Mass Trapping can Provide Season-Long, Insecticide-Free Control of Japanese beetles

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In New England, the invasive Japanese beetle, *Popillia japonica,* continues to be a pest management challenge for fruit farmers, in particular organic producers. At first, traps baited with the Japanese beetle sex pheromone were developed for the purpose of monitoring. In terms of management, many growers would prefer not having to spray insecticides specifically for Japanese beetle, and organic options for the management of this pest are very limited, ineffective, and expensive.

Developing a mass trapping system to control this pest is a relatively new approach. 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.

In this article I present results from research conducted over a 6-year period (2012 to 2017) during my time as an IPM Specialist at Lincoln University in Missouri. This project's main goal was to develop a low-maintenance mass trapping system design that farmers could use to control Japanese beetles in agricultural areas with little or no insecticide inputs. Both organic and non-organic farmers may find this information useful. I also provide detailed instructions on how to develop traps and how to get the lures. The full research article can be found HERE.

Materials and Methods

Experimental sites. This study was conducted at two Missouri locations. The first location was a 1-acre elderberry orchard located at the Lincoln University George Washington Carver farm in Jefferson City, Missouri. This orchard comprises nine elderberry cultivars: 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 in Jefferson City, Missouri, U.S.A. This orchard is comprised of three blueberry cultivars (Duke, Liberty, and Blue Crop).

The mass trapping system. During 2012-2014, we evaluated an experimental sock (Fig. 1A), constructed using aluminum-based screen wire. While this sock provided excellent results, I realized that growers would not be willing to construct such devices and therefore the mass trapping design was improved to make it more grower-friendly. The improved mass trapping system is a 32-gallon black round trash can (Fig. 1B) that has two windows on each side, to provide air circulation. Previously, my team and I found that by adding ventilation more beetles will be captured given the dissemination of additional pheromones and other odors released by the beetles before dying. For detailed instructions on how to construct mass trapping devices, refer to the guide on building mass trapping systems for Japanese Beetles.

Attractants. All traps were baited with a double lure system comprised of a floral-based lure and the Japanese beetle sex pheromone. 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 Japanese beetle lures can be purchased from Great Lakes IPM http://www.greatlakesipm.com.

NOTE: Great Lakes IPM has indicated that the yellow funnel tops will become available during the summer. They did not specify a date.

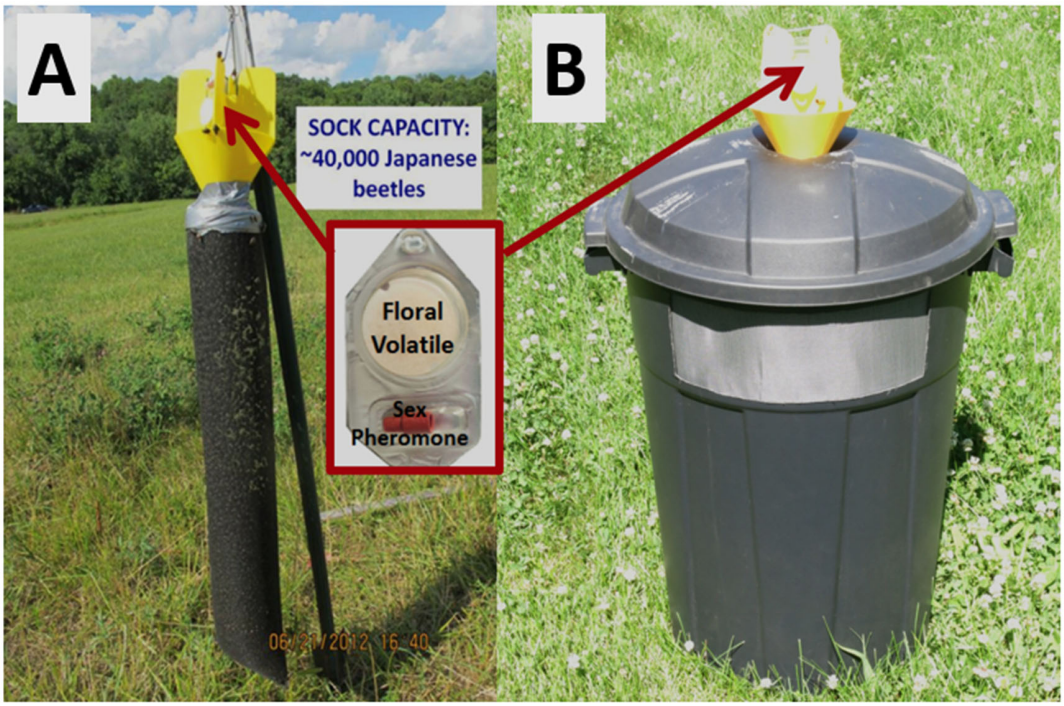

Figure 1. (A) Mass trapping design developed for research purposes only, (B) High-capacity mass trapping system intended to be used by farmers to trap Japanese beetles on farms, developed by Piñero and Dudenhoeffer (2016).

Trap deployment patterns. For each location, 7 mass trapping systems were deployed per acre, along two of the four orchard sides based on the direction of Japanese beetle pressure. All mass trapping systems were deployed around the perimeter, leaving a buffer zone of approximately 15-20 yards between the traps and the crop. I did not put traps too close to the crop because of potential residual beetles swarming around the traps to accidently land on foliage. Prior to deploying the mass trapping system I deployed a single monitoring trap in late May in mid-Missouri. Once the first Japanese beetles were captured in the monitoring trap, I proceeded to deploy the full spread of traps. The goal was to intercept the beetles before they would arrive at the crop. Traps are meant to be a barrier to intercept beetles before they land on crops. Trap capture data were collected once per week.

Three-year assessment of Japanese beetle densities on crop plants and feeding injury. Visual inspections of Japanese beetle presence on perimeter-row plants and feeding damage to foliage were performed at both farms in 2014, 2015, and 2016. 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.

Results

Trap captures over a 6-year period. Table 1 presents total Japanese beetle captures per year, according to orchard. In all, traps captured over 15.5 million adult Japanese beetles from 2012 to 2017. Click HERE to access a short

Table 1. Captures of adult Japanese beetles by mass trapping devices at two farms over a 6-year period. Research conducted in Missouri.

Summary of captures (2012-2017)

FARM	2012	2013	2014	2015	2016	2017	TOTAL
LU Carver farm	801,000	92,300	848,710	1'602,089	2'649,294	2'895,000	8'888,393
LU Busby farm	710,800	100,400	792,466	1'641,995	2'800,591	672,000	6'718,252
TOTAL	**1'511,800**	**192,700**	**1'641,176**	**3'244,084**	**5'449,885**	**3'567,000**	**15'606,645**

videoclip showing the mass trapping system in action.

Three-year assessment of Japanese beetle densities on crop plants and feeding injury. 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. Table 2 shows a representative example of ability of the mass trapping system to remove Japanese beetles from the population in the elderberry orchard. In 2016, for each of six weeks the average number of Japanese beetles recorded on elderberry plants was very low whereas over the same period over 2.6 million Japanese beetles were captured.

Table 2. Total number of Japanese beetles trapped, mean densities of beetles on perimeter-row elderberry plants, and percent defoliation recorded on 100 perimeter-row plants on each of six sampling dates in 2016.

Sampling date	Total number of Japanese beetles trapped on given dates	Mean no. (± SEM) of Japanese beetles observed per plant	Mean cumulative defoliation (in %) per plant
30 Jun	315,910	0.7 ± 0.2	1.8 ± 0.1
7 Jul	322,491	8.7 ± 1.5	8.7 ± 1.2
14 Jul	581,400	0.3 ± 0.1	11.2 ± 1.9
22 Jul	832,813	0.6 ± 0.2	13.2 ± 2.1
5 Aug	550,656	1.3 ± 0.7	13.9 ± 2.1
11 Aug	46,024	0.02 ± 0.01	14.1 ±2.2
TOTAL	**2'649,294**	----	----

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. In contrast, 2.8 million Japanese beetles were killed by the trapping devices.

A note on cost-effectiveness of the mass trapping system. To qualify as a viable alternative to insecticide sprays, IPM tools such as mass trapping must be cost-effective. The estimated costs associated with the construction of one mass trapping device using a trash bin is approximately $35 (combining cost of yellow top, bin with lid, mesh, and glue). Assuming deployment of 7 trash bins per acre (general trap density used at the blueberry orchard), then the total cost of traps will be $245 (a one-time investment). Accordingly, the annual cost of 14 lures ($4.50 each) for the 7 traps, including one replacement (one lure is added at the peak of Japanese beetle activity) is $63 per acre. The bins and trap (funnel) tops are made of durable materials and they are expected to last several years. Therefore, the annual expense incurred will only involve the lures ($63/acre). No evaluations have been conducted to determine whether fewer than 7 trapping systems could be used. This is conceivable, especially in crops that are relatively less attractive to Japanese beetles, such as blueberry.

Conclusions

Over a 6-year period, the mass trapping system consistently captured high numbers of adult Japanese beetles while comparatively few adults and little damage to the foliage were recorded on plants (data recorded over a 3-year period). Mass trapping provide an effective alternative management options of this pest with less or no insecticides applied to the crop. This new mass trapping system design may provide producers, in particular organic, with an affordable solution for Japanese beetle management. The trash bins and yellow trap tops can be re-used for years, so the only annual cost is replacing the lures.

In 2023, we will conduct some mass trapping research at the UMass Cold Spring Orchard and at a couple of grower cooperator farms using a new approach.

Acknowledgments

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References

Piñero, J.C., Dudenhoeffer, A. 2018. Mass trapping designs for organic control of the Japanese beetle, *Popillia japonica* (Coleoptera: Scarabaeidae). Pest Management Science https://doi.org/10.1002/ps.4862.

For more information: Video showing the mass trapping system in action