

# The *PAMS* approach

*Prevention, Avoidance, Monitoring and Suppression*

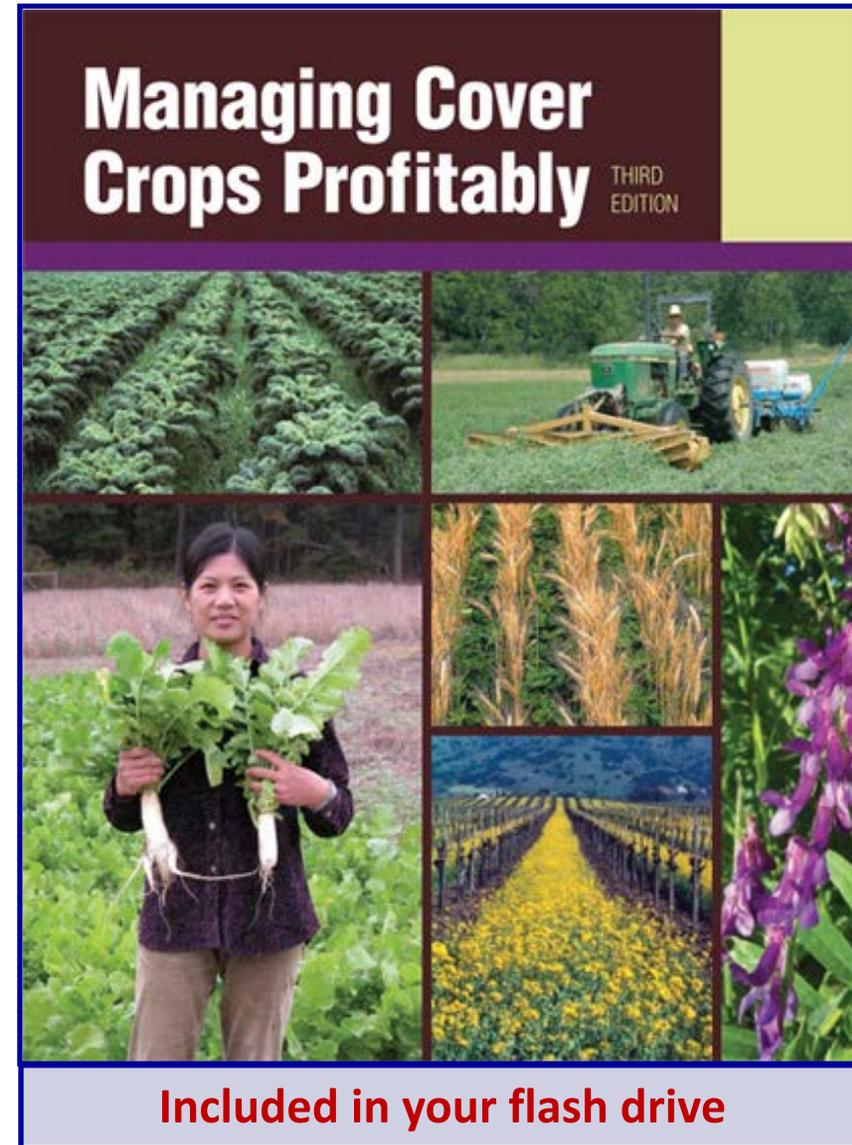
- **Cover crops** (crops planted primarily to manage soil fertility, soil quality, water, weeds, pests, diseases, biodiversity and wildlife in farms)
- [www.extension.org/](http://www.extension.org/) (also, see handout with links to websites)
- **Trap crops**



*This rye–vetch cover crop mulch delayed weed growth sufficiently to prevent significant weed competition against the broccoli. The cover crop was mowed and the broccoli transplanted about 7 weeks before this picture was taken on Cape Cod, MA. Figure credit: Mark Schonbeck, Virginia Assoc. for Biological Farming*

# Some advantages of cover crops

- *“Cover crops slow erosion, improve soil, smother weeds, enhance nutrient and moisture availability, help control many pests and bring many other benefits to your farm”*
- *“At the same time, they can reduce costs, increase profits and even create new sources of income. You’ll reap dividends on your cover crop investments for years, because their benefits accumulate over the long term”*



*Increasing energy costs will have a profound effect on farm economics in coming years.*

*Since cover crop economics are rooted in nitrogen dynamics (how much N you save or produce with cover crops), fuel costs (the cost of N and trips across the field) and commodity prices, energy prices will certainly impact the economics of cover crop use*



Butternut squash grown under strip tillage. A winter rye cover crop was planted in the fall following light disking of last year's bean crop; squash was planted into 9-inch wide by 12-inch deep strips that were tilled in the spring. *From Michigan State Univ.*

# Cover crops and IPM...



**Bacterial fruit blotch**

07/15/2012 07:08



**buckwheat**

07/24/2012 09:21

# Carver Farm (Dr. Sanjun Gu)

Sorghum/Sudan grass  
Hybrid (cover crop)

peppers

07/24/2012 09:12

# Carver Farm (Dr. Sanjun Gu)

Sorghum/Sudan grass  
Hybrid (cover crop)

tomato

07/24/2012 09:18

# Push-Pull Strategy and Trap Cropping

**Behavioral manipulation of insect pests and their natural enemies via the integration of stimuli that act to:**

- (1) make the protected resource unattractive or unsuitable to the pests (**PUSH**) while
- (2) luring them toward an attractive source (**PULL**) from where the pests are subsequently removed or killed

## **REQUIREMENTS:**

**Trap crop plants, lures, traps, and repellents**

**MOSTLY, NON-TOXIC COMPONENTS**

# Trap Crops

- Most insects show a preference for particular plants
- **Trap Crops:** Plants that are planted next to a higher value crop so as to attract pest as either a food source or oviposition site
- **Trap crops** can attract pests to the border areas, where can they be killed. Pest numbers on the unsprayed cash crop can be reduced



Aggregations of spotted cucumber beetles on young Blue Hubbard squash (trap crop)



# Advantages

1. Decrease pesticide use and costs
2. Natural enemies can reproduce in trap crop plants
3. Improve crop's quality
4. Help conserve the soil and environment



Stink bug trap crops (left) adjacent to soybean in October in north Florida  
(Picture: Univ. Florida)

# Ideal Features of a Trap Crop Plant

- Attracts target pests, preferably multiple species
- Seeds readily available
- Cost effective relative to other tactics
- Culture and management well known
- Maturity time (range short to long)
- Duration extendable (by ratooning)
- Multi-functions (attracts pollinators, beneficial insects, etc.)



**Ratooning:** Mowing down to 0.5 m to induce repeat shoot production and heading

(Picture: Univ. Florida)

# Example: Stink Bugs and Leaf-footed bugs

- Stink/leaf-footed bugs display a definite edge response to and buildup populations in **border rows** of crops before moving into the crop interior
- These bugs are tolerant of most insecticides and difficult to manage effectively
- They prefer to feed on specific parts of plants in specific maturity stages, primarily seeds in the **milk stage**



Green stink bugs on millet  
(Picture: Univ. Florida)

# Example: Stink Bugs and Leaf-footed bugs

- Buckwheat is easy to obtain and culture, grows quickly and is highly attractive to stink/leaf-footed bugs when in seed. The flowers also provide pollen and nectar to pollinators, predators and parasites
- Millet and sorghum also provide highly attractive seeds
- Sorghum, millet, and buckwheat may be ratooned, thereby extending the life of the trap crops



Millet

Picture: [www.pecad.fas.usda.gov](http://www.pecad.fas.usda.gov)

# Some Recommendations (Univ. Florida)

- By planting multiple sorghum cultivars with different maturity dates, the life of a trap crop can be extended
- For smaller growers: May wish to grow these trap crops in combinations in large containers that can be moved around the field to protect specific plantings
- For larger fields: surround the main crop with a 2-3 meter border of the trap crops. Smaller areas can be protected using parallel or edge-planted plots



Small plantings of species such as triticale, sorghum, millet, buckwheat, soybean, amongst others provide superior food plants for stink bugs and leaf-footed bugs while also attracting parasites, predators, and pollinators

(Picture: Univ. Florida)

# Example: Cabbage Caterpillars

- Collards are excellent trap crops when planted around cabbage. Caterpillars congregate in the collards and cabbage may not need to be sprayed
- 'Vates', 'Georgia' or 'Champion' collard varieties make good trap crops
- Make sure the trap crop barrier remains lush all through the season to attract the pest and the barrier extends all the way around the crop you wish to protect



Cabbage fields surrounded by 2 rows of collards (in Florida)



Trap crops can also preserve natural enemies

# Collards as Trap Crops

- Unless you plan to market the collards, researchers in Florida recommend **not spraying the trap crop** to allow it to build up high populations of DBM parasites.
- Fields in the Northeast may have parasitism rates as high as 50 to 70%
- There are also many other effective, naturally-occurring predators and parasites that can build up in the trap crop area to help provide control of DBM and other cole crop pests.



A native parasitoid, consistently parasitizes 80-85% of larva populations (at least for mid-and late-season cabbage in MN and WI  
Picture: Univ. Vermont

# Alfalfa as a Trap Crop for Strawberries

- Western Tarnished Plant Bug is a significant cosmetic pest of strawberries in California
- One insect pest management techniques used by strawberry growers in CA is whole field deployment of tractor-mounted insect vacuums, or “bug vacs”
- Alfalfa used as a trap crop accumulated WTPB at 5-10 times greater density than strawberries
- The vacuumed trap crop treatment reduced damage due to WTPB bug feeding in associated strawberry rows by 38-47% compared with the whole field vacuuming



Catfacing in strawberries caused by Western Tarnished Plant Bug  
Picture: Univ. Vermont





Striped cucumber beetle



Spotted cucumber beetle  
(= Southern Corn Rootworm)

Pictures: Whitney Cranshaw, Colorado State Univ.



Striped cucumber beetle aggregations



Larvae tunneling at plant base producing plant collapse



Zucchini plant infected with bacterial wilt



Scarring of cantaloupe/honeydew skin

# Blue Hubbard squash: An excellent trap crop



Very attractive to adult cucumber beetles  
Not susceptible to bacterial wilt



# Using Trap Crops for Control of *Acalymma vittatum* (Coleoptera: Chrysomelidae) Reduces Insecticide Use in Butternut Squash

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J. Econ. Entomol. 102(3): 1101–1107 (2009)

- Use of Blue Hubbard as a trap crop reduced insecticide use by 94% compared to insecticides applied to the entire field
- Surveyed growers who participated in the experiments and found a high level of satisfaction with the effectiveness and simplicity of the system

# One example

- In Massachusetts, 6 butternut growers planted a Blue Hubbard border around fields (2 to 6 acres). These 6 fields were compared to butternut fields where beetles were controlled with full-field insecticide sprays
- Fields were scouted twice weekly until first leaves, then weekly until flowering. **Borders were sprayed at the first arrival of the beetles**
- CB were only found in the trap crop and insecticides were only applied to the perimeter trap crop
- Excellent performance of Blue Hubbard squash (cash crop was not sprayed). In addition, yield in PTC plots was 12.5% higher in plots surrounded by Blue Hubbard, lowest yield was in sprayed plots

**85% less insecticide was applied**

# Buttercup Squash Provides a Marketable Alternative to Blue Hubbard as a Trap Crop for Control of Striped Cucumber Beetles (Coleoptera: Chrysomelidae)

ANDREW F. CAVANAGH,<sup>1</sup> LYNN S. ADLER,<sup>2,3</sup> AND RUTH V. HAZZARD<sup>1</sup>

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Environ. Entomol. 39(6): 1953–1960 (2010); DOI: 10.1603/EN10056



Two-row perimeter of buttercup squash around a main crop of butternut.

Picture: Univ. of Massachusetts

# 2011 On-farm Trap Crop Study



- Mr. Jose Fonseca (St. Peters, MO)
- 13 acres, mostly tomatoes (9 acres), cucurbits (3), cole crops (1),
- Conventional vegetable farmer, very interested in IPM

**Problem:** cucumber beetles get inside hoophouse and kill the seedlings

**Solution:** Application of systemic insecticide Imidacloprid (Admire PRO)



**Systemic insecticides:** Those in which the **active ingredient** is taken up, primarily by plant roots, and transported to other locations throughout the plant, such as growing points, where it can affect plant-feeding pests.

Systemic insecticides are most effective on insects with piercing—sucking mouthparts, such as aphids, whiteflies, mealybugs, and soft scales, because these insects feed within the vascular plant tissues.

## 2011 Trap Crop Approach:

Mr. Fonseca planted Blue Hubbard squash, planted in pots, and placed 4 plants outdoors, on the corners of the hoophouse



# May 8, 2011



- Mr. Fonseca counted **121 striped** cucumber beetles and **4 spotted** beetles on the **4 Blue Hubbards**
- Imidacloprid was applied to the 4 potted plants at this moment
- No beetles were seen inside the hoop house (1,000 zucchini seedlings)
- Suggested to grow more Blue Hubbards and plant 2 perimeter-rows to protect the zucchinis when transplanting to the field

# June 6, 2011



- Mr. Mbogho and I travelled to Mr. Fonseca's farm. Couldn't find the 2 rows of Blue Hubbards!
- Farmer indicated that *"was unable to grow more Blue Hubbard plants"*
- Conducted a random sampling of 25 Zucchini; also counted beetles on the 4 Blue Hubbard plants that he had transplanted to the field
- Results?

# June 6 - Results

Insect	Mean 4 BH	Mean 25 Zuch.
Striped	16.5	0.00
Spotted	1.0	0.04
Squash bugs	3.5	0.00



# June/July - Results

Date	Insect	Mean 4 BH	Mean 25 Zuch.
06.20	Striped	3.0	0
06.20	Spotted	1.2	0
06.20	Squash bugs	0.0	0

Date	Insect	Mean 4 BH	Mean 25 Zuch.
07.11	Striped	0.25	0
07.11	Spotted	0.50	0
07.11	Squash bugs	0.75	0

Date	Insect	Mean 4 BH	Mean 25 Zuch.
06.27	Striped	0	0
06.27	Spotted	0.5	0
06.27	Squash bugs	0	0

Date	Insect	Mean 4 BH	Mean 25 Zuch.
07.18	Striped	0	0
07.18	Spotted	0.75	0
07.18	Squash bugs	0	0

Date	Insect	Mean 4 BH	Mean 25 Zuch.
07.05	Striped	0	0
07.05	Spotted	0.75	0
07.05	Squash bugs	0	0

Date	Insect	Mean 4 BH	Mean 25 Zuch.
07.25	Striped	0.5	0
07.25	Spotted	2.0	0.04 <b>Sprayed!</b>
07.25	Squash bugs	0	0

# 2012 Results

- Jose Fonseca tried the trap cropping approach for a second year in a row
- Planted 2,400 zucchinis directly from seed, placed Blue Hubbard squash plants (trap crops) in the corners
- May 3, 2012: killed 64 spotted beetles in Blue Hubbard plants
- Very few insect pests observed in zucchinis, saw good number of beneficial insects (predators)
- Did not apply a drop of insecticide in his zucchinis
- Also, planted buckwheat in one section to attract pollinators and other beneficial insects



# Using Repellents

Surround = kaolin clay

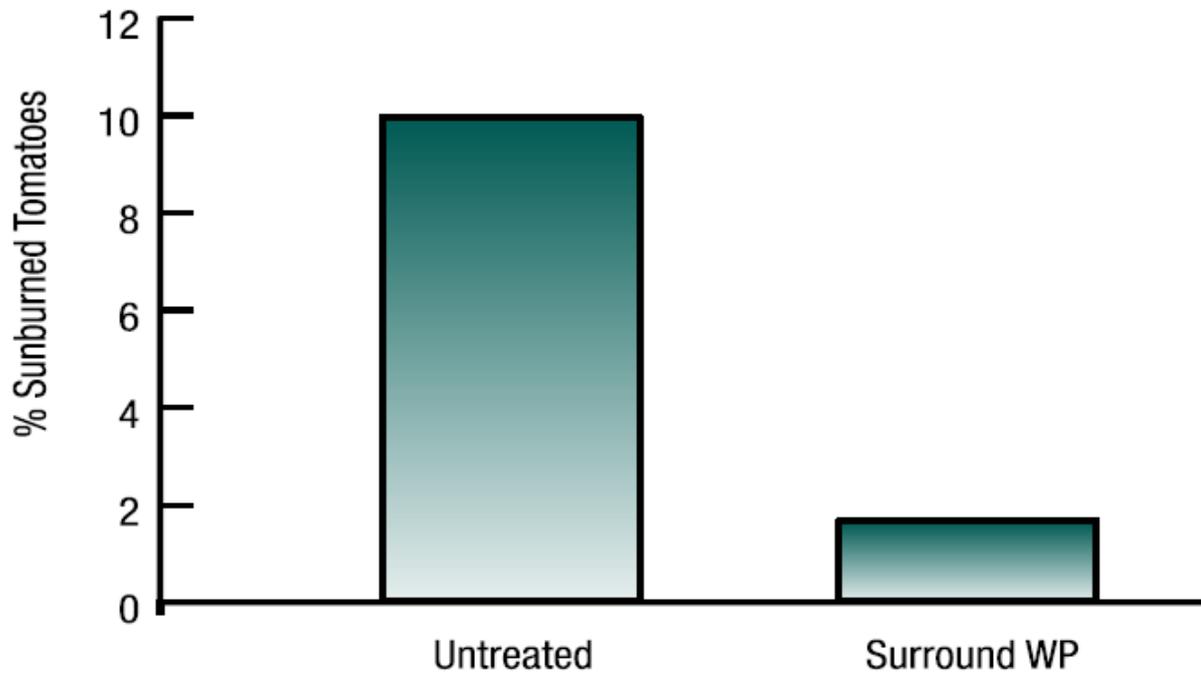
- Surround WP acts as a repellent, mechanical barrier and irritant
- The active ingredient is specially processed **kaolin clay**, a naturally-occurring edible mineral used as an anti-caking agent in processed foods
- Can be used against cucumber beetles in combination with trap crops (Blue Hubbard squash planted in the perimeter)
- Surround has been shown to significantly increase marketable yield by reducing heat stress and sunburn damage

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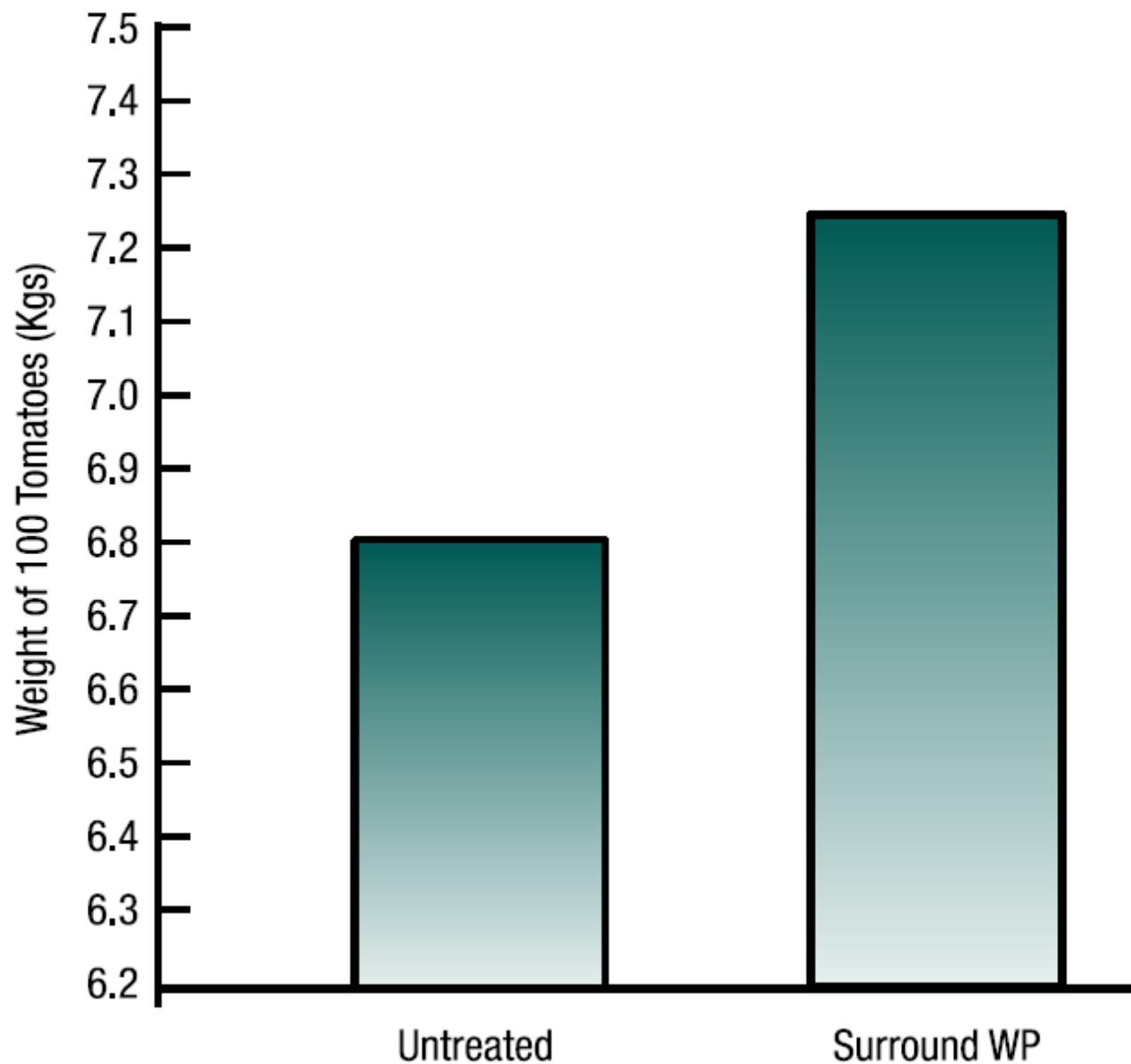


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- Excessive heat can stress the entire tomato plant, causing irreversible damage to plant function or development. Temperatures higher than 90 to 95°F can interfere with pollination and fertilization, contributing to poor fruit set
  - Higher temperatures may result in blossom and fruit drop or oddly shaped fruit
  - Heat also affects fruit color, as lycopenes and carotenes are not synthesized above 86°F

## Sunburn in Tomatoes



## Improved Yields in Tomatoes



When applied season-long, Surround has increased tomato yields, in this trial by 6.6%.

Problem	Lbs/Acre	Application Instruction
Cucumber beetle, grasshoppers*	25-50	Start prior to infestation, applying every 5-7 days, with the first two applications 3 days apart.
Powdery mildew*		Apply every 7-14 days as required to maintain coverage.
Sunburn and heat stress	25-100	Apply to sunburn-prone fruit before conditions leading to sunburn occur. If initiating sprays for sunburn suppression, where there have been no prior sprays, provide thorough coverage of all fruit and leaves prior to sunburn-causing conditions with one to two full-rate applications 7 days apart. Depending upon the length of the high heat period, three to four applications in total often are needed with subsequent applications every 7-21 days. Make subsequent applications at half to full rates if even coverage is maintained throughout the high heat period. Under windy conditions, Surround WP can be rubbed off by leaf movement making reapplication necessary.

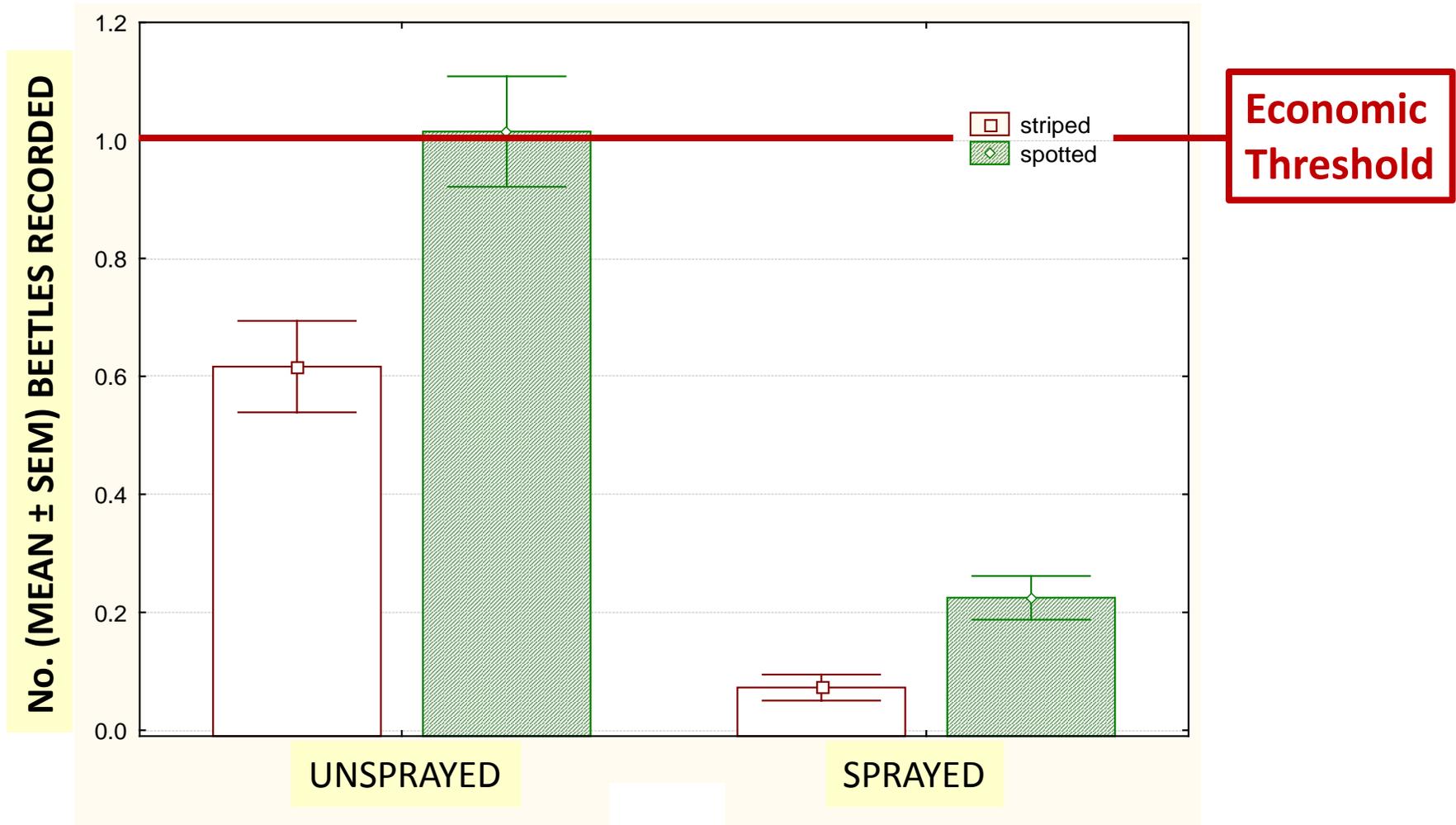
\*Suppression Only. If complete control is needed, consider using supplemental controls.

# Effect of Surround on cucumber beetles



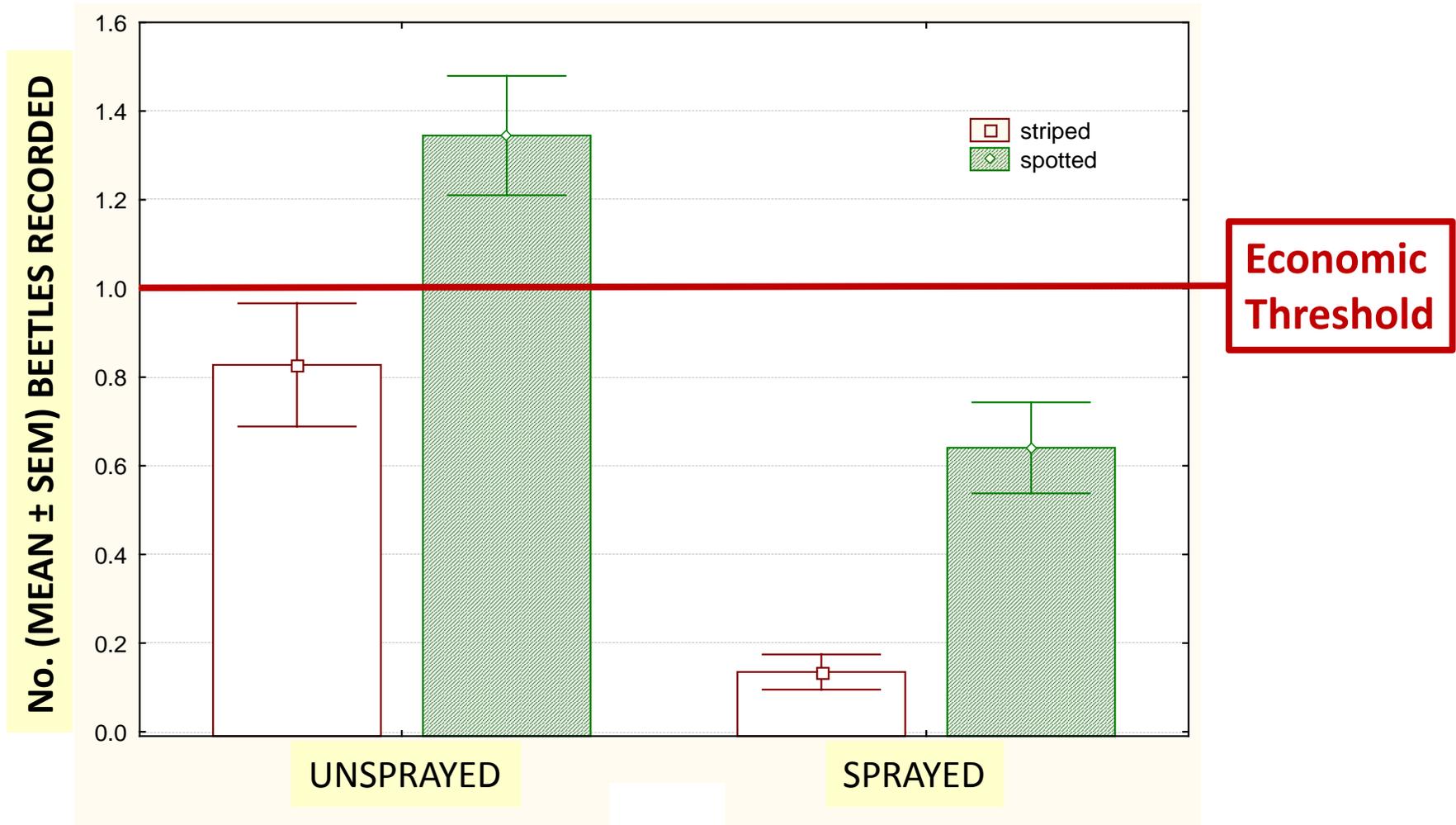
- 2 rows of cucumber (150 plants/row)
- Half of the plants were sprayed (alternating groups of 10 plants)
- Each plant inspected every day for 5 days, then again at day 10
- Number of beetles (per species) **PER PLANT** was recorded

## 24 HOURS LATER



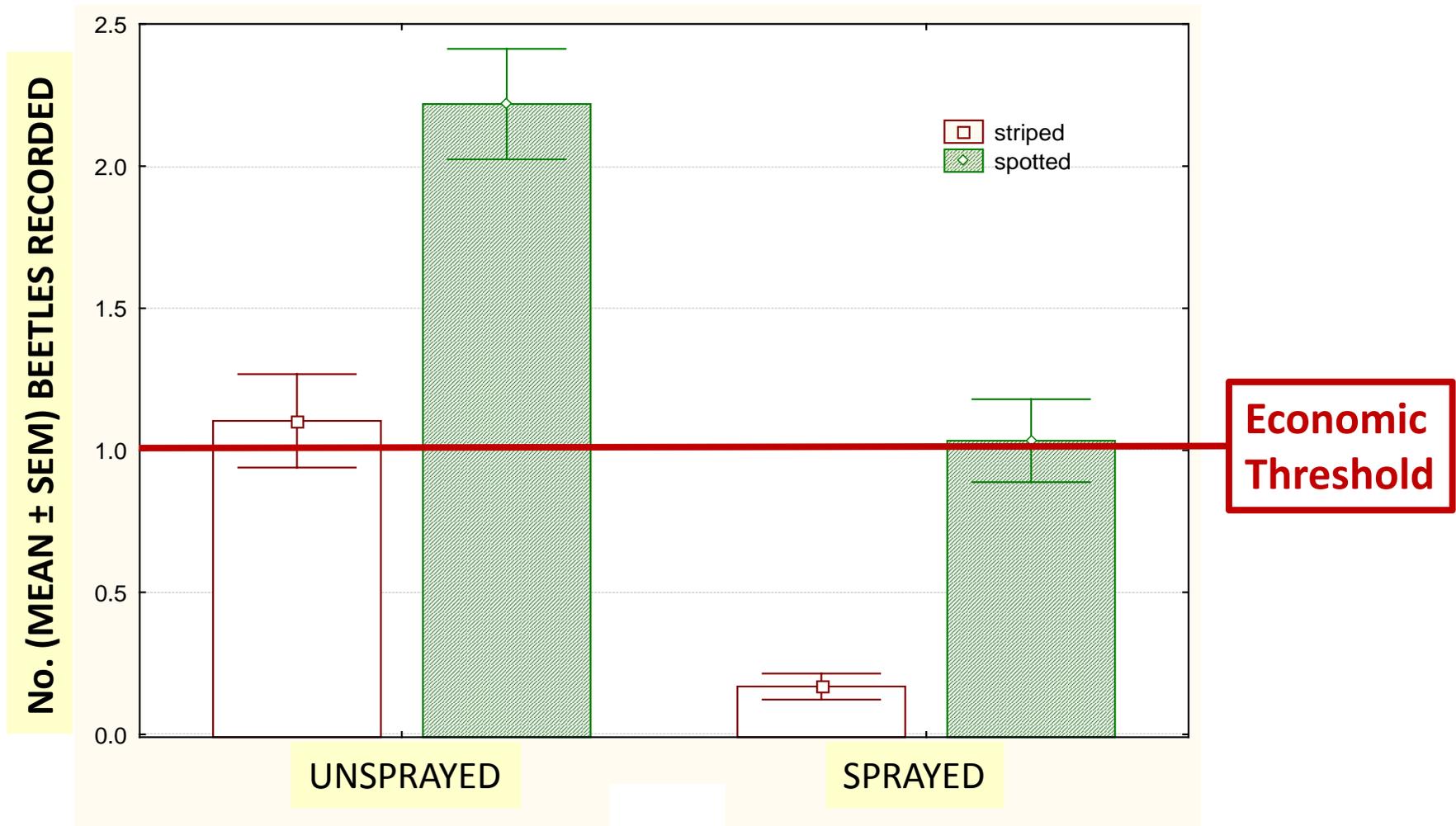
- STRIPED: 83 % reduction
- SPOTTED: 78% reduction

## 48 HOURS LATER



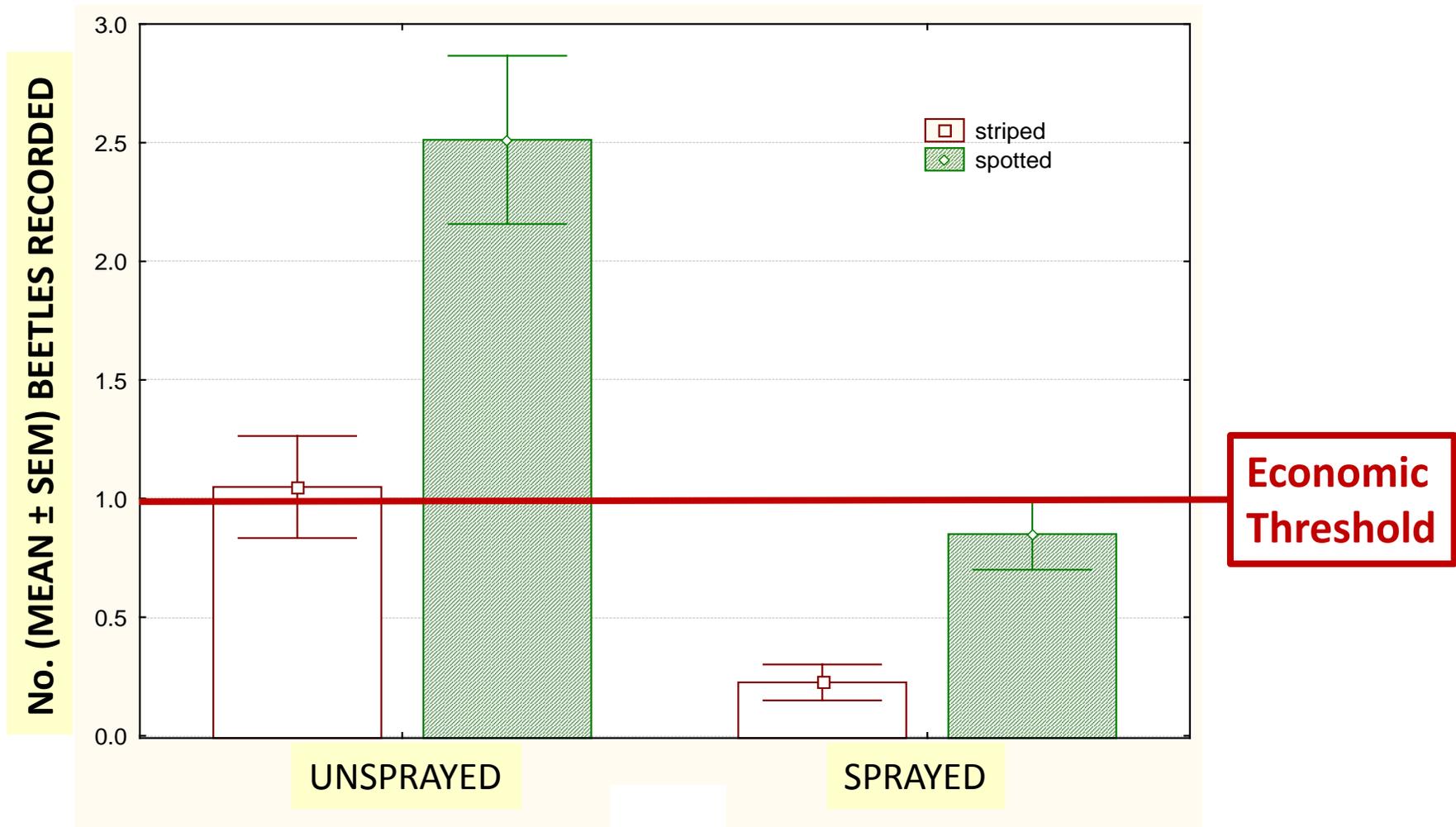
- STRIPED: 65 % reduction
- SPOTTED: 53% reduction

## 72 HOURS LATER



- STRIPED: 80% reduction
- SPOTTED: 52% reduction

## 96 HOURS LATER



- STRIPED: 76% reduction
- SPOTTED: 68% reduction

## Other Examples

- In experiments conducted in two apple orchards in Missouri, Surround WP was successful at suppressing plum curculio damage to fruits, red-banded leafroller damage to leaves (but not consistently to fruits), and flyspeck and sooty blotch diseases on fruits.
- Researchers in Florida reported that the application of Surround WP on the strawberry foliage resulted in a 40% reduction of establishment irrigation volumes, which might represent major water savings for strawberry production.



# Using Repellents

## Neem Products

- Various Neem products have shown to be effective at both repelling insects and inhibiting their feeding

