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Mass Trapping as an Organic Management Option for the Japanese Beetle on Farms

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Introduction

The invasive Japanese beetle, Popillia japonica, possesses a pest management challenge for crop farmers, in particular organic producers. Considering that organic options for the management of this pest are limited, developing a mass trapping system to control this pest is a relatively new approach. At first, traps baited with the Japanese beetle sex pheromone were created for the purpose of monitoring. In this article we present results from research conducted from 2012 to 2017 by the Lincoln University Integrated Pest Management (IPM) program, which aimed at developing a mass trapping system that could provide effective Japanese beetle control in agricultural areas with less or no insecticides applied to the crop. Both organic and non-organic farmers may find this information useful. We also provide detailed instructions on how to develop traps and how to get the lures.

Seasonal Activity of Japanese Beetles.

In mid-Missouri, significant numbers of Japanese beetles begin emerging in mid to late June, the population usually peaks the second week of July, and declines by early August. The timing of the onset and end of Japanese beetle adult activity may vary by a couple weeks depending on weather. For instance, if warm, humid conditions occur—they will emerge earlier. If it's cold and rainy, they may not become active until late June.

Peach fruit covered with Japanese beetles. Photo by Sarah Williams.

Daily feeding behavior is also subject to weather. If you are checking your plants, you might not see any beetles on a cold, rainy day – but don't assume your pest problems are over! Thousands of Japanese beetles may burst from the ground on the very next day if it's warm and sunny. Feeding damage to crop plants can happen within 48 hours. Your pest management strategy should be "proactive"—not "reactive." Too often, growers wait until they see catastrophic damage before acting.

Feeding frenzy

Feeding on plant tissue by adult Japanese beetles causes the release of plant volatiles from the damaged sites, and of additional pheromones from females. This results in aggregations of beetles, triggering a feeding frenzy. If you are able prevent beetle aggregations by dislodging or killing the first arrivers, you may be able to limit the damage. Conversely, if a feeding frenzy starts, it will be difficult to remove the beetles unless insecticides are applied.

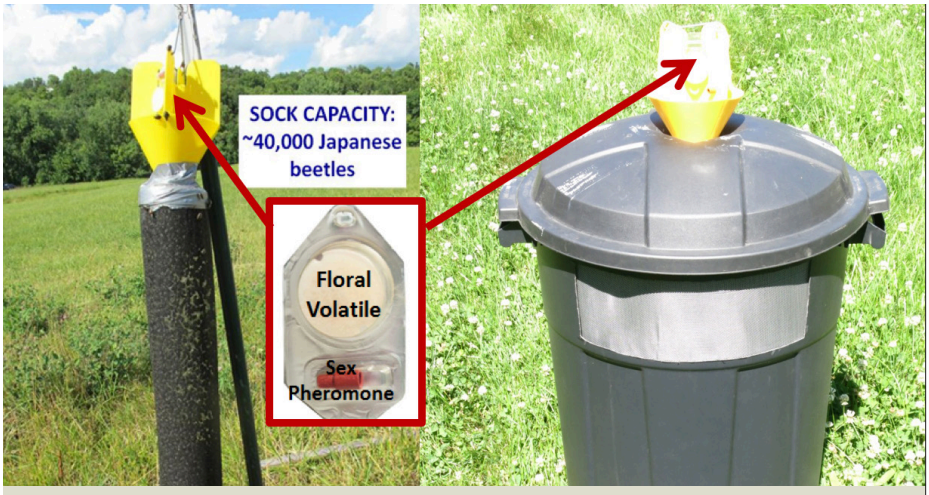
What is Mass Trapping?

Mass trapping is a behaviorally-based method of reducing pest numbers by luring them in large numbers to a trap or device that contains an attractant (usually a food component or a pheromone, in some cases in combination with attractive colors) and then killing the pests either, with a toxicant or a mechanism that prevents them from leaving the traps. For Japanese beetles, the two main trap designs that have been evaluated are presented below.

The Mass Trapping Systems Developed for Japanese Beetle Control.

For research purposes, a mass trapping design that consisted of an aluminum mesh sock 4 feet long by one foot in diameter was evaluated in most years. Velcro was used to secure the sock to the yellow funnel with duct tape for added strength. Seams were stapled. Research conducted during 2015 and 2016 compared the effectiveness of 32 gallon capacity black plastic bins that require less maintenance to that of the aluminum mesh sock. For detailed instructions on how to construct mass trapping devices, refer to our guide on building mass trapping systems for Japanese Beetles on the back cover.

All traps are baited with a double lure system comprised of a floral-based lure and the Japanese beetle sex pheromone.



Missouri farmers have expressed the need for an organic management tool for Japanese beetles.
Left: Mass trapping design developed for research purposes. **Right:** High-capacity mass trapping system intended to be used by farmers to trap Japanese beetles on farms, developed by Piñero and Dudenhoeffer (2018).

These lures are for agricultural use. Japanese beetle lures are always used in conjunction with trap tops that consist of yellow panels that intersect at 90° with a funnel underneath ending in a wide rim. Beetles hitting the vane fall through the funnel into the collecting device. Yellow tops and lures can be purchased from Great Lakes IPM: http://www.greatlakesipm.com.

Prior to deploying the mass trapping system it is recommended to hang a single monitoring trap in late May in mid-Missouri. Check it regularly so you know exactly when the pest arrives and deploy the full spread of traps to make a "force field" once the first beetles are captured in the monitoring trap. Place traps along the entire perimeter—like a fence—around the crop you wish to protect. Traps are meant to be a barrier to intercept beetles before they land on crops. However, if the area is too big or the number of traps is too small for that, you can place them along the side(s) of highest pressure. Japanese beetle larvae feed on the roots of grass. This makes fescue pasture an ideal breeding ground. If there is a large area of grass (backyard, golf course, or pasture), that is likely to be the side of highest Japanese beetle pressure. Always consider placing traps upwind. Do not place traps in the center of the field because that will make things worse. Once Japanese beetles are happily feeding and mating on plants, they will be reluctant to leave unless shaken off the foliage, pushed away by a repellent (such as kaolin clay "Surround"), or by spraying an OMRI-listed insecticide.

Trap Deployment Patterns.

The "ideal" number of traps to be used for a given area depends on the size of the plot, pest pressure, and time / resources available. From 2012 to 2017 we evaluated the ability of novel mass trapping systems to capture Japanese beetles in elderberry and blueberry orchards located at two Missouri locations. The first location was a 0.5 acre elderberry orchard located at the Lincoln University George Washington Carver farm in Jefferson City, Missouri. This orchard comprises nine elderberry genotypes: Bob Gordon, Dallas, Deer, Marge, Ocoee, Ozone, Sperandio, Wyldewood, and York. The second location was a 2.5 acre blueberry orchard at the Lincoln University Alan T. Busby organic research farm. This orchard comprises three blueberry cultivars (Duke, Liberty, and Blue Crop).

For blueberries, 16 traps have proven to be effective at suppressing beetles from the blueberry plants. In our studies, traps have been deployed along two of the four orchard sides based on the direction of Japanese beetle pressure, with about 20 yards between traps. Since elderberries are more attractive to Japanese beetles than blueberry, at the elderberry farm traps have been spaced about 5 yards apart. As you place the traps around the perimeter, be sure to leave a buffer zone of approximately 10 yards between the traps and the crop. Do not put traps too close to the crop because you don't want residual beetles swarming around the traps to accidently land on foliage.

Main Research Findings.

Beetle Densities on Crop Plants and Level of Feeding Damage to Crop Foliage

Visual inspections of Japanese beetle feeding damage to perimeter row plants were performed at both farms. The number of beetles per plant and the level of defoliation to the nearest 5th percentile (0-5%, 6-10%, 11-15%) were recorded. At Carver farm, the entire perimeter (60 plants) was checked on a weekly basis. At Busby farm, 100 blueberry plants in the perimeter row and 100 plants in row 3 were checked on a weekly basis. Only data from 2014 to 2016 are presented below.

At the elderberry orchard, the season-long average number of Japanese beetles was only 0.5, 3.7, and 1.9 adult Japanese beetles per plant, in 2014, 2015, and 2016, respectively. The season-long mean percent defoliation was 2.5% in 2014, 8.2% in 2015, and 9.7% in 2016 on average. Thus, the number on elderberries remained below economic threshold (<5 beetles per plant) and defoliation was less than 10% for all 3 years while traps succeeded in catching massive number of adults.

At the blueberry orchard, the season-long average number of beetles on foliage was 0.06, 0.07, and 0.01 per plant, for 2014, 2015, and 2016 respectively. The season-long mean percent defoliation was, on average, 0.3% in 2014, 0.07% in 2015, and 0.02% in 2016. Visual inspections

Trap capture data

FARM	2012	2013	2014	2015	2016	2017	TOTAL
LU Carver farm	801,000	92,300	873,400	1'602,000	2'649,300	2'895,000	8'913,000
LU Busby farm	710,800	100,400	817,050	1'531,000	2'800,600	672,000	6'631,850
TOTAL	**1'511,800**	**192,700**	**1'690,450**	**3'133,000**	**5'449,900**	**3'567,000**	**15'544,850**

Total Japanese beetle captures per year, according to orchard. In all, traps captured over 15.5 million adult Japanese beetles from 2012 to 2017.

revealed that the number of beetles and total percent damage per row was extremely low. Meanwhile, Japanese beetles were caught by traps in very high numbers during the same period.

Based on our research, high capacity traps represented by trash bins were effective at suppressing Japanese beetle populations without the "spillover effect" associated with small monitoring traps. Trash bins and yellow trap tops can be re-used for years, so the only annual cost is replacing the lures. This new mass trapping system design may provide producers with an affordable organic solution for Japanese beetle management.

Recommended Trap Density

So far no research has been conducted to determine the minimum number of traps per acre that could be used to protect crops. Once again, in the elderberry orchard 15 traps have been deployed around the entire perimeter of the 0.5-acre plot, except for 2017 when the number of traps was reduced to five. However, having only five traps during the year of highest Japanese beetle pressure resulted in heavy injury on some perimeter-row plants. Therefore, for 2018 trap density will be returned to 15 to ensure elderberry plants are protected adequately.

In the 2.5-acre blueberry orchard, 16 traps have been deployed along the two sides of highest pressure. From 2012 to 2016 trap density was seven traps per acre. In 2017, we evaluated Japanese beetle control using only five traps for the entire blueberry orchard, with excellent results (almost no beetles and no damage to foliage were recorded on plants).

Costs

Estimated costs associated with the construction of one mass trapping device using a trash bin is $30.50 (approx. cost of yellow top: $10.50; cost of bin with lid: $15.00; cost of mesh + glue: $5.00). Assuming deployment of 7 trash bins per acre (general trap density used at the blueberry orchard), then the total cost of traps will be: $213.50 (a one-time investment). Accordingly, the annual cost of 14 lures ($4.25 each), including one replacement (done during the peak of Japanese beetle activity) is $59.50.

In contrast, the cost of spraying PyGanic 5.0 EC against Japanese beetle in one-acre plot is approx. $77.00 per application, using the high label rate. Such estimate is for the cost of insecticide only, without including time savings, etc. If a person sprays PyGanic twice a week for six weeks then the season-long cost of spraying organic insecticides would amount to $924. Use of traps also means that negative impacts of insecticide application on non-targets will be avoided.

Advantages of Using a Large Capacity Mass Trapping System

By using large trash bins, traps may not need to be emptied once a week. If the bins need to be emptied, then the easiest way to do this is to raise the lid slightly, slide a garbage bag over the opening, and pull it down so that no beetles can escape. Dump the bin upside down so the plastic bag is on the ground and smack the bottom of the bin with the palm of your hand. The beetles will fall into the garbage bag effortlessly. You can easily dump the beetles from one plastic bag into another until it's full. Any live beetles will suffocate quickly in the sealed plastic bag. Once all beetles are dead, you can tear the bag open, dump the dead beetles on a compost pile, and throw the plastic bag away. While it takes a bit of time to empty and maintain the traps, this would be offset by the time and insecticide cost savings in not having to spray a crop.

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To avoid having to empty the trash bins, beetles can be composted on-site, by adding carbon sources (wooden mulch, dry leaves, moisten shredded paper) periodically to form layers of dead beetles and carbon sources. Proper composting can help minimize or avoid the foul smell of dead Japanese beetles, which is caused mostly by release of ammonia.

How to Construct a Large-Capacity Mass Trapping System

Drill small holes in bottom of the 32 gallon bin with 3/8ths inch bit to allow rain water to drain.

Cut a 5 by 15 inch rectangle out of cardboard. Use as a template to draw 2 windows (one on each side of bin)

Use an aviation "tin-snip" tool to cut out the window you traced with permanent marker.

The front and back of bin should look like this.

Stand the bin on it's base

Use sandpaper to sand the inside edges of the windows. This will allow the glue to adhere to the plastic. WARNING: Do not use hot glue because it will melt outside in the summer heat!

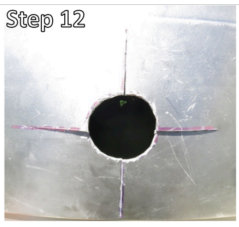
Cut a 7 by 20 inch rectangle out of cardboard. Use this template to cut out 2 window screens.

Lay the bin on one side and secure the aluminum screen inside with duct tape. Glue the screen to the bin and allow glue to dry overnight. Gorilla glue is best—you can also use epoxy or E6000.

Both steel mesh windows in place

At the center of the lid, draw an "X" that is 4 inches by 4 inches. Draw a 2 inch circle around the center.

Drill a large hole in the center and use that as a starting point to cut out the "X" & circle shape you drew.



It should look like this.

Push the base of yellow commercial top through the slots you made.

Use Gorilla tape or duct tape to seal the cracks so beetles can't escape.

Snap lid onto bin

To keep the bin upright, we used two 4 ft. metal "electric fence posts" slid through the handles (price: about $1.50 each). You can also use Rebar or simply hammer a tomato stake in the ground. Then, wrap a piece of string or wire around the bin to secure it.

Peel the silver tab off of lure, remove rubber pheromone stopper, and place in cutout hole.

Make a perimeter of traps approximately 15 meters away from the crop you want to protect. By placing traps on the side of highest pressure they will be more likely to intercept beetles before they reach the crop. Remember, Japanese beetles emerge from fescue pasture, so traps positioned between the pasture and cash crop will intercept incoming beetles.

Trap tops & lures can be purchased from Great Lakes IPM:
www.greatlakesipm.com
Telephone: (989) 268-5693

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