A Celebration of Science and Service

UC Cooperative Extension | University of California Agriculture and Natural Resources

New research and outreach tools

IPM solutions for lygus bug,
Impact of *Beauveria bassiana* on strawberry plant health and yield,
and
Demonstration of smartphone application, IPMinfo

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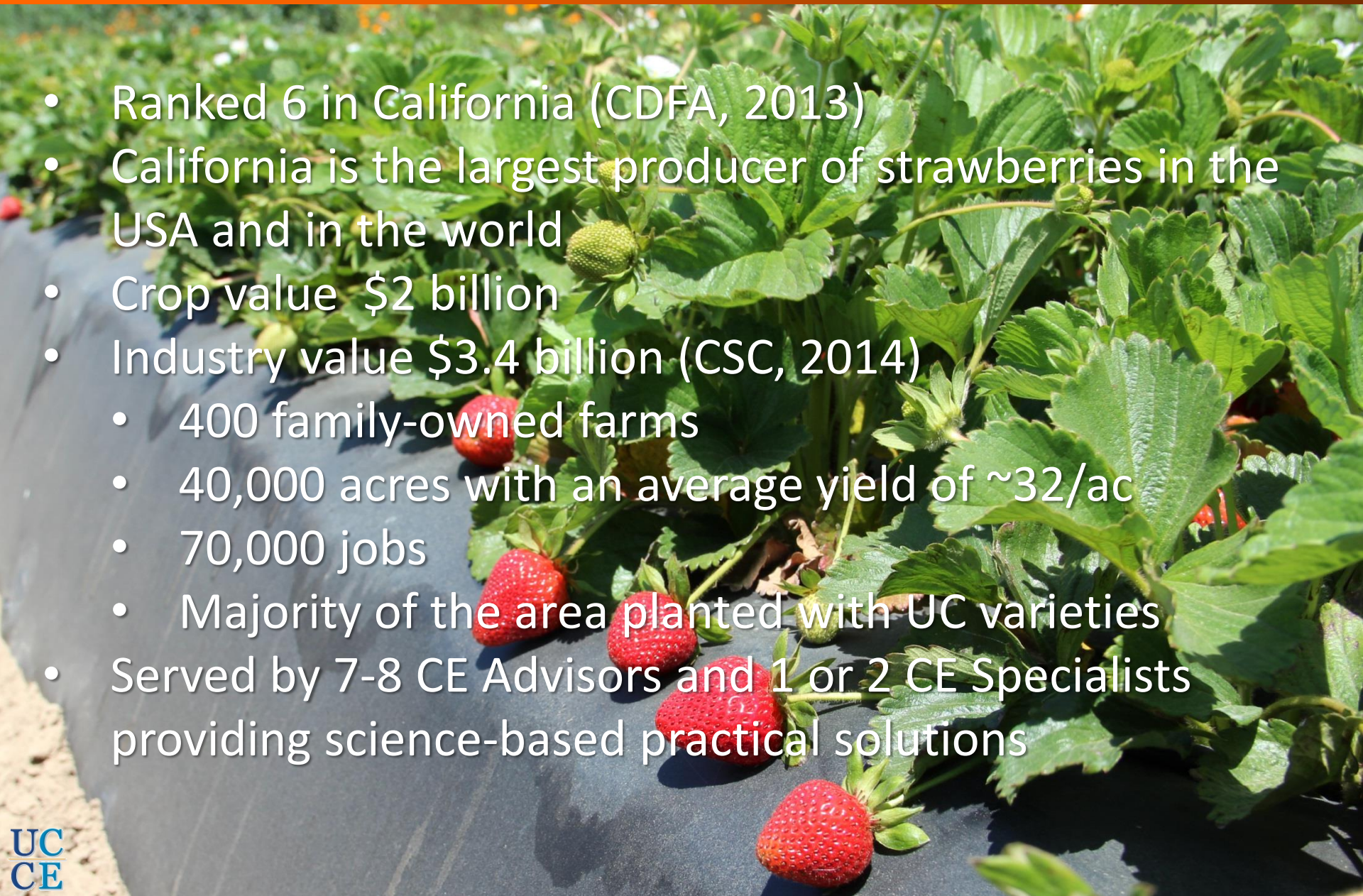
California strawberries



- Ranked 6 in California (CDFA, 2013)
- California is the largest producer of strawberries in the USA and in the world
- Crop value $2 billion
- Industry value $3.4 billion (CSC, 2014)
  - 400 family-owned farms
  - 40,000 acres with an average yield of ~32/ac
  - 70,000 jobs
  - Majority of the area planted with UC varieties
- Served by 7-8 CE Advisors and 1 or 2 CE Specialists providing science-based practical solutions

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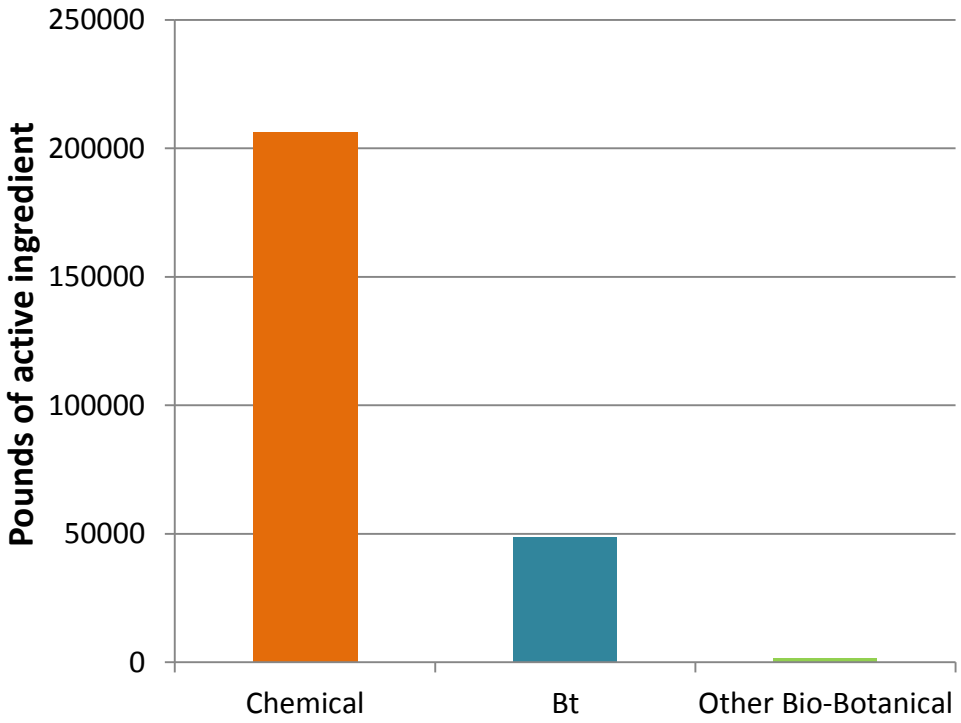
California strawberries

Value of the California strawberry industry	$3.4 billion
Value of the UCCE research and outreach	*Priceless*

Pesticide use in California strawberries

Active Ingredient	Pounds
Abamectin	1,114
Acetamiprid	4,135
Bifenazate	22,161
Bifenthrin	5,252
Buprofezin	2,082
Chlorpyrifos	12,043
Chlorantraniliprole	2,152
Fenpyroximate	941
Fenpropathrin	5,794
Imidacloprid	5,639
Malathion	101,892
Naled	20,896
Novaluron	4,717
Pyperonyl butoxide	5,205
Spinetoram	3,086
Spinosad	1,155
Spiromesifen	6,700
Thiamethoxam	1,466
Chemical total	***206,430***
Azadirachtin	266
Bt	48,719
Beauveria bassiana	47
Pyrethrins	1,042
Bio-Botanical total	***50,074***



http://www.cdpr.ca.gov/docs/pur/pur12rep/comrpt12.pdf

IPM Study to manage lygus bug

Evaluation of botanical, chemical, mechanical, and microbial insecticides for a sound IPM program

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Chemicals-Mode of action groups

4A	Neonicotinoids
4C	Sulfoximines
6	Chloride channel activators
9C	Selective homopteran feeding blockers
15	Inhibitors of chitin biosynthesis

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Non-chemical alternatives

- Entomopathogenic fungi, *Beauveria bassiana* and *Metarhizium brunneum*
- Botanical insect growth regulator, azadirachtin
- Diatomaceous earth

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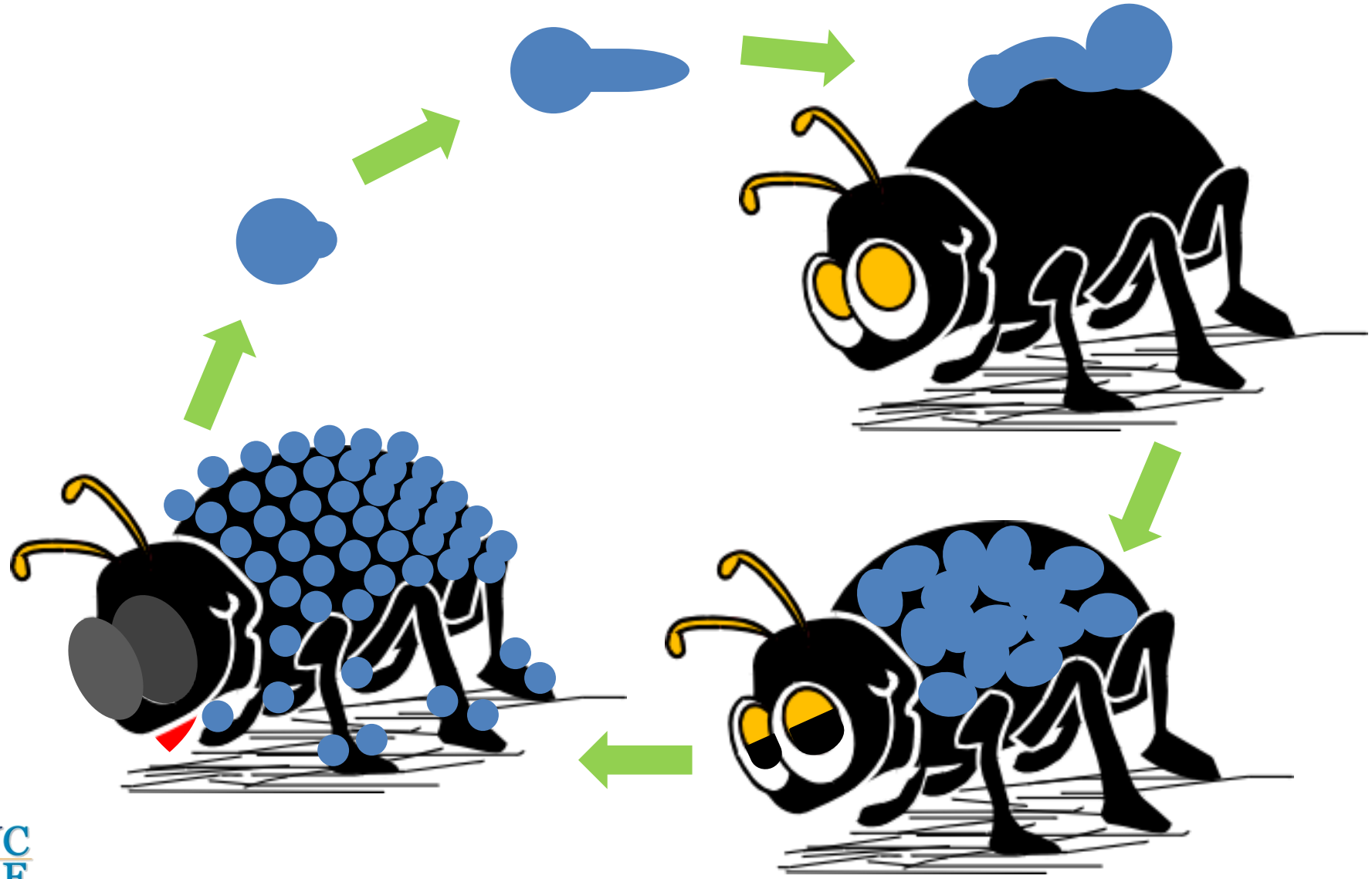
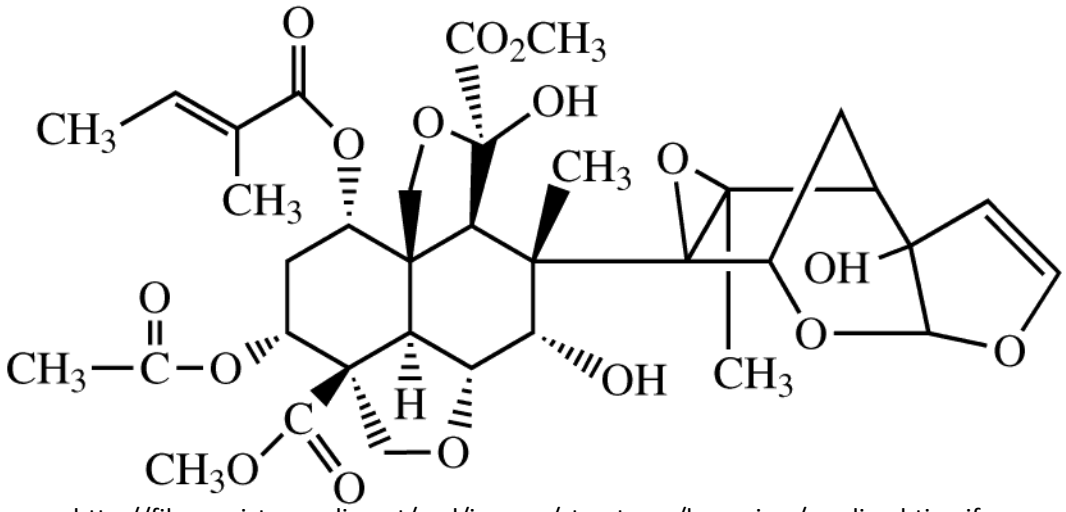
Entomopathogenic fungus mode of action



Azadirachtin mode of action



http://files.meistermedia.net/cpd/images/structures/largeview/azadirachtin.gif

- Interferes with protein synthesis
- Affects molting and metamorphosis
- Disturbs mating and sexual communication
- Sterilizes adults
- Reduces reproductive ability
- Acts as antifeedant and repellent

Diatomaceous earth mode of action

- Powder form of fossilized remains of diatoms (contains silicon dioxide)
- Absorbs waxy layer of insect cuticle causing water loss
- Causes death due to desiccation

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Lygus bug

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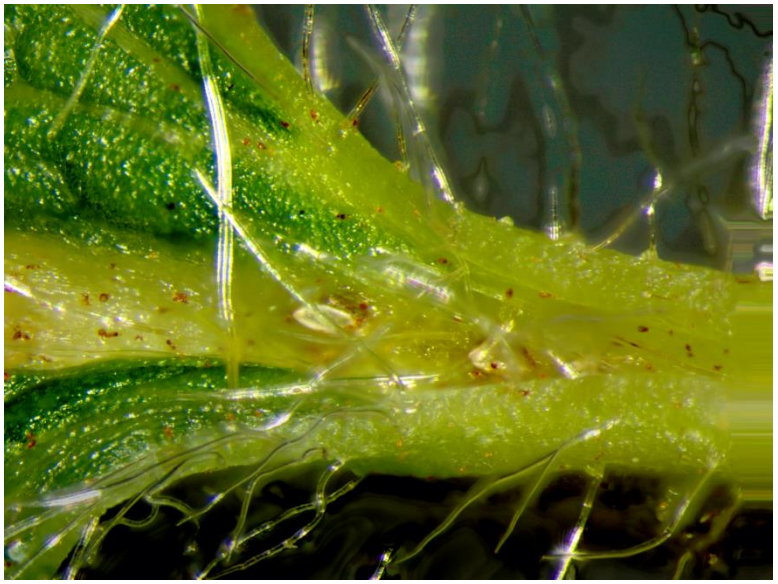
Lygus bug



Photos by Rodney Cooper, USDA-ARS

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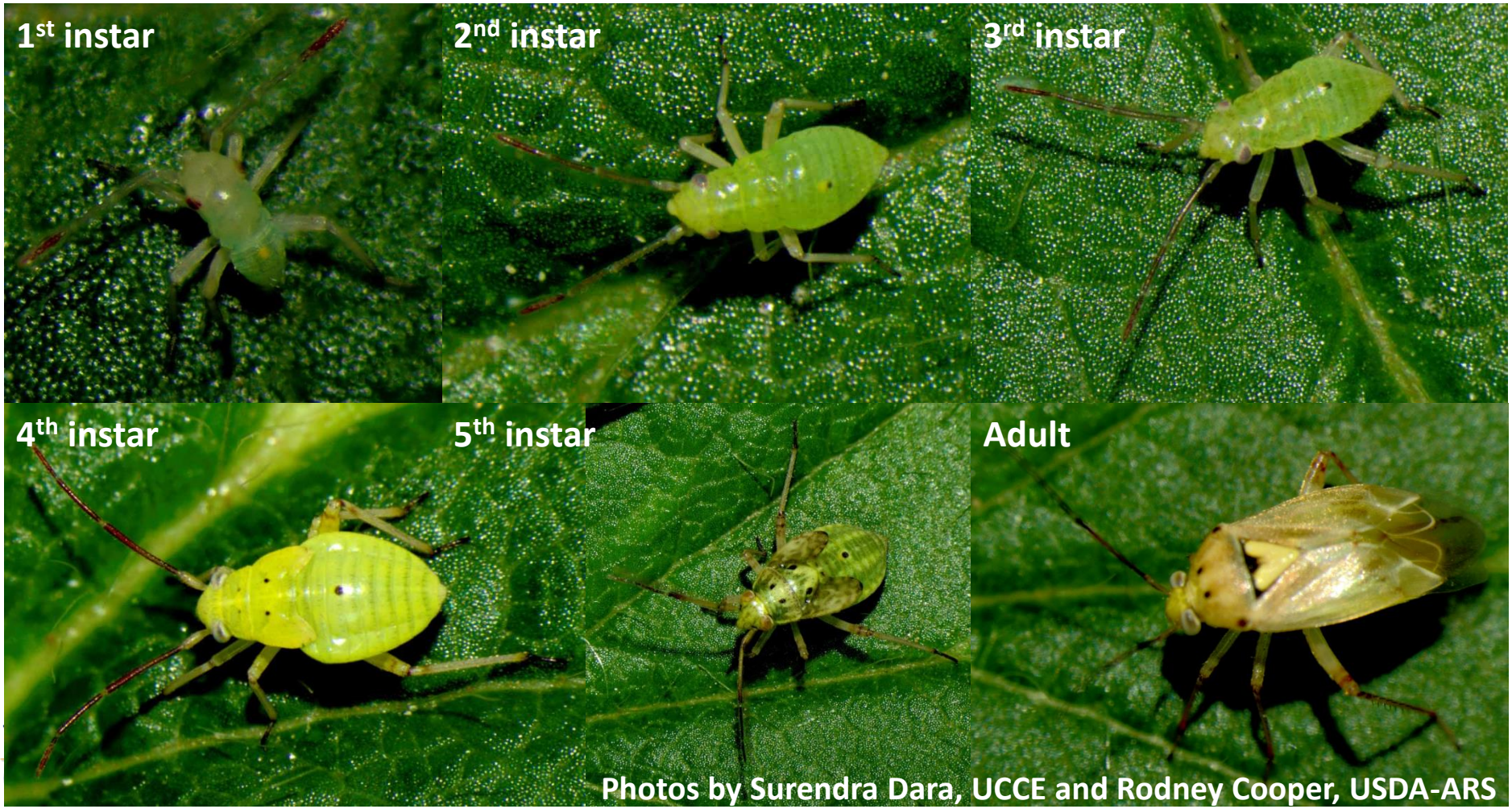
Lygus bug


1st instar
2nd instar
3rd instar
4th instar
5th instar
Adult
Photos by Surendra Dara, UCCE and Rodney Cooper, USDA-ARS

Strawberry pests

Deformation from lygus feeding and environmental factors

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Strawberry-IPM trial 2013

	1st application (Rate/acre)	2nd application (Rate/acre)	3rd application (Rate/acre)
1	Untreated	Untreated	Untreated
2	Assail 70 WP (3 oz) **4A***	Assail 70 WP (3 oz) **4A**	Assail 70 WP (3 oz) **4A**
3	Beleaf 50 SG (2.8 oz) **9C**	Beleaf 50 SG (2.8 oz) **9C**	Athena (17 fl oz) **3A+6**
4	Athena (17 fl oz) **3A+6**	Athena (17 fl oz) **3A+6**	Beleaf 50 SG (2.8 oz) **9C**
5	Rimon 0.83 EC (12 fl oz) **15** + Brigade (16 oz) **3A**	Rimon 0.83 EC (12 fl oz) **15** + Brigade (16 oz) **3A**	EverGreen (16 fl oz) **3A+POB**
6	Rimon 0.83 EC (12 fl oz) **15** + Brigade (16 oz) **3A**	BotaniGard ES (2 qrt) + Molt-X (8 fl oz)	BotaniGard ES (2 qrt) + Molt-X (8 fl oz)
7	Grandevo (2 lb)	Grandevo (2 lb)	Grandevo (2 lb)
8	BotaniGard ES (2 qrt) + Molt-X (8 fl oz)	Grandevo (2 lb)	Beleaf 50 SG (2.8 oz) **9C**
9	EverGreen (16 fl oz) **3A+POB**	EverGreen (16 fl oz) **3A+POB**	Assail 70 WP (3 oz) **4A**
10	BotaniGard ES (2 qrt) + Low Assail (1.5 oz) **4A**	BotaniGard ES (2 qrt) + Low Beleaf 50 SG (1.4 oz) **9C**	BotaniGard ES (2 qrt) + Low Athena (10 fl oz) **3A+6**
11	Closer (4.5 oz) **4C**	Closer (4.5 oz) **4C**	BotaniGard ES (2 qrt) + Grandevo (2 lb)
12	Closer (3 oz) **4C**	Closer (3 oz) **4C**	Beleaf 50 SG (2.8 oz) **9C**

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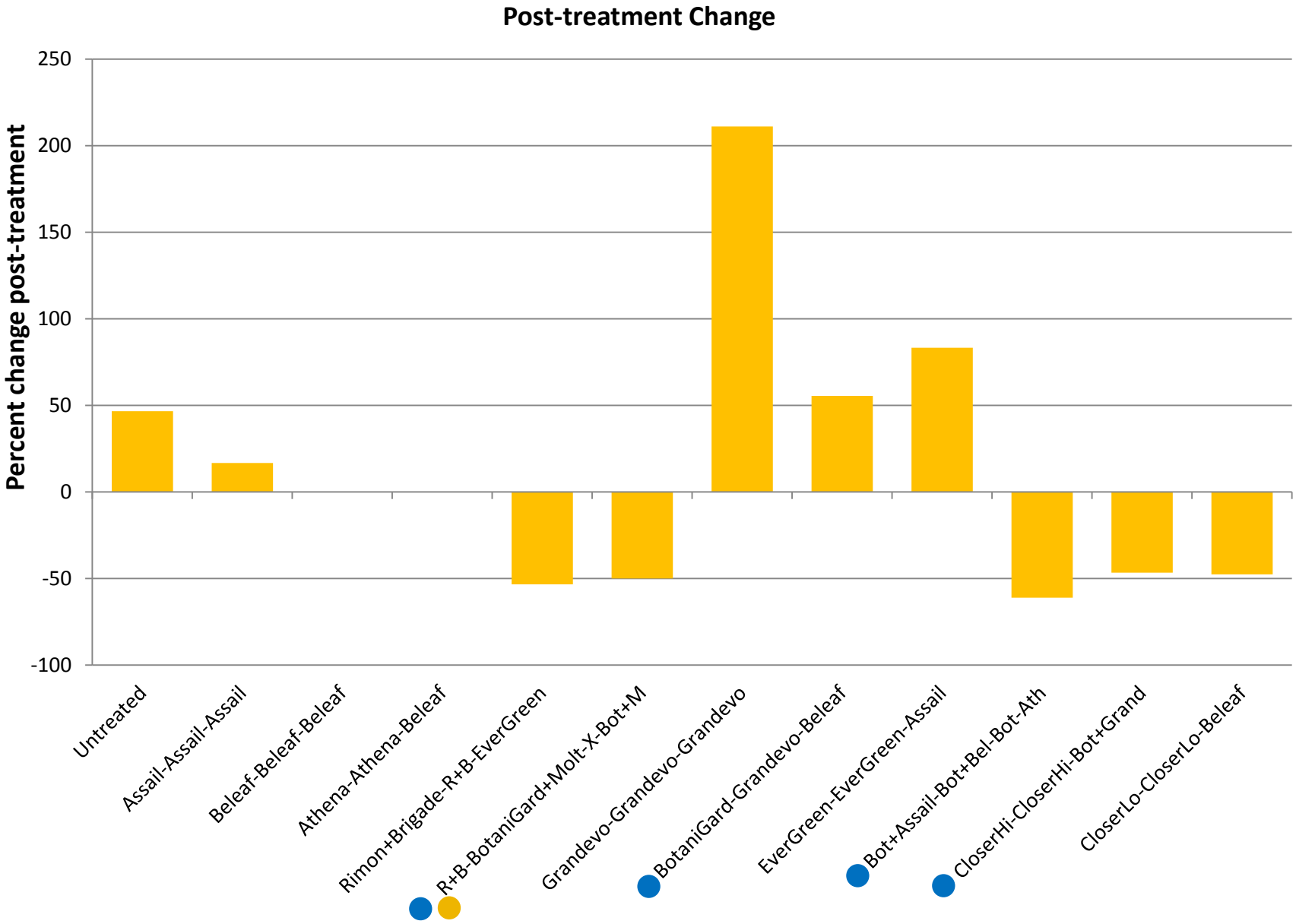
*MoA group

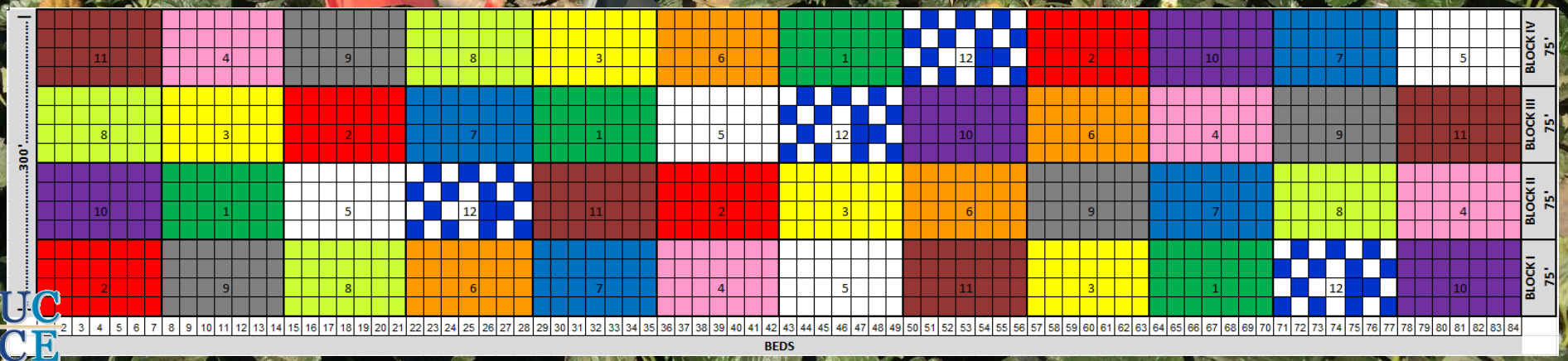
3A Pyrethrins
4A Neonicotinoids
4C Sulfoximines
6 Chloride channel activators
9C Selective homopteran feeding blockers
15 Inhibitors of chitin biosynthesis

2013 Strawberry IPM trial



2014 Strawberry IPM trial

Goodwin Berry Farms, Santa Maria



2014 Strawberry IPM trial

	1st application (Rate/acre)	2nd application (Rate/acre)	3rd application (Rate/acre)
1	Untreated	Untreated	Untreated
2	Assail 70 WP (3 oz) **4A***	Assail 70 WP (3 oz) **4A**	Assail 70 WP (3 oz) **4A**
3	Rimon 0.83 EC (12 fl oz) **15** + Assail 30SG (6.9 oz) **4A**	Rimon 0.83 EC (12 fl oz) **15** + Closer SC (4.5 fl oz) **4C**	Rimon 0.83 EC (12 fl oz) **15** + Assail 30SG (6.9 oz) **4A**
4	Rimon 0.83 EC (12 fl oz) **15** + Brigade (16 oz) **3A**	BotaniGard ES (2 qrt) + Molt-X (8 fl oz)	BotaniGard ES (2 qrt) + Molt-X (8 fl oz)
5	Rimon 0.83 EC (12 fl oz) **15** + Assail 30SG (6.9 oz) **4A**	Rimon 0.83 EC (12 fl oz) **15** + Beleaf 50 SG (2.8 oz) **9C**	Rimon 0.83 EC (12 fl oz) **15** + Assail 30SG (6.9 oz) **4A**
6	BotaniGard ES (2 qrt) + Molt-X (8 fl oz)	BotaniGard ES (2 qrt) + Low Beleaf 50 SG (1.4 oz) **9C**	Low BotaniGard ES (1 qrt) + Low Closer (3 oz) **4C**
7	Actara (4 oz) **4A**	Actara (4 oz) **4A** + Agri-Mek SC (3.5 fl oz) **6**	BotaniGard ES (2 qrt) + Molt-X (8 fl oz)
8	High Closer (4.5 oz) **4C**	High Closer (4.5 oz) **4C**	High Closer (4.5 oz) **4C**
9	Low Closer (3 oz) **4C**	Low Closer (3 oz) **4C**	Low Closer (3 oz) **4C**
10	High Diafil 610 Slurry (70 lb)	Low BotaniGard ES (1 qrt) + Low Closer (3 oz) **4C**	Met52 EC(16 fl oz) + Assail 70 WP (3 oz) **4A**
11	Low Diafil 610 Slurry (35 lb)	Low Closer (3 oz) **4C** + Molt-X (8 fl oz)	Met52 EC(16 fl oz)
12	High Diafil 610 Dust (70 lb)	Low BotaniGard ES (1 qrt) + Assail 70 WP (3 oz) **4A**	Met52 EC (16 fl oz) + Molt-X (8 fl oz)

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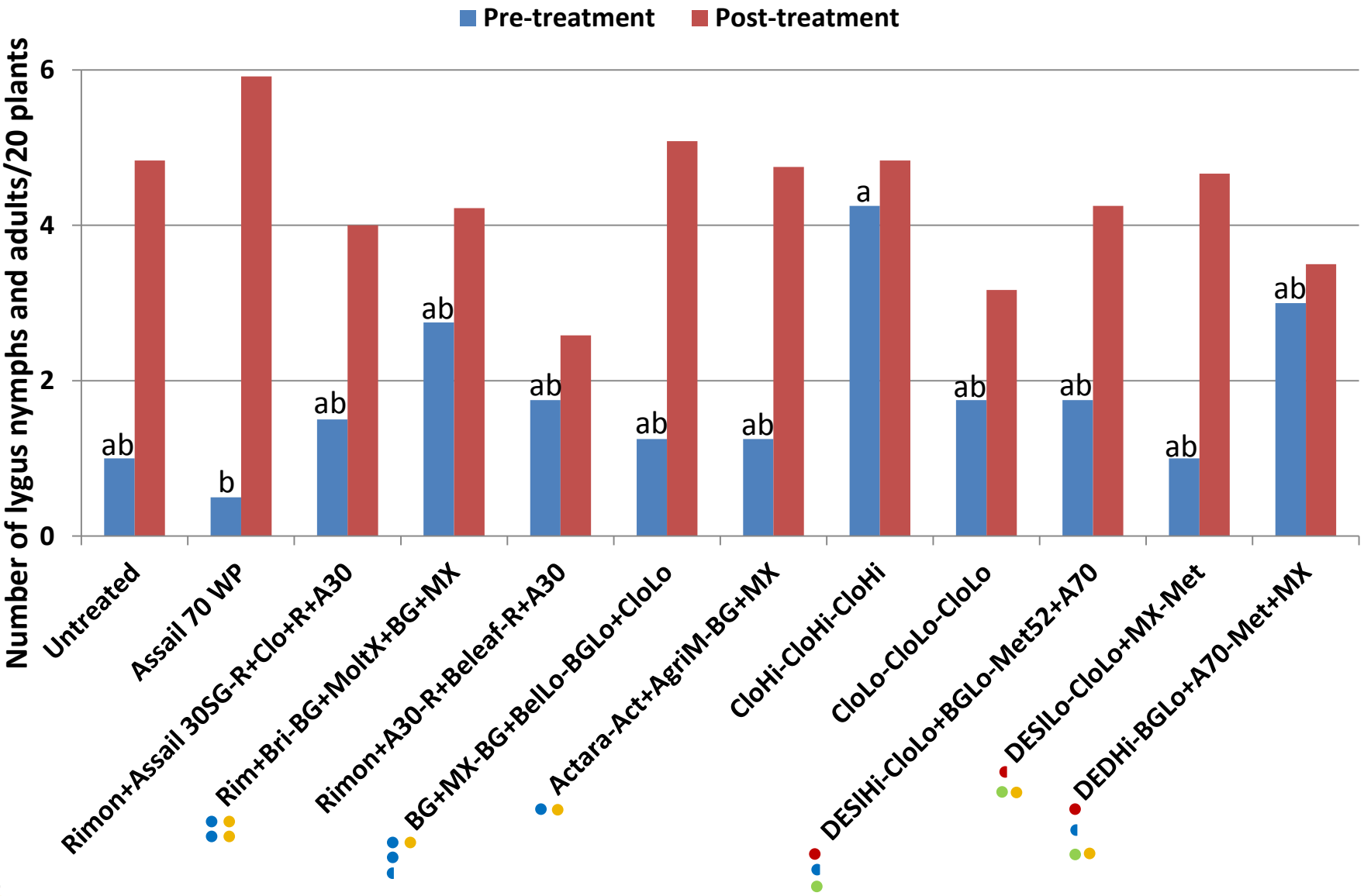
*MoA group

4A Neonicotinoids
4C Sulfoximines
6 Chloride channel activators
9C Selective homopteran feeding blockers
15 Inhibitors of chitin biosynthesis

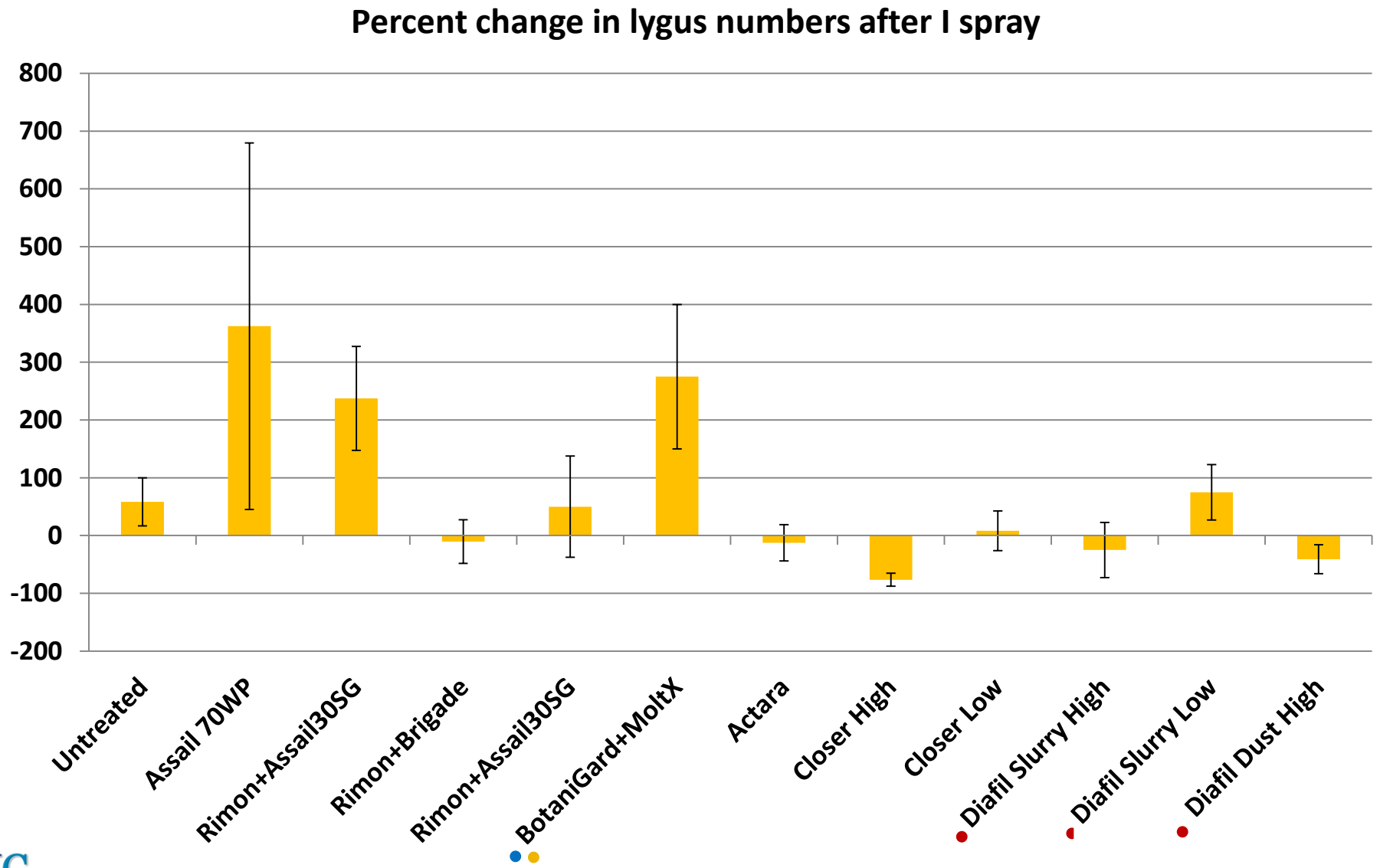
Treatments and sampling

2014 Strawberry IPM trial

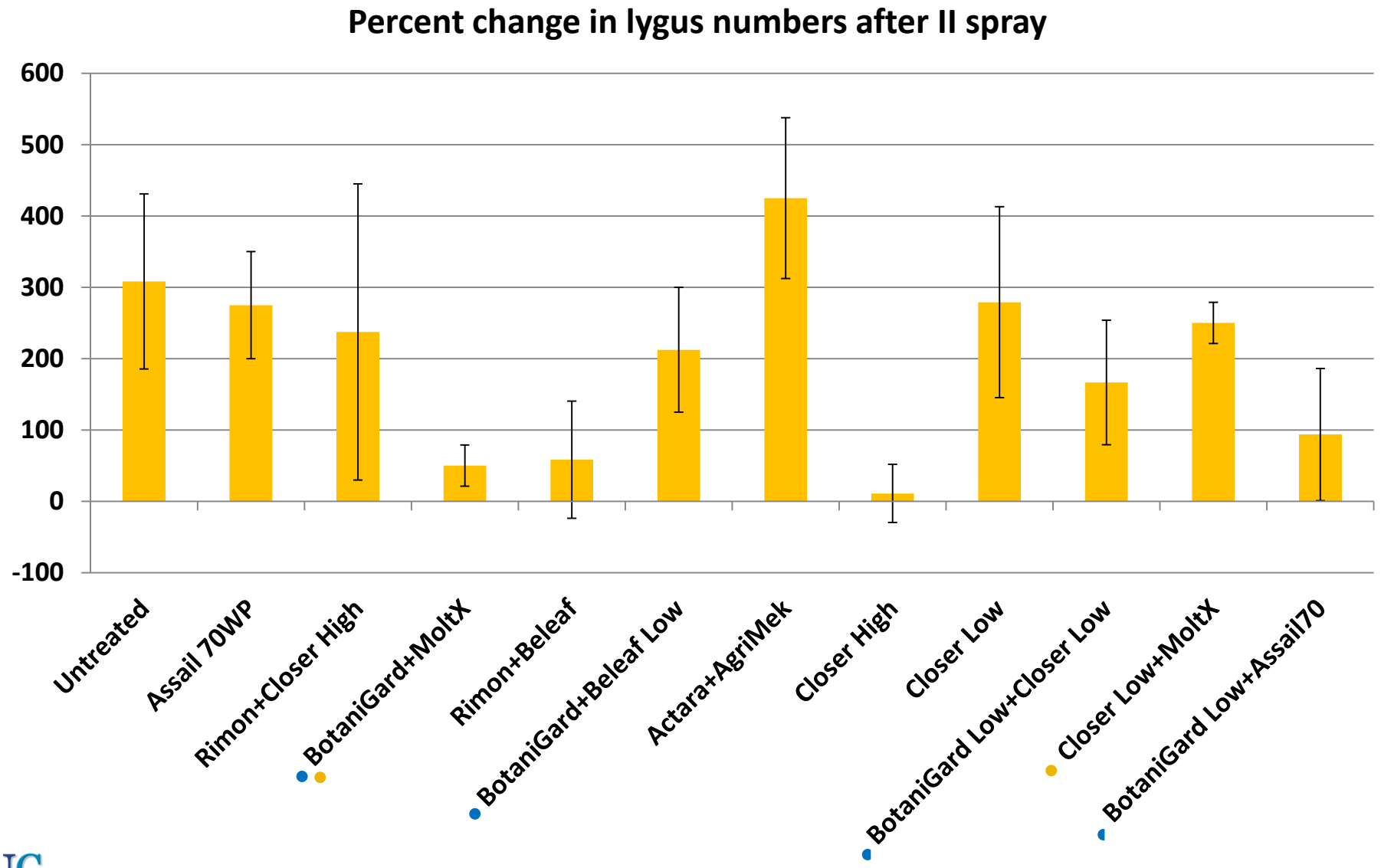


Tukey's HSD $P < 0.05$

2014 Strawberry IPM trial-I Spray



2014 Strawberry IPM trial-II Spray



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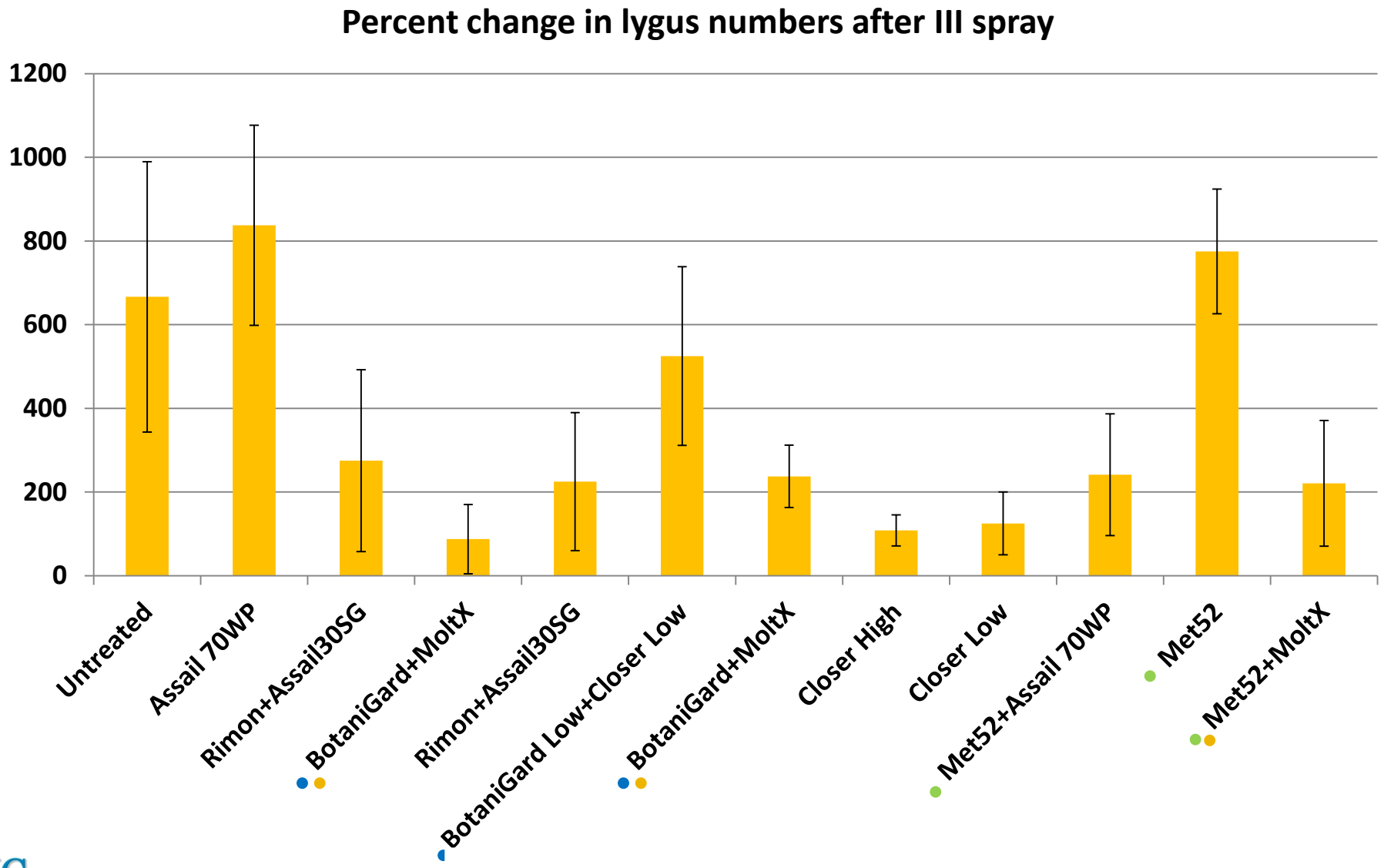
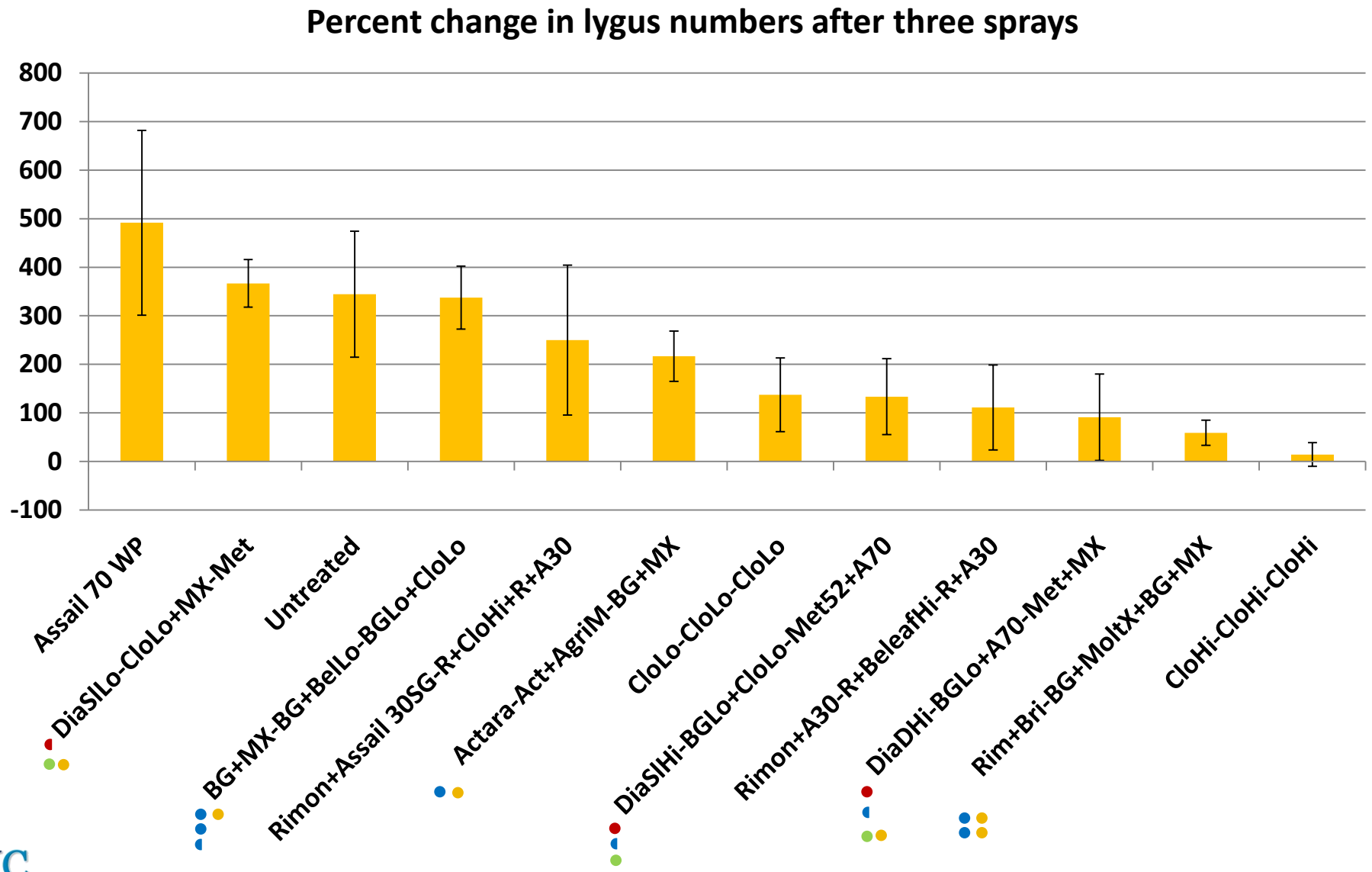
2014 Strawberry IPM trial-III Spray



2014 Strawberry IPM trial



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2014 Strawberry IPM trial

Rank	%Change	I Spray	II Spray	III Spray
I	14	Closer High	Closer High	Closer High
II	17	Diafil Dust High	BotaniGard Low + Assail 70WP	Met52 + Molt-X
III	48	Rimon + Assail 30SG	Rimon + Beleaf 50SG	Rimon + Assail 30SG
IV	54	Rimon + Brigade	BotaniGard ES + Molt-X	BotaniGard ES + Molt-X
V	81	Closer Low	Closer Low	Closer Low
VI	143	Diafil Slurry High	Closer Low + BotaniGard ES Low	Met52 + Assail 70WP
VII	167	Rimon + Assail 30SG	Rimon + Closer High	Rimon + Assail 30SG
VIII	280	Actara	Actara + Agri-Mek	BotaniGard ES + Molt-X
IX	307	BotaniGard ES + Molt-X	BotaniGard ES + Beleaf 50SG Low	BotaniGard ES Low + Closer Low
X	367	Diafil Slurry Low	Closer Low	Met52 + Molt-X
XI	383	Untreated	Untreated	Untreated
XII	1083	Assail 70WP	Assail 70WP	Assail 70WP

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2014 Strawberry IPM trial

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Conclusions

- Microbial and botanical pesticides play an important role in strawberry IPM
- Rotating or combining with chemical pesticides provides good control
- Considering multiple tools is important for a sound IPM strategy

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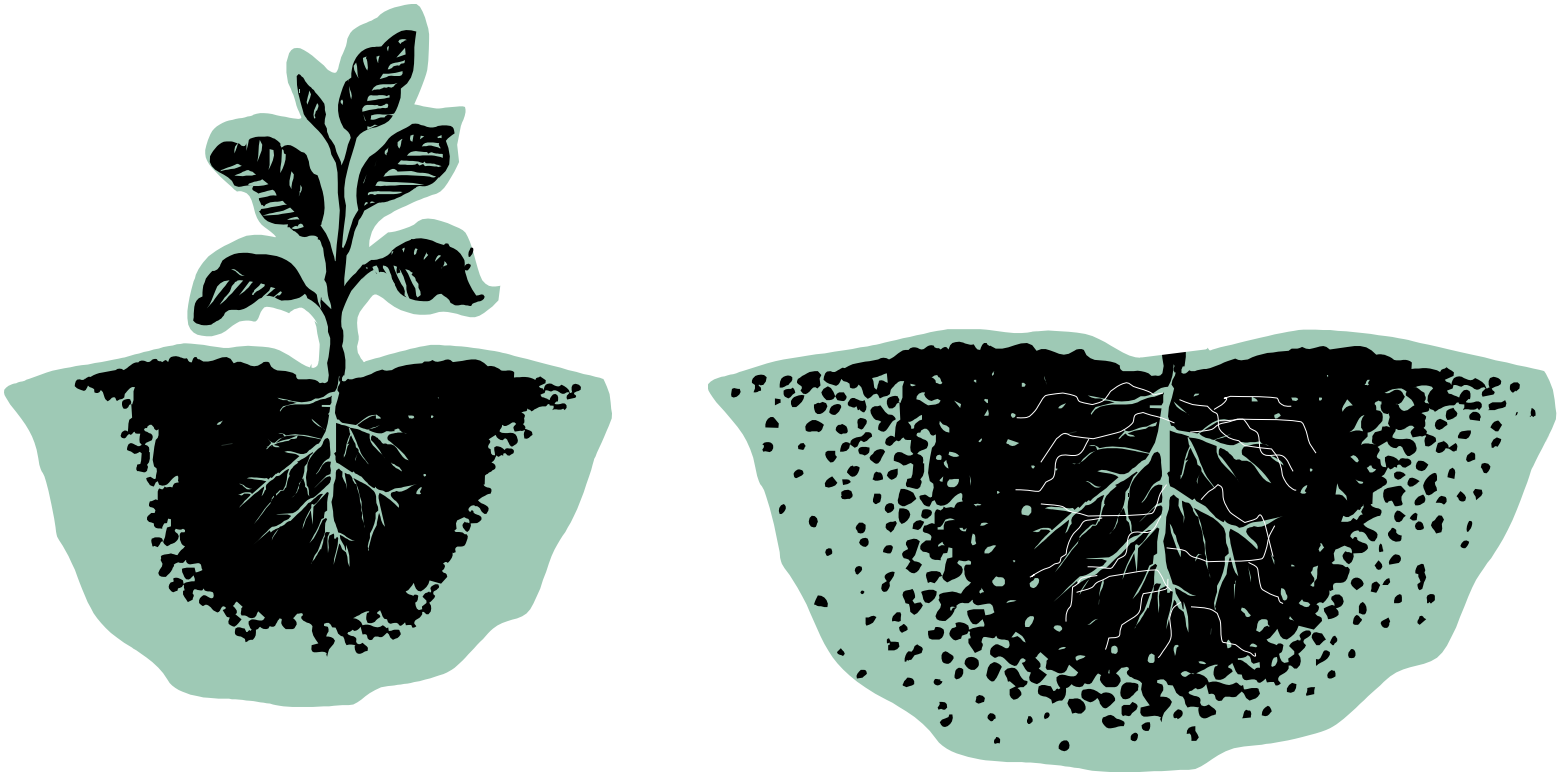
Impact of *B. bassiana* on strawberries



Impact through mycorrhizal interaction

- Promote plant growth
  - Improving water and nutrient absorption
- Promote plant health
  - Protecting from pests and pathogens

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Mycorrhizal interactions

Study conducted at Los Angeles County Jail, 2013

Maximizing
Education
Reaching
Individual
Transformation

1. Untreated
2. HYTA-Microbial growth enhancer
3. *B. bassiana*

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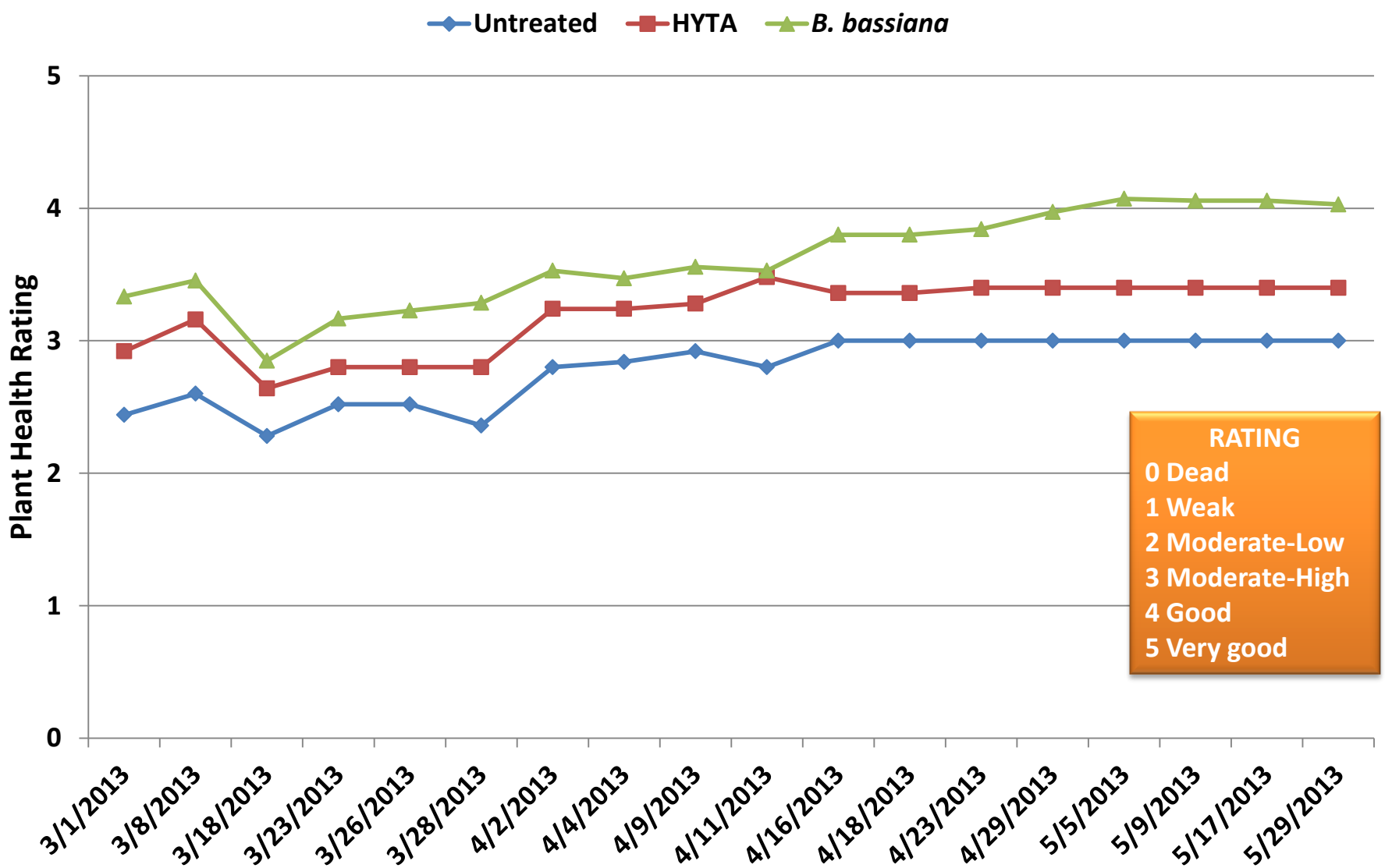
Mycorrhizal interactions



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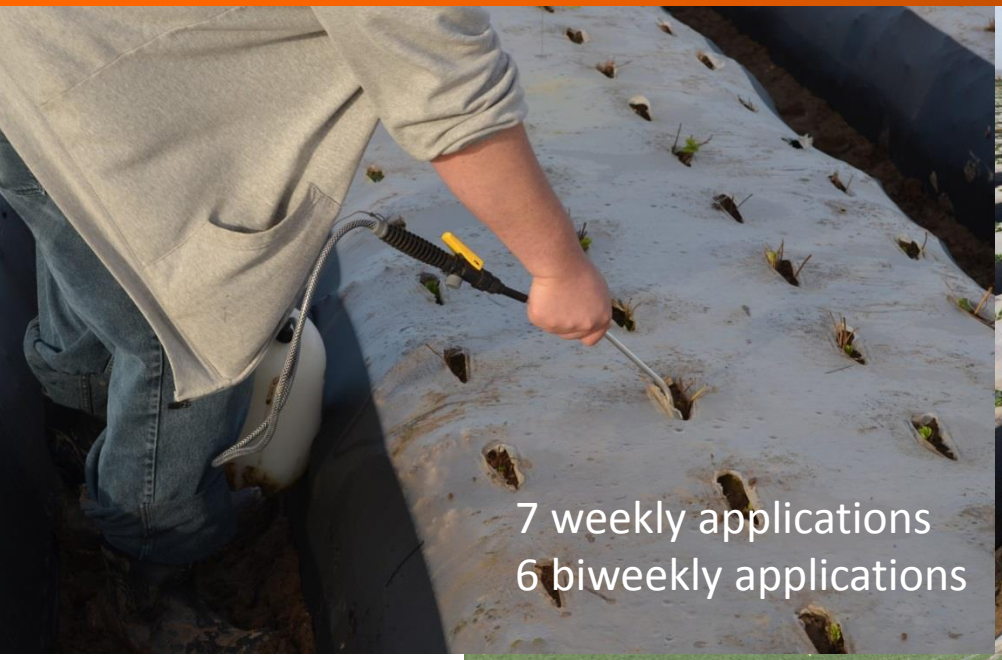
Tukey's HSD $P < 0.05$

Mycorrhizal interactions

Mycorrhizal interactions



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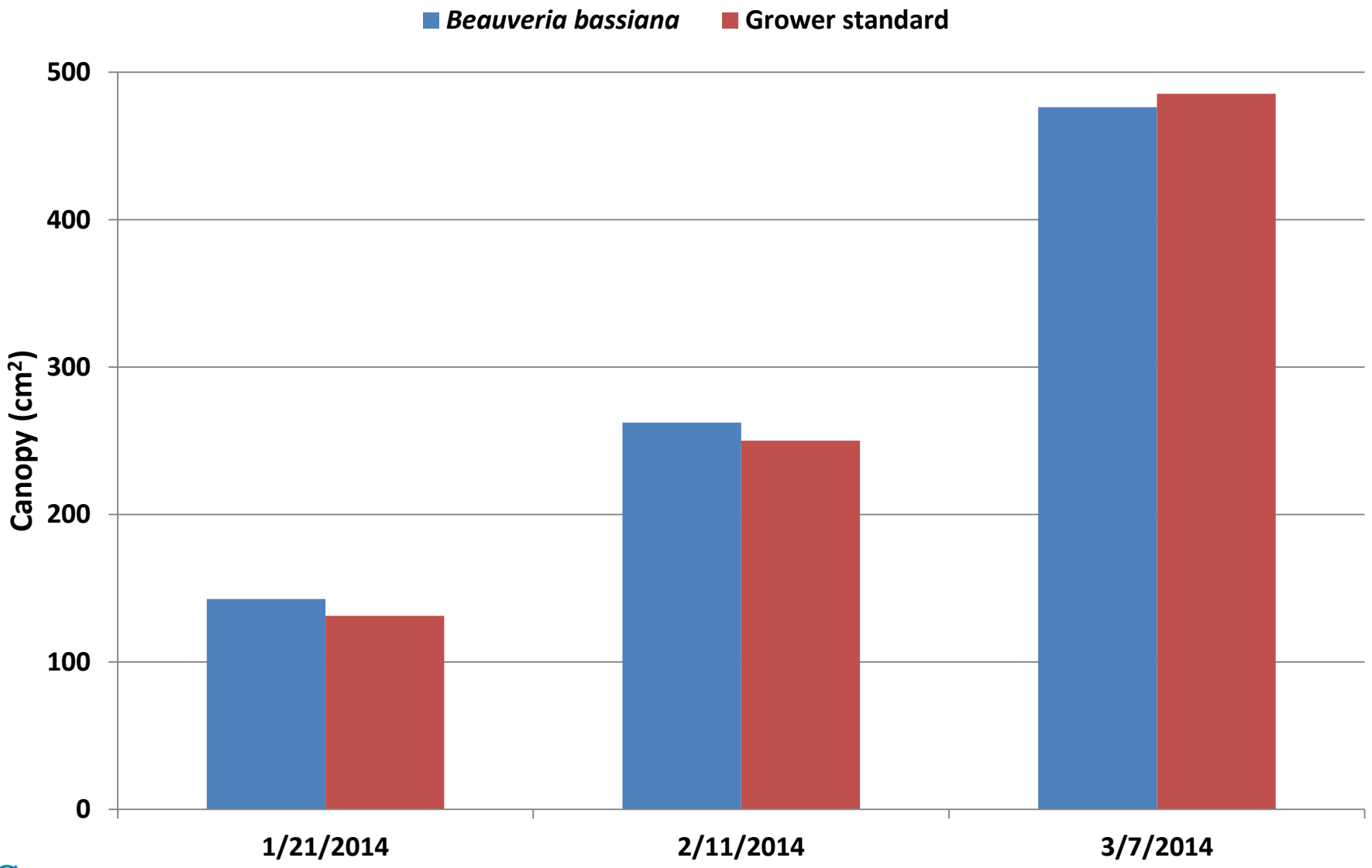
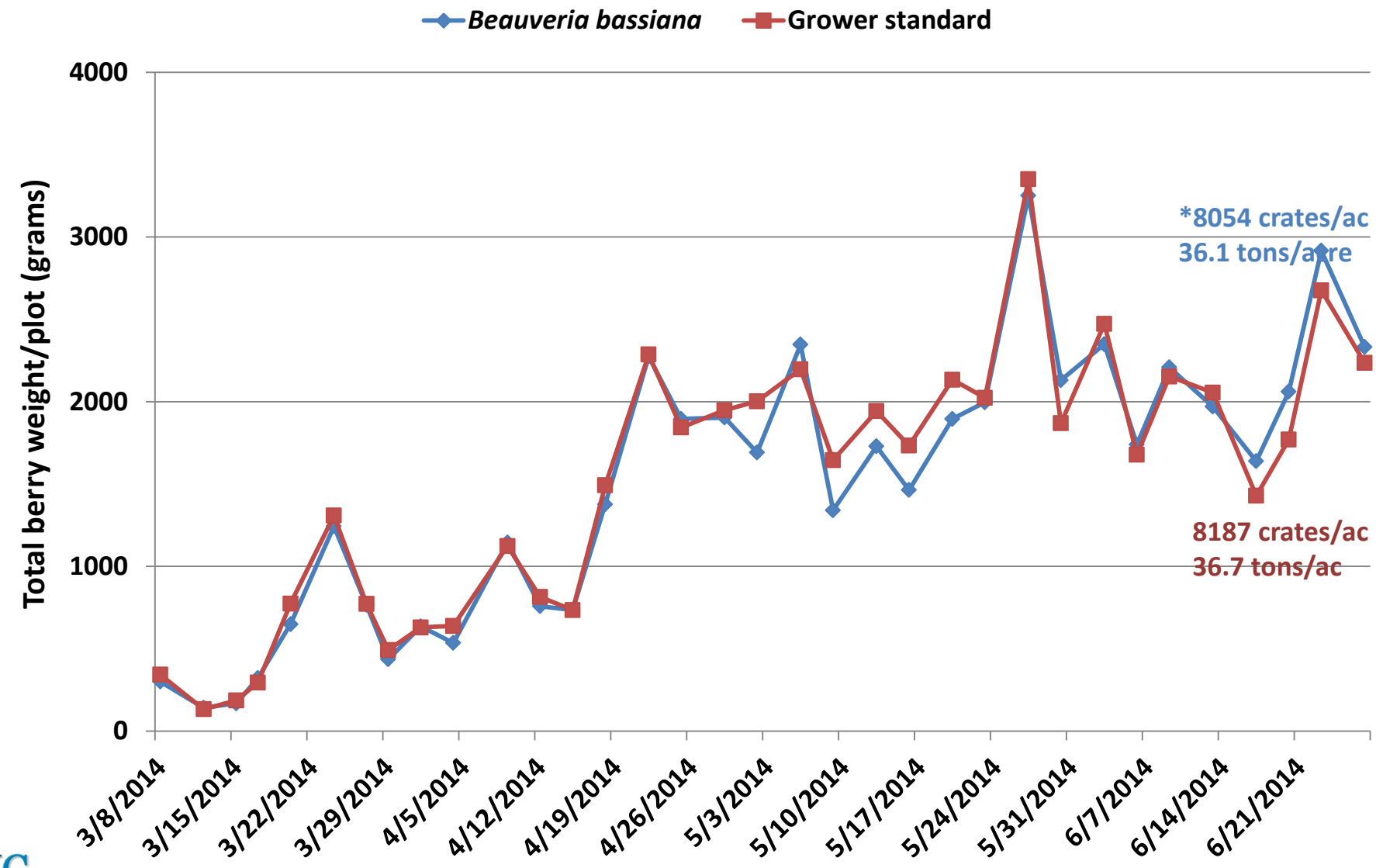
Strawberry plant growth



Tukey's HSD $P \geq 0.05$

Total strawberry yield



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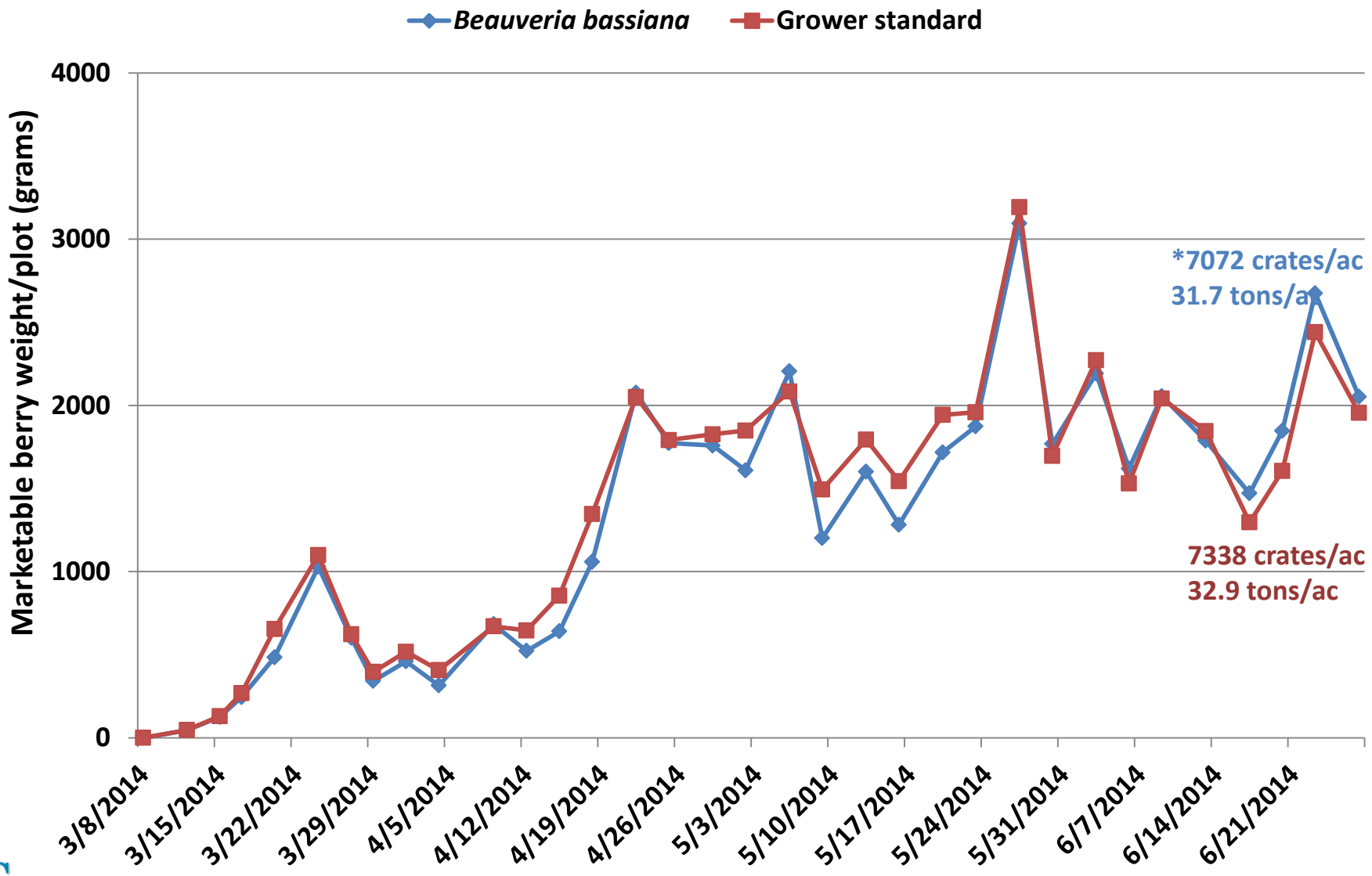
* Tukey's HSD $P \geq 0.05$

Marketable strawberry yield



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* Tukey's HSD $P \geq 0.05$

Conclusions

- *B. bassiana* seems to have an impact on plant growth and yield
- Additional studies are necessary to determine appropriate rates and application timings

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Acknowledgements

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