University of California
Agriculture and Natural Resources
Making a Difference for California

Pest Management in Santa Maria Strawberries: Chemical, Botanical, and Microbial Solutions

Surendra Dara
Strawberry and Vegetable Crops Advisor and Affiliated IPM Advisor
University of California Cooperative Extension
Santa Barbara and San Luis Obispo Counties
skdara@ucdavis.edu

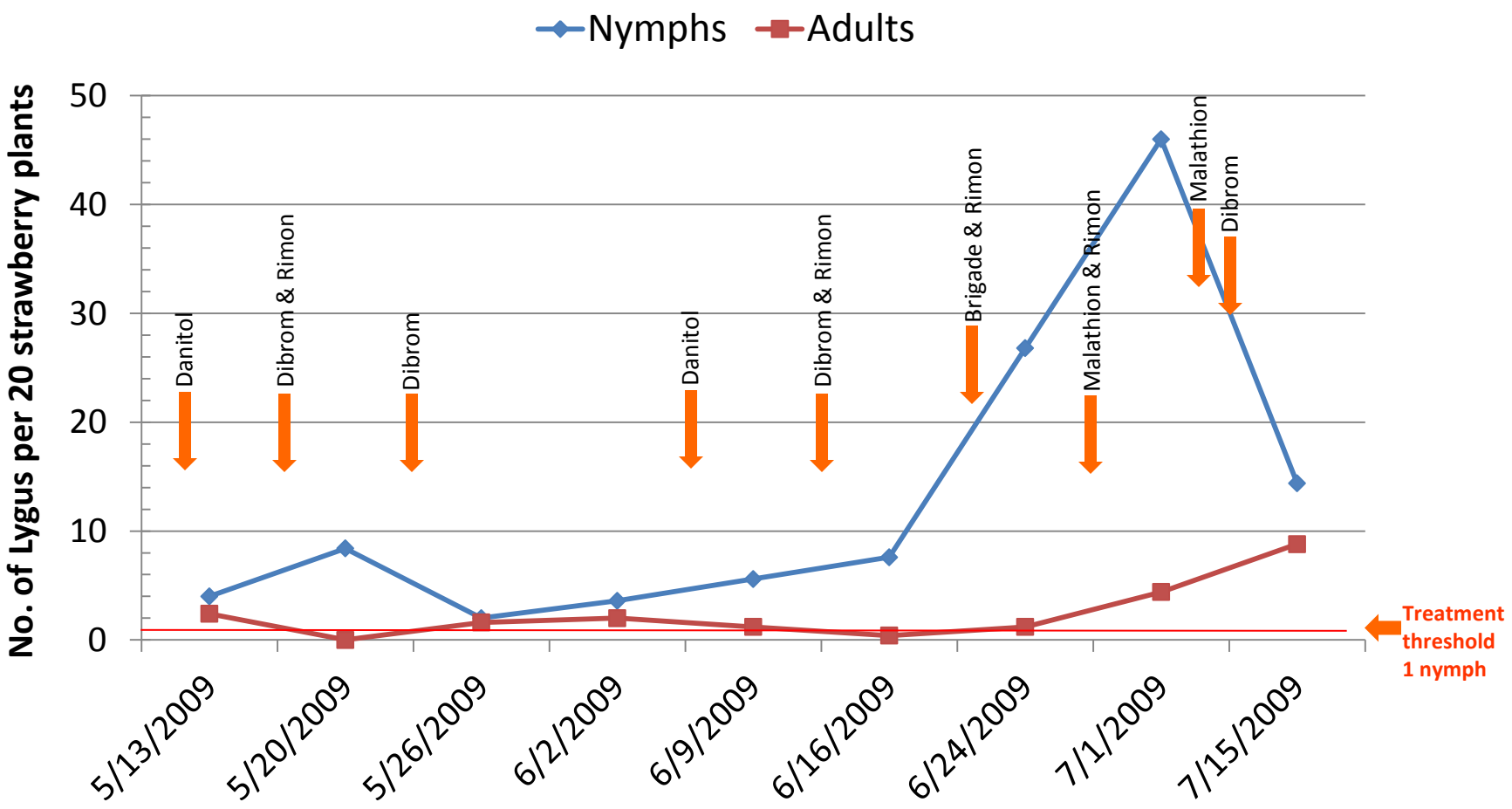
strawberriesvegetables @calstrawberries @calveggies

Major strawberry pests

Other strawberry pests

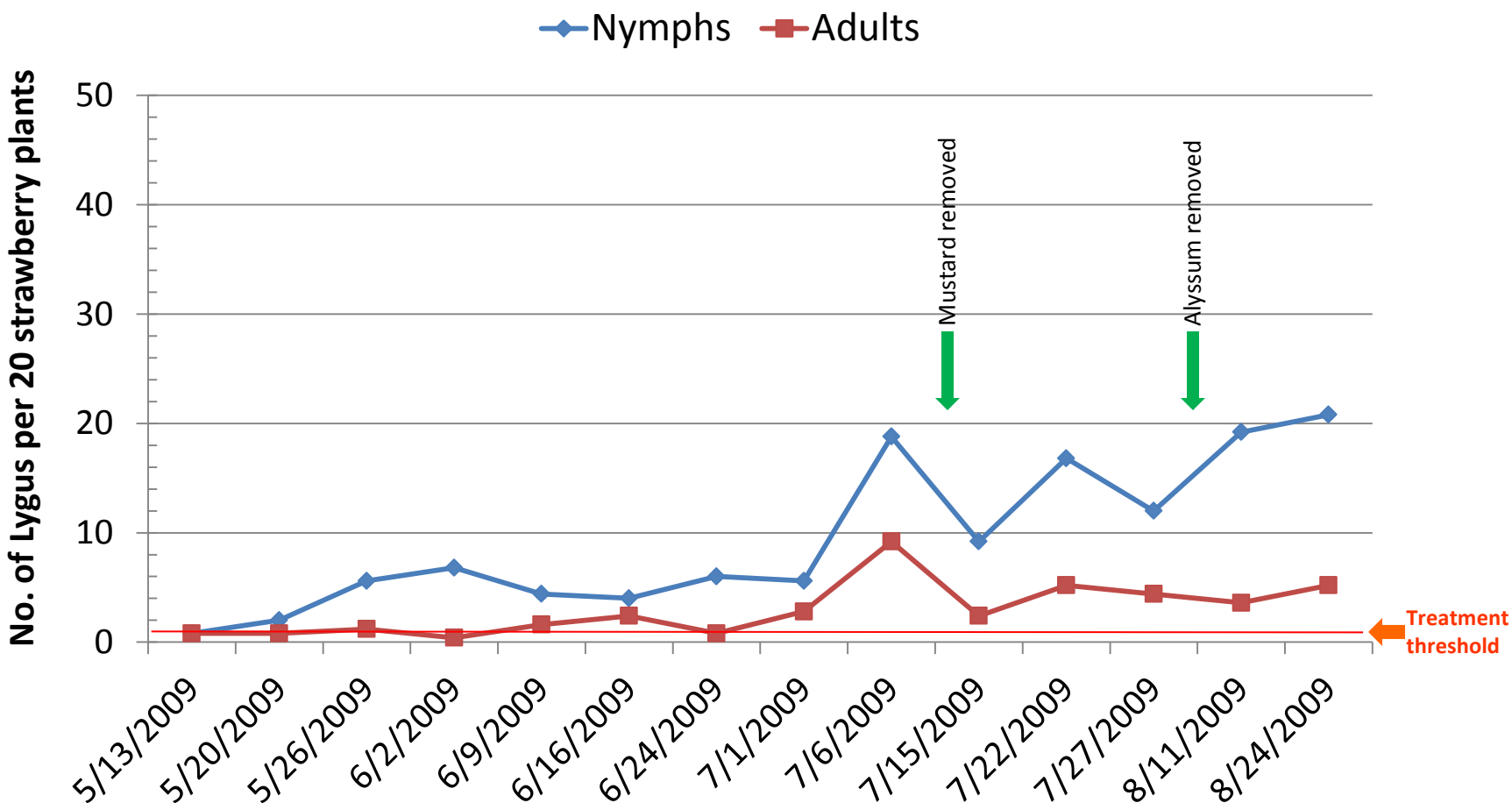
Seasonal occurrence of lygus bug

Conventional strawberry field (second year)



Seasonal occurrence of lygus bug

Organic strawberry field

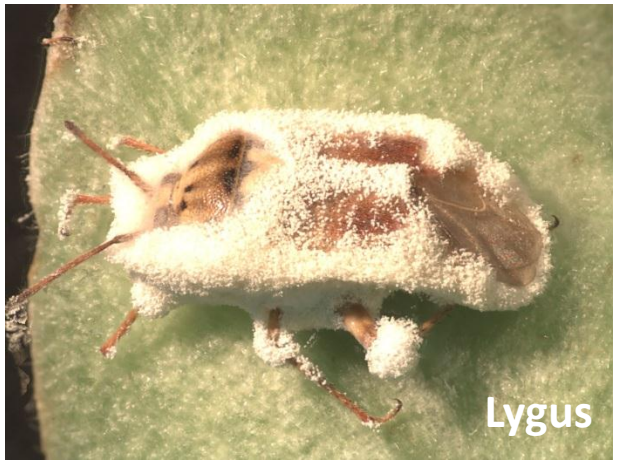


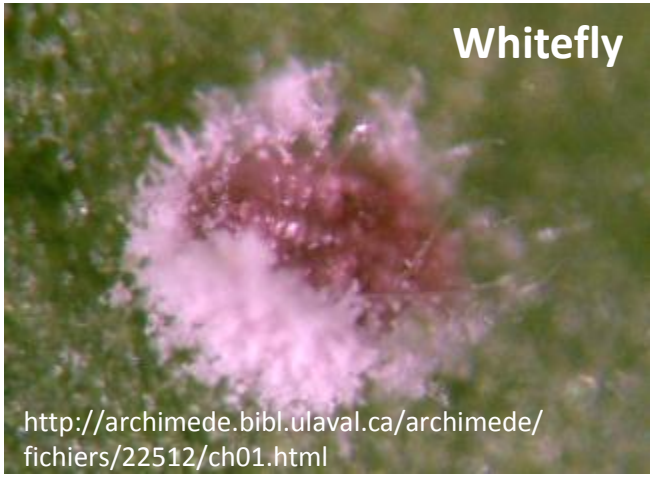
Current pest management practices

- Chemical pesticides and to a limited extent insecticidal soaps, oils, pyrethrin, spinosad, and *Bt*
- Release of predatory mites

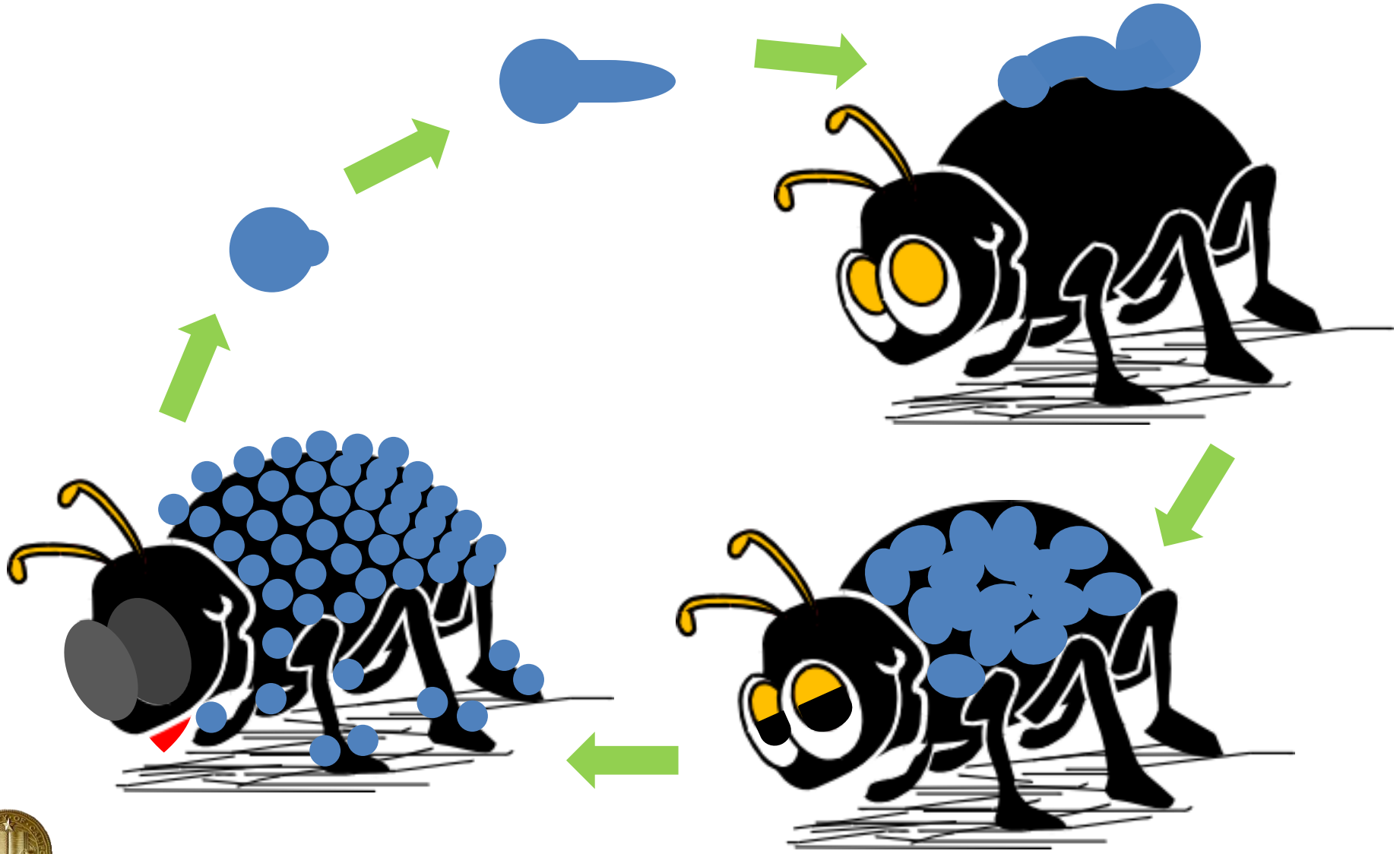
Potential of entomopathogens

- Entomopathogens like *Beauveria bassiana* are pathogenic to most of the strawberry pests





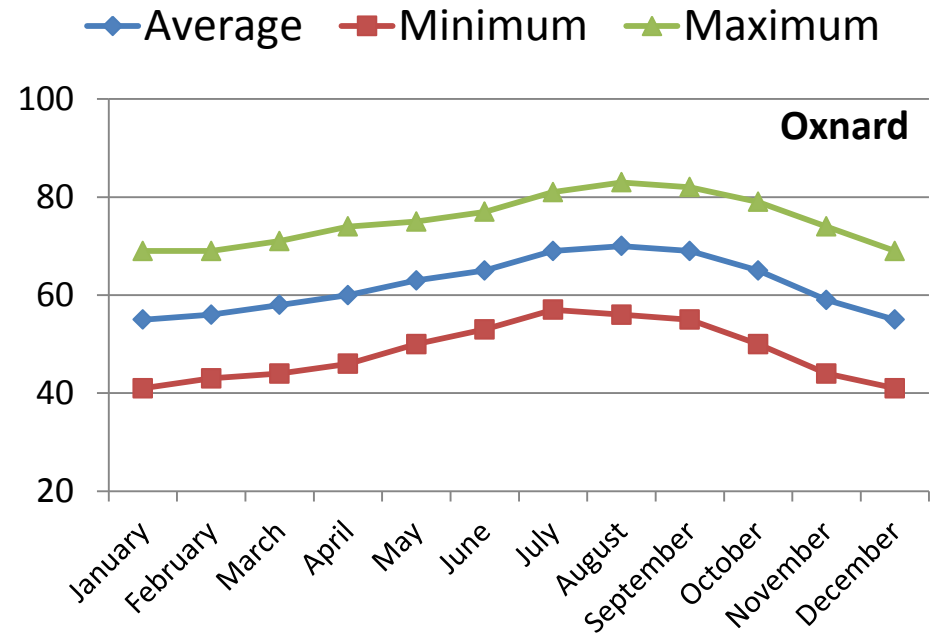
How entomopathogenic fungi infect insects

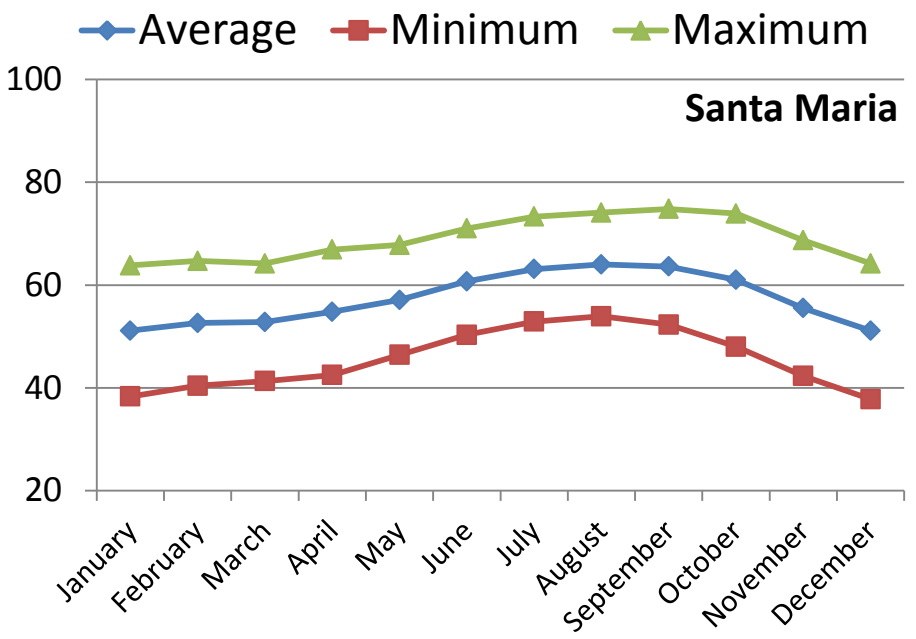


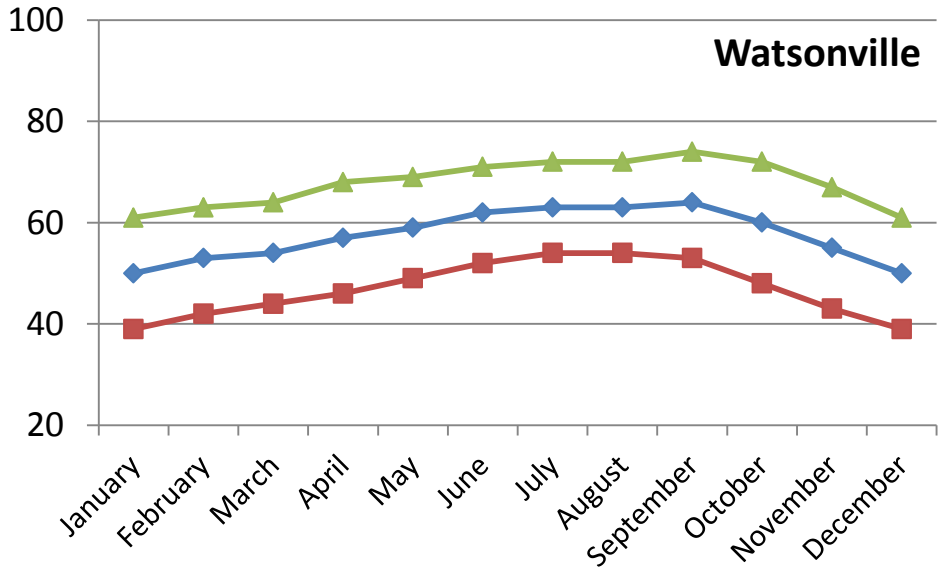
Potential of entomopathogens

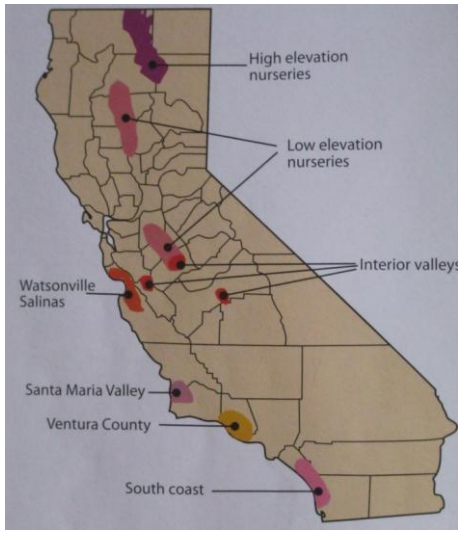
- California Central Coast weather is favorable for entomopathogens

Potential of entomopathogens









Strawberry pests-entomopathogens

- *B. bassiana* is a naturally occurring soil fungus
- Strawberry plant structure is ideal

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

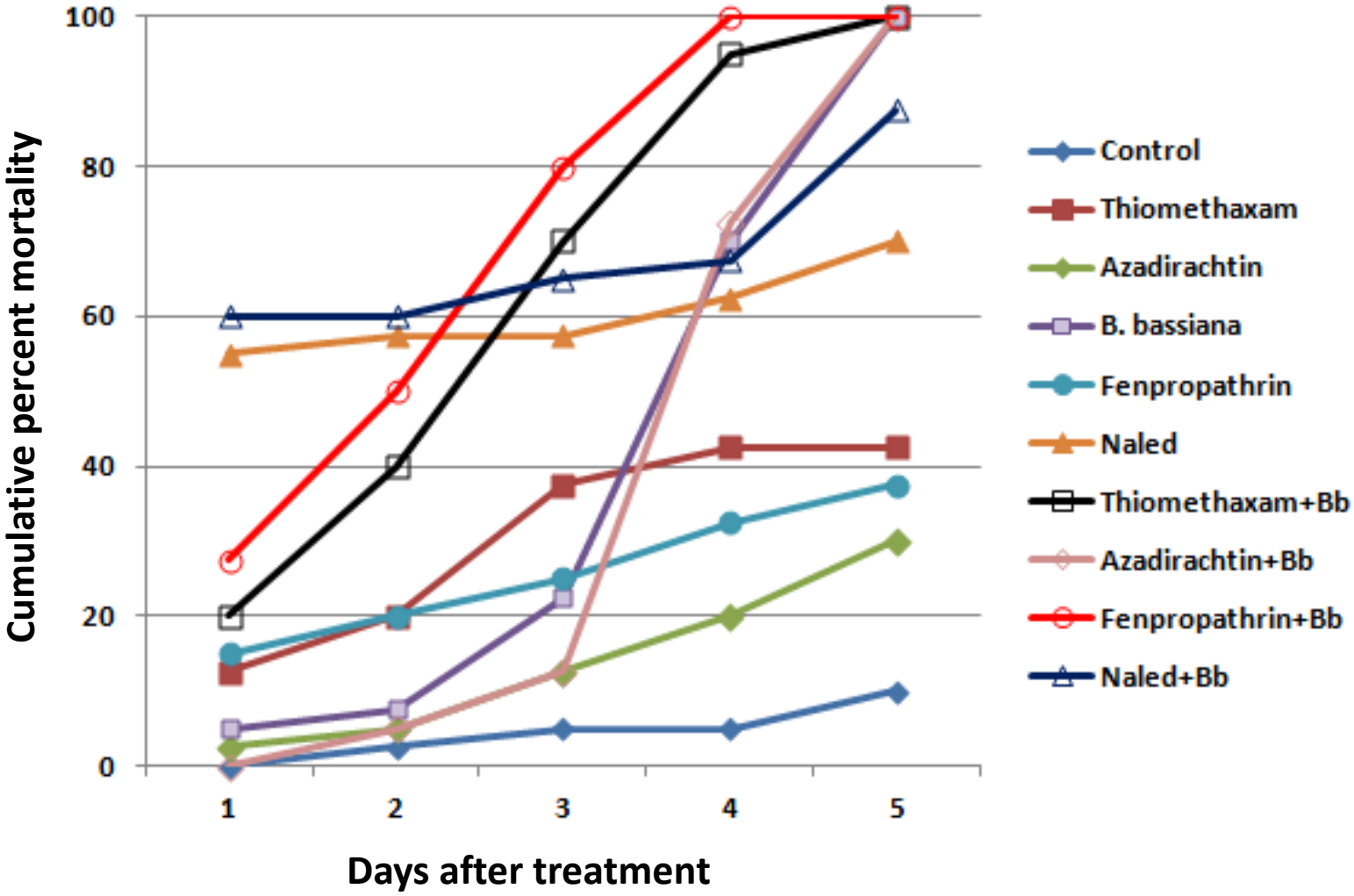
Possible microbial control strategy

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

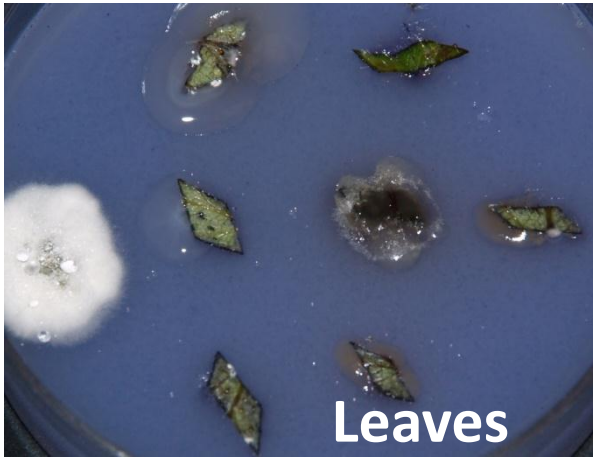
Impact on strawberry IPM

- 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

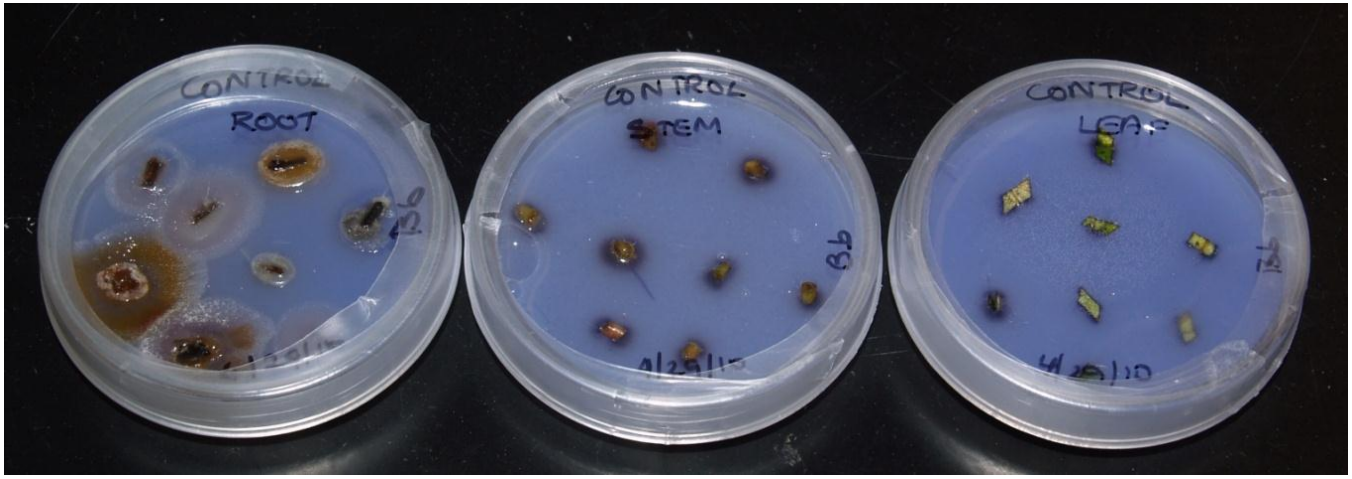
Assays with *B. bassiana* and chemicals



Endophytic colonization

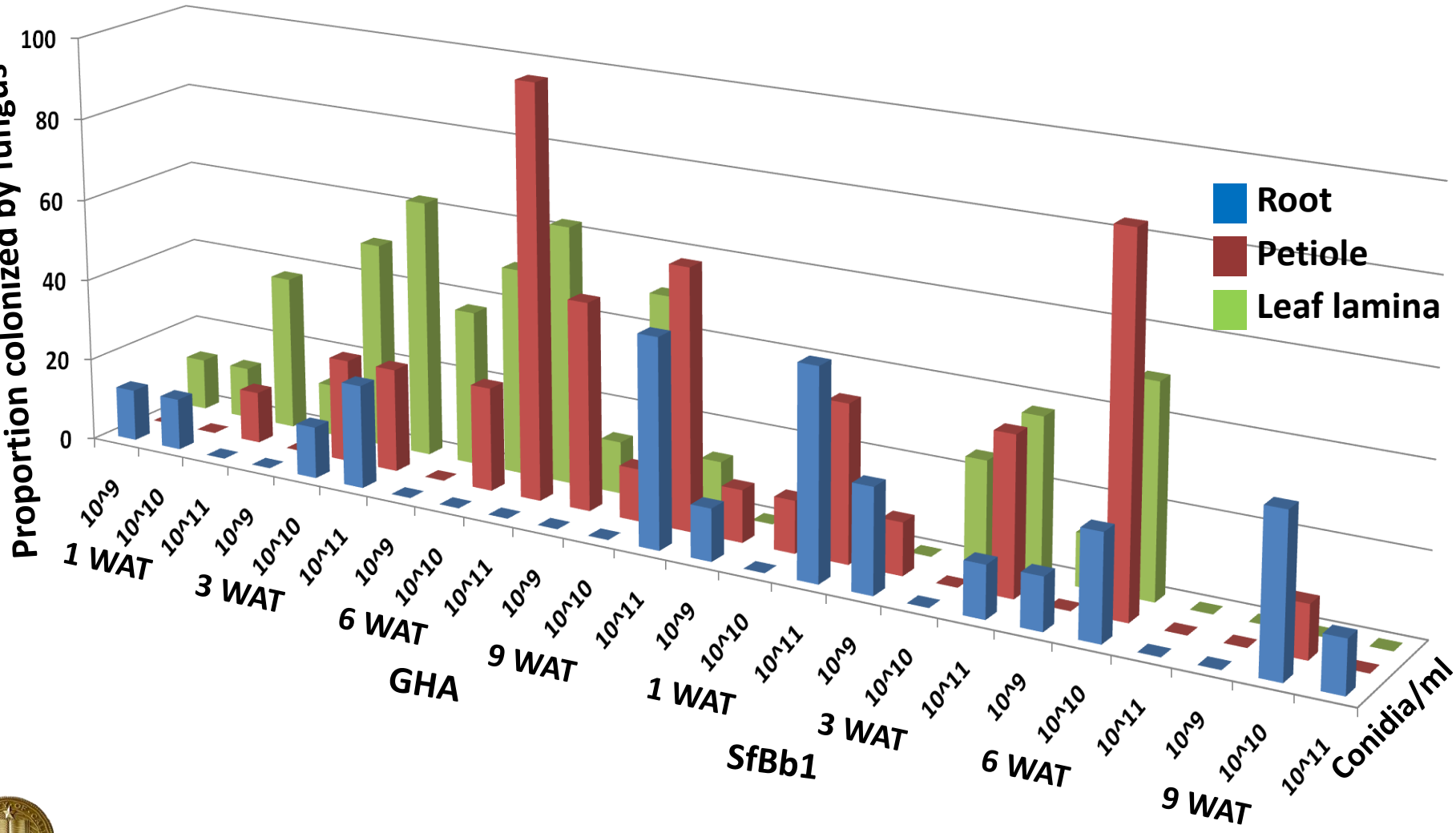


Emergence of colonized *B. bassiana* from treated plant tissue

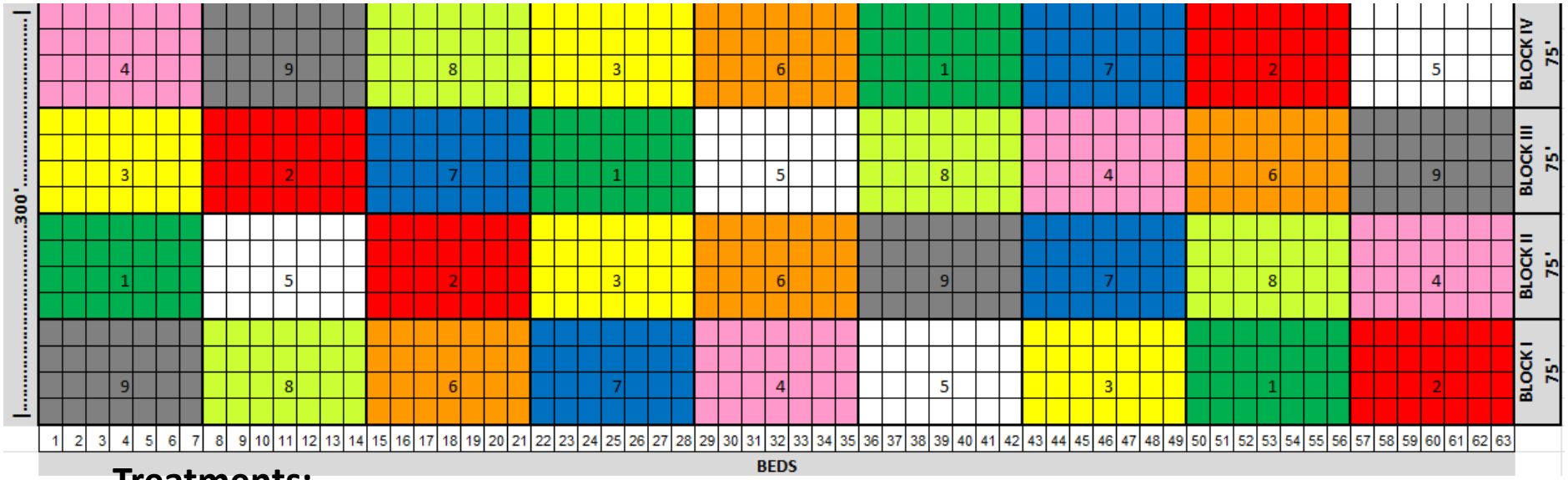


No *B. bassiana* detected in controls

Endophytic colonization



Large commercial field IPM trial 2012

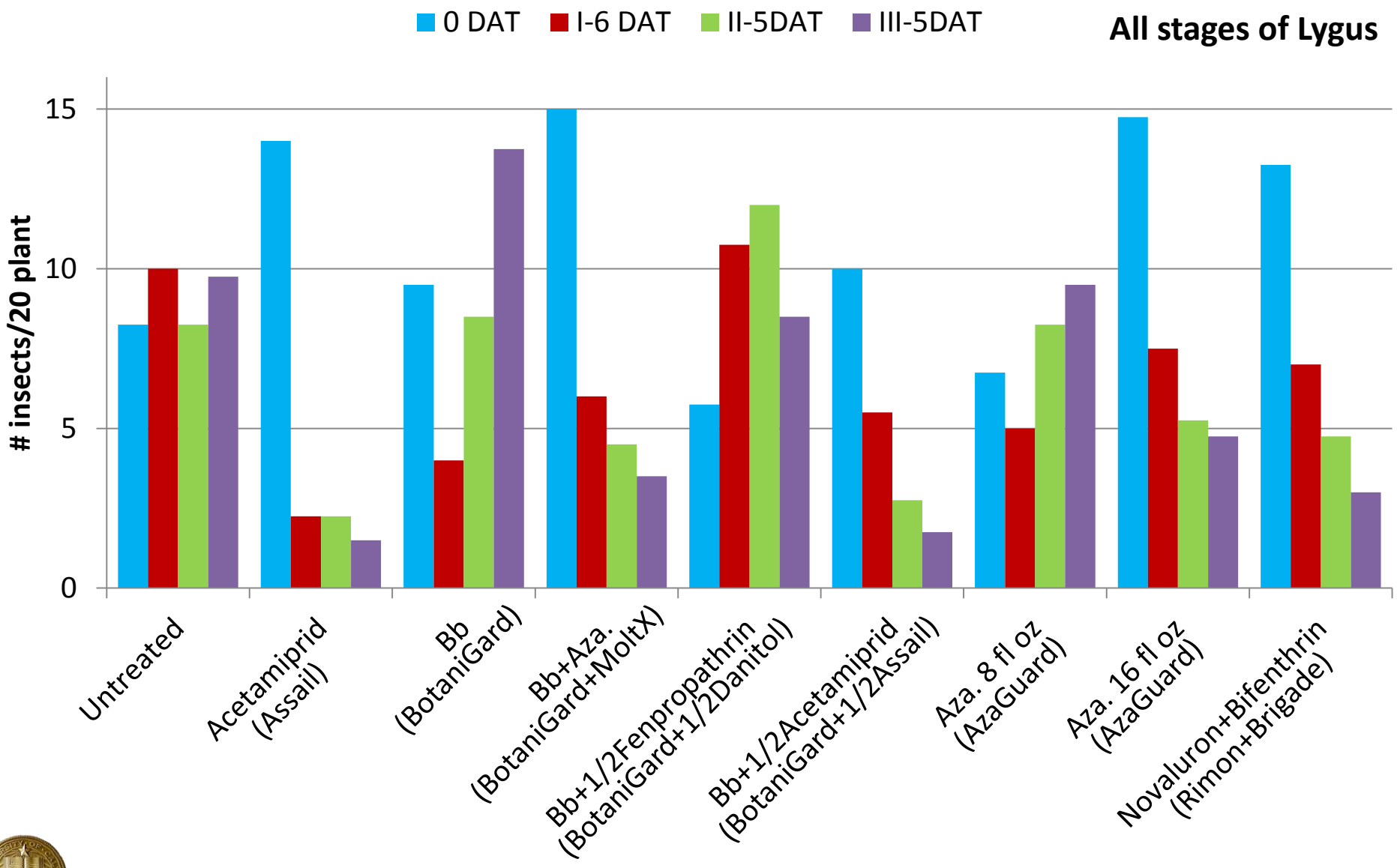


Treatments:

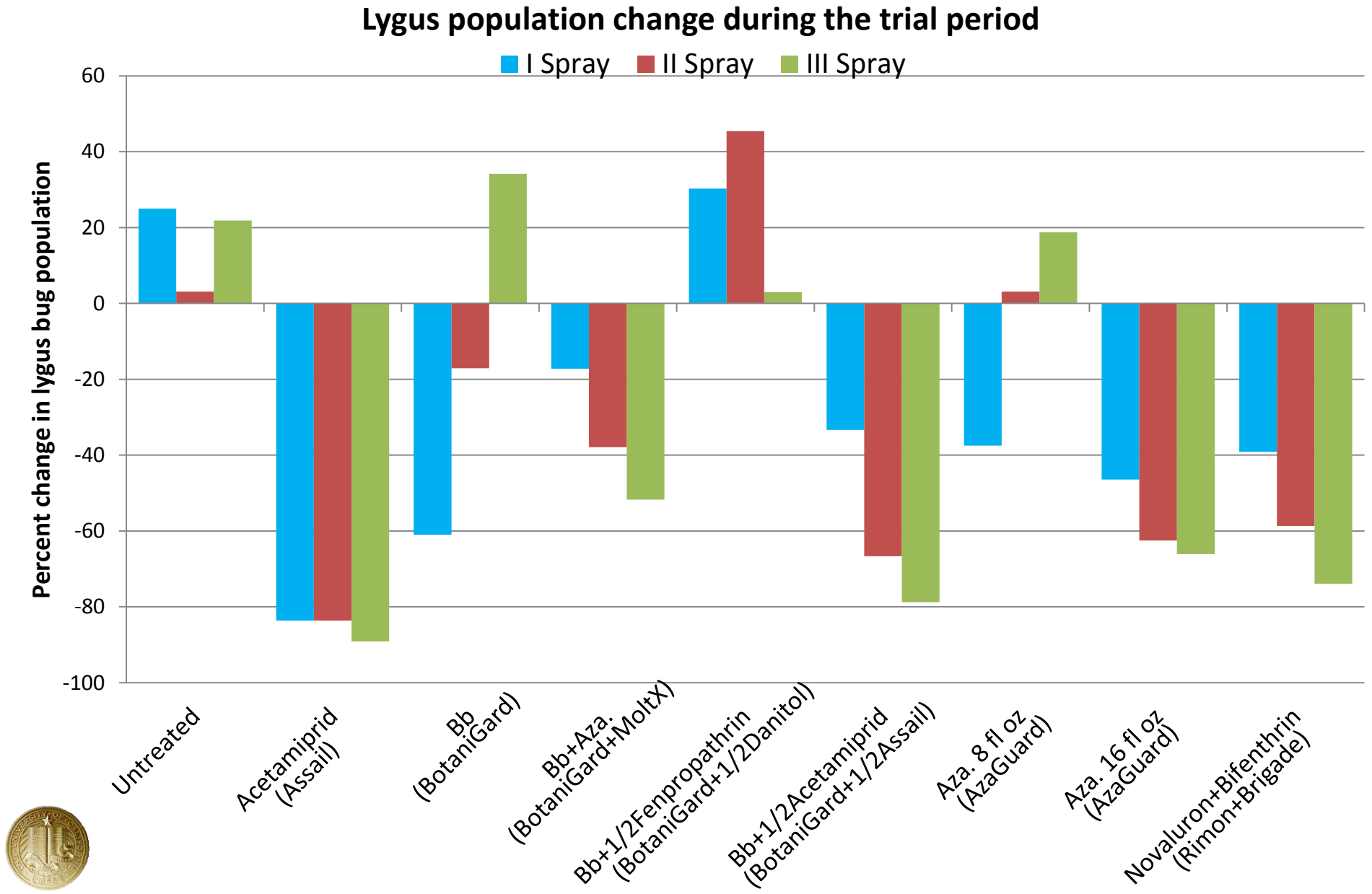
1. Untreated control
2. Assail 70 WP (acetamiprid) 3 oz/ac in 50 gal
3. BotaniGard WP (*Beauveria bassiana)* 2lb/ac in 50 gal
4. BotaniGard WP 2lb/ac + Molt-X (azadirachtin) 8 fl oz/ac in 50 gal
5. BotaniGard WP 2lb/ac + Danitol (fenpropathrin) ½ label rate 5.3 fl oz/ac in 50 gal
6. BotaniGard WP 2lb/ac + 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

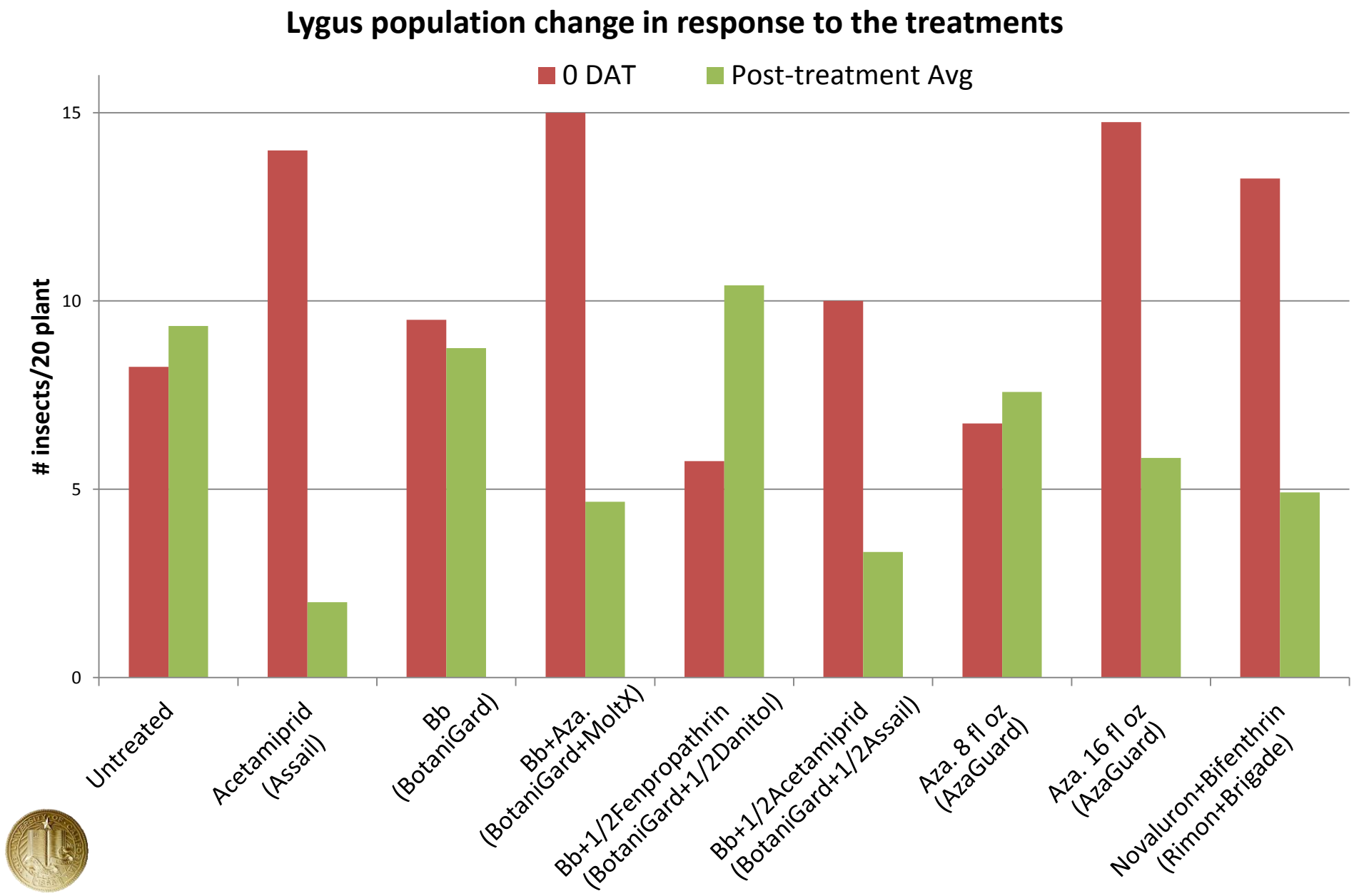
Large commercial field IPM trial 2012



Large commercial field IPM trial 2012

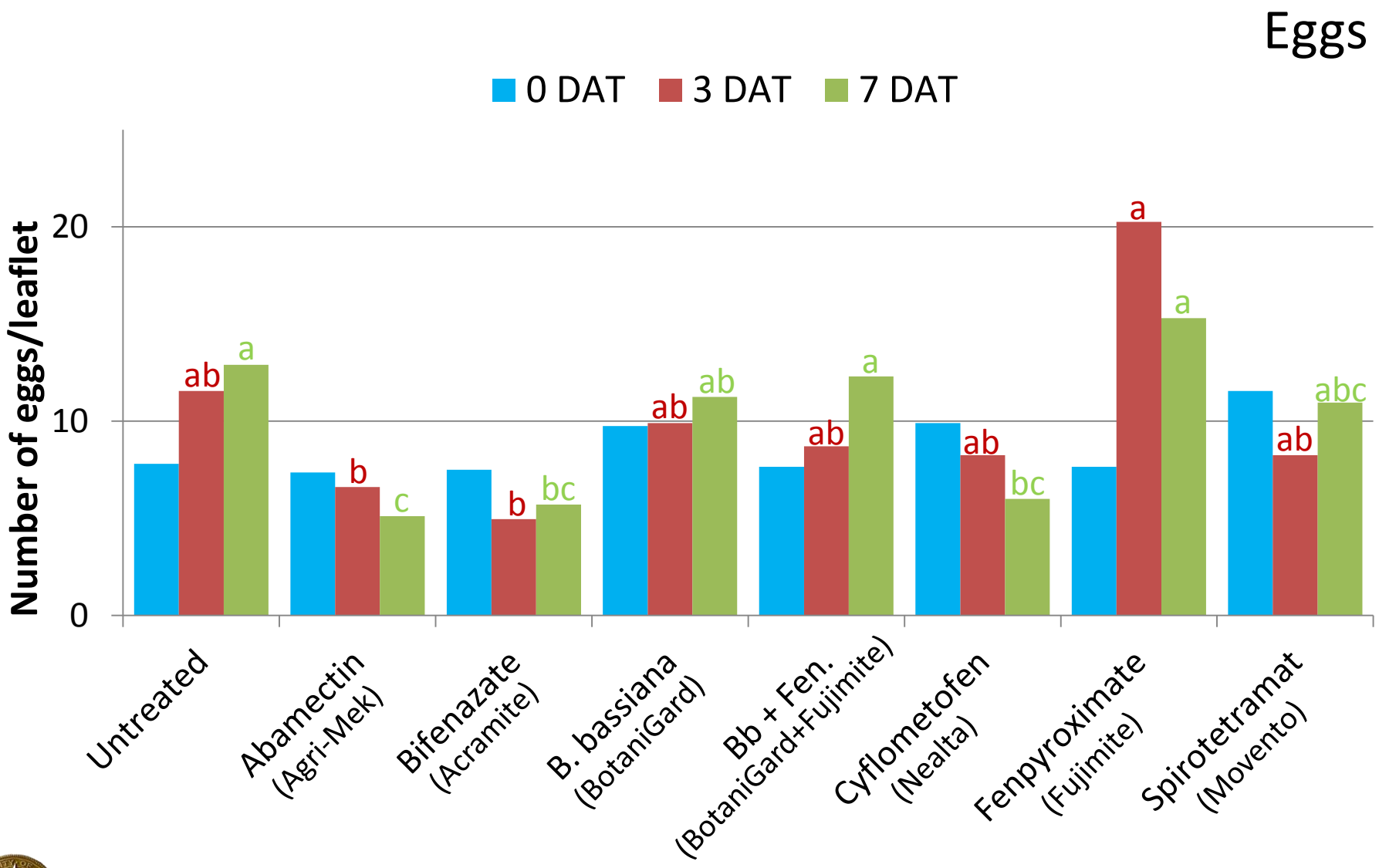


Large commercial field IPM trial 2012



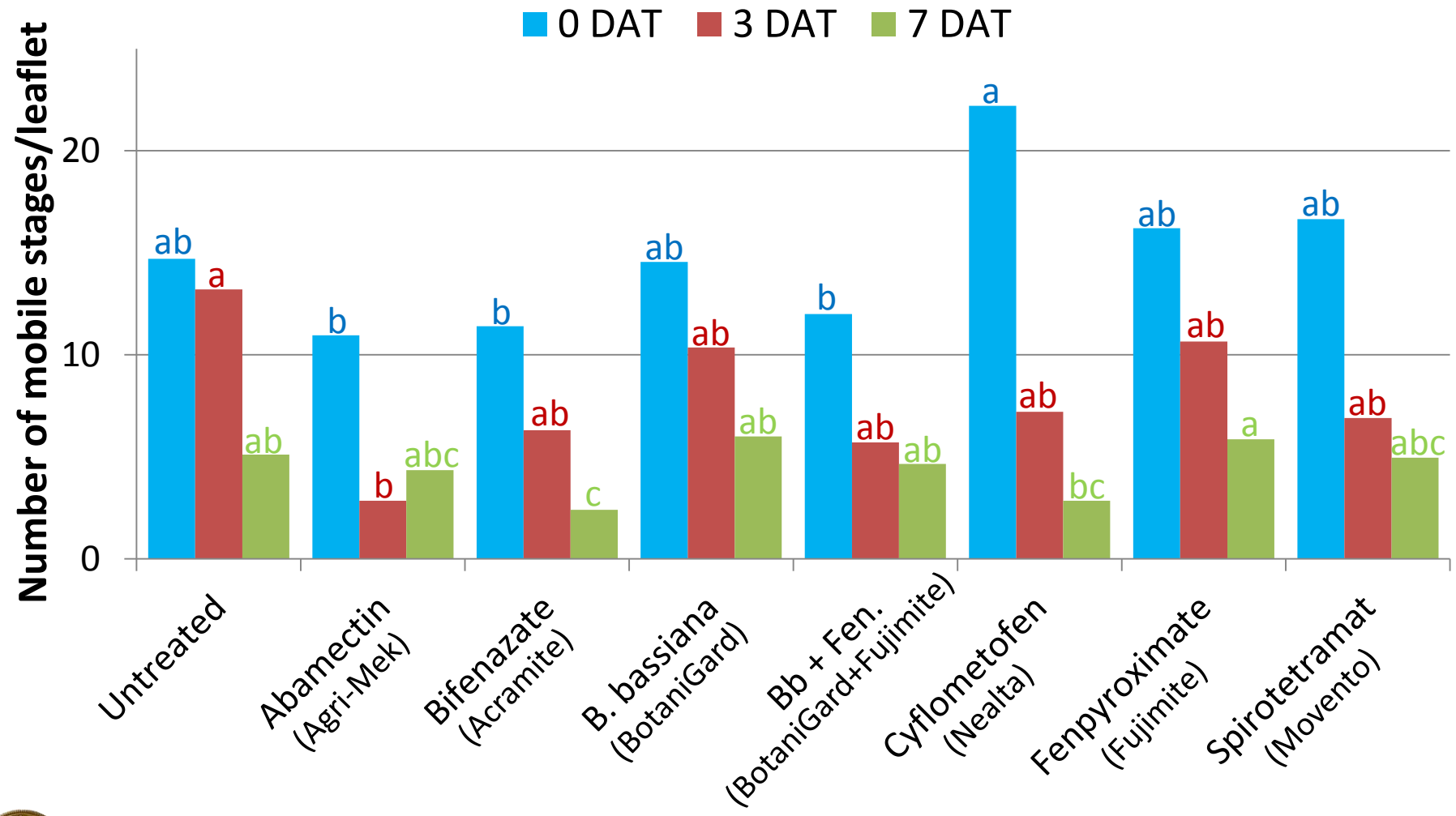
Commercial field trial 2012-Spider mites

Commercial field trial 2012-Spider mites



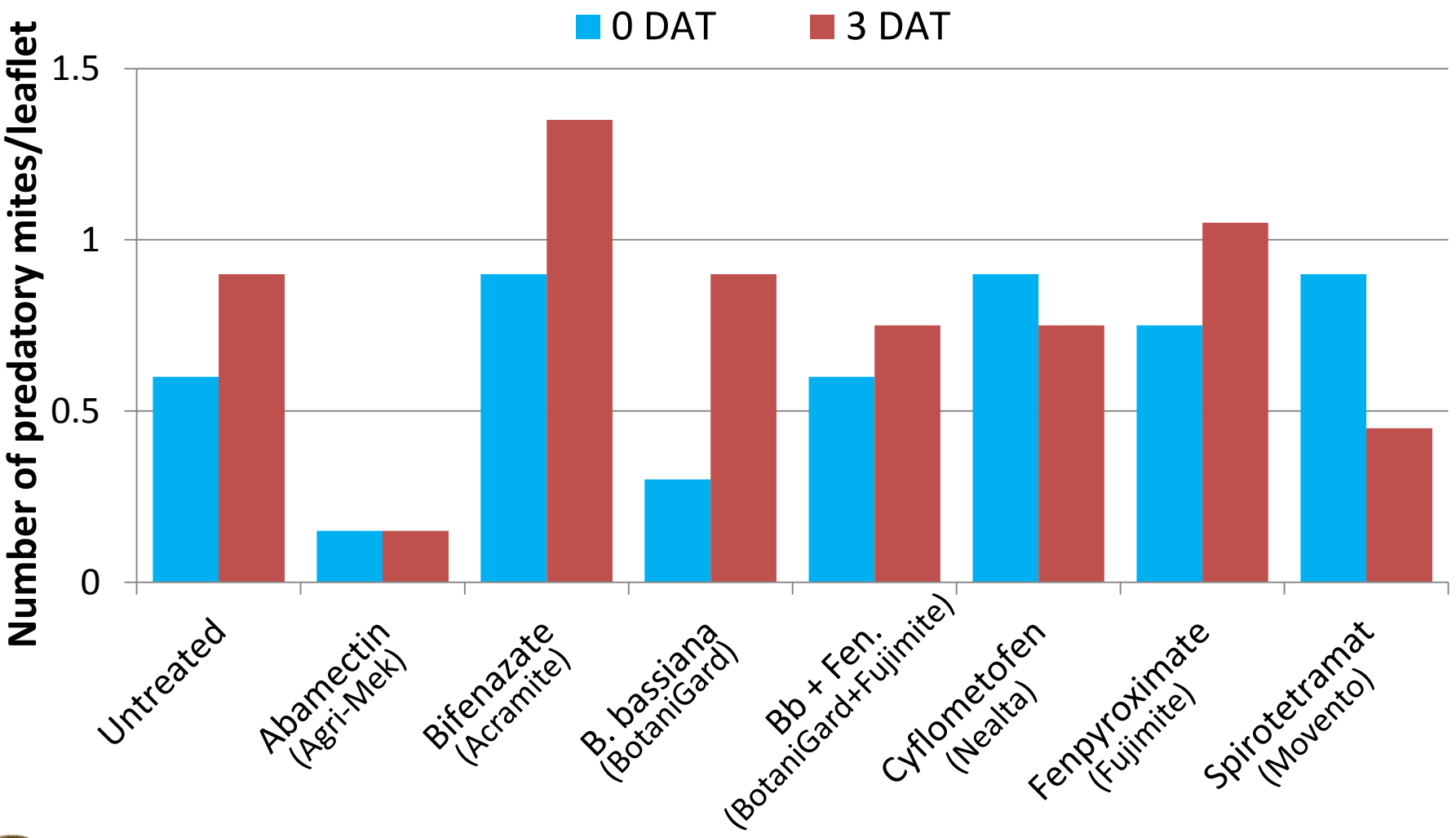
Commercial field trial 2012-Spider mites

Nymphs and adults



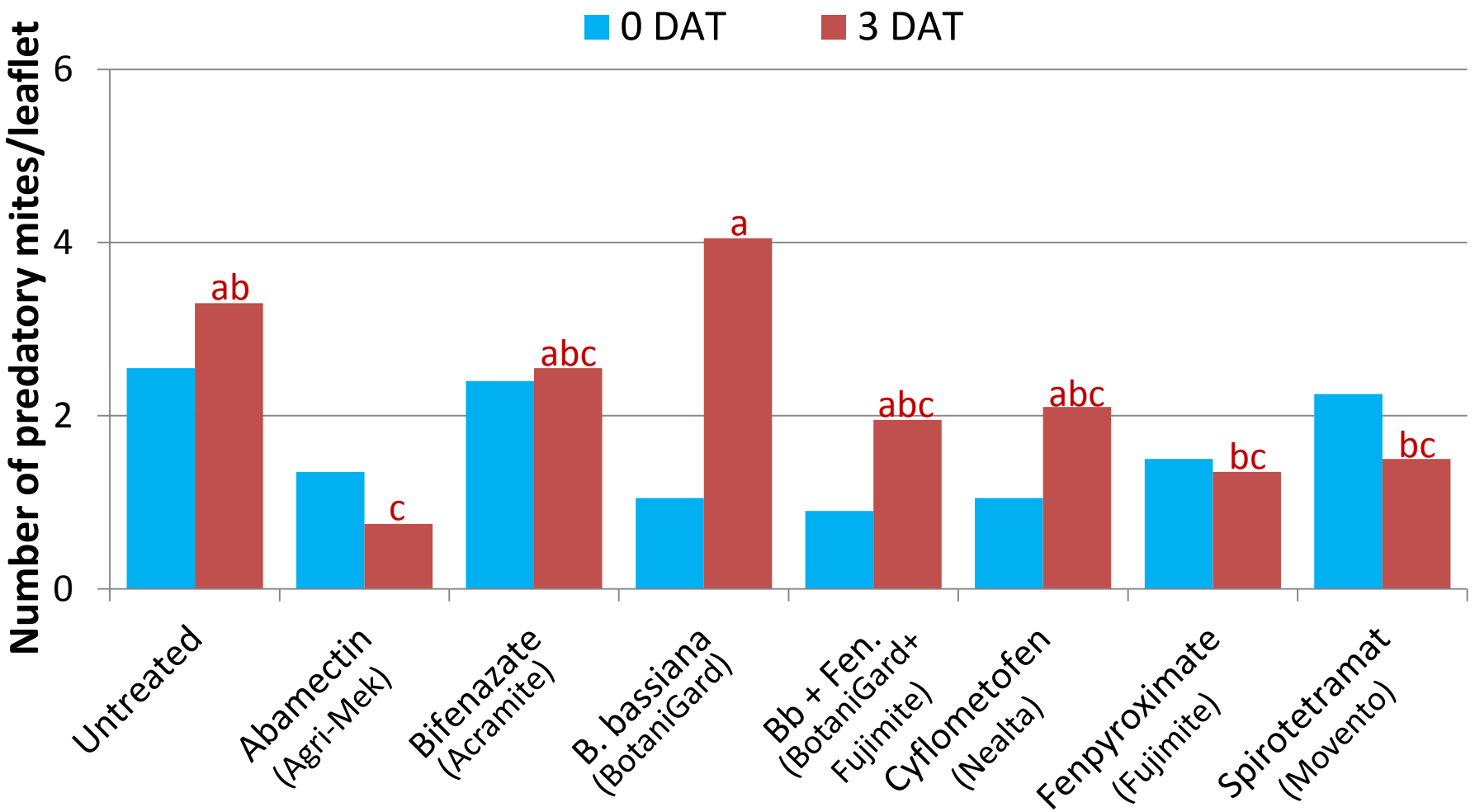
Commercial field trial 2012-Predatory mites

Eggs-*Neoseiulus* spp.



Commercial field trial 2012-Predatory mites

Nymphs and Adults-*Neoseiulus* spp.

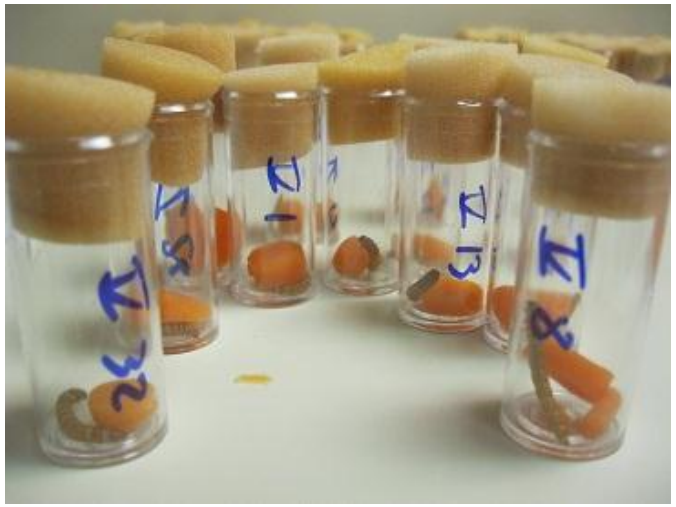


Conclusions

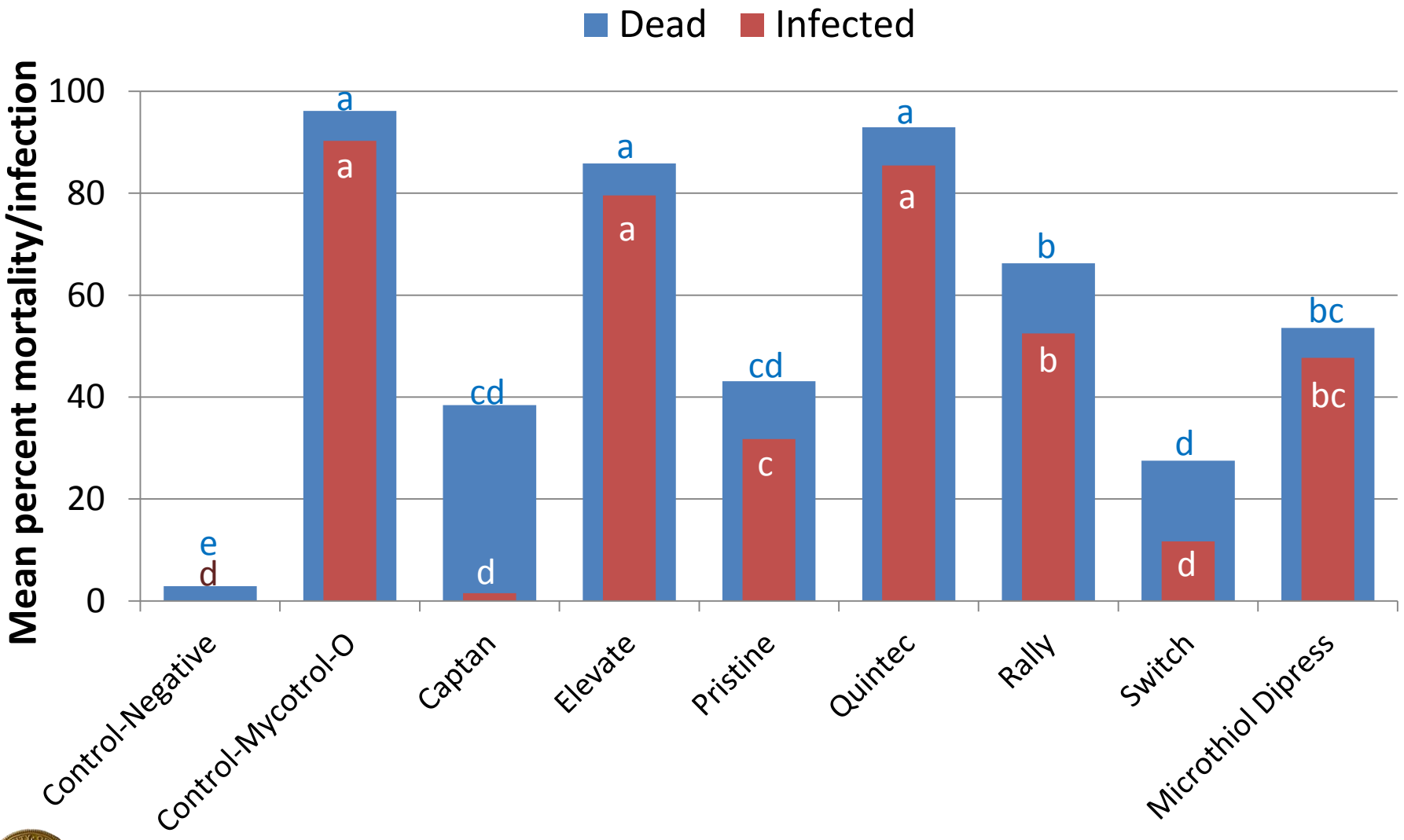
- Microbial and botanical solutions have a good potential in strawberry IPM
- *B. bassiana*+ ½ acetamiprid, *B. bassiana*+azadirachtin, and azadirachtin did fairly well compared to chemicals for lygus control
- *B. bassiana* was comparable to miticides in its efficacy and was safer to predatory mites
- 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

Conclusions

- Elevate and Quintec are compatible with *B. bassiana*
- Other fungicides may be compatible with appropriate time intervals.
- Appropriate time intervals for fungicide and *B. bassiana* applications will be determined

Strawberry IPM

Rotating chemicals from different classes

Judiciously using effective chemicals

Regularly monitoring and making right treatment decisions

Using microbial and botanical pesticides

Conserving natural enemies

Releasing predatory mites

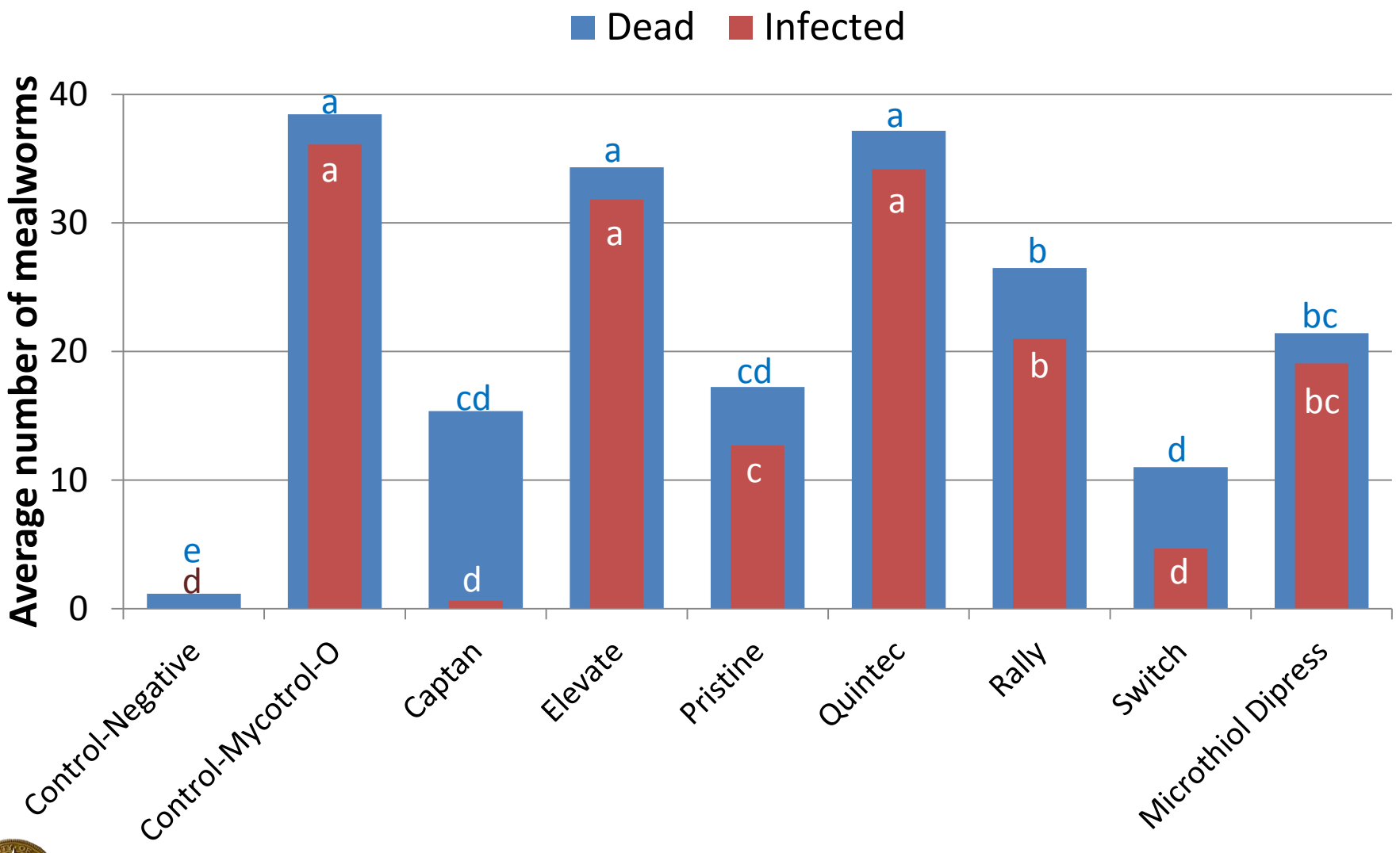
Acknowledgments

Growers and Team
Daniel Ibarra
Dave Peck
J Cardenas & Sons

Technical assistance
Jacob Conway
Maria Murrietta

Pesticide Industry
Curtis Engle, United Phosphorus
Eduardo Garcia, Chemtura
Kate Walker, BASF
Pedro Hernandez, Nichino America
Phil McNally, Bayer
Randy Martin, BioWorks Inc

Compatibility of *B. bassiana* and fungicides



Average of 6 assays