made early in the morning or later in the evening to reduce the effect of insecticides on honeybees or other pollinators. ALWAYS follow label instructions and safety procedures, and check to make sure the chemical you are using is registered for use in your crop. Mention of trade names or commercial products does not constitute endorsement or recommendation for use. If you are an organic certified producer make sure that the substance, including its brand name and formulation, is listed in your organic system plan, reviewed, and approved by your USDA-accredited certification agency.

Evaluating the success of trap cropping

Factors influencing the efficacy of trap cropping include (1) having Blue Hubbard squash under water / nutrient stress, (2) having cash crop plants bigger in size than the trap crop plants, and (3) not removing the pest from trap crop plants. Provide the Blue Hubbard squash with enough water and nutrients - in the same way you manage the cash crop.

One way to determine the success of trap cropping is by scouting both the trap crops and the cash crop at least once a week. For squash bugs, apply insecticide to the cash crop if cash crop plants are in the seedling stage, squash bugs are present, and some wilting is observed. At the early flowering stage, cash crop plants can tolerate an average of 1 egg mass per plant.

As a result of research and outreach conducted since 2011, some Missouri farmers that have increased production of high-quality vegetable crops using more sustainable IPM methods such as trap cropping. This has led, for some producers, to increased profits and less negative impact on pollinators and other beneficial insects while decreasing pesticide use, labor and other farm inputs.

View of a zucchini field protected by Blue Hubbard squash (larger plants at the end of rows). Buckwheat (blooming plants on the left) was planted to enhance crop pollination and to bring beneficial insects. Trap cropping allows for the use of pollinator/ insectary plants because less or no insecticides are sprayed to the cash crop.

Funding for trap cropping research was provided by the Ceres Trust: An Organic Initiative (http://cerestrust.org/), and by the USDA/National Institute of Food and Agriculture (NIFA) Capacity Building Award No. 2011-38821-30867. Funding for mass trapping research was provided by the North Central Region IPM Center through Sub-Award # 2007-04967-35 and by the USDA/NIFA Capacity Building Grant program, Award No. 2011-38821-30867.

Considerations for successful implementation of trap cropping: (1) Grow Blue Hubbard squash seedlings before the cash crop. Transplant 2-week old Blue Hubbard squash plants to the field at the same time you sow the seeds of the cash crop, or 2 weeks before you transplant your cash crop.(2) Insect pests congregating on trap crop plants need to be removed. To control squash bugs and squash vine borer, insecticide applications to the trap crop plants are recommended.

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APRIL GARDENING CALENDAR

Category	Week				Activity
	1	2	3	4	
Ornamentals	x	x	x	x	Study your landscape for gaps that could be nicely filled with bulbs. Mark these spots carefully and make a note to order bulbs next August.
	x	x	x	x	Enjoy, but do not disturb the many wildflowers blooming in woodlands throughout Missouri.
	x	x	x	x	When buying bedding plants, choose compact, bushy plants that have not begun to flower.
	x	x	x		When crabapples are in bloom, hardy annuals may be transplanted outdoors.
	x	x	x		Fertilize established roses once new growth is 2 inches long. Use a balanced formulation. Begin spraying to control black spot disease.
	x	x			Examine shrubs for winter injury. Prune all dead and weakened wood.
	x				Groundcovers can be mowed to remove winter burn and tidy plants up. Raise mowers to their highest settings. Fertilize and water to encourage rapid regrowth.
	x				Shrubs and trees best planted or transplanted in spring, rather than fall, include butterfly bush, dogwood, rose of Sharon, black gum (Nyssa), vitex, red bud, magnolia, tulip poplar, birch, ginkgo, hawthorn and most oaks.
	x				Winter mulches should be removed from roses. Complete pruning promptly. Remove only dead wood from climbers at this time. Cultivate lightly, working in some compost or other organic matter.
		x	x	x	Look for flowering dogwoods in bloom.
		x	x	x	Break off rims from peat pots when transplanting seedlings, otherwise they can act as a wick to draw moisture away from the roots.
		x	x		Transplant Virginia bluebells (Mertensia virginica) after bloom, but before the foliage disappears.
			x	x	Do not prune boxwoods before April 15.
			x	x	Evergreen and deciduous hedges may be sheared. Prune the top narrower than the base so sunlight will reach the lower limbs.
			x	x	Oaks and hickories bloom.
			x	x	If soil conditions allow, take a chance sowing peas, lettuce, spinach and radish. If the weather
			x	x	Easter lilies past blooming can be planted outdoors. Set the bulbs 2 to 3 inches deeper than they grew in the pot. Mulch well if frost occurs.
			x	x	Apply controls for holly leaf miner when the new leaves are just beginning to grow.
			x	x	Balloon flower (Platycodon), hardy hibiscus, gasplant (Dictamnus albus) and some lilies are slow starters in the spring garden. Cultivate carefully to avoid injury to these tardy growers.
				x	Prune spring flowering ornamentals after they finish blooming.
				x	Begin planting out summer bulbs such as caladiums, gladioli and acidanthera at 2 week intervals.
Lawns	x	x	x	x	Start mowing cool season grasses at recommended heights. For complete details, refer to University Extension Guide #6705, Cool Season Grasses.
	x	x			Topdress low spots and finish overseeding thin or bare patches.
	x	x			Aerate turf if thatch is heavy or if soil is compacted.
	x	x			Apply crabgrass preventers before April 15. Do not apply to areas that will be seeded.
Vegetables	x	x	x		Finish transplanting broccoli, Brussels sprouts, cabbage, and cauliflower plants into the garden. High phosphorous fertilizers help get transplants off to a quick start.
	x	x			Plants started indoors should be hardened off outdoors in cold frames before being transplanted into the garden.
	x	x			Start cucumber, cantaloupe, summer squash, and watermelon seeds indoors in peat pots.
	x	x			Finish sowing seeds of all cool-season vegetables not yet planted.

*Gardening Calendar supplied by the staff of the William T. Kemper Center for Home Gardening located at the Missouri Botanical Garden in St. Louis, Missouri. (**www.GardeningHelp.org**)*

APRIL GARDENING CALENDAR

Category	Week				Activity
	1	2	3	4	
	x	x			Plastic films can be used to preheat the soil where warm season vegetables are to be grown.
	x	x			Asparagus and rhubarb harvests begin.
		x	x	x	Handpick and destroy asparagus beetles.
		x	x	x	Keep your hoe sharp! Don't allow weeds to get an early start in your garden.
		x	x	x	Flower stalks should be removed from rhubarb plants, if they develop.
		x	x	x	Try an early sowing of warm-season crops such as green beans, summer squash, sweet corn, New Zealand spinach and cucumbers.
		x	x		Thin out crowded seedlings from early plantings of cool season crops such as beets, carrots, lettuce, onions and radish.
		x	x		Sow seeds of luffa and hard-shell gourds indoors in peat pots. Soak seeds overnight before planting.
		x	x		Make succession sowings of cool-season crops.
			x	x	Begin planting lima beans, cucumbers, melons, okra and watermelons.
			x	x	Begin setting out transplants of tomatoes, eggplants, peppers and sweet potatoes.
Fruits	x	x	x	x	Blemish-free fruits unmarred by insect or disease injury can rarely be produced without relying on regular applications of insecticides and fungicides For special information, consult University Extension Guide Sheet #G6010, Home Fruit Spray Schedule.
	x	x			Wooden clothespins make useful spreaders for training young fruits limbs. Place pins between the trunk and branch to force limbs outward at a 60 degree angle from the trunk.
	x	x			A white interior latex paint may be brushed on the trunks of newly planted fruit trees to prevent sunburn. This will gradually weather off in time.
	x	x			Stink bugs and tarnished plant bugs become active on peaches.
	x	x			Leaf rollers are active on apple trees. Control as needed.
	x	x			Prune peaches and nectarines now.
	x				Plant bare-root or potted fruit trees as soon as the soil can be worked.
	x				Remove tree wraps from fruit trees now.
		x	x	x	Protect bees and other pollinating insects. Do not spray insecticides on fruit trees that are blooming.
		x			Destroy or prune off webs of eastern tent caterpillars. "B.t." (Dipel) is a safe biological spray.
			x	x	Orange, jelly-like galls on cedar trees spread rust diseases to apples, crabapples and hawthorns.
			x	x	Begin sprays for fire-blight susceptible apples and pears using an agricultural streptomycin.
				x	Spider mites and codling moths become active on apples.
Miscellaneous	x	x			Termites begin swarming. Termites can be distinguished from ants by their thick waists and straight antennae. Ants have slender waists and elbowed antennae.
	x	x			Look for morel mushrooms when lilacs bloom and the forest floor turns green.
	x				Mount a rain gauge on a post near the garden to keep track of precipitation so you can tell when to water. Most gardens need about 1 inch of rain per week between April and September.
		x	x	x	Mole young are born in chambers deep underground.
			x	x	Honeybees are swarming. Notify a local beekeeper to find a new home for these beneficial insects.
				x	Soaker hoses and drip irrigation systems help you save water and money.
				x	Hummingbirds return from their winter home in Central America.
				x	Wasp and hornet queens begin nesting.

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