Integrated Pest Management
University of Missouri

June 2016

Integrated Pest & Crop Management

Mizzou Pest Management Field Day is July 7th

by Mandy D. Bish

The annual Mizzou Pest Management Field Day will be Thursday July 7th at the Bradford Research and Extension Center, approximately 8 miles east of Columbia, Missouri.

Registration will begin at 8:00 a.m. with opening comments by Dr. Kevin Bradley at 8:30. The morning will include guided wagon tours with stops that feature presentations of research results by university-trained scientists.

Weed management research topics that will be discussed this year include the effects of soybean seed treatments on early season herbicide injury; the integration of pre-emergent, residual herbicides with cover crops in soybean production; comparisons of new herbicide-resistant soybean systems; best management practices for herbicide applications; a variety of research results and topics pertaining to the management of herbicide-resistant weeds, and many other topics and periodic stops along the guided tour.

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Dr. Bradley discusses herbicide-resistant weeds at the 2015 Mizzou IPM Field Day.

In This Issue

Lunch will be served at noon after which attendees will have the opportunity to view plots that showcase a variety of herbicide treatments and weed management programs for use in corn, soybean, or grain sorghum. These plots will be clearly labeled and mapped out so that they can be viewed easily.

Registration for the field day will be $10.00 to cover cost associated with lunch and refreshments.

To register call 573-884-7945 or send an e-mail to chismt@missouri.edu by Thursday, June 30th.

For certified crop advisors, CEU credits are pending.

The Bradford Research and Extension Center is located at 4968 Rangeline Road, Columbia, MO 65201. To learn more about the largest plant sciences' research farm in the state of Missouri visit the Web site: Bradford.cafnr.org.

To learn more about Mizzou Weed Science, visit the Web site at www.weedscience.missouri.edu or find us on Facebook and Twitter at Mizzou Weed Science.

Dr. Bish discusses the off-target movement of herbicides at the 2015 Mizzou IPM Field Day.

Early-season herbicide injury to soybean will be one stop on the 2016 Mizzou IPM tour.

Integrating pre-emergent, residual herbicides with cover crops in soybean production systems will be discussed at the 2016 Mizzou IPM Field Day.

Stunted Corn Following Prevented Planting - Fallow Syndrome

by Gregory A. Luce

There are many corn fields in Missouri, in particular the NE portion of the state, where corn is stunted and uneven following prevented planting acres. Many farmers, extension and industry agronomists and consultants are working with fields that are showing dramatically poorer corn growth in prevented planting vs fields following a crop in 2015. In a number of cases there are side by side comparisons where soybean or a cover crop was planted in the same field last year that had portions unplanted. The answer commonly given to explain the poorer growth behind prevented planting has been the effect of what is known as Fallow Syndrome. In some cases the answers involve multiple factors, and there are fields where not all of the stunted corn growth may be attributed to Fallow Syndrome. However, there are many fields in the NE counties, where Fallow Corn Syndrome appears to be the predominant cause. The degree of stunted corn varies greatly and factors such as field drainage, nitrogen management, manure application, the previous season weed cover and the phosphorus soil test levels all may have a part in the range of severity.

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Figure 1. Phosphorus deficient Corn plants – a typical symptom associated with corn grown following fallow.

Figure 2. Corn in foreground followed soybean; the smaller, pale corn is growing following no crop in 2015.

What is Fallow Syndrome?

Fallow syndrome got the name from cropping systems in the dry plains states where they routinely benefited from the additional soil moisture available after the previous year had been summer fallowed. However, corn sometimes suffered from lack of phosphorus uptake and stunted growth when planted following the fallow period. Symptoms may include purple coloration and short, uneven and weak plants. Low soil phosphorus and/or cold and wet soils could certainly magnify the situation.

Fallow Syndrome is a result of population reduction of a particular fungi (vesicular arbuscular mycorrhizae or VAM) due to no plants growing in that field the previous year. The mycorrhizal fungi has a symbiotic relationship with corn and small grains. The mycorrhizae develop around the corn roots and assist the root in taking up nutrients, primarily P and Zn. The mycorrhizae benefit by accessing the sugars from the root system of the host plant. As plants grow out of the phosphorus deficient symptoms they have remained pale and stunted in the most impacted fields.

Most agricultural crops have mycorrhizae, and so do most weeds, but not all benefit equally from the symbiosis, and not all are equally as good of a host. For instance, Brassica crops are not a host. Corn happens to be particularly dependent on mycorrhizae.

Observations by many field representatives also indicate that corn grown on prevented planting acres, where there was weed coverage or small grain cover crops seeded last fall, displays better corn growth than where nothing grew in 2015. As previously mentioned, Brassicas are not hosts for the mycorrhizae. Forage radish and turnips are Brassica family members, and where Brassicas were seeded on prevent plant acres, reports are that there is stunted corn with fallow syndrome type symptoms.

There are many examples of remarkably enhanced corn growth where corn followed soybeans or a grass cover crop directly adjacent to where corn followed prevented planting. The field in Figure 2 is an example of the many observations from across NE Missouri.

Why are we seeing so much problem this year?

It is noted by many farmers and agronomists in Missouri that, although we expected major issues after the floods in the 1990s, we did not experience the extreme issues we have seen in 2016. Many close observers of corn in the Midwest have also indicated that fallow syndrome symptoms are more likely when the fallow occurs during wet, cool conditions. Here are a few thoughts on why we are seeing more issues this year:

- **2015 Extremes!** The 2015 season was truly unique. Many growers that have farmed all their lives in NE Missouri could not ever remember a year like 2015. I had certainly never experienced a season where the extreme wet weather lasted so long that soybean planting did not occur on upland acres. Although we have seen flooding in bottoms that prohibited planting, fallow on such a large amount of upland acres was unprecedented.
- **Drainage impact.** Many of the most impacted corn fields, grown where the crop did not get planted last year, are flatter and more poorly drained. (That's of course why they didn't get planted in 2015). Although many of these fields have very good yield potential, they can be subject to early season stresses related to drainage which are more common on flat, claypan soils. I have observed that portions of problem fields, with somewhat better drainage, show significantly improved growth.
- **Cold, wet conditions** this spring is also a connection. Fields with the greatest issues are in areas that had significant wet periods and it was certainly very cold for a time this spring.
- **Phosphorus content** in the fields showing the most negative issues this year may be lower in soil test P. Bottomland fields often have higher P levels and, perhaps why the less than expected issues following the floods.
- **Fields vary greatly** in degree of stunting, and multiple factors could be involved. Don't assume it is only one factor. Consider all the past management practices and field conditions while assessing the problem.

Impact of Soil Test Phosphorus Level?

Some research on Fallow Syndrome has shown a relationship to fallow having greater negative impact on lower testing soils. Dr. Manjula Nathan, Director of the University of Missouri Soil Testing and Plant Diagnostic Service Laboratories, did her Ph.D. work in South Dakota studying: the Effects of Mycorrhizal Colonization, Early Growth and Phosphorus Uptake of Corn. Her work, in a two year study, showed that fallow negatively impacted phosphorus uptake of corn and also showed reduced corn growth in a low Phosphorus test soil. However, on a high phosphorus testing soil the fallow did not have those negative effects. Dr. Nathan's work also showed that corn following soybean, in the low P test soils, had greater P uptake and early growth than where corn followed fallow, barley or corn. Although mycorrhizal colonization explained some of the benefit to the previous soybean crop, other benefits from soybeans must have been involved. For example, mycorrhizal colonization was also very good following corn, as would be expected, but corn growth after soybean and P uptake after soybean in the low test field were significantly greater than corn following other crops. We know that there would be contribution of nitrogen from soybean, but corn benefits from a previous soybean crop in other respects that we are still trying to identify and understand.

Can the stunted corn be corrected in 2016?

There are no proven recommendations for alleviating the poor corn growth following prevented planting acres but here are some thoughts and suggestions to consider:

- In order to recover stunted corn that is P deficient, broadcasting P will likely have minimal effect on rescuing Fallow Syndrome effected corn.
- There are old references from the 1960s showing some yield improvement by adding additional P close to the row and cultivating it in.
- If the soil is sealed a cultivation alone may aerate the soil and stimulate rooting and enhance plant growth.
- Knifing in additional Nitrogen could be beneficial to plant growth stimulation. If inadequate amounts of N have been applied to this point it would be most advantageous.
- Foliar P is a consideration, however, macronutrients like Phosphorus are not readily taken into the plant through the leaves and root uptake is needed for significant levels to be taken up by the corn plant.

What to do in the future?

With this situation, certainly prevention is a key. When prevented planting occurs again, particularly on upland, claypan fields, here are some suggestions:

- Plant soybeans as long as you possibly can. Soybean has the potential to yield reasonably well when planted late and is a tremendous crop for corn to follow.
- If no crop is planted then plant a cover crop if at all possible. Grasses like cereal rye, wheat or oats would be good choices as would legumes. This would provide a host crop for the mycorrhizae and the earlier in the season, the better. Remember that Brassicas like turnip and radish are not hosts to mycorrhizae and if used after fallow they would need to be mixed with host type cover crops.
- Don't skimp on phosphorus after fallow. If soil test levels are low a banded starter application of Phosphorus and Zinc would be more effective than broadcast applications.
- Soybeans are a good option to plant after prevent plant acres as they are not as susceptible to Fallow Syndrome.
- Typically the effects of Fallow Syndrome are not seen two years after the fallow period.

A novel mass trapping system to control cucumber beetles in cucurbit crops

by Dr. Jaime C. Pinero and Rusty Lee

Striped and spotted cucumber beetles are two key insect pests of cucurbit crops. Without proper management, adult beetles can transmit bacterial wilt, defoliate plants and cause cosmetic damage to fruits. Larvae of the striped beetle also cause damage by feeding on cucurbit roots and stems. Managing these two pests in gardens and small farms can be challenging. 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. To address these concerns, the Lincoln University (LU) IPM program developed a simple, mass trapping system that has proven to be an effective component of an IPM strategy. When deployed in the cucurbit field, the cucumber beetles are drawn to the traps and away from the cash crop. Upon entering the trap, beetles are killed by their consumption of a carbaryl-laced bait.

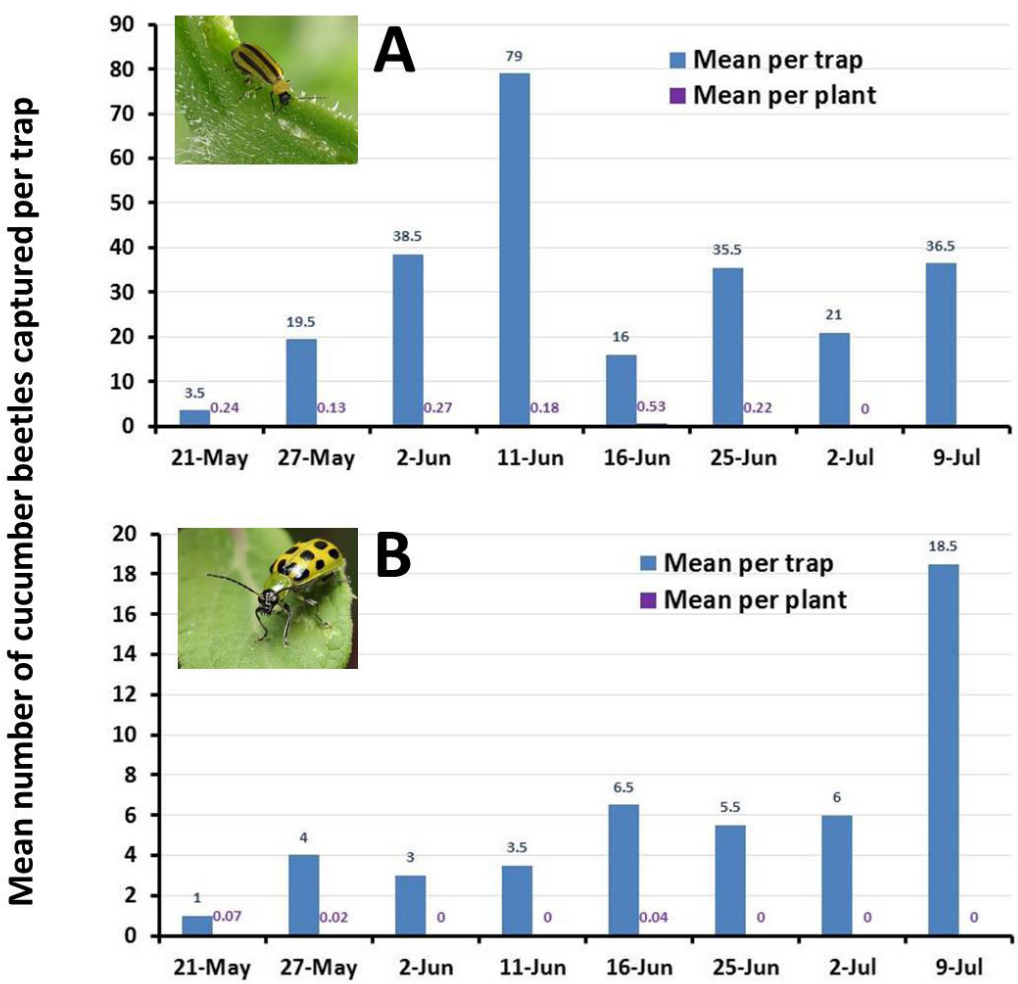


FIGURE 1. Captures of (A) striped, and (B) spotted cucumber beetles in yellow-painted traps in a zucchini plot in Truxton, MO (2015 data). For each trapping date, blue bars show the mean number of beetles captured per trap. Purple bars denote mean number of beetles observed per plant. At each trapping date, 45 plants were inspected thoroughly for cucumber beetles.

The three components of the trap are: (1) a juice / milk jug, (2) a commercial, floral-based lure , and (3) a stun pill composed of carbaryl (Sevin), paraffin wax, and powdered buffalo gourd. For additional trap details, see section 'Trap Construction Using 1 Gallon Milk or Juice Container' later in this article.

Results from research conducted (2011-2013) at the LU George Washington Carver Farm indicated that yellow-painted traps baited with the AgBio lure performed best. In 2011, 28 baited traps, maintained for a 9 day period, killed 2,531 cucumber beetles in a watermelon crop. This combined reduction of spotted and striped cucumber beetles reduced the need for an insecticidal spray while maintaining production of marketable fruit.

2015 on-farm study

On-farm research on mass trapping conducted at one commercial vegetable farm in Truxton MO, indicated that 28 traps killed 3,715 cucumber beetles (combining striped and spotted) over an 8-week period (21 May – 9 July, 2015). Comparatively high numbers of striped (Figure 1A) and spotted (Figure 1B) cucumber beetles were captured by yellow traps in a zucchini plot whereas very few adults were found on plants. Similar results were found in the cucumber plot (Figure 2A,B).

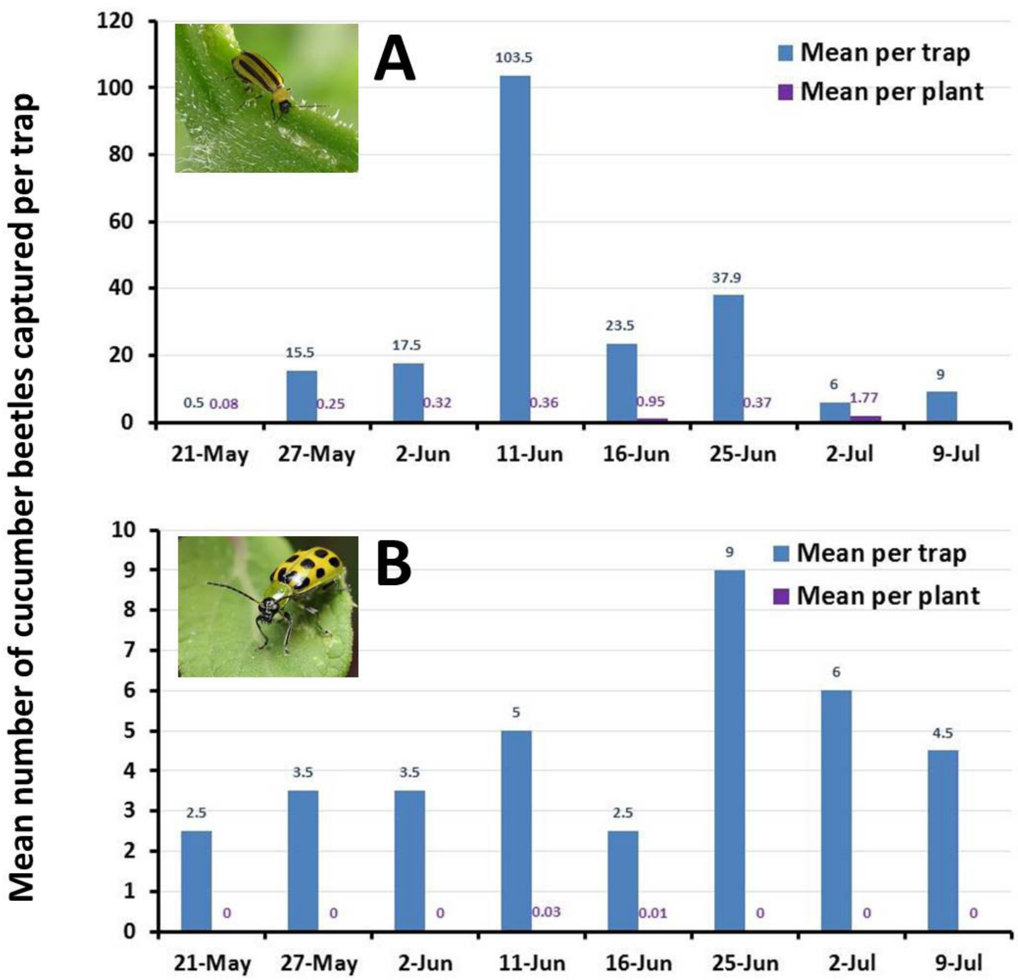


FIGURE 2. Captures of (A) striped, and (B) spotted cucumber beetles in yellow-painted traps in a cucumber plot in Truxton, MO (2015 data). For each trapping date, blue bars show the mean number of beetles captured per trap. Purple bars denote mean number of beetles observed per plant. At each trapping date, 75 plants were inspected for cucumber beetles.

Overall, the level of beetle suppression was so effective that the number of insects found on plants averaged 0.42 per plant, a number that is below what is called an economic threshold (= pest density at which insecticide applications are justified). Overall, our 2015 data indicate that, across the entire trapping period, for each cucumber beetle found on a plant, there were 26 cucumber beetles killed by a trap.

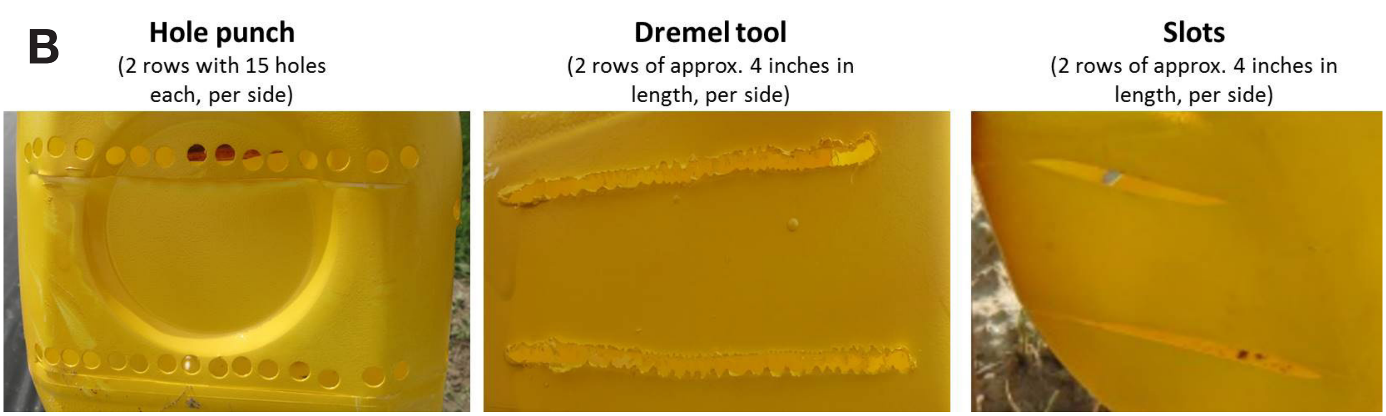
Mass trapping for Fall Sanitation

When cucumber harvest ended on September 25, 2015, a mass trapping system was deployed at the Truxton farm. This consisted of 15 yellow traps baited with the AgBio lure and one stun pill per trap. The goal was to kill as many cucumber beetles as possible to reduce the over-wintering population. When trapping concluded on December 2nd, 2015, a total of 2,043 cucumber beetles had been removed. These results are encouraging and two additional producers are evaluating the mass trapping system at their farms.

2016 on-farm study

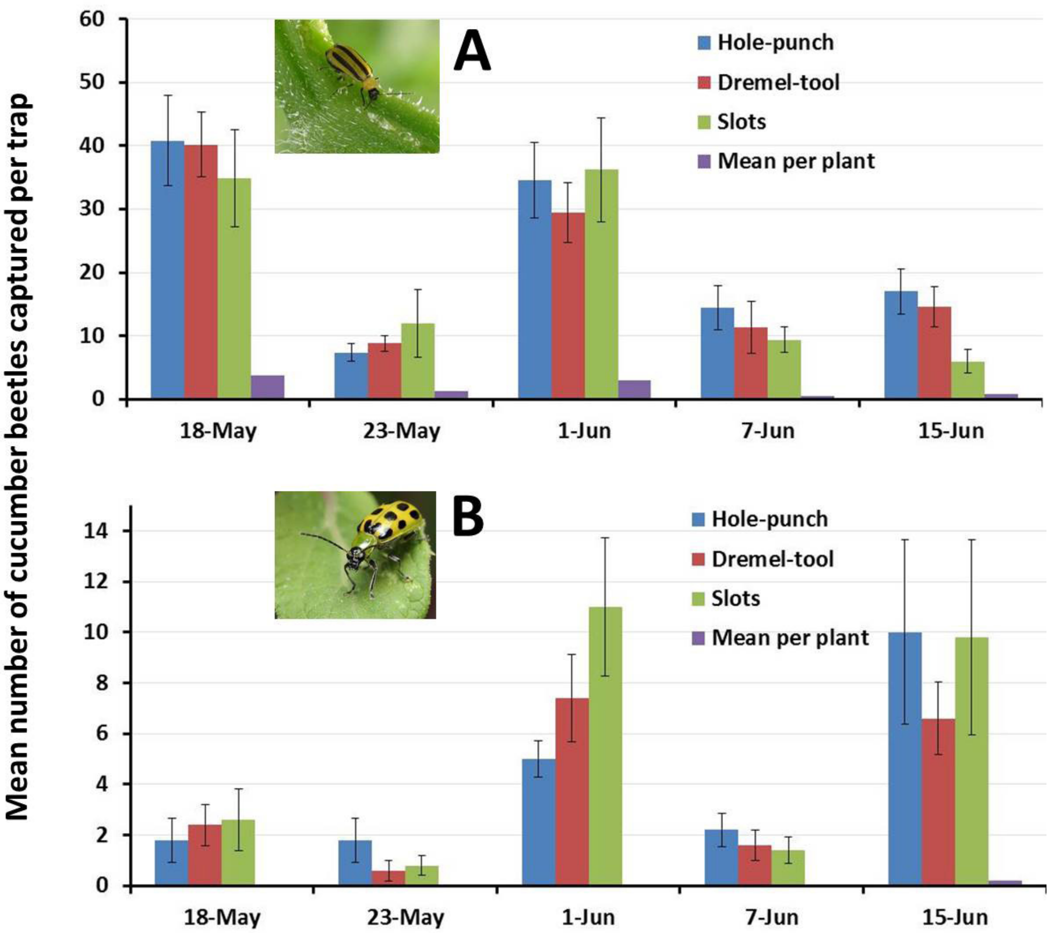
The floral-based AgBio lure used in the traps and the yellow color of the trap can attract honey bees. Therefore, entrances should be sized big enough to allow cucumber beetle access, but exclude the honey bee. On April 29, 2016, 15 yellow-painted traps (Fig 3A) baited with the AgBio lure were deployed in a 2 acre planting of zucchini, yellow summer squash, and cucumbers in Truxton, MO. The objective of the replicated study was to measure the effectiveness of three different slot construction methods: (1) A high-speed cutoff disk mounted on a dremel-type tool made a uniform width slot, but blade thickness limited slot width to 1/8" width, (2) Cutting the slot with a knife allows it to be any width desired, but the difficulty of maintaining a consistent width often created a slot too wide, and (3) A hand-held paper-hole punch that made a ¼" diameter hole. A horizontal knife slit allows the hole puncher to be inserted and when completed, the container sides spring back to close the slit.

FIGURE 3. (A) View of the cucumber beetle mass trapping devices deployed in a summer squash plot in Truxton, MO, (B) The three types of entrance holes for cucumber beetles that were evaluated. The entire surface area is similar across opening types.



Overall, the 15 traps killed 3,217 striped cucumber beetles in a 6-week period. The table below shows the combined beetle counts for all 15 traps, and the average number of beetles killed by traps and seen on plants. The ratio of beetles collected in traps versus beetles found on plants ranged from 7:1 to 23:1. The highest ratio of beetles per trap versus observed on plants, was recorded three weeks after insecticide application, when the pesticide suppression effect should have diminished. This supports the observation that traps have the potential to keep cucumber beetles below the economic threshold for pesticide application.

DATE	Total no. striped cucumber beetles	Average no. striped beetles per trap	Average no. striped cucumber beetles per plant	Ratio*
April 29 - May 12	1,632	108.8	11.9	9.1
May 13- 17	579	38.6	3.7	10.4
May 18-22	141	9.4	1.3	7.2
May 23-31	501	33.4	2.9	11.5
June 1-6	176	11.7	0.5	23.4
June 7-14	188	12.5	0.75	16.7
Total captured	**3,217**			



The new mass trapping system developed by the Lincoln University IPM program can be used as part of a broader IPM program aimed at managing cucumber beetles.

FIGURE 4. Captures of (A) striped, and (B) spotted cucumber beetles in yellow-painted traps according to type of entrance hole in a summer squash plot in Truxton, MO (April 29 – June 15, 2016). Purple bars denote the mean number of beetles observed per plant. At each trapping date, 45 plants were inspected thoroughly for cucumber beetles.

Overall, the conclusions of this study in terms of performance of the entrance hole are: (1) The 1/8" horizontal slot made with the dremel tool seems to be too narrow, (2) the free-handed knife slot would be too variable – yet effective if width can be kept at around ¼", and (3) hole punch entrances excluded honey bees, and allowed maximum cucumber beetle captures. Only one honey bee (by a trap that had slots made with dremel tool) was captured over the entire 6-week trapping period.

Overall, results indicate that the mass trapping system developed is effective at suppressing cucumber beetles from cucurbit plants. Some producers in a couple of Missouri locations are currently evaluating the performance of this mass trapping system.

Trap Construction Using 1 Gallon Milk or Juice Container.

Step 1: Trap entrances can be a series of round holes made by a paper punch tool, or horizontal slots cut with a knife or dremel-type power tool (see results described above). If using the paper-hole punch method, a horizontal knife cut will give tool access. Entrances on all sides of container aid in dispersion of lure scent. Remember, the scent can also be attractive to honey bees so keep the entrance small enough to exclude the honey bee, but still allow access to the cucumber beetle. A hole diameter or slot width of ¼" maximum has performed well.

Step 2: Drop stun pill into trap. Unfold scent-lure and attach short piece of string/wire. Removal of the two protective white flaps (see picture on the right) also aids in scent dispersal. Insert through mouth of trap and catch string under screw-top lid such that the lure is suspended inside trap.

Step 3: Drive a post along edge of vegetable row and suspend trap, with additional wire from container handle, so that trap is upright and approximately 4-6" above the ground.

Step 4: Spray painting traps with yellow high-gloss paint has proven to increase effectiveness. Once installed, it can be easily sprayed in place.

The commercial lure used is produced by AgBio, Inc. (Address: 9915 Raleigh St, Westminster, CO 80031; phone:(303) 469-9221; e-mail: agbio@agbio-inc.com.

The stun pill can be purchased from Trece, Inc. (Address: 7569 OK-28, Adair, OK 74330; phone: (918) 785-3061; e-mail: custserv@trece.com).

Weather Data for the Week Ending June 29, 2016

Station	County	Weekly Temperature (°F)						Monthly Precipitation (in.)		Growing Degree Days‡	
		Avg. Max.	Avg. Min.	Extreme High	Extreme Low	Mean	Departure from long term avg.	June 1-29	Departure from long term avg.	Accumulated Since Apr 1	Departure from long term avg.
Corning	Atchison	89	67	94	64	78	+3	1.12	-3.41	1502	+337
St. Joseph	Buchanan	88	69	92	65	78	+3	1.96	-2.84	1404	+246
Brunswick	Carroll	88	69	94	65	78	+3	2.07	-2.79	1510	+311
Albany	Gentry	85	66	90	62	75	0	4.95	+0.26	1258	+135
Auxvasse	Audrain	89	67	93	60	77	+2	1.19	-3.39	1412	+196
Vandalia	Audrain	90	65	95	60	77	+2	4.02	-0.10	1407	+243
Columbia-Bradford Research and Extension Center	Boone	89	68	92	61	78	+2	1.07	-3.16	1382	+128
Columbia-Capen Park	Boone	93	66	96	59	78	+2	1.26	-3.44	1394	+90
Columbia-Jefferson Farm and Gardens	Boone	91	69	95	62	79	+3	0.93	-3.30	1454	+197
Columbia-Sanborn Field	Boone	90	70	94	63	80	+4	1.41	-3.17	1549	+242
Columbia-South Farms	Boone	90	69	94	62	79	+3	0.96	-3.30	1432	+177
Williamsburg	Callaway	90	65	95	58	76	+1	1.02	-3.32	1350	+176
Novelty	Knox	86	65	92	58	76	+1	1.23	-2.77	1300	+146
Mosow Mills	Lincoln	92	67	97	60	79	+3	0.06	-4.25	1441	+172
Linneus	Linn	86	66	94	62	76	+2	3.92	-0.87	1318	+189
Monroe City	Monroe	90	64	95	57	78	+3	0.38	-3.30	1399	+200
Versailles	Morgan	91	69	95	62	80	+4	1.22	-3.00	1495	+191
Green Ridge	Pettis	90	69	94	64	79	+3	0.91	-3.91	1424	+194
Unionville	Putnam	86	64	91	60	75	+2	1.29	-3.99	1231	+195
Lamar	Barton	91	69	94	67	79	+3	4.38	-1.13	1475	+123
Butler	Bates	88	69	91	62	78	0	2.77	-3.00	1468	+83
Cook Station	Crawford	90	67	94	57	77	+2	0.62	-3.59	1361	+45
Round Spring	Shannon	91	67	98	59	77	+3	3.24	-0.44	1333	+81
Mountain Grove	Wright	88	66	92	60	76	+2	4.43	+0.90	1311	+109
Delta	Cape Girardeau	89	70	94	62	79	+1	1.02	-2.23	1537	+10
Cardwell	Dunklin	90	73	93	68	80	+1	1.89	-1.41	1758	+53
Clarkton	Dunklin	92	72	98	66	81	+2	2.08	-1.23	1723	+58
Glennonville	Dunklin	90	72	94	68	80	+1	2.07	-0.89	1704	+46
Charleston	Mississippi	92	72	96	67	82	+4	1.27	-2.59	1691	+155
Hayward	Pemiscot	90	72	94	66	80	+1	1.95	-1.61	1666	-6
Portageville	Pemiscot	92	73	97	67	82	+3	2.95	-0.77	1781	+93
Steele	Pemiscot	90	73	93	69	80	+1	2.50	-1.42	1755	+54

‡Growing degree days are calculated by subtracting a 50 degree (Fahrenheit) base temperature from the average daily temperature. Thus, if the average temperature for the day is 75 degrees, then 25 growing degree days will have been accumulated.

Weather Data provided by Pat Guinan |GuinanP@missouri.edu | (573) 882-5908

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