Welcome

A recording of this webinar will be available within a week at

http://www.neipmc.org/go/ipmtoolbox
We Welcome Your Questions

• Please submit a question at any time using the Q&A feature to your right at any time

• If you’d like to ask a question anonymously, please indicate that at the beginning of your query.
Presenter

Dr. Andrew Li
Research Entomologist,
USDA-ARS Invasive Insects
Biocontrol and Behavior
Laboratory, Beltsville, MD
Some Questions for You
Host-targeted Tick Control: What Works, What does not, and What’s New

Andrew Y. Li

USDA, ARS, BARC, Invasive Insect Biocontrol and Behavior Laboratory
Beltville, Maryland

The IPM Toolbox Webinar
9/30/2020
Presentation outline

1. Background
2. WFM and WTD as key hosts for the blacklegged tick
3. Integrated Tick Management
4. Host-targeted control
5. Damminix Tick Tubes
6. Thermacell Tick Tubes
7. Select TCS Bait Boxes
8. Reservoir Targeted Vaccine (RTV)
9. “4-Poster”
11. Summary
Major tick species and diseases they transmit in the Northeastern area

**Blacklegged tick (Ixodes scapularis)**
- Borrelia burgdorferi and B. mayonii (Lyme disease)
- Anaplasma phagocytophilum (anaplasmosis)
- B. miyamotoi disease (a form of relapsing fever)
- *Ehrlichia muris eauclairesis* (ehrlichiosis)
- Babesia microti (babesiosis)
- Powassan virus (Powassan virus disease)

**Lone star tick (Amblyomma americanum)**
- *Ehrlichia chaffeensis* & *Ehrlichia ewingii* (which cause human ehrlichiosis)
- Heartland virus
- Tularemia
- STARI

**American dog tick (Dermacentor variabilis)**
- Tularemia
- Rocky Mountain spotted fever

**Asian longhorned tick**
- Dengue fever
- *Candida* albicans (a form of candidiasis)
- *Ehrlichia* risticii (ehrlichiosis)
- *Anaplasma* phagocytophilum (anaplasmosis)
Blacklegged ticks
the vector of
Lyme disease

✓ Erythema migrans (EM) or "bull's-eye" rash
✓ Facial or Bell's
✓ Severe headaches and neck stiffness
✓ Arthritis (pain and swelling in the large joints)
✓ Lyme carditis

Reported Cases of Lyme Disease – United States, 2018

~ 300,000 cases / year
Blacklegged ticks
the vector of
Lyme disease

Historical data (2000-2018):

25,725 confirmed cases of Lyme disease in Maryland.

- Montgomery County: 3,412
- Howard County: 2,835
- Anna Arundel County: 2,088
- Harford County: 1,968
- Frederick County: 1,796
- Carroll County: 1,770
- Cecil County: 1,299

https://www.tickcheck.com/stats/state/maryland/lyme
Life cycle of the blacklegged tick

Confirmed cases by month of disease onset, 2008-2018

LYME DISEASE IN THE US:
Confirmed cases by month of disease onset, 2008-2018
Integrated Tick Management (ITM)

Pesticide spray
- synthetic acaricides
- organic acaricides
- biopesticides (fungi)

Host-targeted tick control
- tick tubes, bait boxes (mice)
- 4-Poster (deer)

Deer reduction / exclusion

Tick barriers - physical, chemical
Major vertebrate animals that can serve as hosts for the blacklegged tick:

- White-footed mouse
- Eastern chipmunk
- White-tailed deer
- Raccoon
- Virginia opossum
- Shrews
- Squirrels

* Brunner et al. 2008, 2011

Diagram credit - Matt Milholland

Host-targeted control to break the life cycle of the blacklegged tick
Questions?
Host-targeted Tick Control - WFM

Whit-footed mice as hosts for nymphs and larvae of the Blacklegged ticks and reservoir for pathogens

USDA-ARS Areawide Tick Control Project in Maryland (Li - unpublished date)

<table>
<thead>
<tr>
<th>Park</th>
<th># of mice</th>
<th>B. burgdorferi</th>
<th>A. phagocytophilum</th>
<th>B. microti</th>
<th>B. miyamatoi</th>
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<tbody>
<tr>
<td>BL</td>
<td>163</td>
<td>56.4</td>
<td>1.8</td>
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<tr>
<td>CL</td>
<td>94</td>
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<td>WT</td>
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<td>37.5</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Mean</td>
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<td>48.2</td>
<td>6.0</td>
<td>0.8</td>
<td>1.2</td>
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<table>
<thead>
<tr>
<th></th>
<th># of mice</th>
<th>B. burgdorferi</th>
<th>A. phagocytophilum</th>
<th>B. microti</th>
<th>B. miyamatoi</th>
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<tr>
<td>2017</td>
<td>215</td>
<td>62.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2018</td>
<td>163</td>
<td>75.5</td>
<td>15.3</td>
<td>0</td>
<td>1.8</td>
</tr>
</tbody>
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<p>| | | | | | |</p>
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<tr>
<td></td>
<td>32</td>
<td>28.1</td>
<td>0</td>
<td>3.1</td>
<td>0</td>
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<tr>
<td></td>
<td>90</td>
<td>43.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>12</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Mean</td>
<td>43.7</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Total</td>
<td>713</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Host-targeted Tick Control - WFM

White-footed mice as hosts for nymphs and larvae of the Blacklegged ticks and reservoir for pathogens

USDA-ARS Areawide Tick Control Project in Maryland (Li - unpublished date)

| B. burgdorferi infection (%) in questing I. scapularis in 2017 |
|-------------------|------------------|------------------|------------------|------------------|
| Park              | n=   | infected adults | n=   | infected nymphs | n=   | total infection |
| BL                | 2    | 0.0             | 8    | 0.00            | 10   | 0.0             |
| CL                | 8    | 50.00           | 11   | 18.18           | 19   | 31.58           |
| CT                | 4    | 25.00           | 15   | 20.00           | 19   | 21.05           |
| DF                | 2    | 0.0             | 12   | 25.00           | 12   | 25.00           |
| MPEA              | 8    | 12.50           | 18   | 5.56            | 26   | 7.69            |
| RB                | 9    | 11.11           | 49   | 12.24           | 58   | 12.07           |
| WT                | 9    | 0.00            | 54   | 0.00            | 63   | 0.0             |
| TOTAL             | 42   | 3.38            | 167  | 7.25            | 207  | 9.18            |
| MEAN              | 14.09| 11.57           |      |                 |      | 13.91           |

| B. burgdorferi infection (%) in I. scapularis removed from Peromyscus in 2017 |
|-------------------|------------------|------------------|------------------|
| Park              | n=   | infected nymphs | n=   | infected larva  | n=   | total infection |
| BL                | 17   | 94.12           | 77   | 28.57           | 94   | 40.43           |
| CL                | 15   | 25.67           | 59   | 30.51           | 74   | 29.73           |
| CT                | 6    | 50.00           | 41   | 39.02           | 47   | 40.43           |
| DF                | 31   | 48.89           | 100  | 53.88           | 221  | 52.94           |
| MPEA              | 4    | 25.00           | 59   | 40.63           | 63   | 39.68           |
| RB                | 3    | 66.67           | 99   | 37.37           | 102  | 38.24           |
| WT                | 3    | 33.33           | 2    | 50.00           | 5    | 40.00           |
| TOTAL             | 79   | 53.16           | 527  | 41.75           | 606  | 43.23           |
| MEAN              | 49.17| 39.98           |      |                 |      | 40.21           |
Damminix Tick Tubes
(EcoHealth, Inc., Boston, MA)

Previous field trials demonstrated various efficacies:

90% reduction in ticks/animal; 72% reduction infestation rate.

No observed differences in host-seeking ticks or proportion of infected ticks.

3 years of treatment demonstrated no reduction in risk of exposure to spirochete infected, host-seeking nymphs & adults of I. dammini.

Confirmed efficacy of Damminix for reducing abundance of vector ticks.
Deployment of Damminix tubes - (1) had conclusive evidence regarding effect on nymphal tick infestation prevalence and intensity during May-June; (2) had measurable effect on larval tick burden in July–August; and (3) resulted in 27.6% and 20.3% control of questing nymphs in treated areas at year 1 and 2 postintervention.
Tick tubes reduce blacklegged tick burdens on white-footed mice in Pennsylvania, USA

Jessica E. Brown | Taylor M. Miller | Erika T. Machtinger

| TABLE 1 | Comparison of Dermacentor variabilis ticks removed from trapped Peromyscus leucopus pre-deployment and post-deployment of tick tubes with cotton treated with either water (control), permethrin or permethrin+ a biting agent (permethrin++) in Centre County, Pennsylvania |

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Date</th>
<th>Number of captured P. leucopus</th>
<th>Mean (Ticks per mouse)</th>
<th>Standard Deviation (Ticks per mouse)</th>
<th>95% Confidence Interval</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Pre-deployment</td>
<td>14</td>
<td>4.78</td>
<td>1.56</td>
<td>1.60 to 7.97</td>
<td>.2020</td>
</tr>
<tr>
<td></td>
<td>Post deployment</td>
<td>18</td>
<td>7.49</td>
<td>1.35</td>
<td>4.38 to 10.20</td>
<td></td>
</tr>
<tr>
<td>Permethrin</td>
<td>Pre-deployment</td>
<td>11</td>
<td>1.55</td>
<td>0.41</td>
<td>-0.94 to 0.94</td>
<td>.0134**</td>
</tr>
<tr>
<td></td>
<td>Post-deployment</td>
<td>9</td>
<td>0.00</td>
<td>0.00</td>
<td>0.69 to 2.40</td>
<td></td>
</tr>
<tr>
<td>Permethrin++</td>
<td>Pre-deployment</td>
<td>8</td>
<td>3.73</td>
<td>0.95</td>
<td>1.72 to 5.74</td>
<td>.0201**</td>
</tr>
<tr>
<td></td>
<td>Post-deployment</td>
<td>11</td>
<td>0.00</td>
<td>0.00</td>
<td>-2.36 to 2.36</td>
<td></td>
</tr>
</tbody>
</table>

*Mean comparisons were made with a t test.
**Indicates significance at \( \alpha = 0.05 \).
How to Make Tick Tubes: Do-It-Yourself (DIY)

https://www.myfrugalhome.com/how-to-make-tick-tubes/

**Tick Tube Instructions:**

*What You’ll Need:*
- Empty toilet paper rolls
- Dryer lint (or cotton balls)
- Gloves
- A mask
- A cardboard box
- Permethrin insect repellent. You can buy it in *diluted form* or as a *concentrate*. Look for it on the camping/hunting aisle.
- A spray bottle (if the permethrin didn’t come with one)
Tick Box Technology Corporation
Norwalk, CT

http://www.tickboxtcs.com/

Not just mice, chipmunks too!
Anatomy of a bait box

Tick Box Tick Control System Reduces Ticks and Lyme Disease.

Our product treats both chipmunks and mice (host animals) which are the reservoirs of the bacteria that cause Lyme Disease.

The Tick Box Tick Control System achieves 97% control and interrupts the transmission cycle of Lyme disease, no other product can make that claim.
Results of field trials have been consistently positive

50% reduction in host-seeking nymphs; 57% reduction in infected nymphs

94% reduction small mammal tick burdens; 90% reduction in host seeking ticks

97.3% control of host-seeking nymphs in treatment sites

81% reduction in host-seeking nymphal I. scapularis; 96% reduction in Borrelia infection in infected small mammals and 93% reduction in infected ticks

Integrated Control of Nymphal *Ixodes scapularis*: Effectiveness of White-Tailed Deer Reduction, the Entomopathogenic Fungus *Metarhizium anisopliae*, and Fipronil-Based Rodent Bait Boxes

Scott C. Williams, Kirby C. Stafford, III, Goudarz Molaie, and Megan A. Linke

**INTEGRATED CONTROL OF NYMPHAL *IXODES SCAPULARIS***

**Table 4. Mean density of questing *I. scapularis* nymphs (/100 m²) for pre-Met52 treatment (baseline) and posttreatment (summer) for control and bait box/Met52 treatments and percent effectiveness.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Treatment</th>
<th>Baseline</th>
<th>Summer</th>
<th>% Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Control</td>
<td>0.27</td>
<td>1.69</td>
<td>95</td>
</tr>
<tr>
<td>2013</td>
<td>Bait box/Met52</td>
<td>0.60</td>
<td>0.20</td>
<td>95</td>
</tr>
<tr>
<td>2014</td>
<td>Control</td>
<td>0.31</td>
<td>0.46</td>
<td>97</td>
</tr>
<tr>
<td>2014</td>
<td>Bait box/Met52</td>
<td>0.55</td>
<td>0.02</td>
<td>97</td>
</tr>
<tr>
<td>2015</td>
<td>Control</td>
<td>1.34</td>
<td>1.06</td>
<td>78</td>
</tr>
<tr>
<td>2015</td>
<td>Bait box/Met52</td>
<td>0.36</td>
<td>0.06</td>
<td>78</td>
</tr>
<tr>
<td>2016</td>
<td>Control</td>
<td>1.14</td>
<td>0.59</td>
<td>78</td>
</tr>
<tr>
<td>2016</td>
<td>Bait box only</td>
<td>0.56</td>
<td>0.51</td>
<td>78</td>
</tr>
</tbody>
</table>

**FIG. 1.** Positive encounters for ≥1 questing *Ixodes scapularis* nymph for May to July 2013, 2014, 2015 and the average for all 3 years combined for all treatment assignments. Columns with the same letter are not significantly different within each year.
Comparison of bait boxes and tick tubes

TCS bait boxes provided 84.0% and 79.1% control, while Tick tubes resulted in 27.6% and 20.3% control of questing nymphs in treated areas at 1 year and 2 year postintervention
Questions?
Ongoing USDA-ARS Project in Maryland

**TCS Bait Boxes** are being used as a component of Integrated Pest Management (IPM)
1. David Force Park (Bait box, Met52)
2. Centennial Park (Untreated Control)
3. Cedar Lane Park (4-Poster, Bait box)
4. MPEA (4-Poster, Bait box)
5. Blandair Park (Bait box, Met52, 4-Poster)
6. Rockburn Park (Bait box, Met52, 4-Poster)
7. Wincopin Trail (Bait box+Met52)
Mouse Trapping in 2017

- Monthly from May to September 2017
- At each of the 7 area-wide parks
- Each trapping effort consisted of two consecutive days of captures, with 72 traps at each park.
- After each mouse was ear tagged, tissue, blood and ticks were collected.

Results:

- Captured a total of 341 individual mice, 620 recaptures.
- Collected a total of 1,463 mouse ear tissue and blood samples.
- Collected 625 ticks from mice.

USDA-ARS Area-wide Tick Control Project in Maryland
(Li - unpublished date)
**Objective:** to determine the percentage of the population of primary rodent reservoirs that consumed bait.

**Results:** In bait box locations, 91% of captured mice were RhB-positive, 89% in hand broadcast locations, and 80% in time-release station locations.

**Williams et al. 2020.**
Vector-Borne Zoonotic Dis. 22(8): 603-612.

Administration of an Orally Delivered Substrate Targeting a Mammalian Zoonotic Pathogen Reservoir Population: Novel Application and Biomarker Analysis

- U.S. Biologic, Inc. - inactivated, recombinant OspA vaccine coated on small bait pellets.

- Initial bait consumption study in 2014 at 22 residences and bait was amended with the dye Rhodamine-B in late summer.

- 2018 study to compare two distribution methods: experimental time-release bait station vs hand-distribution.


*Borrelia burgdorferi* infection in fully, partially, and slightly engorged larval *Ixodes scapularis* parasitizing *Peromyscus leucopus* in 2015 and 2016.

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
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<tr>
<td></td>
<td>Control</td>
<td>RTV</td>
</tr>
<tr>
<td># larvae</td>
<td>54</td>
<td>31</td>
</tr>
<tr>
<td># Infected</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>% infected</td>
<td>41%</td>
<td>35%</td>
</tr>
<tr>
<td>Pearson P value</td>
<td>No Significance</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

During the two-year vaccination period, a significant decrease ($P < 0.001$) in the percentage of *B. burgdorferi*-infected *I. scapularis* larvae parasitizing *P. leucopus* was observed, as was a significant reduction ($P < 0.0001$) in the percentage of infected *P. leucopus*, based on enzyme-linked immunosorbent assay, on RTV-treated properties when compared to control properties.
White-tailed deer

✓ Dramatic increase in population density in many areas.

✓ Increased deer-human conflicts:
  * deer-vehicle collision
  * agricultural damage
  * forest damage
  * damages to households

✓ Primary host for adult ticks
The Relationship Between Deer Density, Tick Abundance, and Human Cases of Lyme Disease in a Residential Community

HOWARD J. KILPATRICK, ANDREW M. LABONTE, AND KIRBY C. STAFFORD, III

J. Med. Entomol. 51(4): 777-784 (2014); DOI: http://dx.doi.org/10.1603/ME13232

Fig. 4. Nymphal tick density and deer densities in the MC community in Groton, CT, 1996-2007.

Fig. 5. Reported cases of Lyme disease and deer densities in the MC community in Groton, CT, 1996-2007.
Lyme Disease
Killing deer can make matters worse
THE HUMANE SOCIETY OF THE UNITED STATES

Important things to know about Lyme disease:

- It's a serious public health issue.
- The black-legged tick spreads the disease by ingesting and spreading a bacterium that is transmitted through blood.
- The black-legged tick itself becomes infected with Lyme disease-causing bacteria by feeding on an infected “reservoir host”, an organism that carries high levels of the bacteria in its bloodstream. In most areas, this first host is the white-footed mouse.
- Deer are one of many vertebrate hosts that carry this tick. Other hosts include mice, chipmunks, raccoons, squirrels, lizards in addition to many popular songbirds, totaling well over 60 species.
- The black-legged tick has three active life stages (larva, nymph, and adult) which each take a single blood meal from a host. The tick seems to prefer a progressively larger host to feed upon at each life stage.
- Killing deer will not reduce the risk of Lyme disease for people.

https://www.humanesociety.org/resources/lyme-disease
Lyme Disease
Killing deer can make matters worse

THE HUMANE SOCIETY OF THE UNITED STATES

Practical solutions

4-Poster Bait Box System
One proven way to reduce tick numbers is the

4-Poster bait box system
It attracts deer to corn bait stations where a tick-killing product is applied to the deer’s neck and shoulders. In essence, this device uses deer to kill ticks and has shown dramatic reductions in tick numbers in areas where it has been used. The 4-Poster bait box is commercially available in the United States, but using and maintaining it requires a special license. For more information, see: http://www.liebertonline.com/toj/vol5/4.

Tick Tubes
Homeowners can use Dermisint Tick Tubes—tubes filled with permethrin-treated cotton balls which mice use for nesting material. This kills the ticks in their early larval stage when they attach to mice as their first host. Dermisint tubes are an effective approach to reducing ticks and are commercially available at garden or hardware stores or the internet.

Avoiding Lyme disease

- Check your body thoroughly for ticks immediately after removing clothing and placing everything in the washer. Do the same for your child until he is old enough to do so for himself. This is the single most important way to find ticks before they engorge themselves and are able to transmit the disease. It generally takes about 36 hours before the tick has consumed enough blood to transmit Lyme disease—thus if a tick is found within 24 hours of attaching to a person, it is unlikely it could have transmitted enough of the bacterium to cause Lyme disease.
ARS ‘4-Poster’ Deer Treatment Bait Station & ‘2-Poster’ Treatment Adaptor:

To Control Ticks Feeding on White-tailed Deer
The Northeast Area-wide Tick Control Project (NEATCP)

✓ 2.1 million, 5-year (1997-2002) project
✓ 7 individual 2-square-mile study sites
✓ in five states: Connecticut, Maryland, New Jersey, New York, and Rhode Island
✓ 60-82% reduction in tick population.
Previous studies


Evaluation of “4-Poster” for control of the blacklegged tick and lone star tick in 5 northeastern states.

Results published in Vector-Borne and Zoonotic Diseases 9(4) 2009

New Jersey (Schulze et al. 2009)
- 83%, 77%, and 94% reduction in host-seeking larvae, nymphs, and adults (I. scapularis)
- 83%, 77%, and 94% reduction in host-seeking larvae, nymphs, and adults (A. americanum)

Maryland (Carroll et al. 2009)
- 69-80% reduction in host-seeking nymphs of the blacklegged tick (I. scapularis)
- 95-99% reduction in host-seeking nymphs of the lone star tick (A. americanum)

Rhode Island (Miller et al. 2009)*
- After 2 years of “4-Poster” use, 50% control of nymphal blacklegged ticks was achieved.
- The tendency of white-tailed deer to use the 4-Poster appeared to be dependent on the availability of alternative food sources.

Connecticut (Stafford et al. 2009)
- 46-70% reduction in host-seeking nymphs and 19% in host-seeking adults (I. scapularis)
- The passive topical application to deer of the acaricide amitraz resulted in a significant decrease in the population of free-living I. scapularis nymphs in the treated core in Connecticut

New York (Daniels et al. 2009)
- 54-80% reduction in host-seeking nymphs (I. scapularis)
- The 4-Poster effectively reduced the density of Ixodes scapularis, though the level of control is dependent on environmental factors that affect feeding behavior of white-tailed deer.

Overall, the density of nymphs infected with B. burgdorferi and consequently the acarological risk for Lyme disease was reduced by 68% among five study sites. (Hoen et al. 2009)
More recent studies

“4-Poster” study on Cape Cod, Martha’s Vineyard, and Nantucket (2012-2015)
Grear et al. 2014. Parasites and vectors
* Achieved only a 8.4% reduction in blacklegged tick abundance.

“4-Poster” study against the lone star tick in Tennessee (4-year study)
* 91%, 68%, and 49% reduction in larval, nymphal and adult abundance close (>300 m) to ‘4-Poster’.
* The use of “4-Poster” has little large scale effect on the health risk posed by ticks in the community.

“4-Poster” Study in Fairfax County, Virginia (2012-2015)
Fairfax County Study Report. 2016
* Although some tick control was seen, widespread reduction in tick abundance was not observed.
* Negative environmental effects; Increased deer density
Issues observed with the “4-Poster” device

Deer Behavior Around 4-Posters

Use by non-target animals

Malfunction of rollers

Use by non-target animals
TickLick - USDA’s new generation of the deer “Bait Treatment System”

Preliminary test of animal access / usage in 9 days (June 1-9, 2017)

<table>
<thead>
<tr>
<th>Animal species</th>
<th>Bait type</th>
<th>Total times visited</th>
</tr>
</thead>
<tbody>
<tr>
<td>White-tailed deer</td>
<td>Salt</td>
<td>63</td>
</tr>
<tr>
<td>Squirrel</td>
<td>Salt</td>
<td>16</td>
</tr>
<tr>
<td>Raccoon</td>
<td>Salt</td>
<td>3</td>
</tr>
</tbody>
</table>

- Mineral/salt block as bait.
- Use the same acaricide formulation (10% permethrin) to treat rollers.
- A patent application has been filed in August 2020.
- New study is planned for Montgomery County, MD (2020 - 2022)
Field trials of “TickLick” by USDA-ARS with cooperation of the University of Maryland (2020 – 2022)

- Deer visits in comparison to “4-poster”
- Non-target animals
- Preferred bait (mineral/salt) blocks for different seasons
- Preferred locations
- Number of units for a given area
Summary

- We have a limited number of host-targeted tick control tools/commercial products for tick control. None has achieved widespread use.

- Pros and Cons:
  - **Tick tubes**
    - + easy to use, relatively inexpensive
    - - uncertain about efficacy; need more studies
  - **TCS Bait Boxes**
    - + proven efficacy, scientific studies
    - - expensive, deployed by pest control professional
  - **“4-Poster” device**
    - + demonstrated efficacy in early studies
    - - not very effective in recent studies
    - - deployed only by pest control professional
    - - costs, maintenance issues, large amount of corns fed to wildlife

- Few new devices are in development, but no silver bullet.
- Studies to test and validate IPM strategies are in progress
- Lack of the organizational structure and funds required for community-based tick IPM.
Acknowledgments

USDA-ARS
Areawide Tick Management Project Team
& Cooperators / Collaborators

Beltsville Agricultural Research Center
Questions?
Some Questions for You
Request for Proposals

• Due date: November 12, 2020
• https://www.northeastipm.org/grant-programs/ipm-center-grants/ipm-partnership-grants/
Find a Colleague

• To post a profile about yourself and your work:
  • http://neipmc.org/go/APra
  • “Find a Colleague” site
  • http://neipmc.org/go/colleagues
Upcoming Webinars

• **Tick IPM #7: Leaf Litter/Snow Removal for Tick Reduction**
  Dr. Kirby C. Stafford III, Connecticut Agricultural Experiment Station, October 7, 2020 – 11:00 a.m.

For Updates: https://www.northeastipm.org/ipm-in-action/the-ipm-toolbox/
Recording of Tick IPM Webinar Series

• Past recordings and today’s Webinar will be available to view on demand in a few business days.

• [http://www.neipmc.org/go/ipmtoolbox](http://www.neipmc.org/go/ipmtoolbox)

• You can watch as often as you like.
Acknowledgments

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