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Biological and Microbial Control Options for Managing Lygus Bug in Strawberries

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Lygus bug


Lygus bug first instar next to aphid, 4th and 5th instars, and adult

Current pest management practices

- Chemical pesticides and to a limited extent insecticidal soaps, oils, pyrethrin, spinosad, and *Bt*
- Release of predatory mites
- No major emphasis on biological control of lygus bug

Acres treated with insecticides in strawberries

Insecticide	2006	2007	2008	2009	2010
Acres treated with different insecticides					
Oil	690	7,408	20,204	36,957	53,860
Novaluron (Rimon)				24,497	41,149
Fenpyroximate (Akari)					41,149
Sulfur	129,069	139,486	134,076	146,790	157,125
Naled (Dibrom)	18,681	23,819	33,916	51,937	44,587
Spiromesifen (Oberon)	10,375	16,225	18,439	22,485	29,404
Fenpropathrin (Danitol)	20,217	21,272	25,688	27,885	21,229
Abamectin (Agri-Mek)	13,024	16,962	26,103	29,751	35,876
Total	**191,366**	**217,764**	**238,222**	**278,848**	**288,221**
Acreage in California	**29,187**	**29,937**	**31,169**	**35,915**	**34,426**
Total amount of pesticides in pounds (fungicides, insecticides, and herbicides used)					
	9,394,745	**9,669,764**	**9,918,143**	**10,041,462**	**10,972,995**

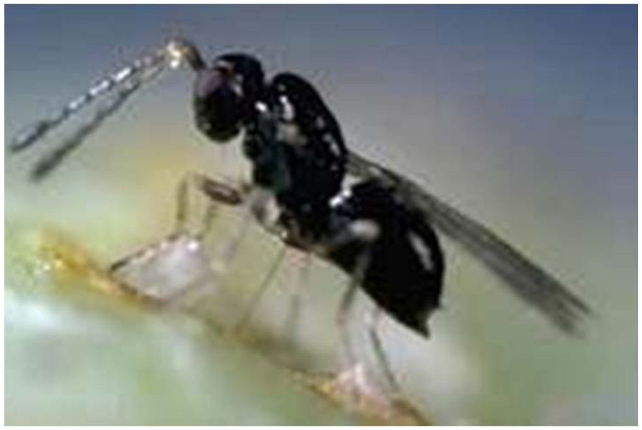
Pesticide Use Report Data 2010, CDPR

Pesticide use in California strawberries-2009

Chemical name	Chemical class	Trade name	Gross pounds	Acres treated
Bifenazate	Unclassified	Acramite, Floramite	17,353	35,480
Bifenthrin	Pyrethroid	Brigade	4,485	41,235
Chlorpyrifos	Organophosphorus	Lorsban	11,323	11,384
Fenpropathrin	Pyrethroid	Danitol	9,243	27,783
Malathion	Organophosphorus	Malathion	144,417	76,208
Methomyl	N-methyl carbamate	Lannate	6,104	7,641
Naled	Organophosphorus	Dibrom	48,723	51,689
Spiromesifen	Keto-enol	Oberon	5,338	22,477
Total			**246,986**	**273,897**

Pesticide Action Network North America
http://www.pesticideinfo.org/DS.jsp?sk=1016

Biocontrol agents and basics



Egg parasitoid, *Anaphes iole*

Nymphal parasitoid, *Peristenus stygicus*

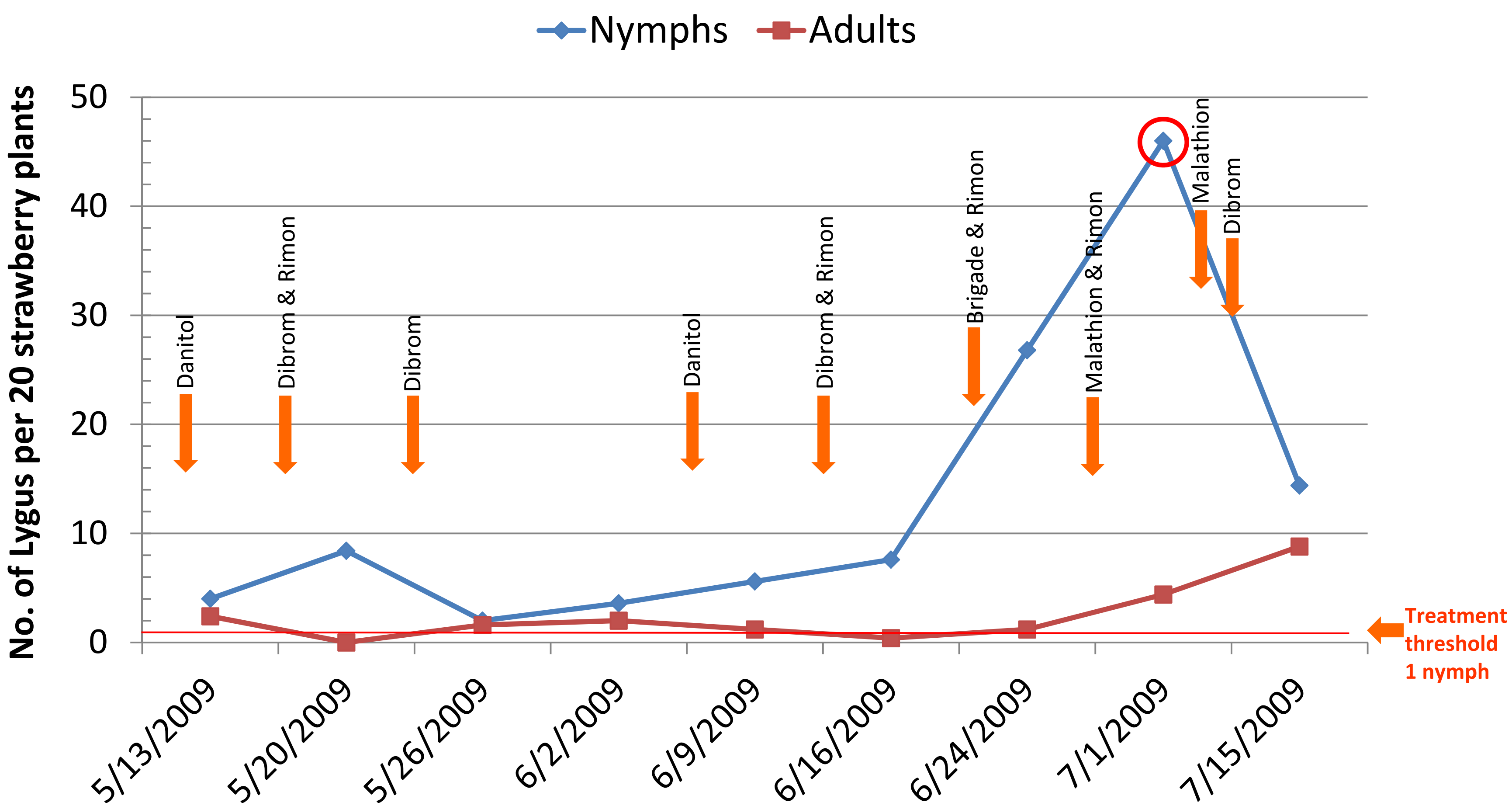
Lygus adult killed by *Beauveria bassiana*




- Multiple natural enemies for different life stages of pest
- Conserving natural enemies
- Providing refuge for natural enemies
- Using chemicals that are less disruptive to natural enemies

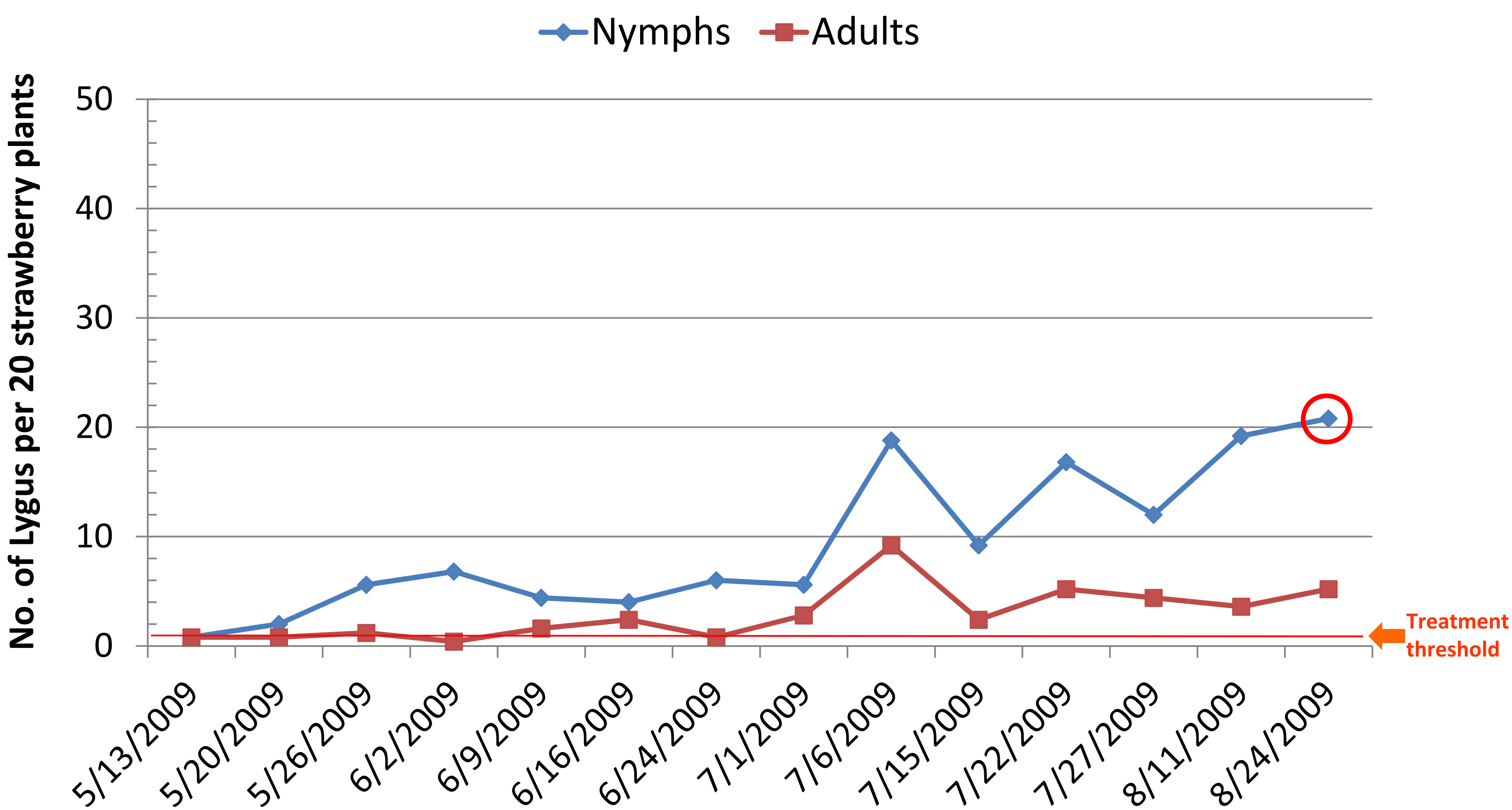
Seasonal occurrence of lygus bug

Conventional strawberry field



Seasonal occurrence of lygus bug

Organic strawberry field



Generalist Predator Gut Content Analyses

Lygus bug predation rates of field-collected predators (via PCR)*

J. Hagler, D. Nieto, S. Swezey, S. Machtley and J. Bryer

Big-eyed bug (N = **84**)
% preyed upon lygus bugs: **13%**

Minute pirate bug (N = **286**)
% preyed upon lygus bugs: **14%**

Damsel bug (N = **108**)
% preyed upon lygus bugs: **20%**

Crab spider (N = **89**)
% preyed upon lygus bugs: **26%**

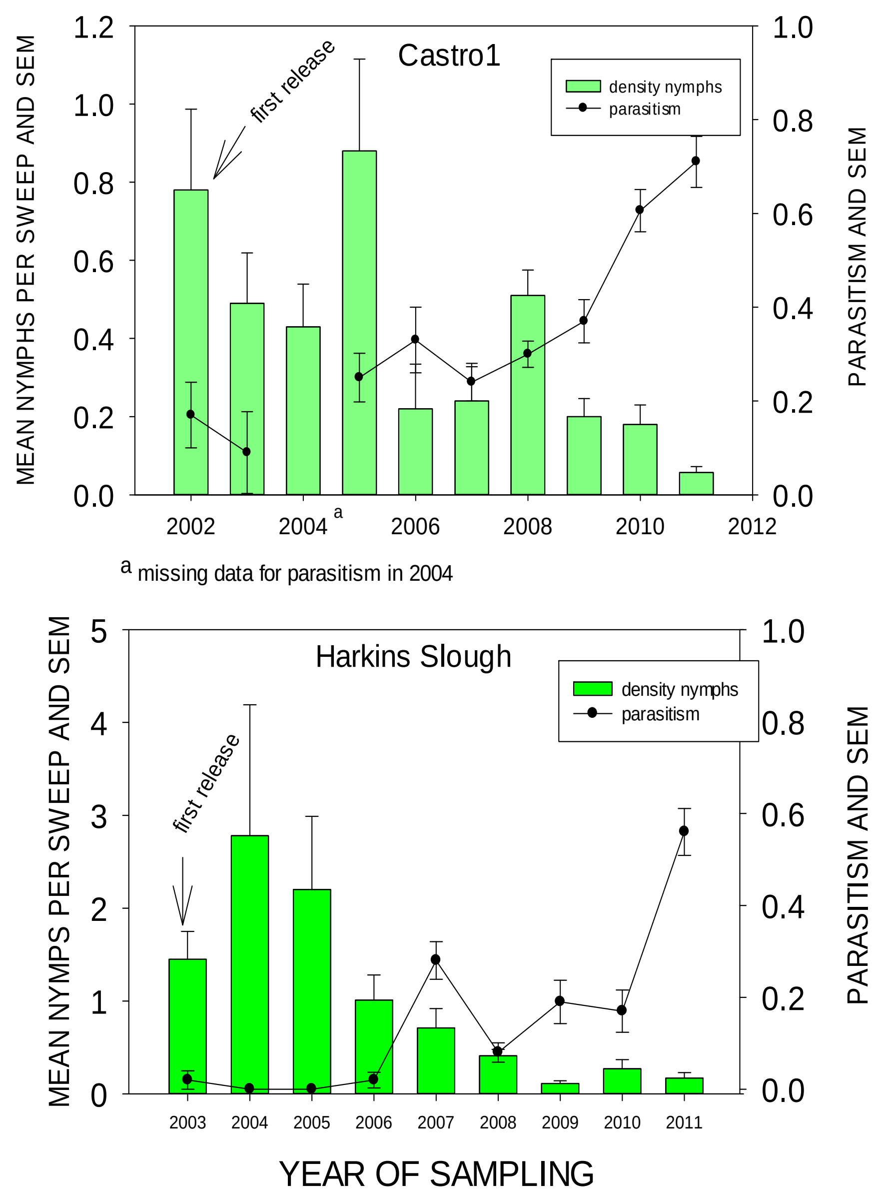
*preliminary data

Parasitism of lygus bug nymphs by the introduced parasitoid *Peristenus relictus*

C. Pickett, S. Swezey, D. Nieto and J. Bryer

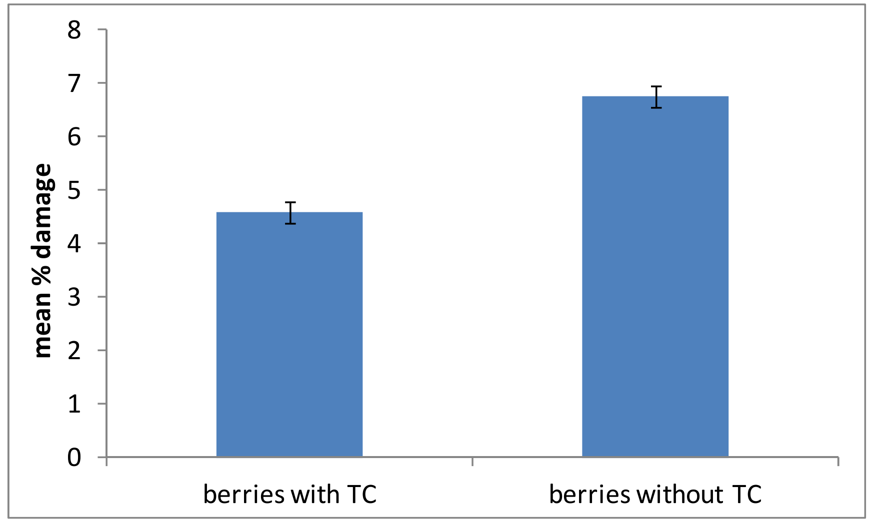
Photo by Charles Pickett

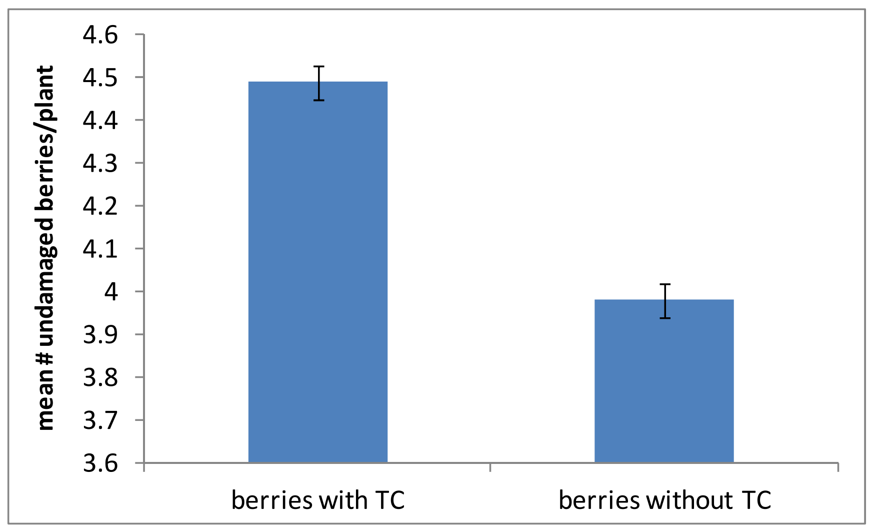
Fig. 1. Seasonal trends in Lygus densities and proportion parasitized by *P. relictus*. Wild vegetation release sites, Castro1 and Harkins Slough. Averaged over July, August, and September.



Alfalfa Trap Crops and Yield (2012)*

D. Nieto, S. Swezey and J. Bryer



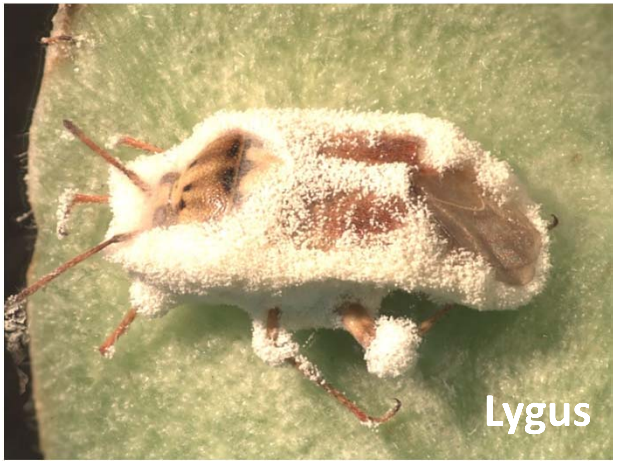


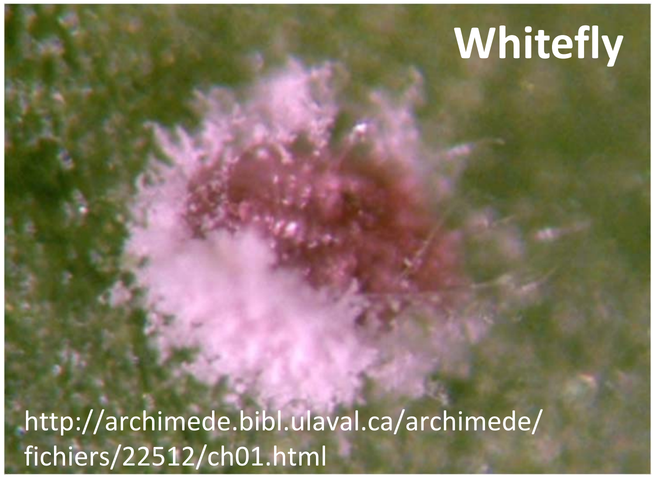
Field data from 2012 organic strawberries in rows 1-4, 7-10, 13-16 and 19-22 adjacent to an alfalfa trap crop (TC) and control row of strawberries

*preliminary data

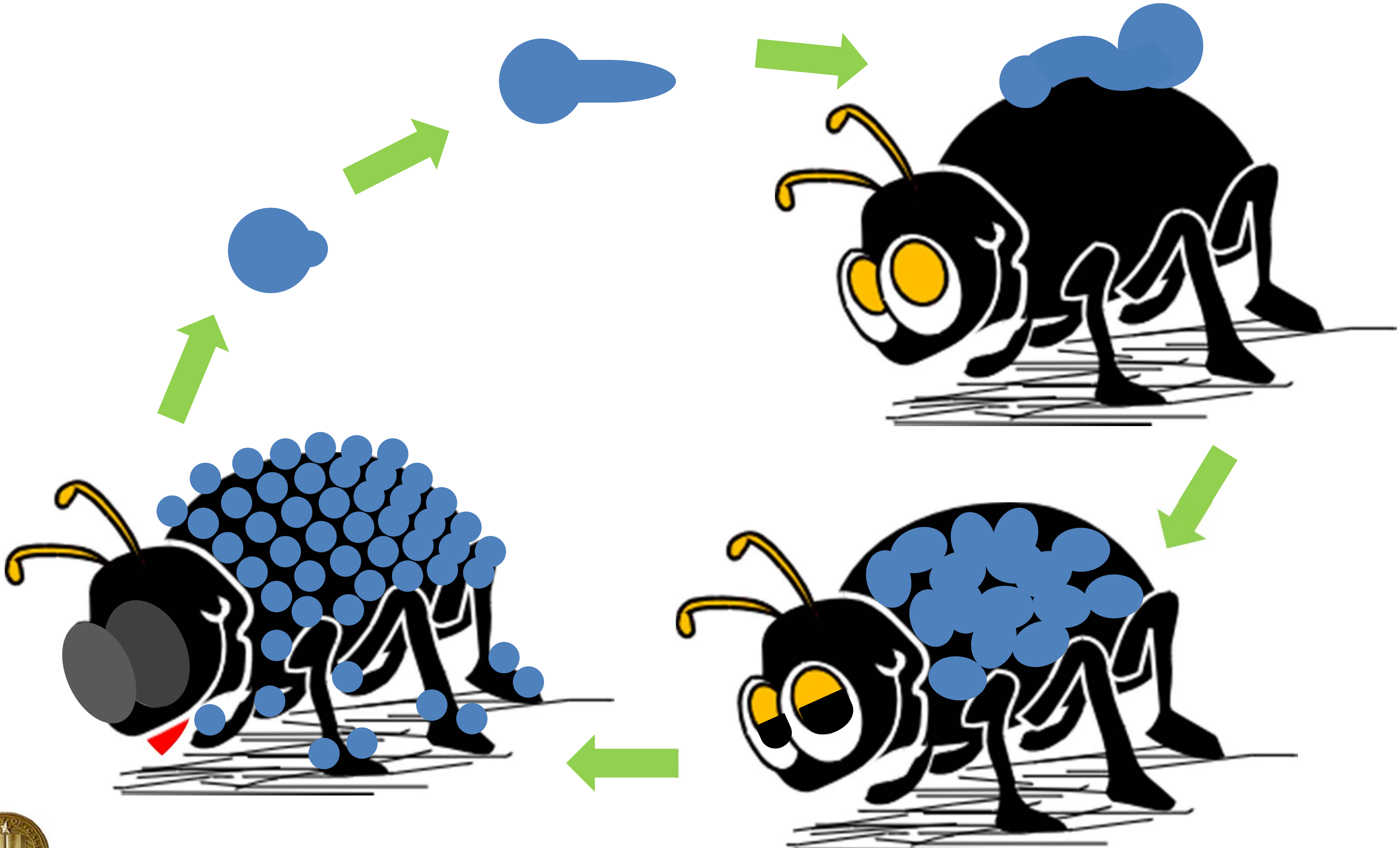
Potential of entomopathogens

- Entomopathogens like *Beauveria bassiana*, *Metarhizium anisopliae*, and *Isaria fumosorosea* are pathogenic to most of the strawberry pests

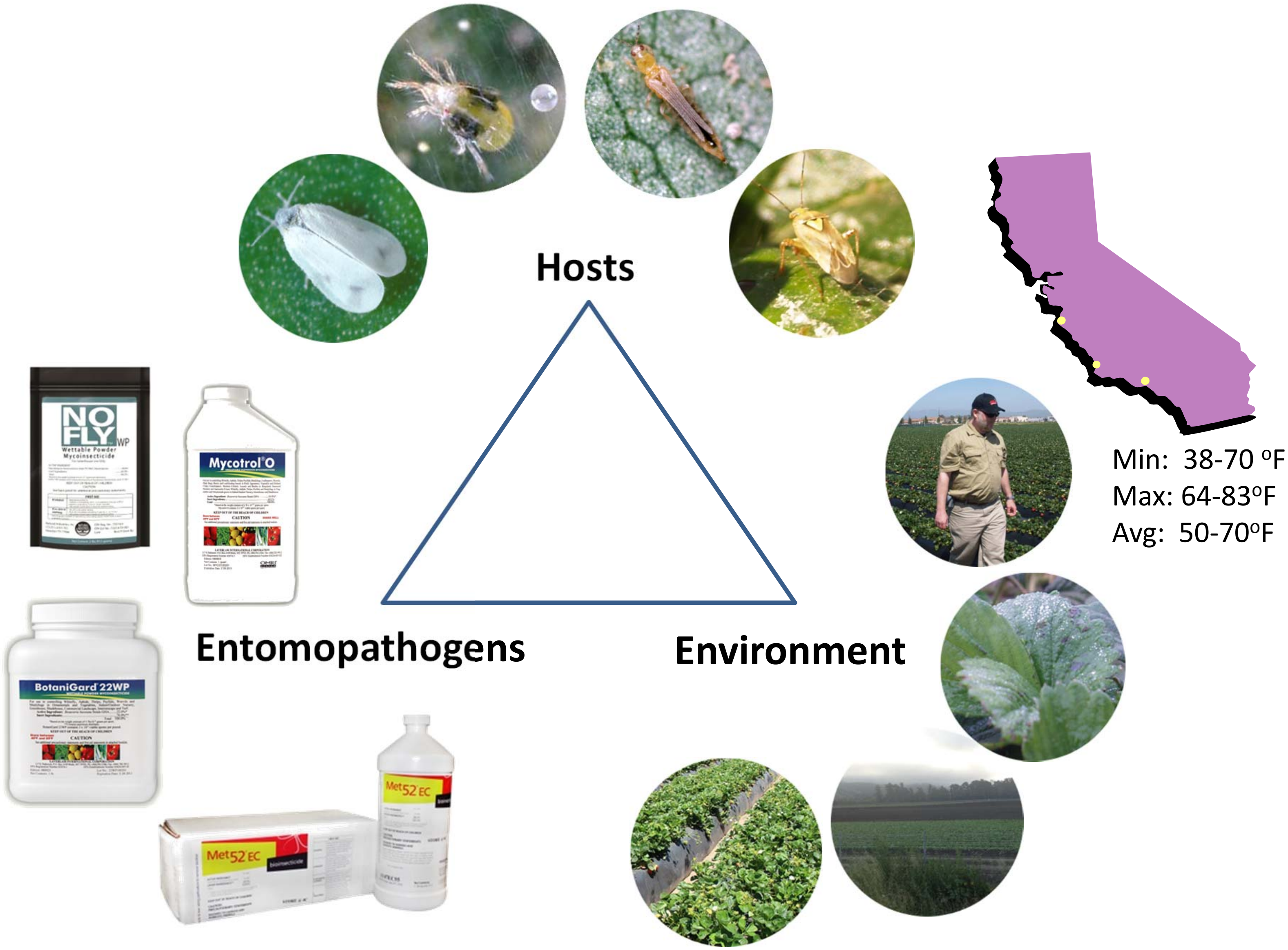




How entomopathogenic fungi infect insects



Potential of entomopathogens



Possible microbial control strategy

- Incorporating microbial control into IPM
- Foliar application – alone and along with chemical pesticides
- Endophytic colonization of the strawberry plants

Impact on strawberry IPM

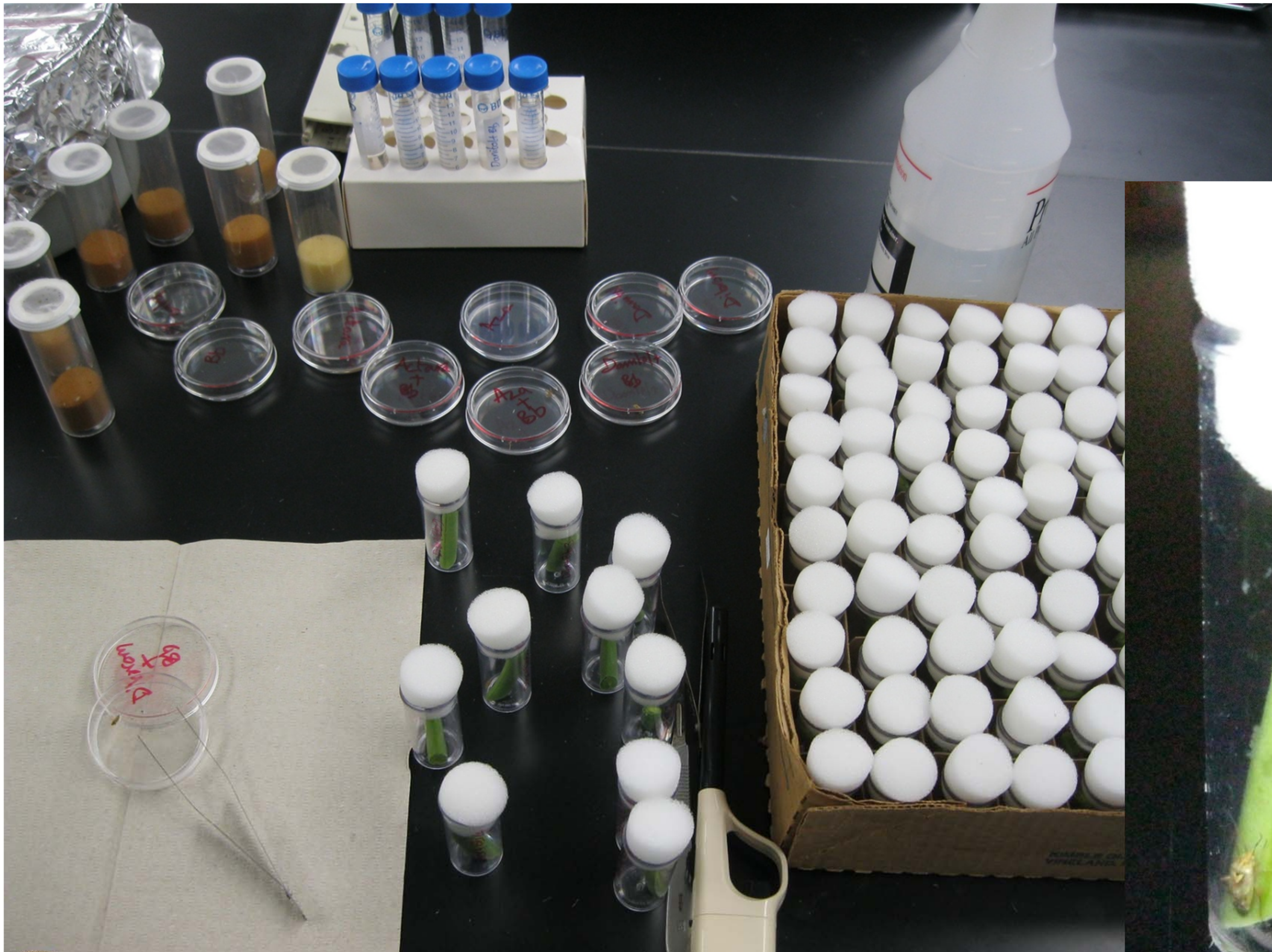
- Reduces the chemical pesticide use
- Reduces the risk of pesticide resistance
- Extends the life of effective chemicals
- Improves the pest management
- Enhances the efficacy of IPM

Chemicals and *B. bassiana* against Lygus

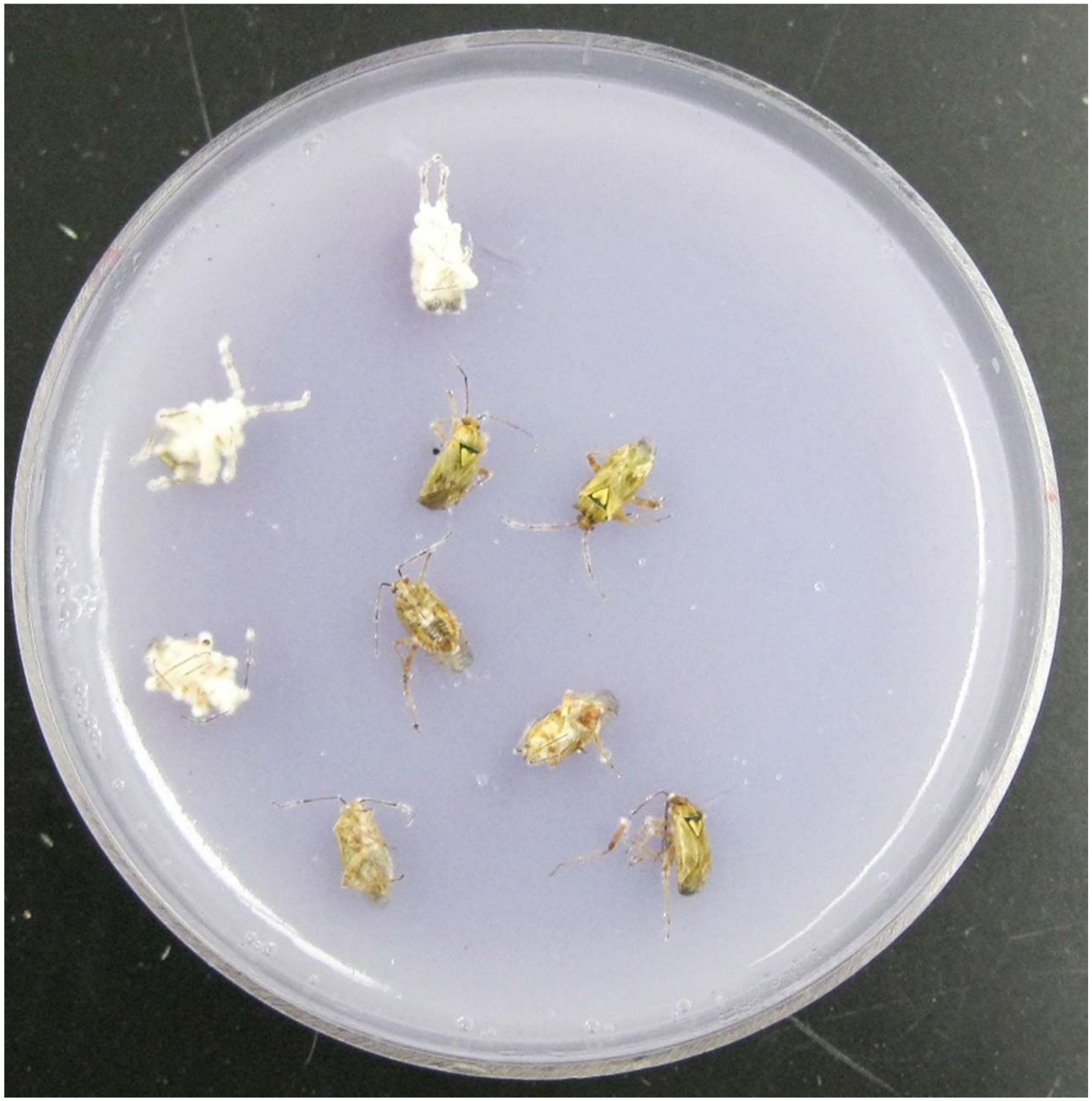
- **Objectives**
  - Improve the efficacy of *B. bassiana*
  - Reduce the usage of chemicals

- **Treatments**
  - 0.19 lb/ac or $1X10^7$ conidia/ml of BotaniGard 22 WP (label rate 1/2-2 lb/acre)
  - 1/5 the label rate of
    - Actara (1 pt/ac),
    - Aza-Direct (2 qrt/ac),
    - Danitol (11 oz/ac) and
    - Dibrom (1 pt/ac)

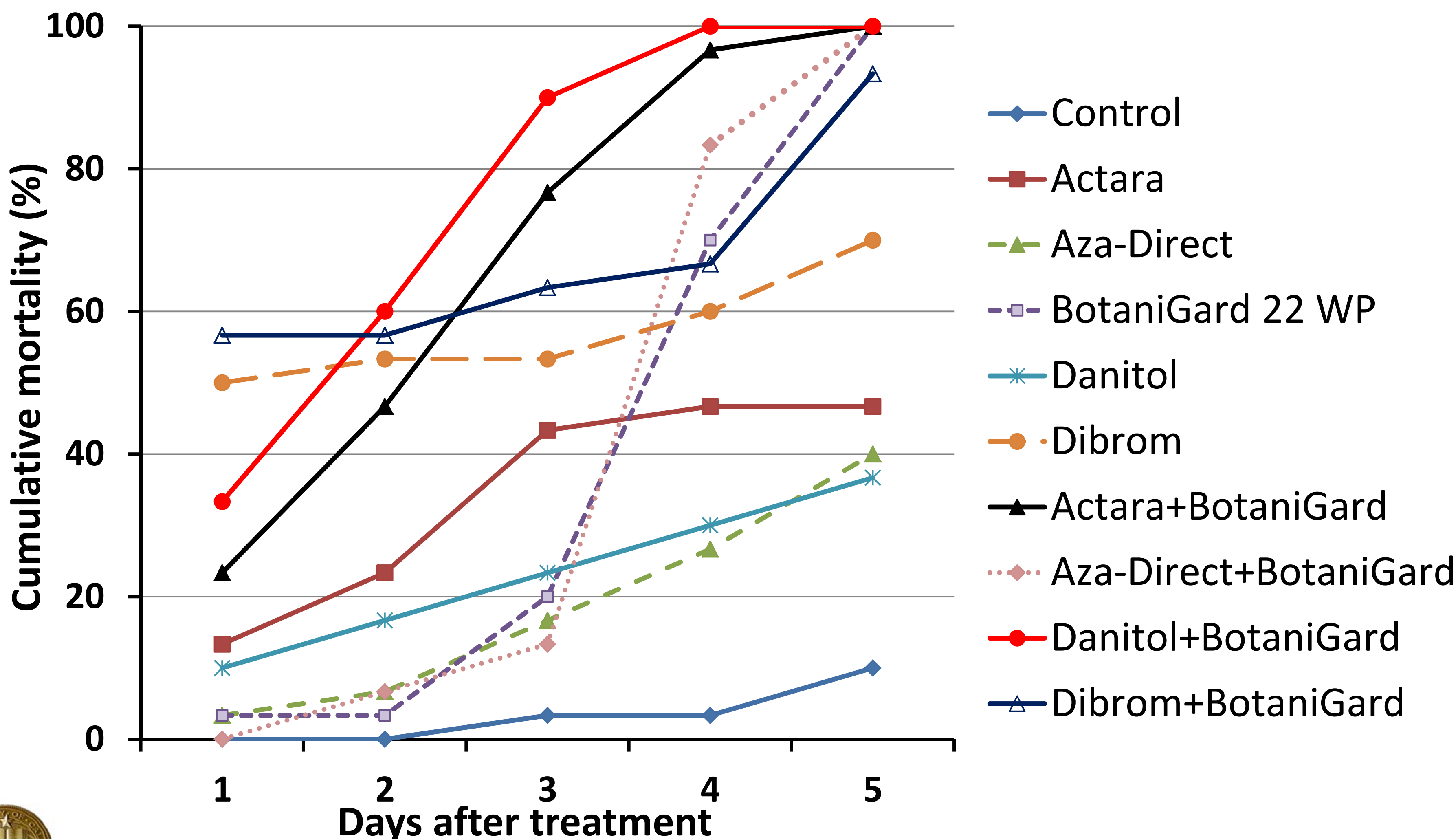
Chemicals and *B. bassiana* against Lygus



Chemicals and *B. bassiana* against Lygus



Chemicals and *B. bassiana* against Lygus

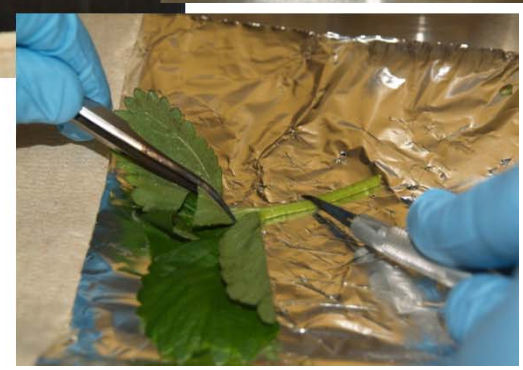


Endophytic colonization

- **Objectives**
    - What is an ideal method of inoculation?
    - Does the fungus colonize strawberry plants?
    - If it does, how long does it persist in the plant?
    - Does the colonized fungus protect the plant from herbivore damage?

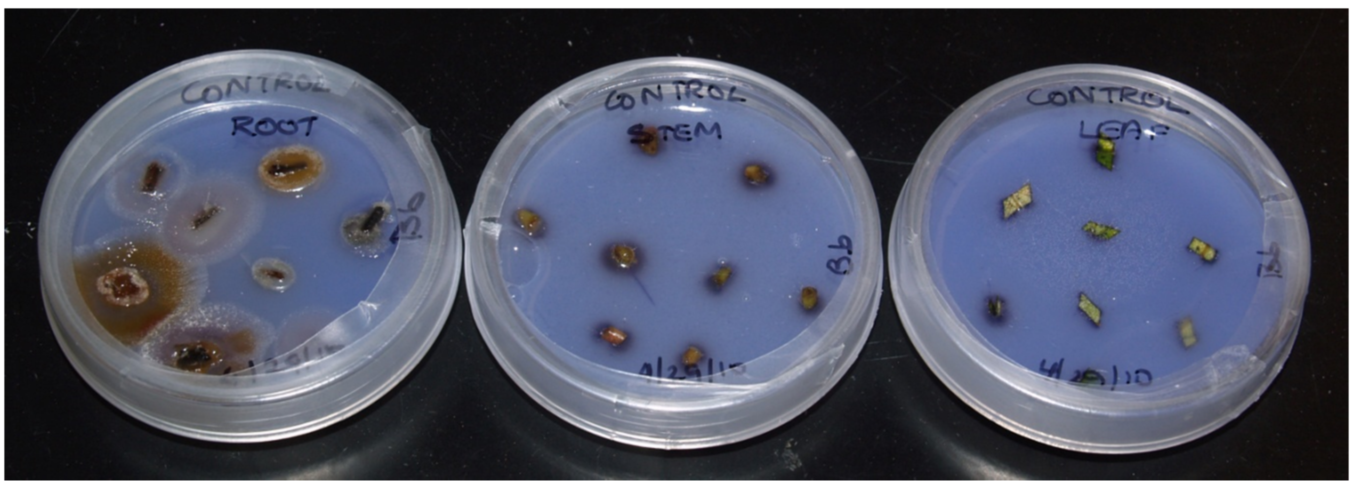
Endophytic colonization-*B. bassiana*

- Rinsed, surface-sterilized and rinsed the plant material
- Plated plant tissue on selective medium
- Plated rinsate on medium to verify contamination



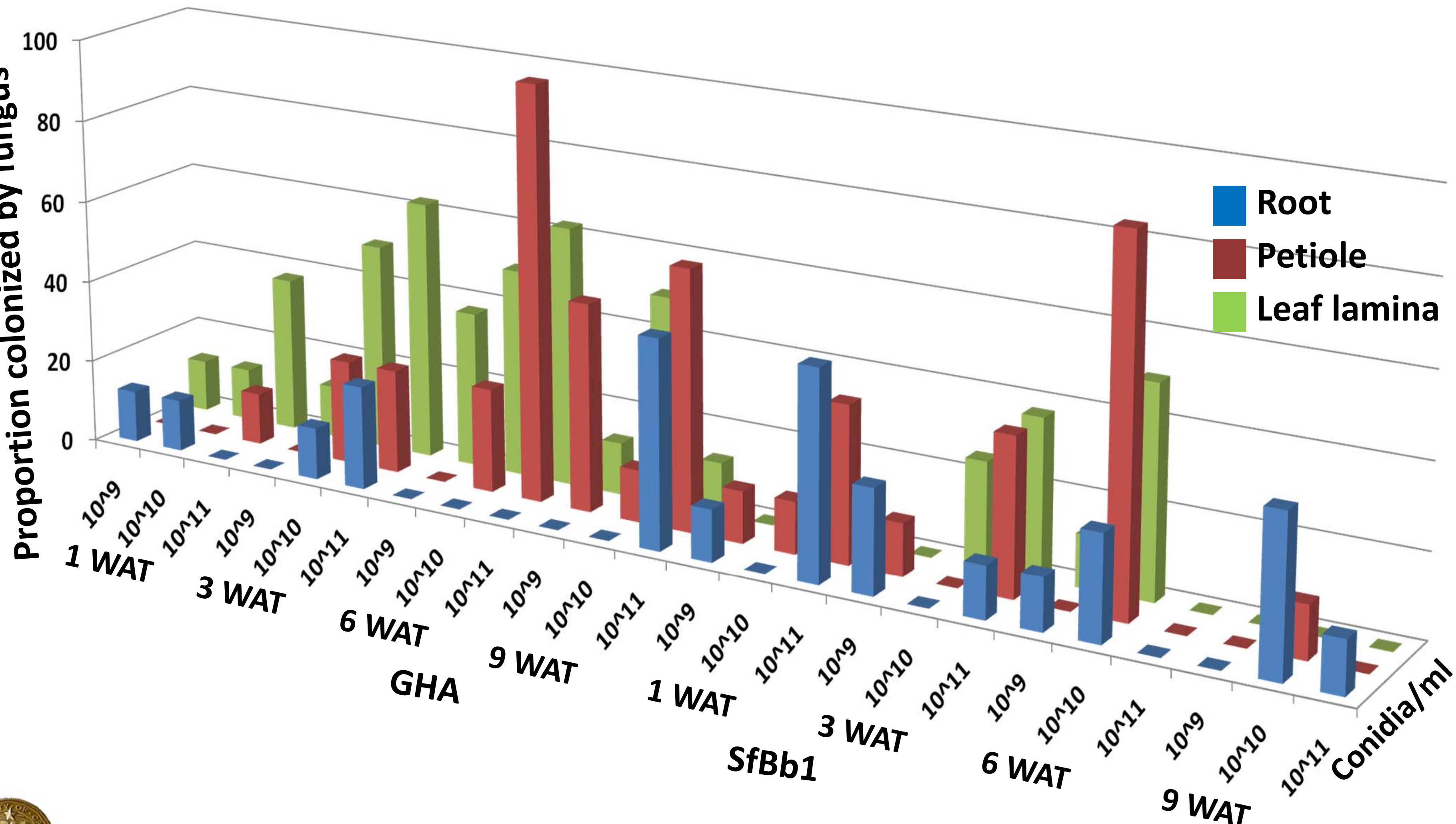
Endophytic colonization-*B. bassiana*

Emergence of colonized *B. bassiana* from treated plant tissue

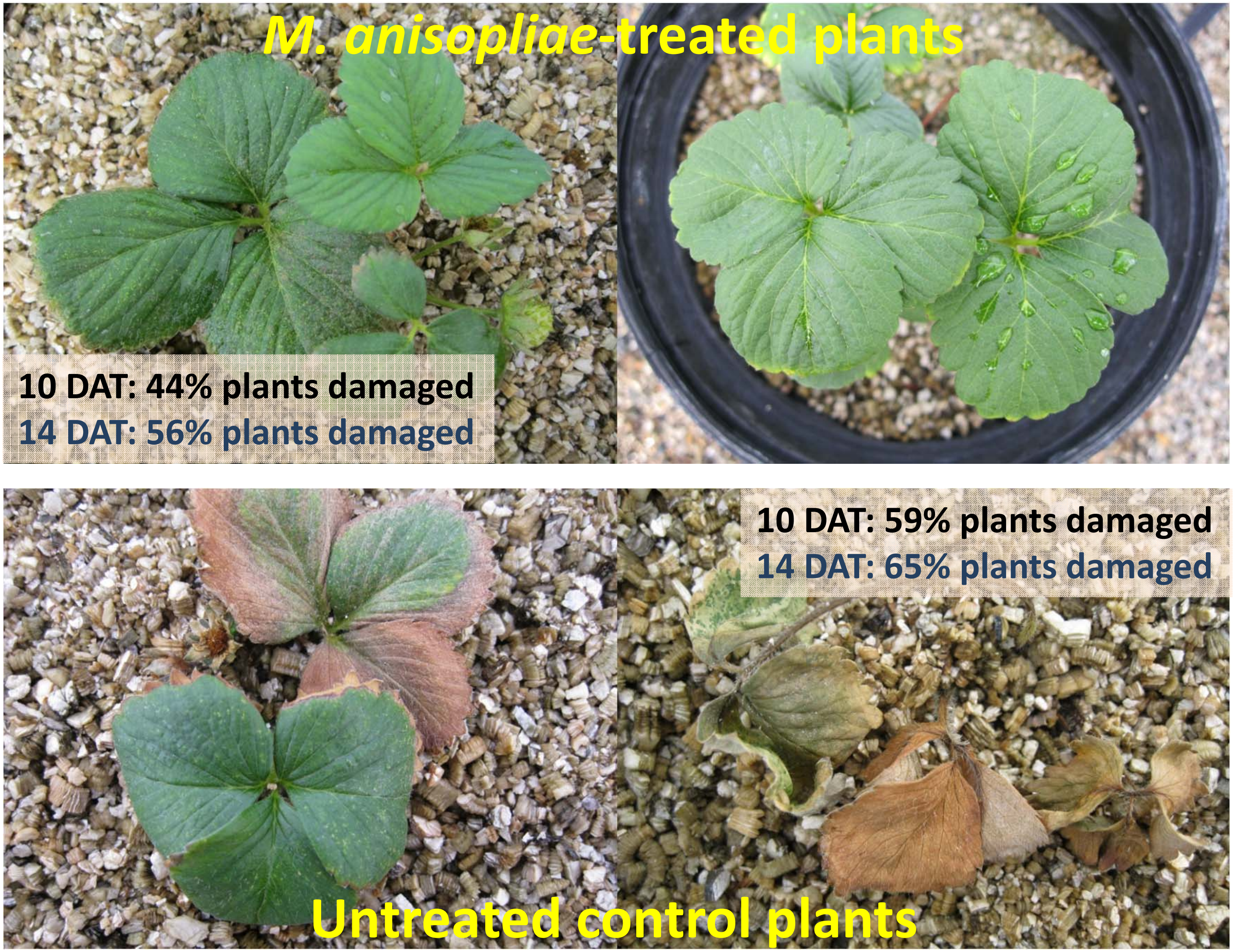


No *B. bassiana* detected in controls

Endophytic colonization-*B. bassiana*

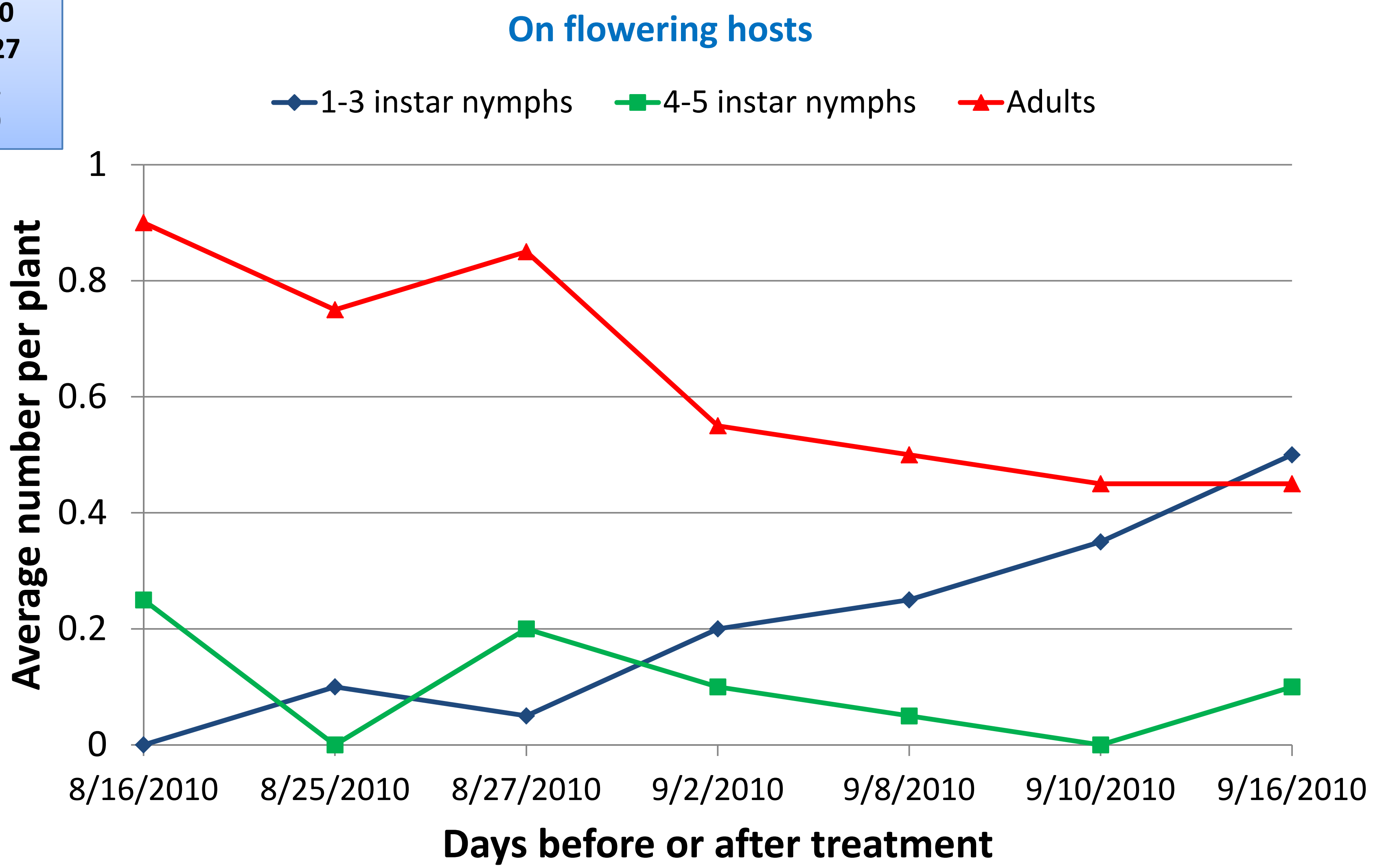


Endophytic colonization-*M. anisopliae*

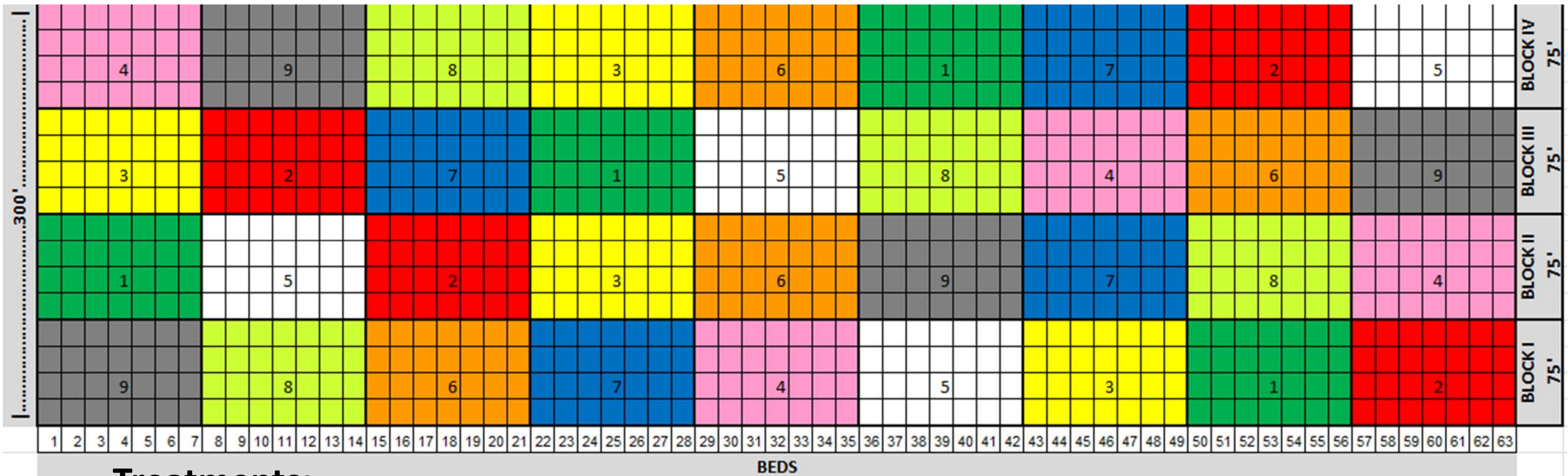


Small plot field trial-2010

Treatments
1st – 8/20
2nd – 8/27
3rd – 9/2
4th – 9/9



Large field trial-2012

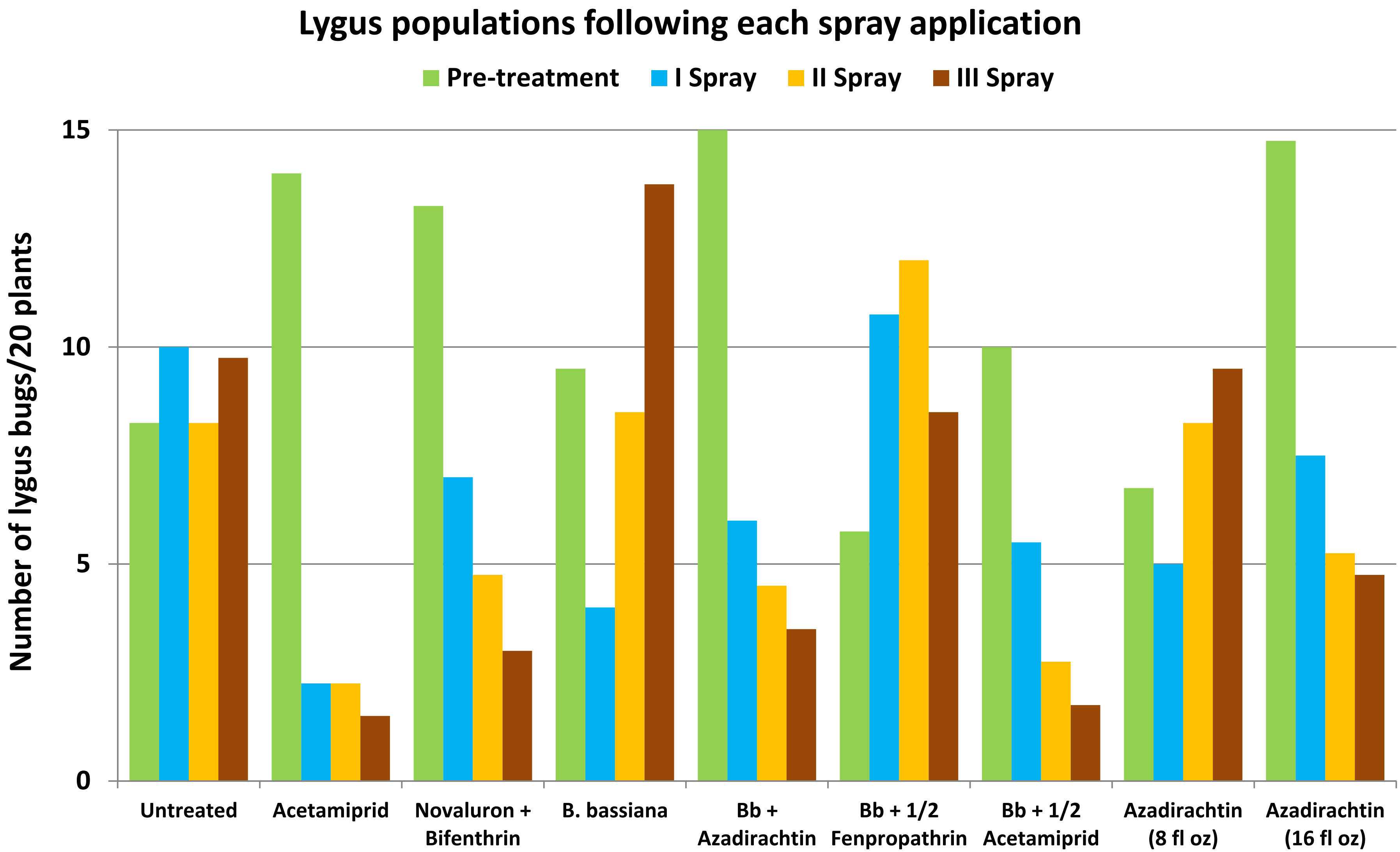


Treatments:

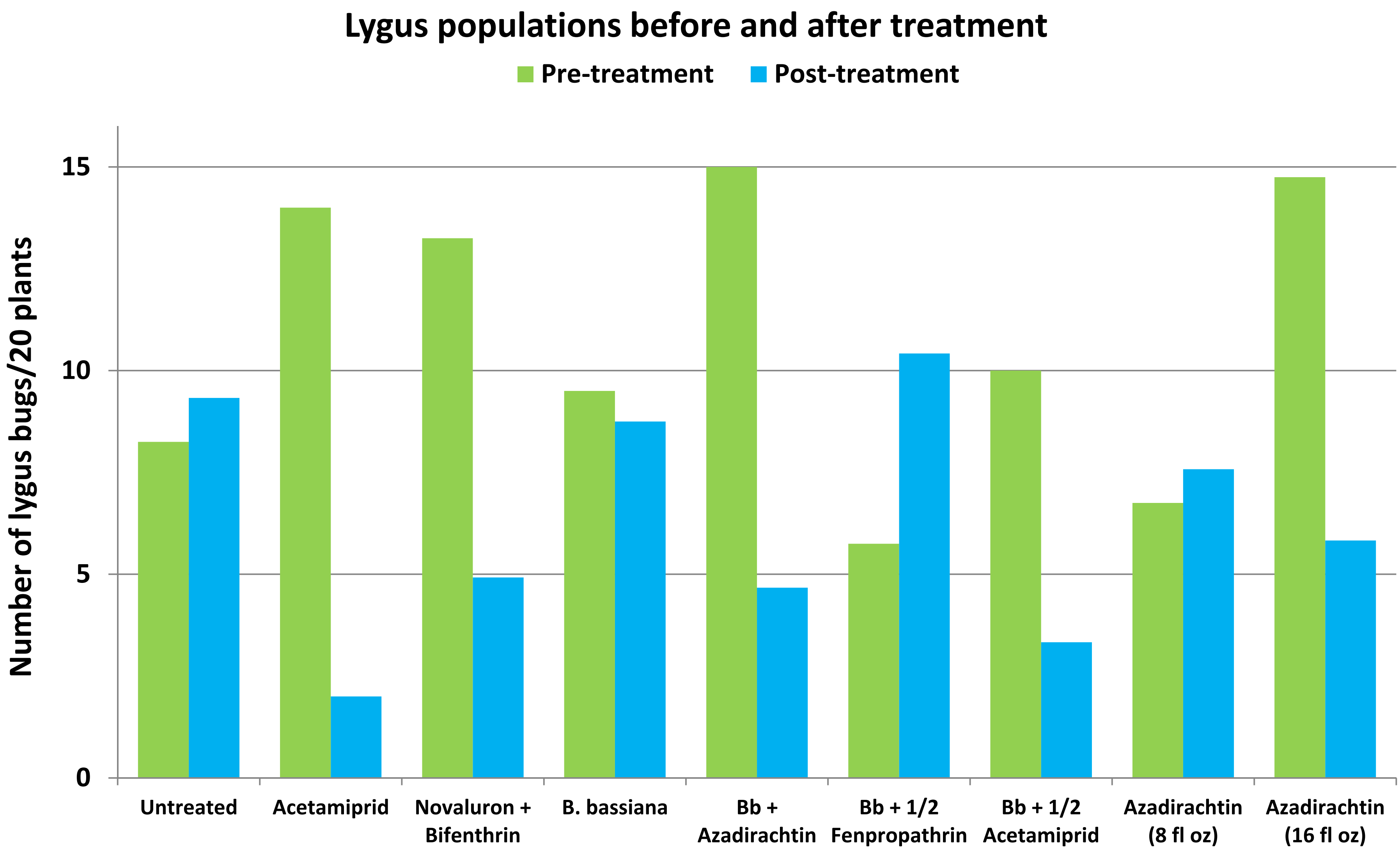
1. Untreated control
2. Assail 70 WP (acetamiprid) 3 oz/ac in 50 gal
3. BotaniGard WP (*Beauveria bassiana)* 2lb/ac in 50 gal
4. BotaniGard WP 2lb/ac + Molt-X (azadirachtin) 8 fl oz/ac in 50 gal
5. BotaniGard WP 2lb/ac + Danitol (fenpropathrin) ½ label rate 5.3 fl oz/ac in 50 gal
6. BotaniGard WP 2lb/ac + Assail ½ label rate 1.5 oz/ac in 50 gal
7. AzaGuard (azadirachtin) 8 fl oz/ac in 50 gal
8. AzaGuard 16 fl oz/ac in 50 gal
9. Rimon 0.83 EC (novaluran) 12 fl oz/ac + Brigade (bifenthrin) 16 oz/ac in 50 gal

Experimental period: July-August, 2012

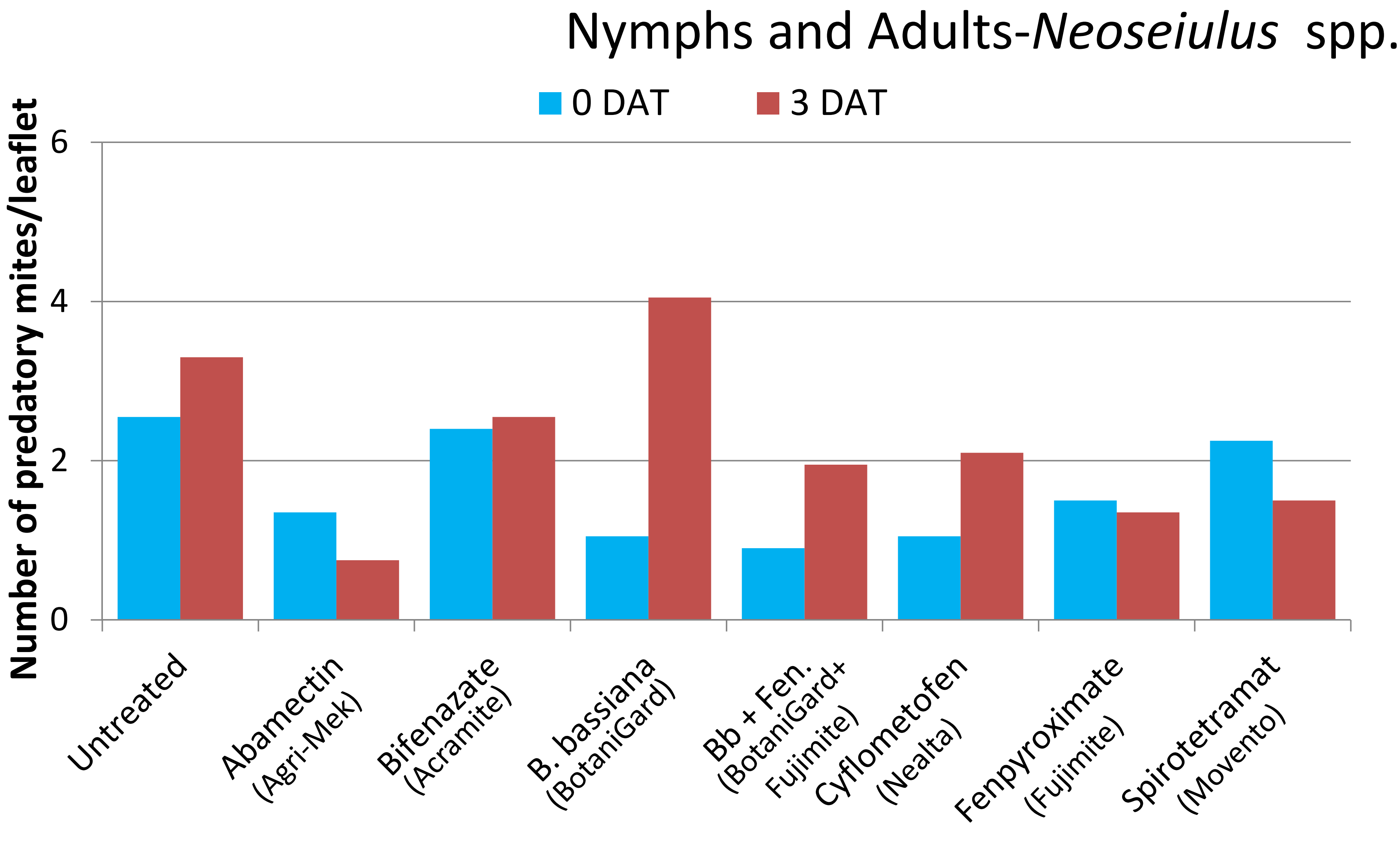
Large field trial-2012



Large field trial-2012



Miticide trial 2012 – Mobile predatory mites

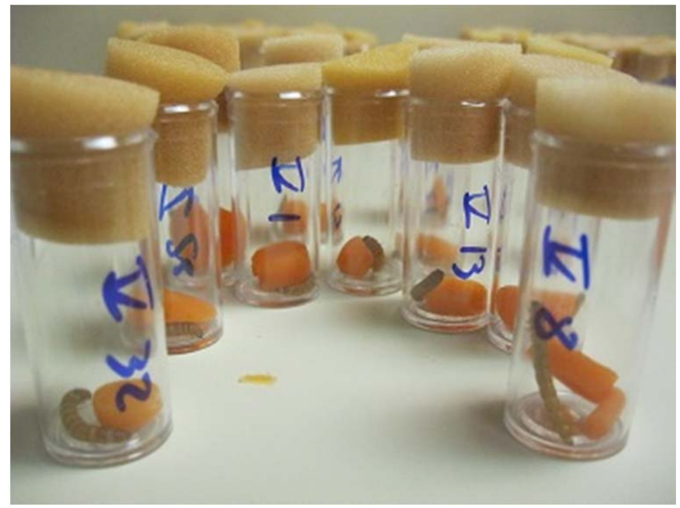


Conclusions

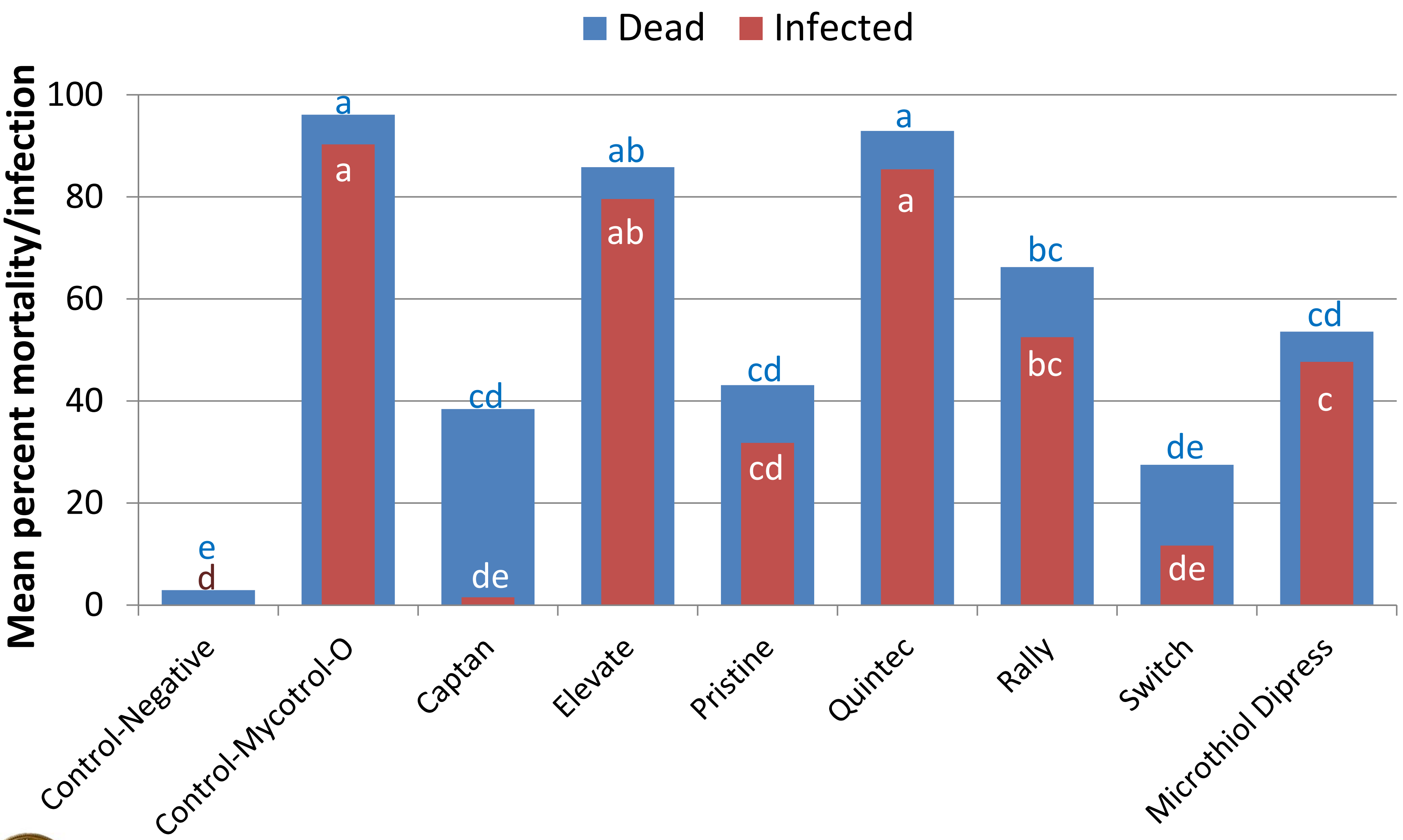
- Conserve biocontrol agents to exploit their potential
- Microbial and botanical solutions have a good potential in strawberry IPM
- *B. bassiana*+ ½ acetamiprid, *B. bassiana*+azadirachtin, and azadirachtin did fairly well compared to chemicals for lygus control
- Consider combinations of reduced rates of chemicals and other options for good IPM

Compatibility of *B. bassiana* and fungicides

Lab assay with mealworms (*Tenebrio molitor*), *B. bassiana*, and some common strawberry fungicides

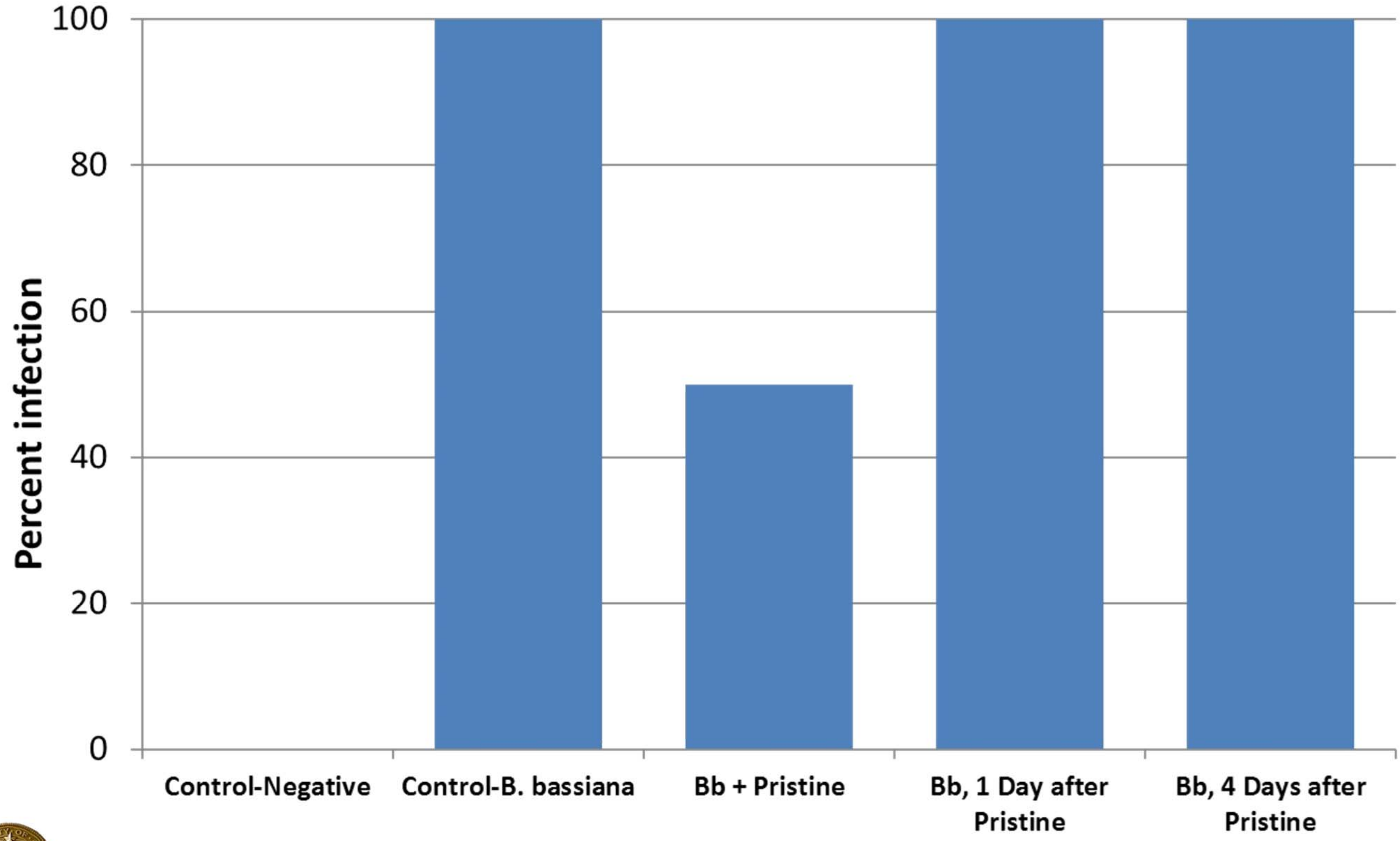


Compatibility of *B. bassiana* and fungicides



Average of 6 assays

Compatibility of *B. bassiana* and Pristine



Conclusions

- Elevate and Quintec are compatible with *B. bassiana*
- *B. bassiana* was not affected by Pristine when applied after one day.
- Other fungicides may be compatible with appropriate time intervals.

Acknowledgments

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Pest infestations