University of California
Agriculture and Natural Resources

Potential of Non-chemical Alternatives for Pest and Disease Management

Surendra Dara PhD, DAIT
Strawberry and Vegetable Crops Advisor
University of California Cooperative Extension
skdara@ucdavis.edu
Dave Peck
Manzanita Berry Farms, Santa Maria, CA
Sumanth Dara and Suchitra Dara
Global Agricultural Solutions, Bakersfield, CA
Tim Anderson
Dow AgroSciences, Shafter, CA

UCCE 28 November, 2017

Studies

- Solar-powered UV light trap to manage insect pests in strawberry
- Beneficial microbial treatments to improve strawberry health and yield
- Entomopathogenic fungi to control a plant pathogen

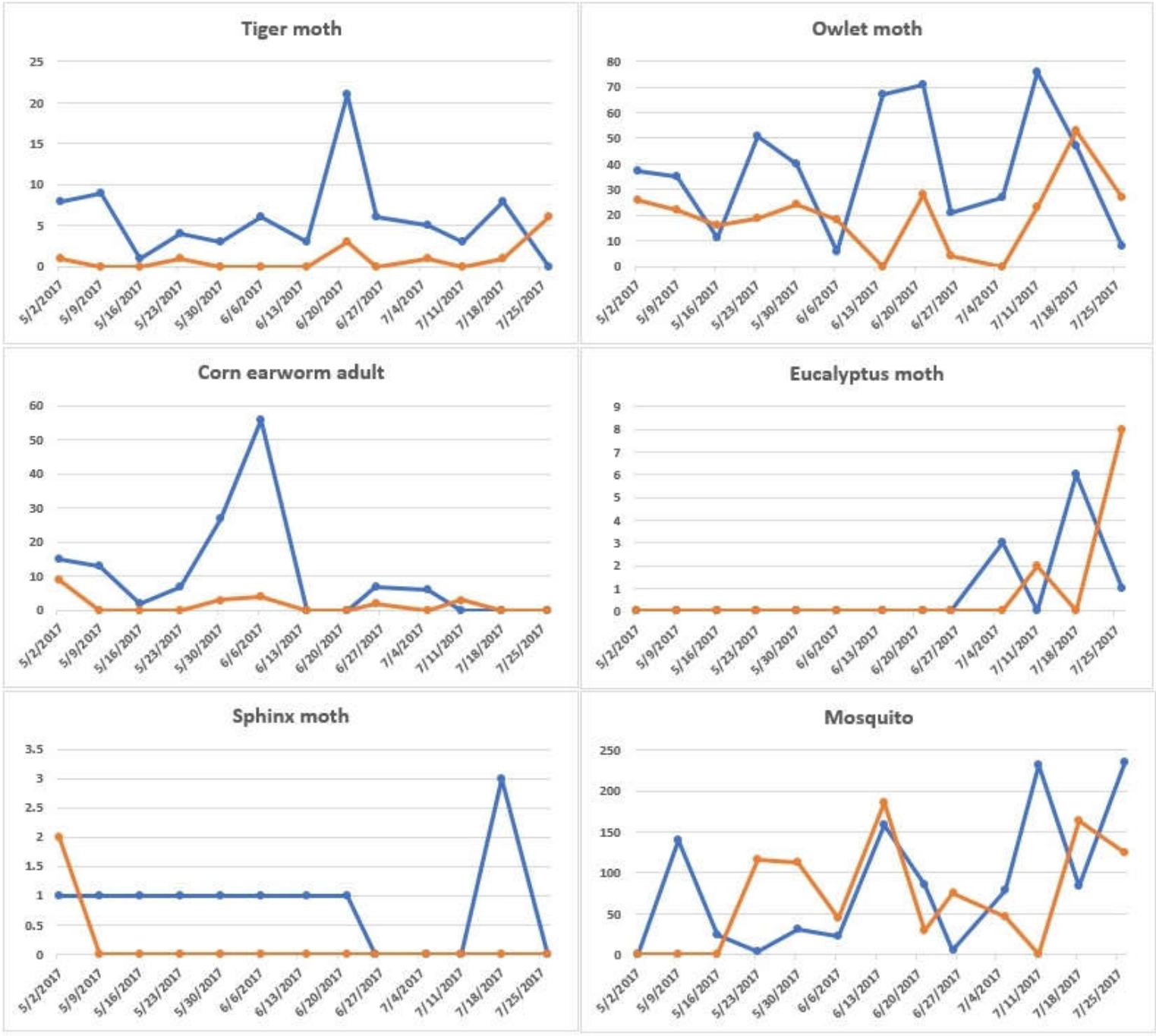
http://ucanr.edu/strawberries-vegetables

UC CE

Light trap-strawberry pest management

Manzanita Berry Farms and Eraud Farms
Collaborator: Dave Peck

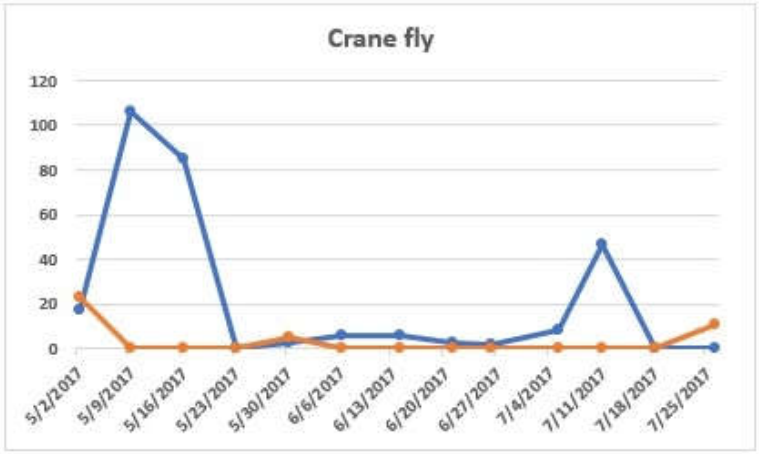
Light trap-seasonal occurrence of pests

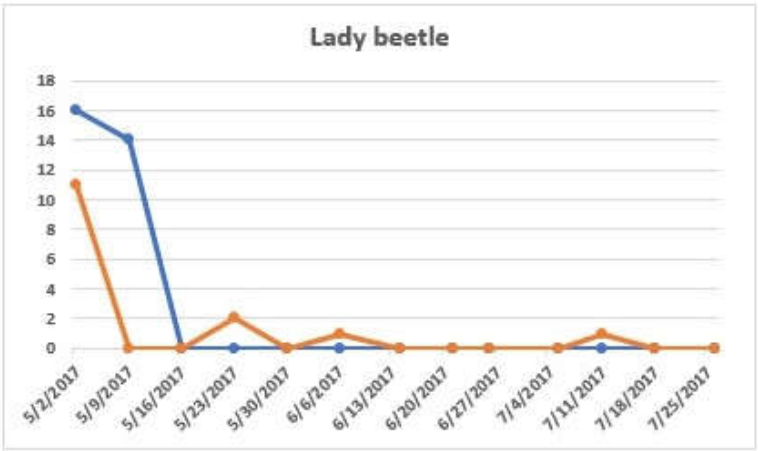


Organic

Conventional

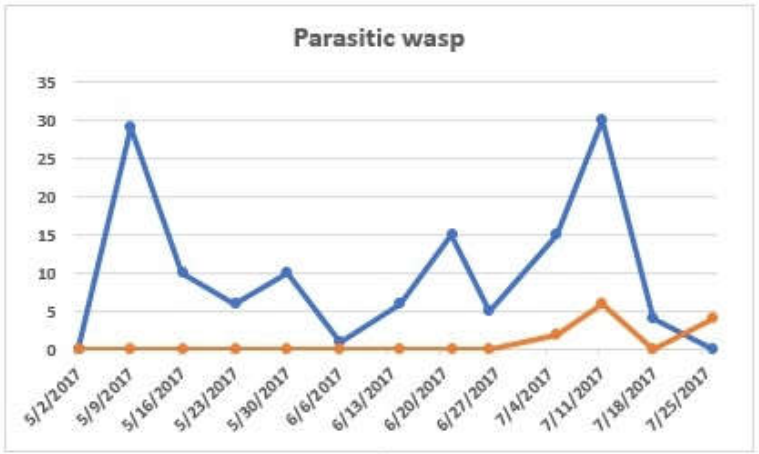
Light trap-seasonal occurrence of beneficials

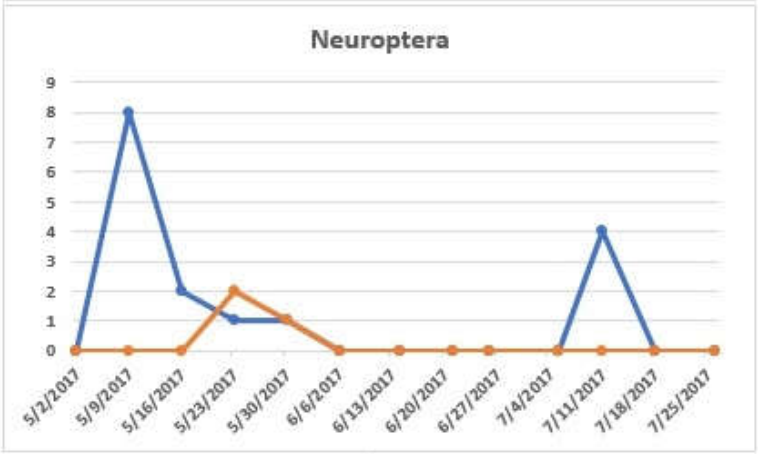


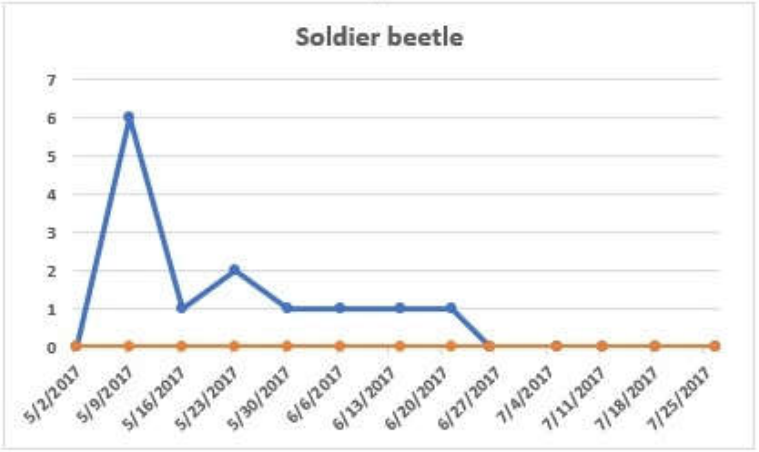


Organic

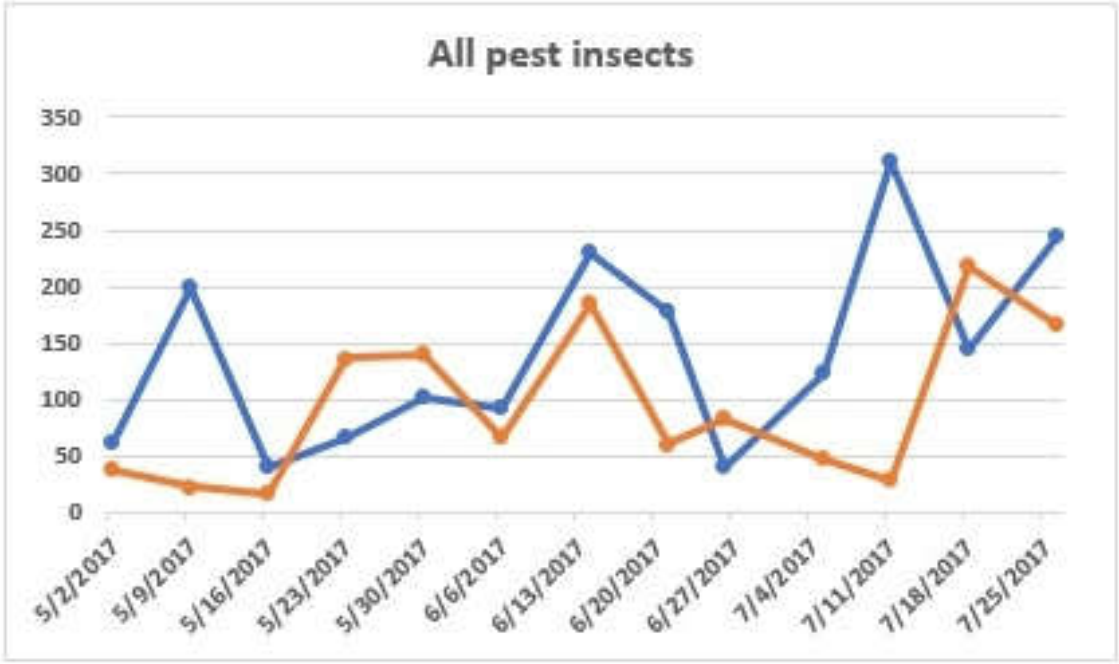
Conventional

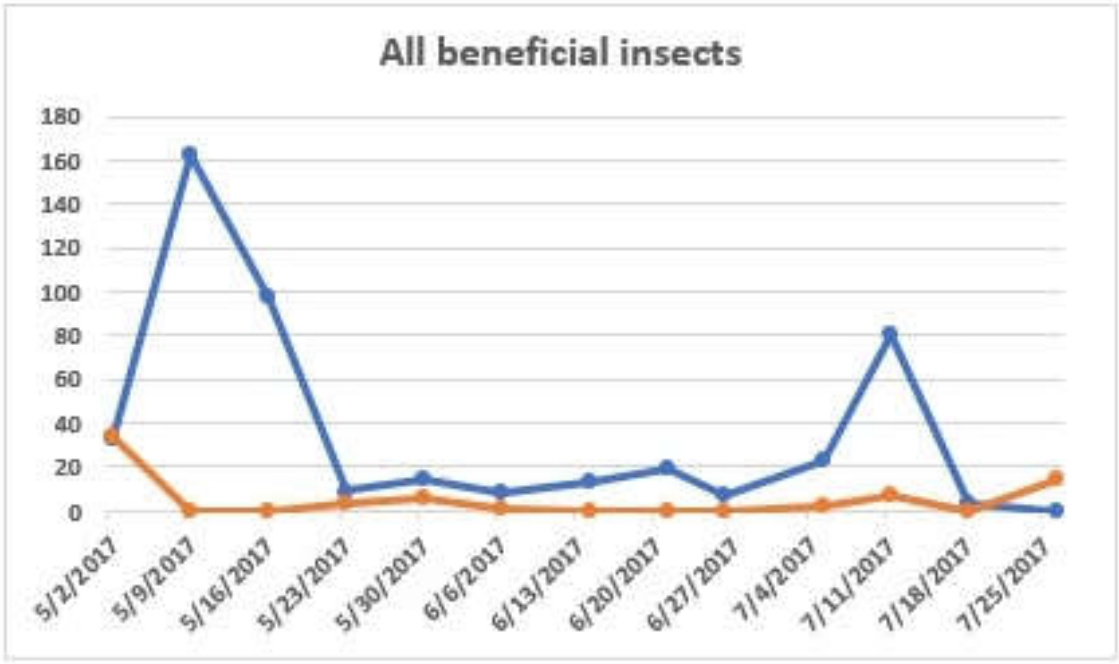






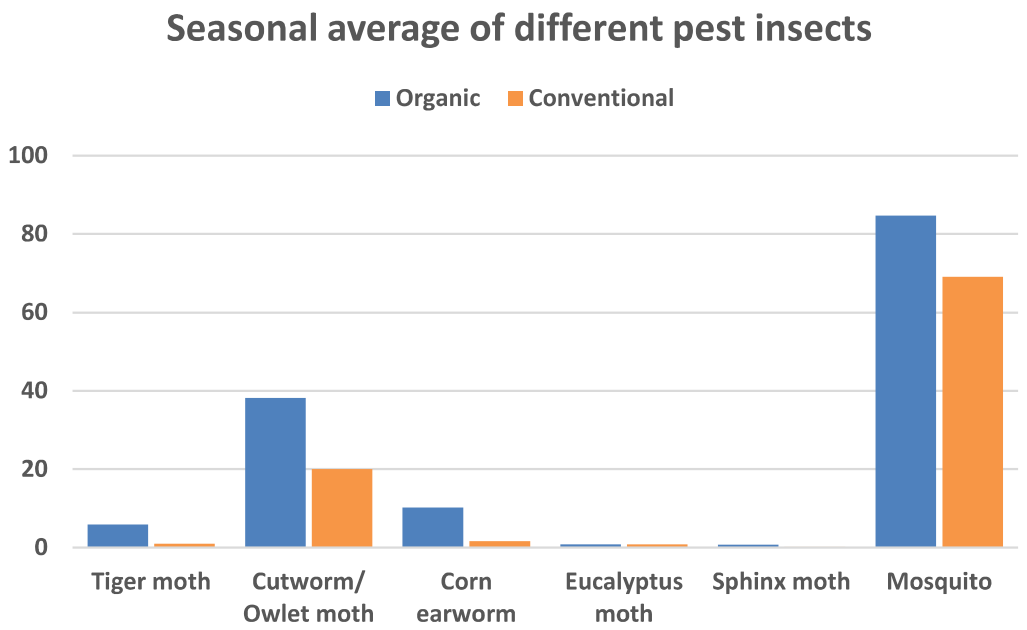
Light trap-seasonal occurrence of all insects

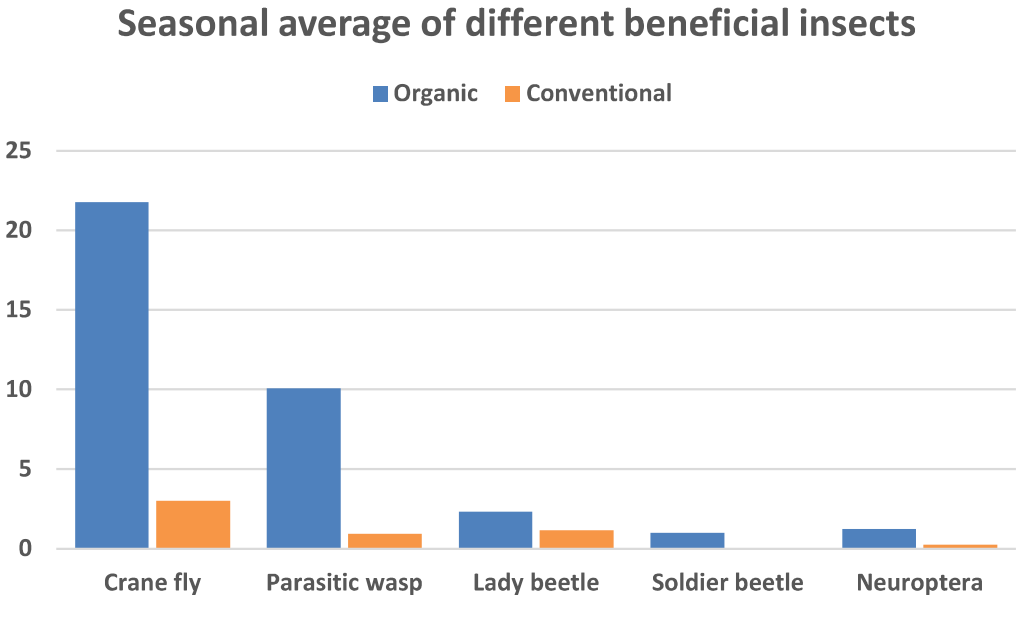


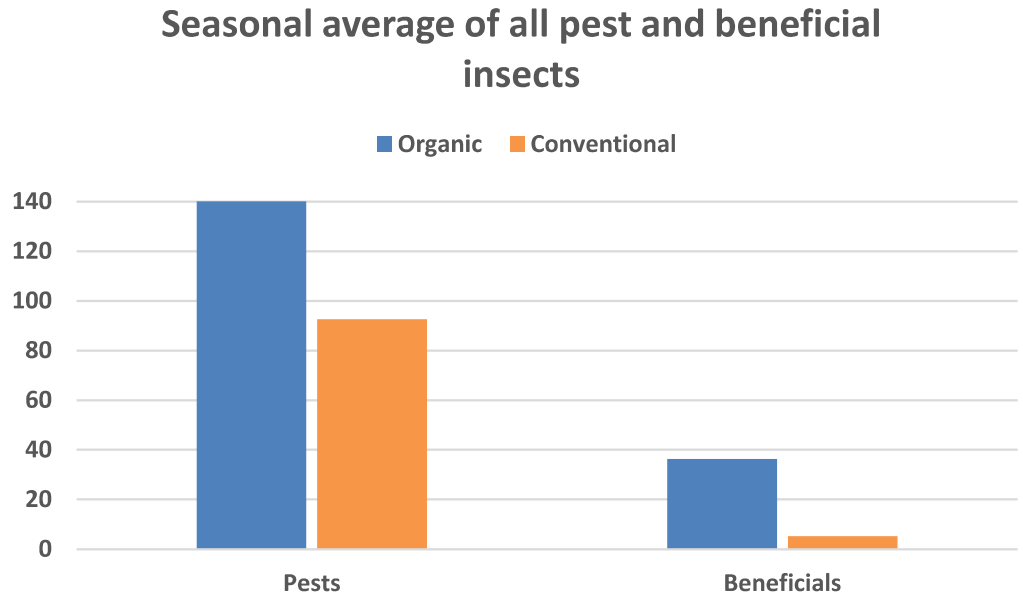


Organic
Conventional

Light trap-seasonal average







Conclusions

- Lygus bugs were present in the fields during the study, but they could not be detected in the traps
- Traps could be considered for managing lepidopteran pests

UC CE

Beneficial microbes-strawberry health

Manzanita Berry Farms
Collaborator: Dave Peck

Beneficial microbes-strawberry health

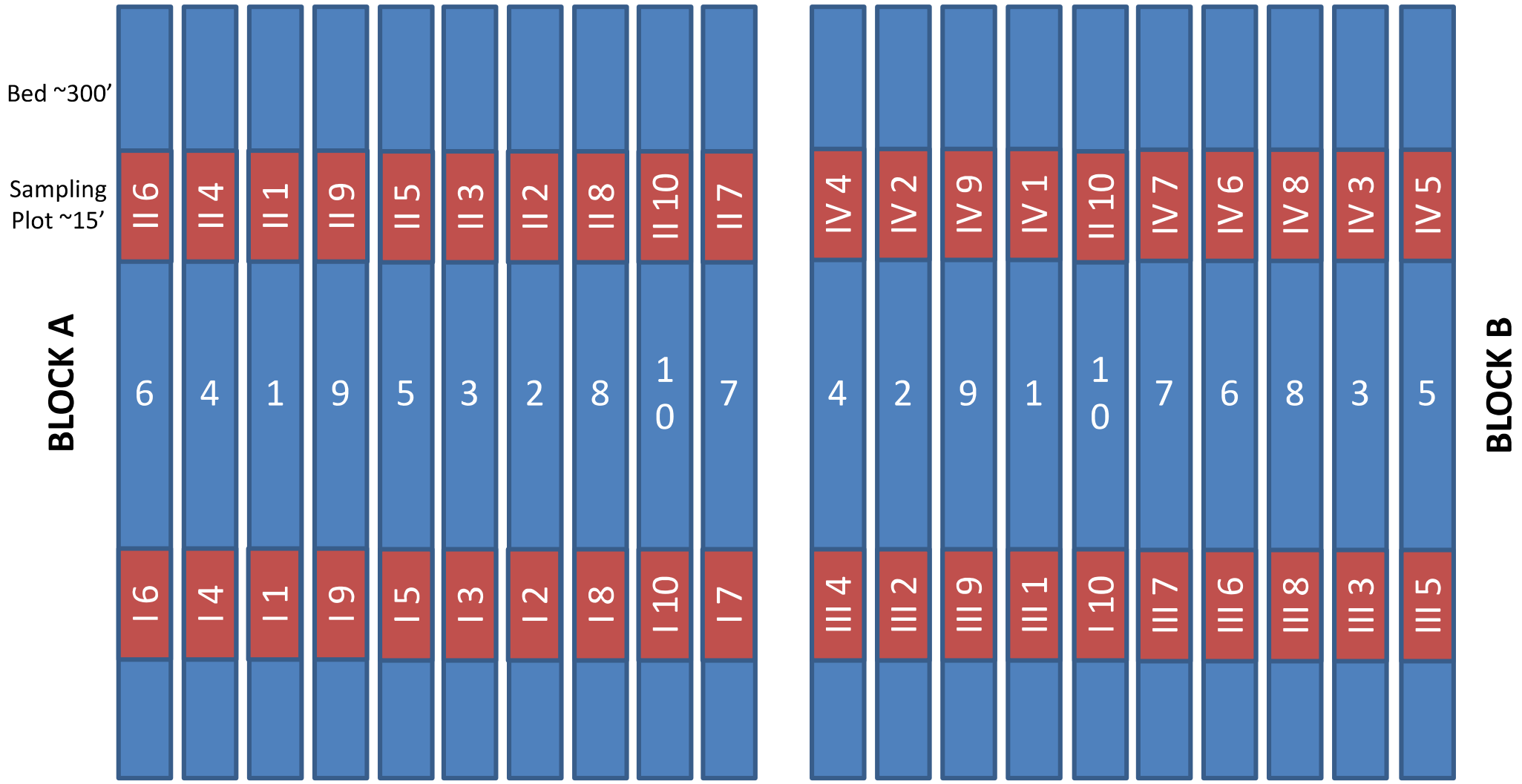
1 Untreated control
2 GS-Healthy Soil
3 MycoApply EndoMaxx 2 gpa transplant dip
4 MycoApply EndoMaxx 2 gpa drip at planting
5 MycoApply EndoMaxx 2 gpa transplant dip + 2 gpa drip at planting
6 MycoApply EndoMaxx 4 gpa transplant dip
7 MycoApply EndoMaxx 4 gpa drip at planting
8 MycoApply EndoMaxx 4 gpa transplant dip + 4 gpa drip at planting
9 Actinovate AG 6 oz/ac transplant dip + 6 oz drip at planting + 6 oz drip monthly
10 Inocucor Garden Solution 1 gpa drip at planting + 1 gpa drip monthly

Trade Name	Active Ingredients
MycoApply EndoMaxx	*Glomus intraradices, G. aggregatum, G. mosseae,* and *G. etunicatum*
Actinovate AG	*Streptomyces lydicus* WYEC 108
Inocucor Garden Solution	*Saccharomyces cerevisiae* and *Bacillus subtilis*

Variety: Portola
Planted: 21 May, 2016
Replications: Four

Canopy size: 6/21, 7/5, and 7/20
Powdery mildew: 8/3, 9/1, 10/10, and 11/16
Botrytis: 9/13, 9/17, 10/11, and 10/18
Dead and dying plants: 9/16 and 10/23
Yield: 8/20 to 11/18

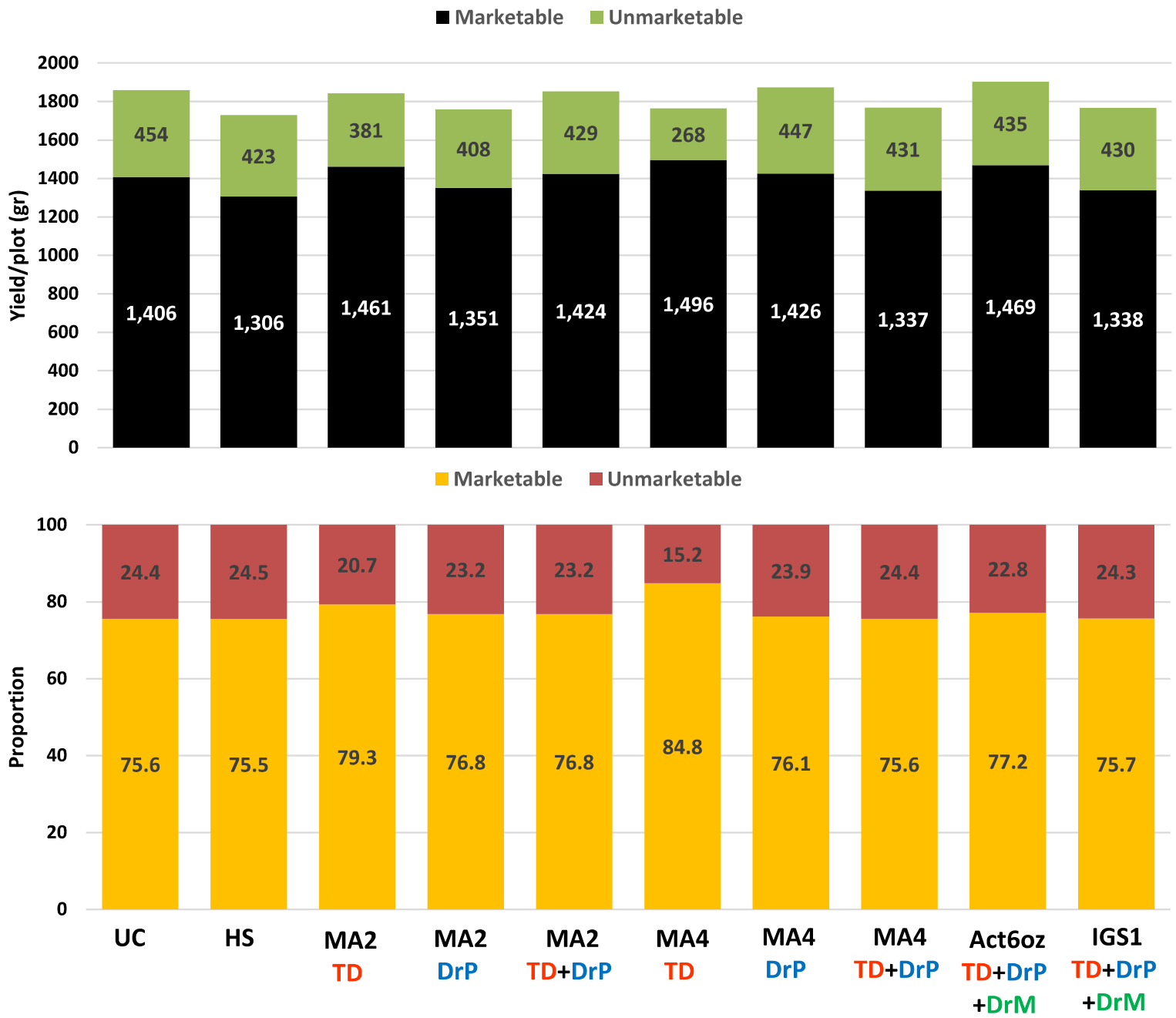
Beneficial microbes-strawberry health



Beneficial microbes-results

Treatment	Canopy growth from 6/21 to 7/20/16 (cm^2)	Average powdery mildew severity	Average botrytis fruit rot severity		Dead and dying plants on 10/23/16	Seasonal total of marketable berries/plot (lb)
			3 DAH	5 DAH		
1. Untreated Control	601.04±27.48 bc*	0.33±0.03 abc	1.06±0.06	3.44±0.12	0.50±0.28 b	71.27±2.48
2. GS-Healthy Soil	587.49±30.36 c	0.24±0.07 c	1.13±0.07	3.31±0.15	3.75±1.31 a	66.22±1.42
3. MA2-TD	701.55±27.40 a	0.44±0.04 a	1.13±0.07	3.75±0.14	1.50±0.86 b	74.10±3.26
4. MA2-DrP	609.35±44.80 bc	0.24±0.12 c	1.00±0	3.50±0.27	1.25±0.25 b	68.50±0.75
5. MA2-TD+DrP	723.08±9.28 a	0.36±0.05 abc	1.06±0.06	3.31±0.12	0.50±0.50 b	72.19±2.80
6. MA4-TD	669.15±20.50 ab	0.29±0.05 bc	1.00±0	3.56±0.12	0.75±0.75 b	75.87±9.85
7. MA4-DrP	612.88±19.02 bc	0.24±0.04 c	1.00±0	2.94±0.12	0.50±0.28 b	72.32±0.42
8.MA4-TD+DrP	655.64±15.74 abc	0.39±0.04 ab	1.06±0.06	3.56±0.15	1.00±1.00 b	67.80±2.95
9. Act-TD+DrP+DrM	669.86±35.16 ab	0.25±0.02 c	0.94±0.06	3.63±0.07	0.25±0.25 b	74.48±1.89
10. IGS-TD+DrP+DrM	582.15±26.95 c	0.34±0.02 abc	1.00±0	3.25±0.37	1.25±0.75 b	67.85±2.91
P	<0.0001	0.0271	0.2369	0.1991	0.0429	0.6517

Seasonal yield average



Conclusions

- Some treatments seemed to have a positive impact on crop health and yield
- More studies are necessary to determine appropriate application rates and frequencies

UC CE

Entomopathogenic fungal infections

Isaria fumosorosea-Bagrada bug

Beauveria bassiana-Bagrada bug

Metarhizium brunneum-Bagrada bug

Beauveria bassiana-Lygus bug

Beauveria bassiana-GWSS

Metarhizium brunneum-GWSS

Paecilomyces sp.-Western harvester ant

Beauveria bassiana-Western harvester ant

Entomophthora sp.-Strawberry aphid

UC CE

Entomopathogenic fungi vs. plant pathogen

Entomopathogenic fungi
Beauveria bassiana (BotaniGard ES)
Metarhizium brunneum (Met 52EC)
Isaria fumosorosea (PFR-97 20% WDG)

Plant pathogen
Fusarium oxysporum f.sp. *vasinfectum* Race 4

Plant
Pima cotton susceptible to FOV Race 4

UC CE

Entomopathogenic fungi vs. *F. o. vasinfectum* Race 4

Treatments

1. Healthy potting mix (negative control)
2. Potting mix with FOV Race 4 (positive control)
3. Potting mix with FOV Race 4 + BotaniGard ES (*B. bassiana* Strain GHA) 2 qrt/ac
4. Potting mix with FOV Race 4 + Met 52EC (*M. brunneum* Strain F52) 2 (foliar rate) and 2.5 (soil rate) qrt/ac
5. Potting mix with FOV Race 4 + Pfr-97 20% WDG (*I. fumosorosea* Apopka Strain 97) 2 lb/ac
6. Potting mix with FOV Race 4 + Actinovate AG (*Streptomyces lydicus* WYEC 108) 54 oz/ac
7. Potting mix with FOV Race 4 + Regalia (Extract of *Reynoutria sachalinensis*) 4 qrt/ac
8. Potting mix with FOV Race 4 + MBI 110 (developmental product from Marrone Bio Innovations) 4 qrt/ac

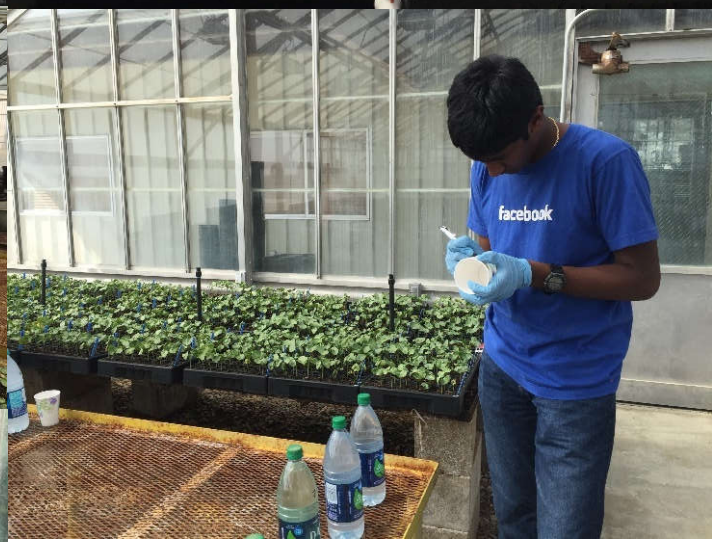
Regimen A - 10 ml of water or treatment liquid at soil application rate administered right after planting cotton seed.

Regimen B - 10 ml of water or treatment liquid at soil application rate administered right after and 1 and 2 weeks after planting.

Regimen C – 10 ml of water or treatment liquid at foliar application rate administered right after planting.

UC CE

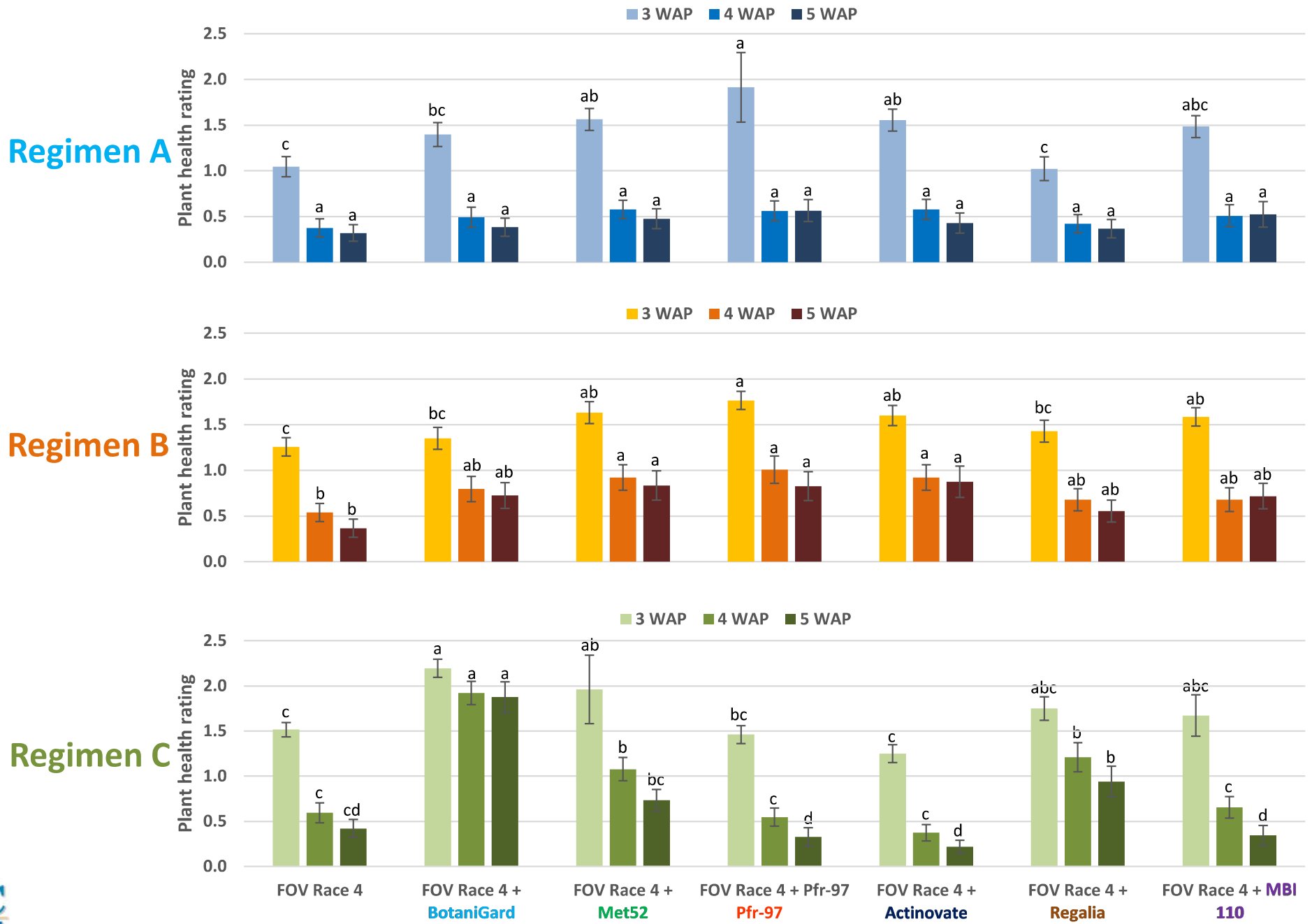
Entomopathogenic fungi vs. *F. o. vasinfectum* Race 4



UC CE

Entomopathogenic fungi vs. *F. o. vasinfectum* Race 4

Disease control



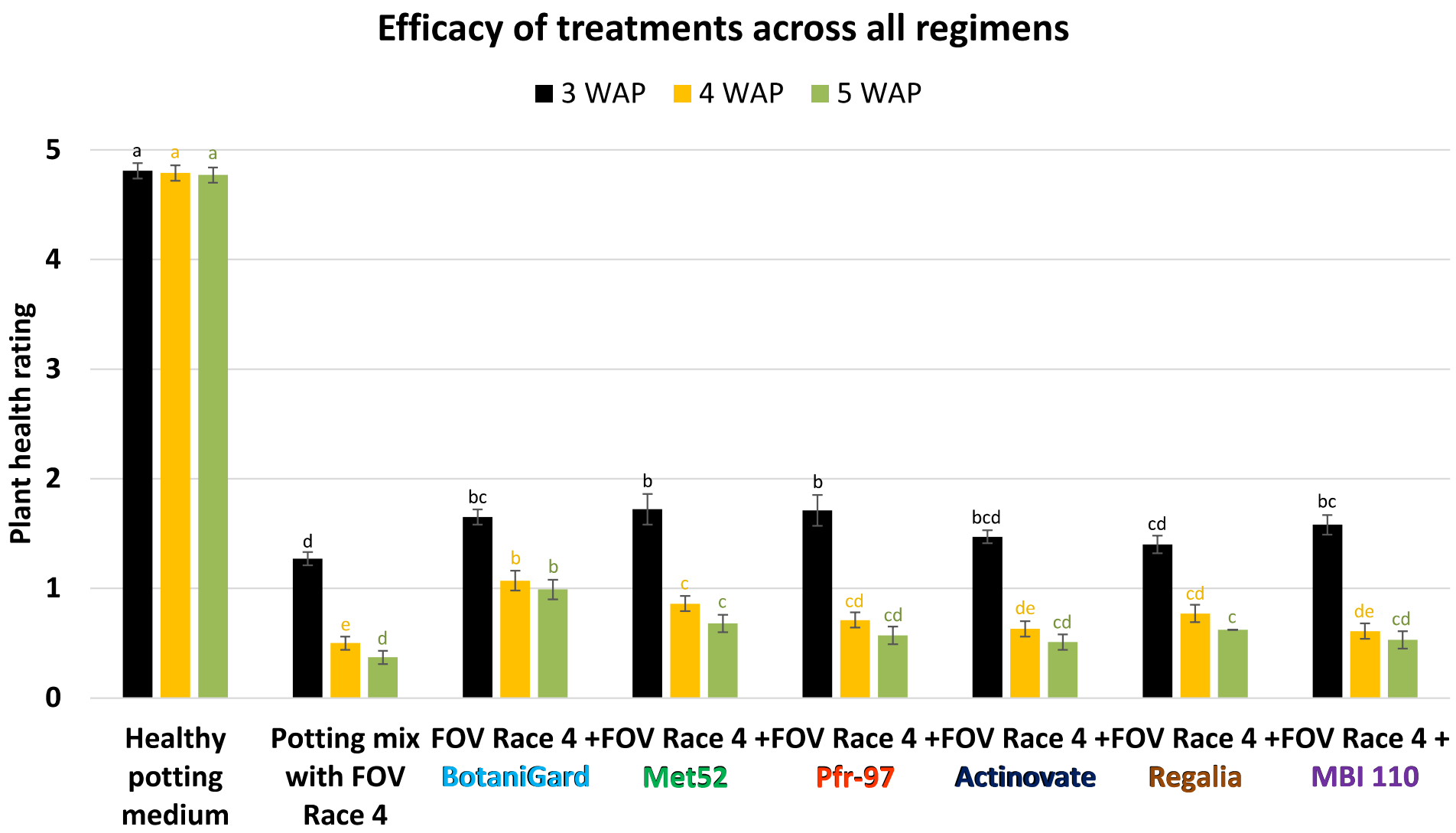
Efficacy of different treatments

Treatments	3 weeks after planting			4 weeks after planting			5 weeks after planting		
	A	B	C	A	B	C	A	B	C
1. Healthy potting medium	4.84±0.11a*	4.83±0.11a	4.77±0.13a	4.84±0.10a	4.76±0.12a	4.78±0.12a	4.76±0.13a	4.75±0.13a	4.78±0.12a
2. Potting mix with FOV Race 4	1.05±0.11d	1.26±0.10d	1.52±0.08cd	0.38±0.10b	0.54±0.10c	0.59±0.11d	0.32±0.09b	0.37±0.10c	0.42±0.10de
3. FOV Race 4 + BotaniGard	1.40±0.13cd	1.35±0.12cd	2.20±0.10b	0.49±0.11b	0.80±0.14bc	1.92±0.13b	0.38±0.10b	0.73±0.14bc	1.88±0.17b
4. FOV Race 4 + Met52	1.56±0.12bc	1.63±0.12bc	1.96±0.38bc	0.58±0.10b	0.92±0.14b	1.08±0.13c	0.48±0.11b	0.83±0.16b	0.73±0.12cd
5. FOV Race 4 + Pfr-97	1.91±0.38b	1.77±0.10b	1.46±0.10cd	0.56±0.11b	1.01±0.15b	0.55±0.10d	0.56±0.12b	0.83±0.16b	0.33±0.10e
6. FOV Race 4 + Actinovate	1.55±0.12bc	1.60±0.11bc	1.25±0.10d	0.58±0.11b	0.92±0.14b	0.38±0.09d	0.43±0.11b	0.88±0.17b	0.22±0.07e
7. FOV Race 4 + Regalia	1.02±0.13d	1.43±0.12cd	1.75±0.13bcd	0.42±0.10b	0.68±0.12bc	1.21±0.16c	0.37±0.10b	0.55±0.12bc	0.94±0.17c
8. FOV Race 4 + MBI 110	1.48±0.12bcd	1.59±0.10bc	1.67±0.23cd	0.51±0.12b	0.68±0.13bc	0.66±0.12d	0.52±0.14b	0.72±0.14bc	0.34±0.11e

*Means followed by the same letter within a column are not significantly different ($P < 0.00001$) using LSD means separation test.

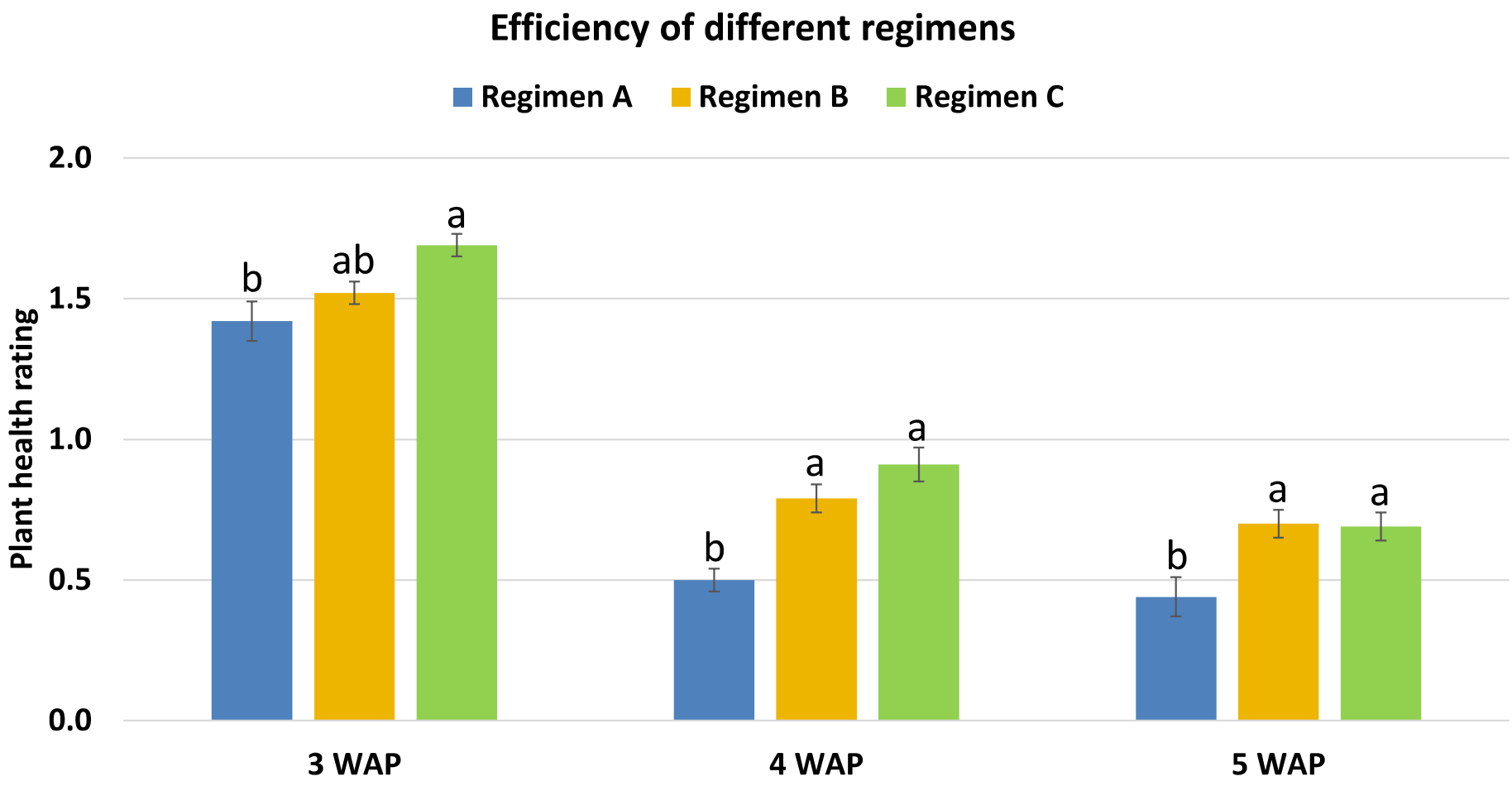
UC CE

Efficacy of treatments across regimens



Tukey's HSD $P < 0.05$

Efficacy of different regimens



Tukey's HSD $P < 0.05$

Conclusions

- Entomopathogenic fungi *B. bassiana*, *I. fumosorosea*, and *M. brunneum* antagonized *F. oxysporum* f.sp. *vasinfectum* Race 4
- Multiple applications or higher rates are more effective

UC CE

Acknowledgements

Collaborators
Dave Peck, Manzanita Berry Farms
Tim Anderson, Dow

Technical assistance
Chris Martinez
Manzanita Berry Farms crew
Maria Murrietta
Tamas Zold

Industry collaborators-Equipment/samples/funding
Bill Schwoerer, Inocucor
Todd Burkdoll, Valent
Certis USA, GreenFuture Equipment, and Marrone Bio Innovations

UC CE

Download IPMinfo app