Entomopathogenic Fungi as Plant Growth Promoters and Disease Antagonizers

Sumanth S. R. Dara and Suchitra S. Dara
Global Agricultural Solutions
Bakersfield, CA

Entomopathogenic role

Endophytic role

Fungal colonization of the plant tissue, either in the stem, leaves or roots

Mycorrhiza-like role

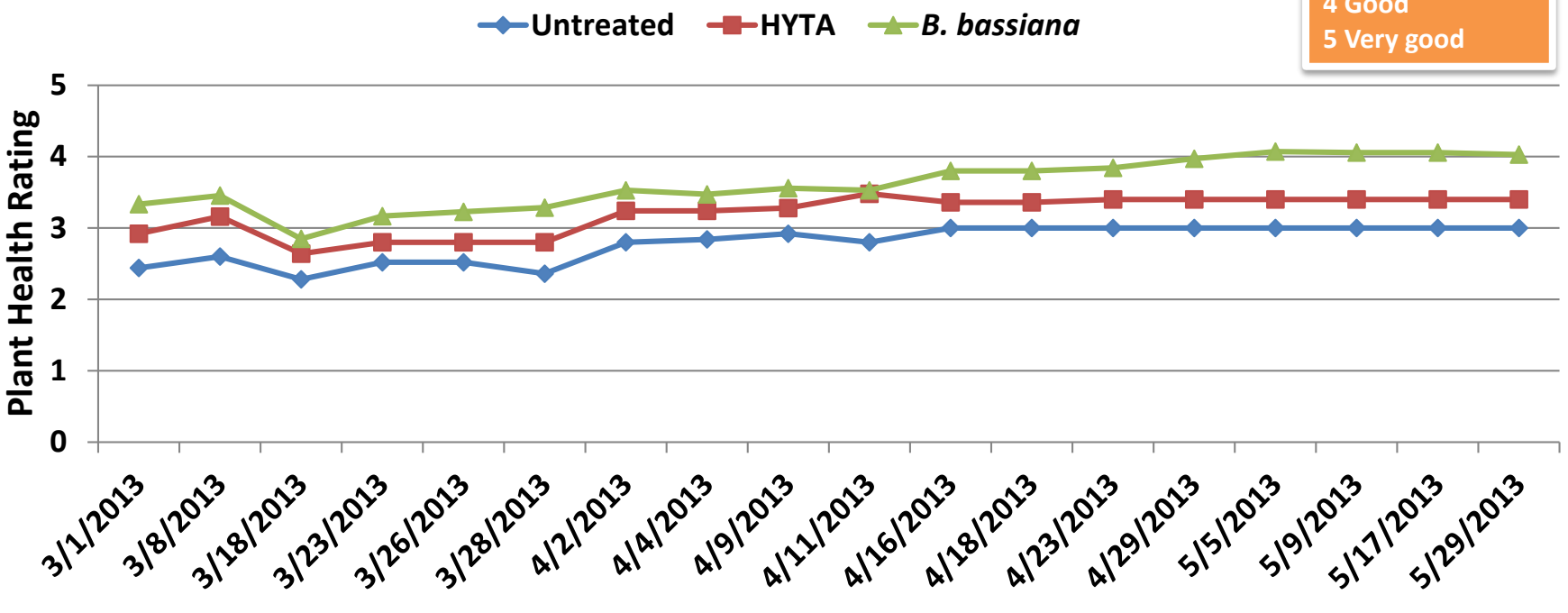
- Plant growth
  - Increased nutrient and water absorption
- Plant health
  - Protection against various forms of pathogens

Myco- → Fungus
-rrhiza → Root

Beauveria bassiana improving strawberry growth

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

RATING
0 Dead
1 Weak
2 Moderate-Low
3 Moderate-High
4 Good
5 Very good



Scientific Research Publishing

American Journal of Plant Sciences, 2017, 8, *-*
http://www.scirp.org/journal/ajps
ISSN Online: 2158-2750
ISSN Print: 2158-2742

Impact of Entomopathogenic Fungi on the Growth, Development, and Health of Cabbage Growing under Water Stress

Surendra K. Dara[1*], Sumanth S. R. Dara[2], Suchitra S. Dara[2]

[1]University of California Cooperative Extension, San Luis Obispo, Solutions, Bakersfield, California, USA
[2]Global Agricultural Solutions, Bakersfield, California, USA
Email: *skdara@ucdavis.edu

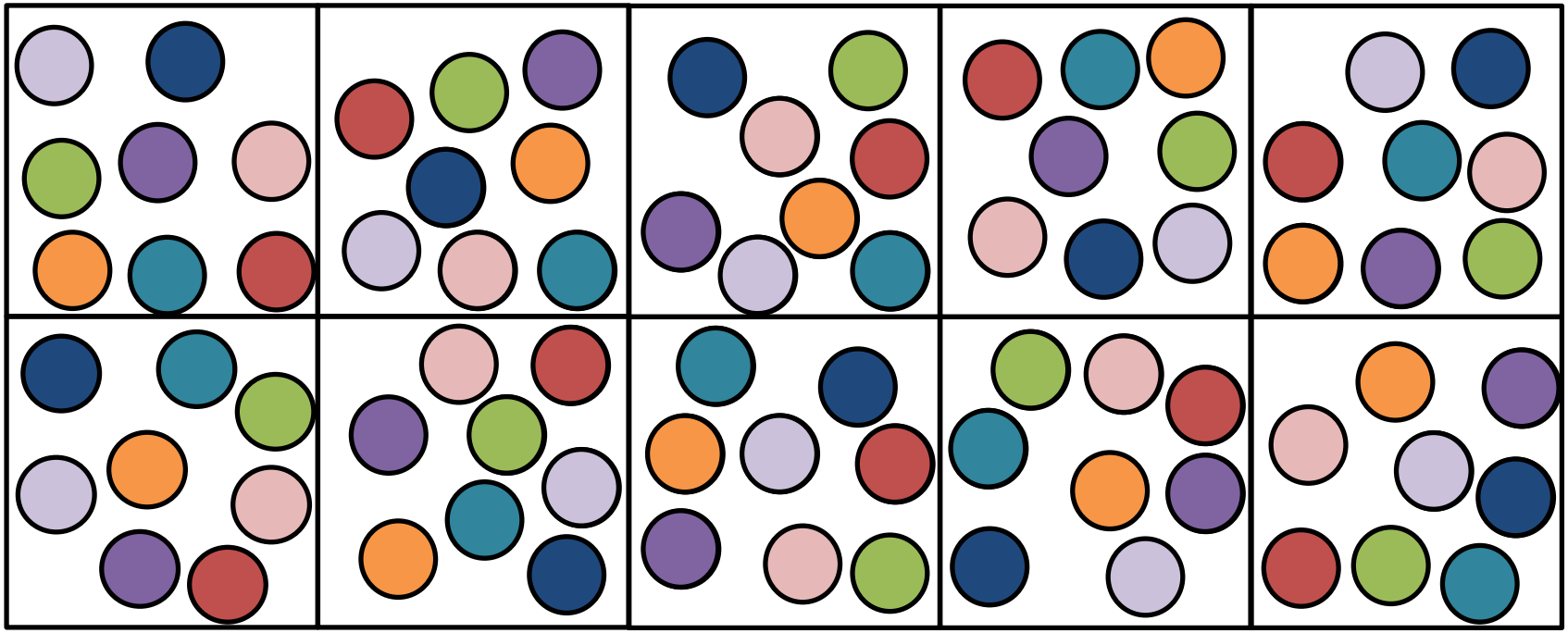
Impact on cabbage plant growth and health

Experimental design

Treatments

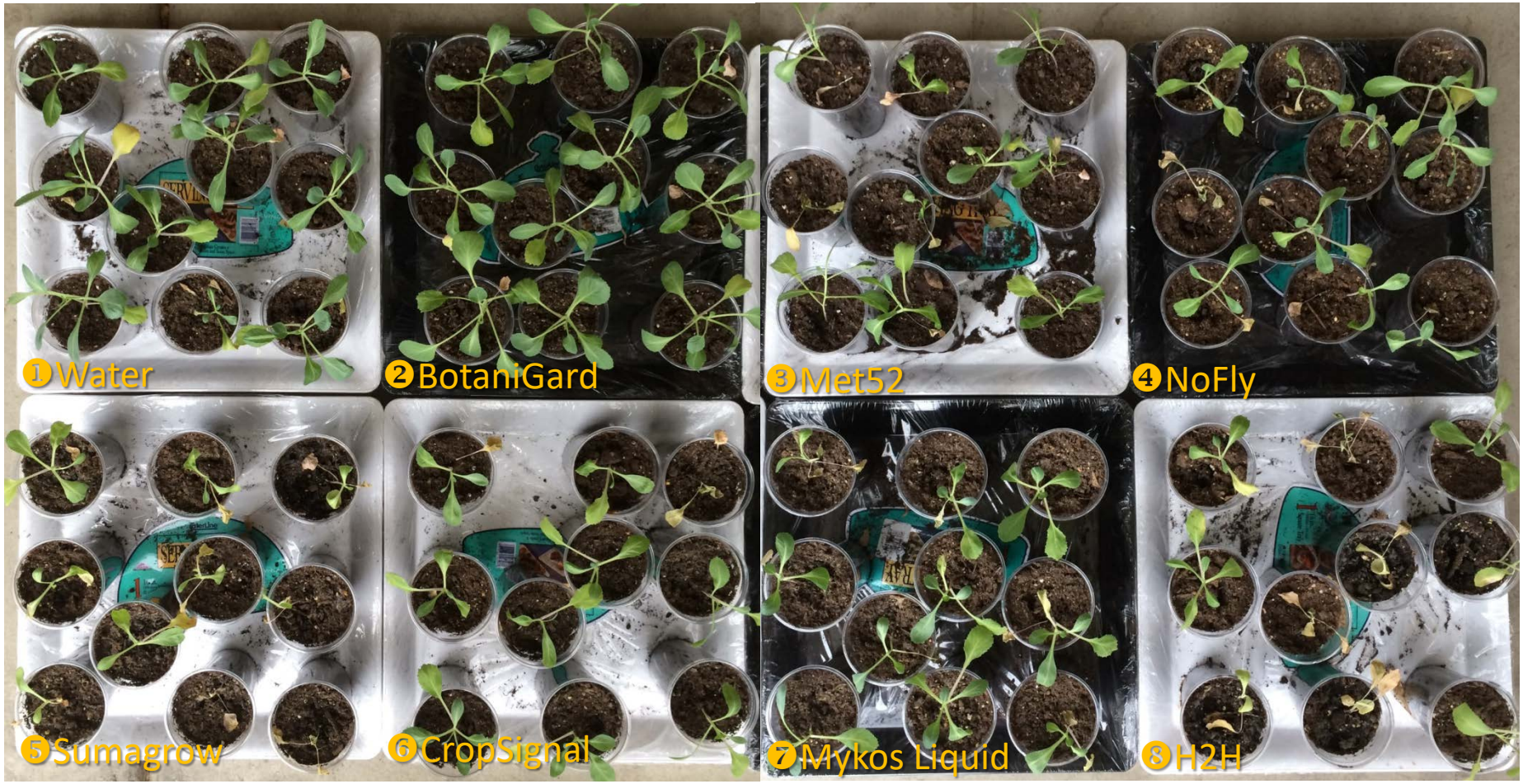
1. Miracle-Gro (negative control)
2. Miracle-Gro + BotaniGard
3. Miracle-Gro + Met52
4. Miracle-Gro + NoFly
5. Miracle-Gro + SumaGrow
6. Miracle-Gro + Crop Signal
7. Miracle-Gro + Mykos Liquid
8. Miracle-Gro + H2H

- 100 mL of treatment solution
- Watered plants twice
- Artificial (grow) lights

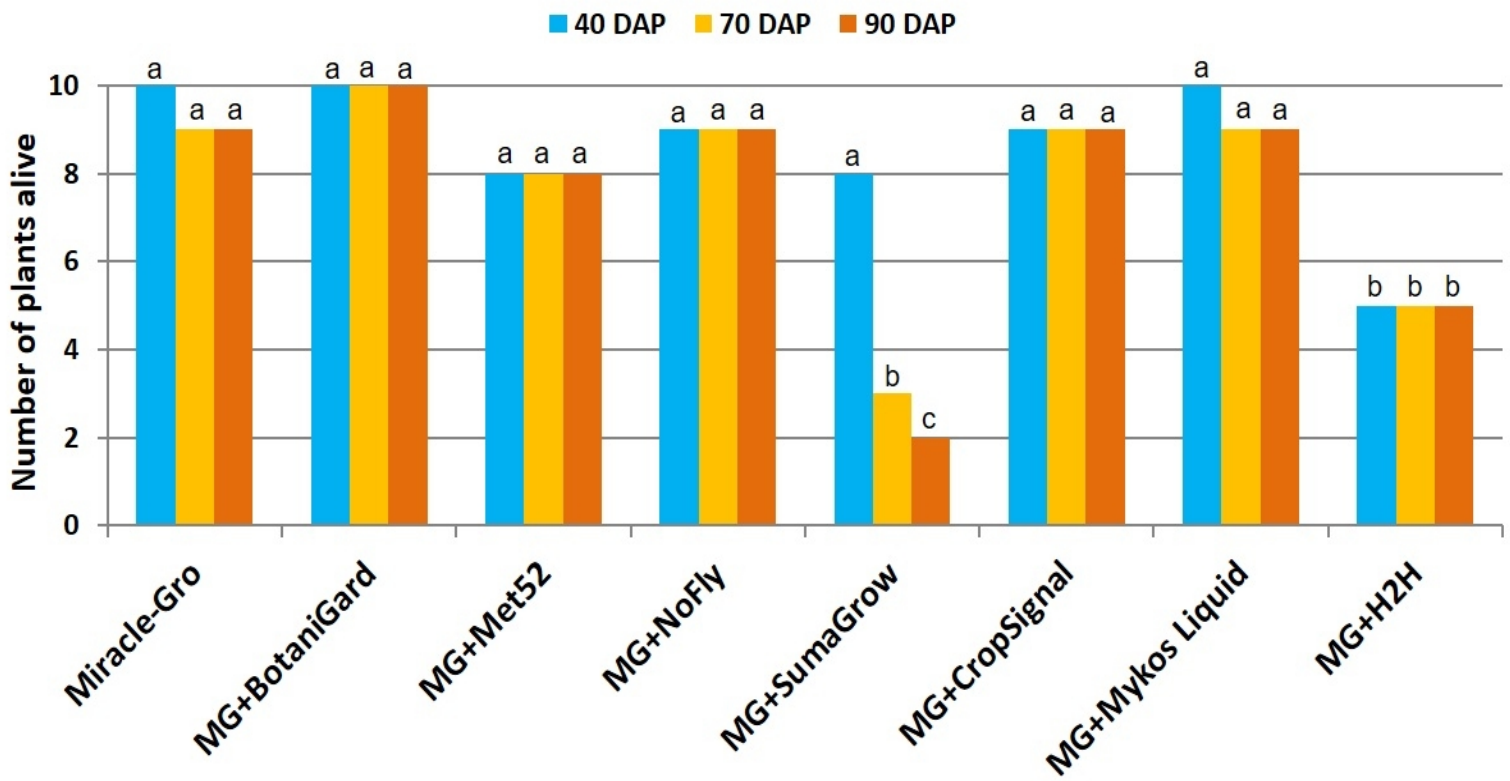


Results-Plant growth and health

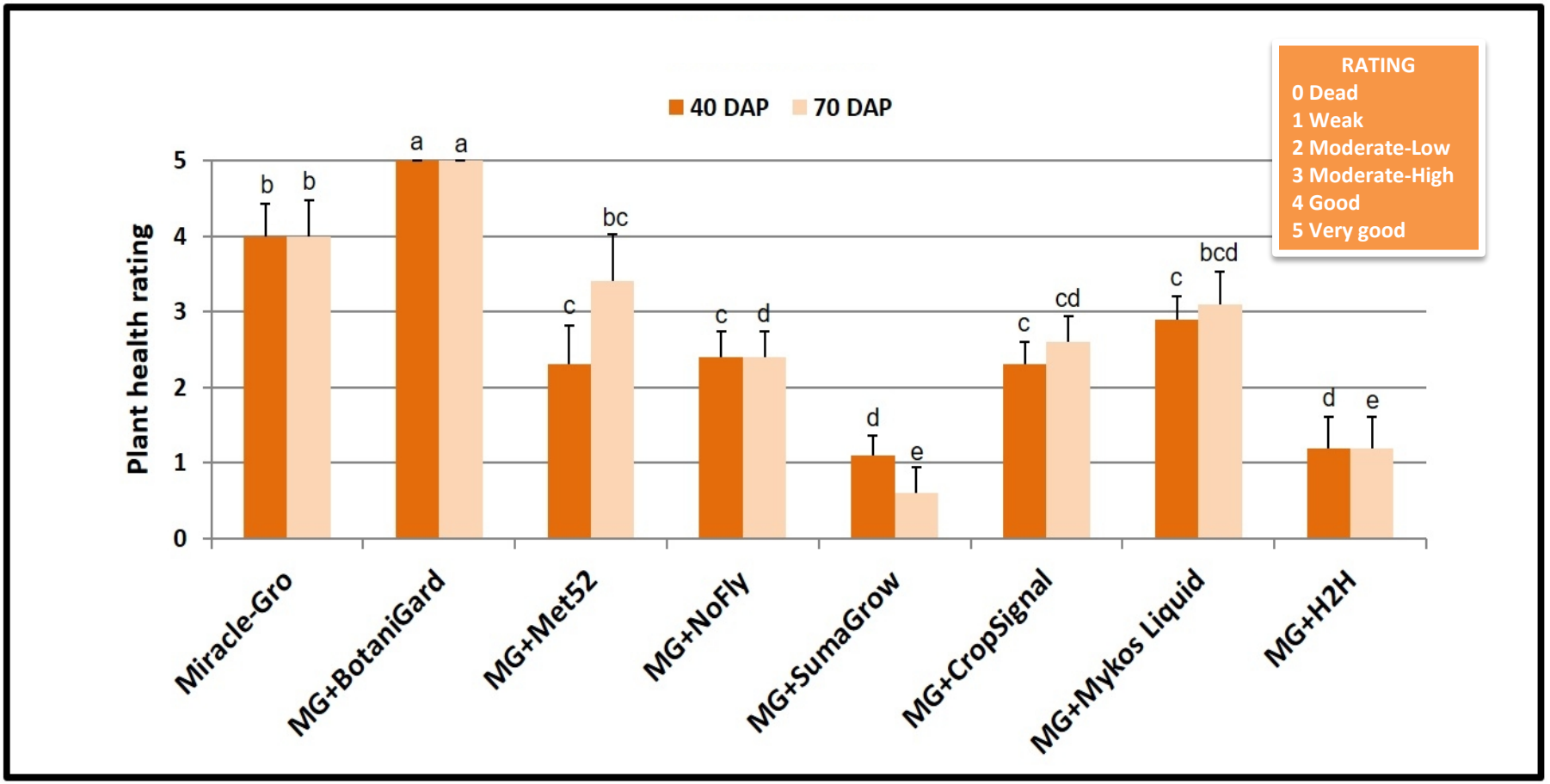
40 days after planting



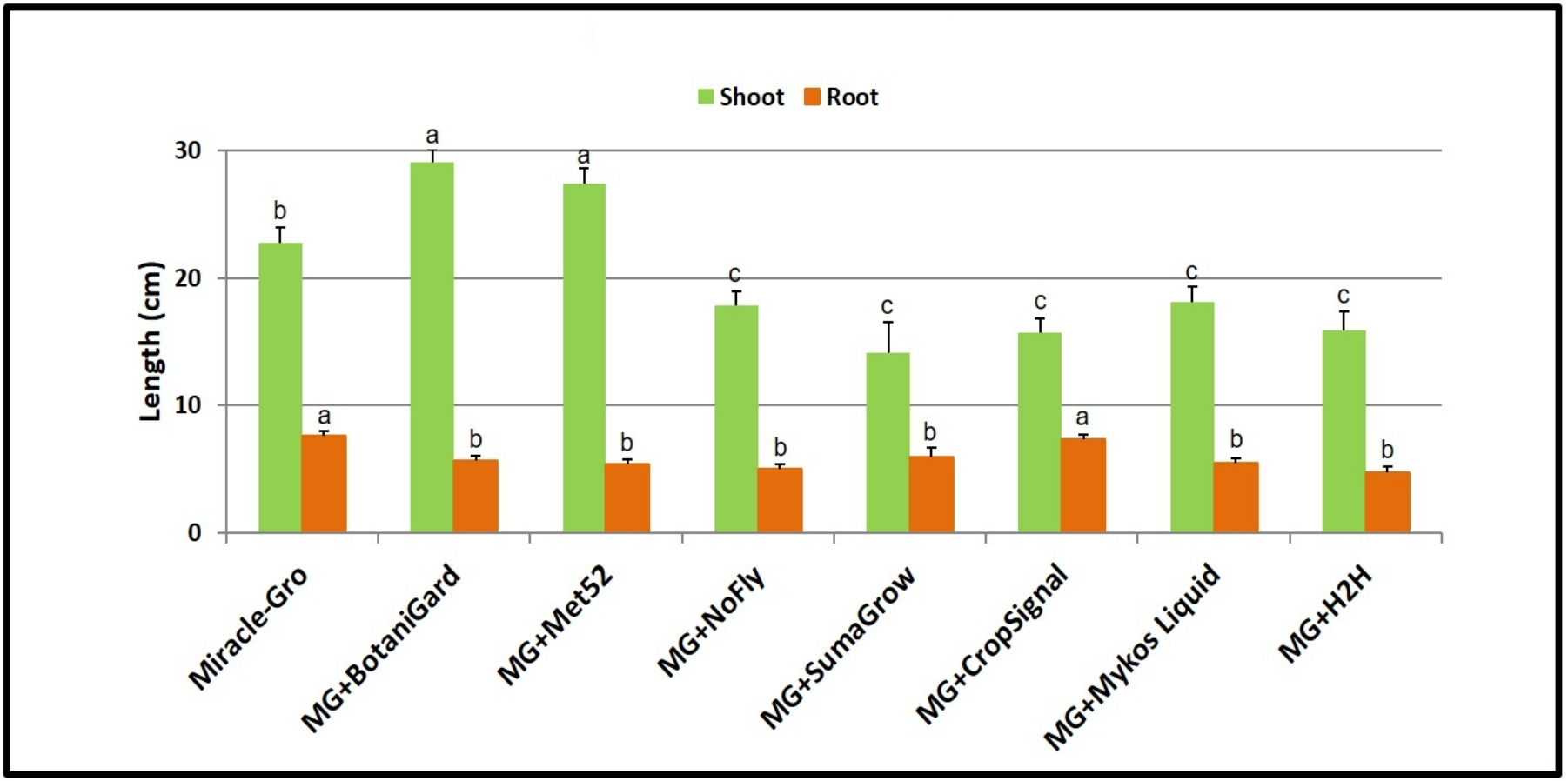
Results-Plant survival



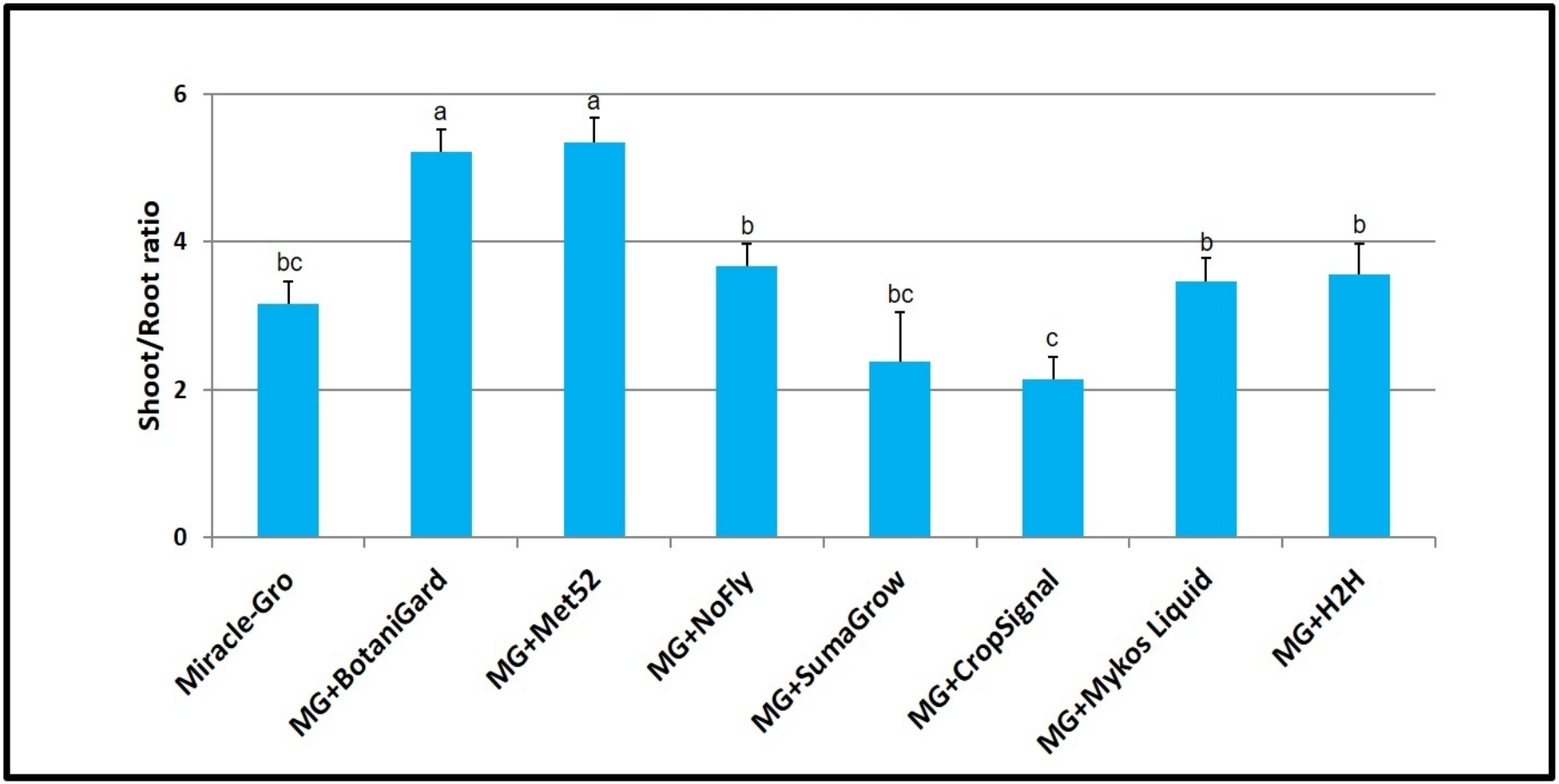
Results-Plant health



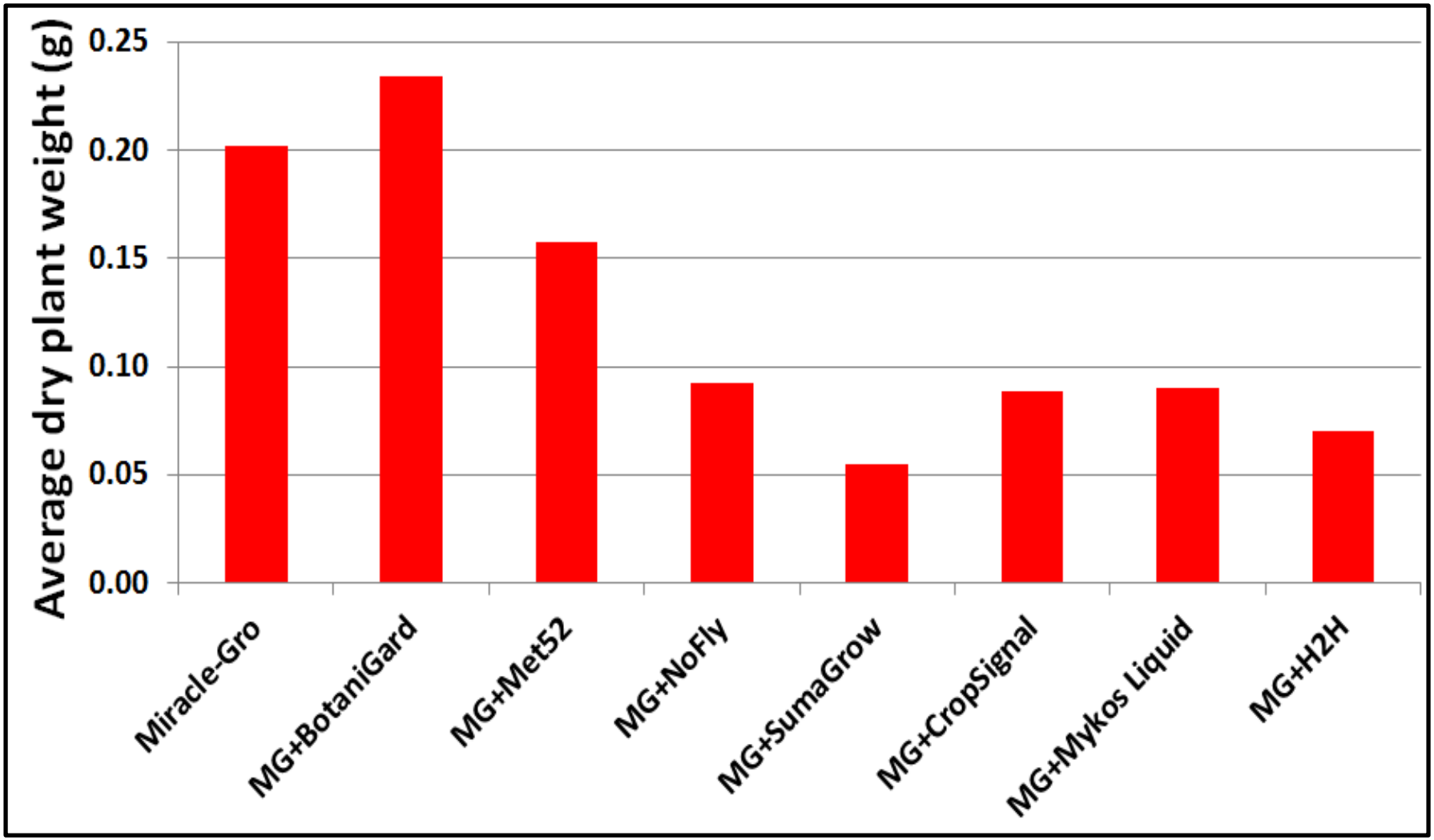
Results-Shoot and Root length



Results-Shoot/Root ratio



Results-Dry weight of surviving plants



Results-Nutrient efficiency

Treatment	Dry Weight (mg)	N (mg)	P (mg)	K (mg)	Fe (mg)	Weight/N	Weight/P	Weight/K	Weight/Fe
Miracle-Gro	202.22	1.139	0.130	1.610	0.0105	177.51	1558.44	125.61	19271.95
MG+BotaniGard	234.00	0.889	0.136	1.617	0.0097	263.16	1715.27	144.72	24213.08
MG+Met52	157.50	0.852	0.132	1.333	0.0074	184.76	1197.60	118.17	21276.60
MG+NoFly	92.22	0.509	0.074	0.748	0.0035	181.09	1246.54	123.29	26162.79
MG+SumaGrow	55.00	1.312	N/A*	N/A	N/A	41.93	N/A	N/A	N/A
MG+CropSignal	88.89	0.521	0.075	0.667	0.0042	170.45	1178.01	133.33	21028.04
MG+Mykos Liquid	90.00	0.532	0.072	0.778	0.0026	169.17	1253.48	115.68	35294.12
MG+H2H	70.00	0.658	0.137	1.071	0.0043	106.38	510.73	65.36	16129.03

*Not enough sample to analyze

Conclusions

- *B. bassiana* was the most effective treatment
- Probably by acting as mycorrhizae, entomopathogenic fungi help increase plant survival in stressful conditions, root and shoot lengths, and nutrient absorption of cabbage plants

STRAWBERRIES AND VEGETABLES
eJournal on production and pest management practices for strawberries and vegetables

First report of three entomopathogenic fungi offering protection against the plant pathogen, Fusarium oxysporum f.sp. vasinfectum

Author: **Surendra K. Dara**
Author: Suchitra S. Dara
Author: Sumanth S. R. Dara
Author: Tim Anderson, Dow

Published on: September 27, 2016

Experimental design

Treatments

1.Healthy potting mix (negative control)
2.Potting mix with FOV Race 4 (positive control with $3.3X10^2$ CFU/g)
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 (*Bacillus amyloliquefaciens*) 4 qrt/ac

Each treatment had 16 plants replicated four times

Treatment Regimens

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.

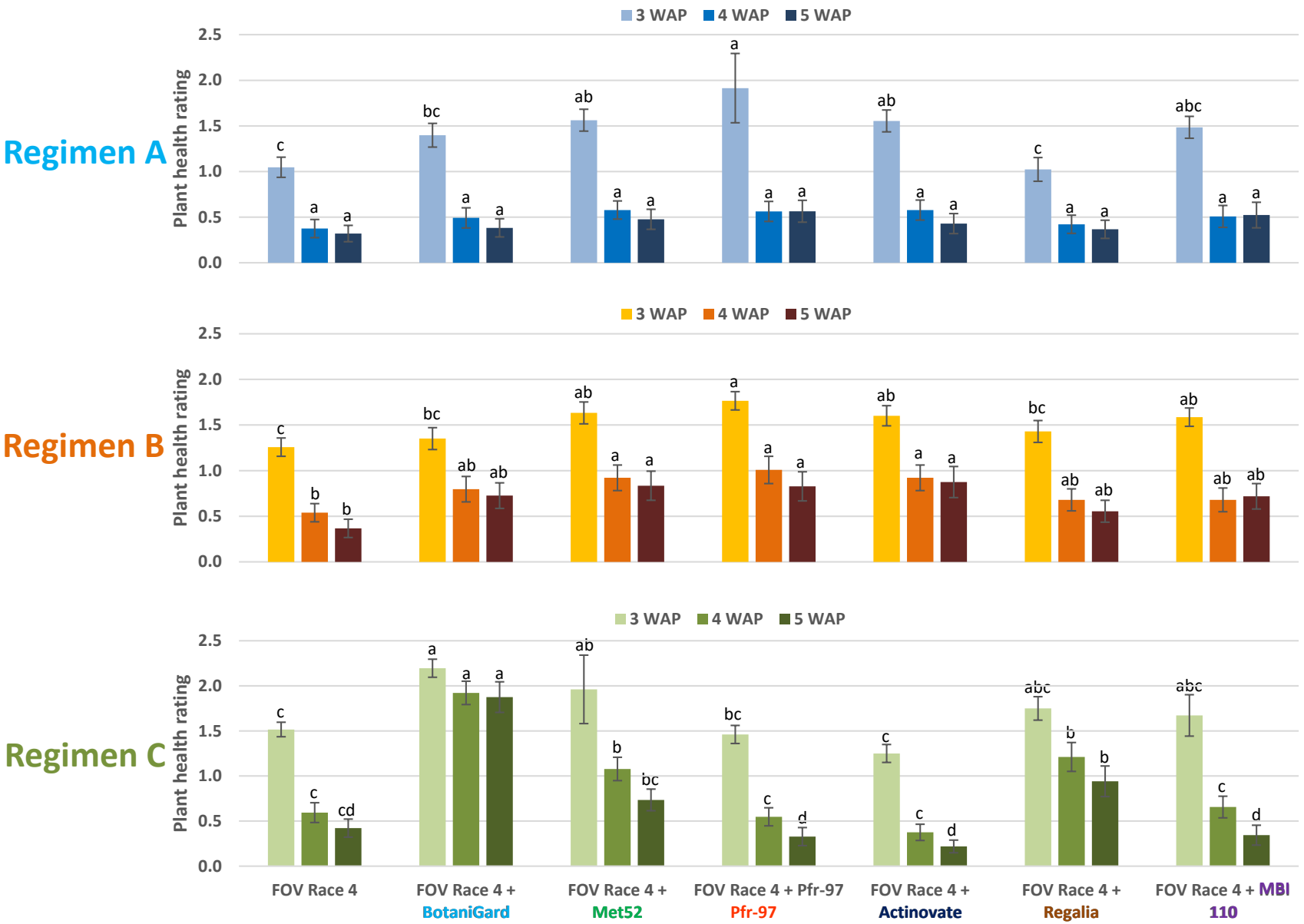
Regimen C – 10 ml of water or treatment liquid at foliar application rate administered right after planting.

Experimental setup and execution

Plant Health Rating Scale

0 - Did not germinate or dead or necrosis of cotyledons/leaves and hypocotyl/stem
1.0 - Stem green, but dying leaf/leaves
1.5 - At least one green leaf and cotyledons/other leaves necrotic
2.0 - Green new leaves and yellowing cotyledons/older leaves
2.5 - Green and bigger new leaves with slightly yellowing older leaves
3.0-4.5 - Varying levels of healthy plant
5.0 - Very healthy plant with optimal growth

Results-Efficacy of different treatments

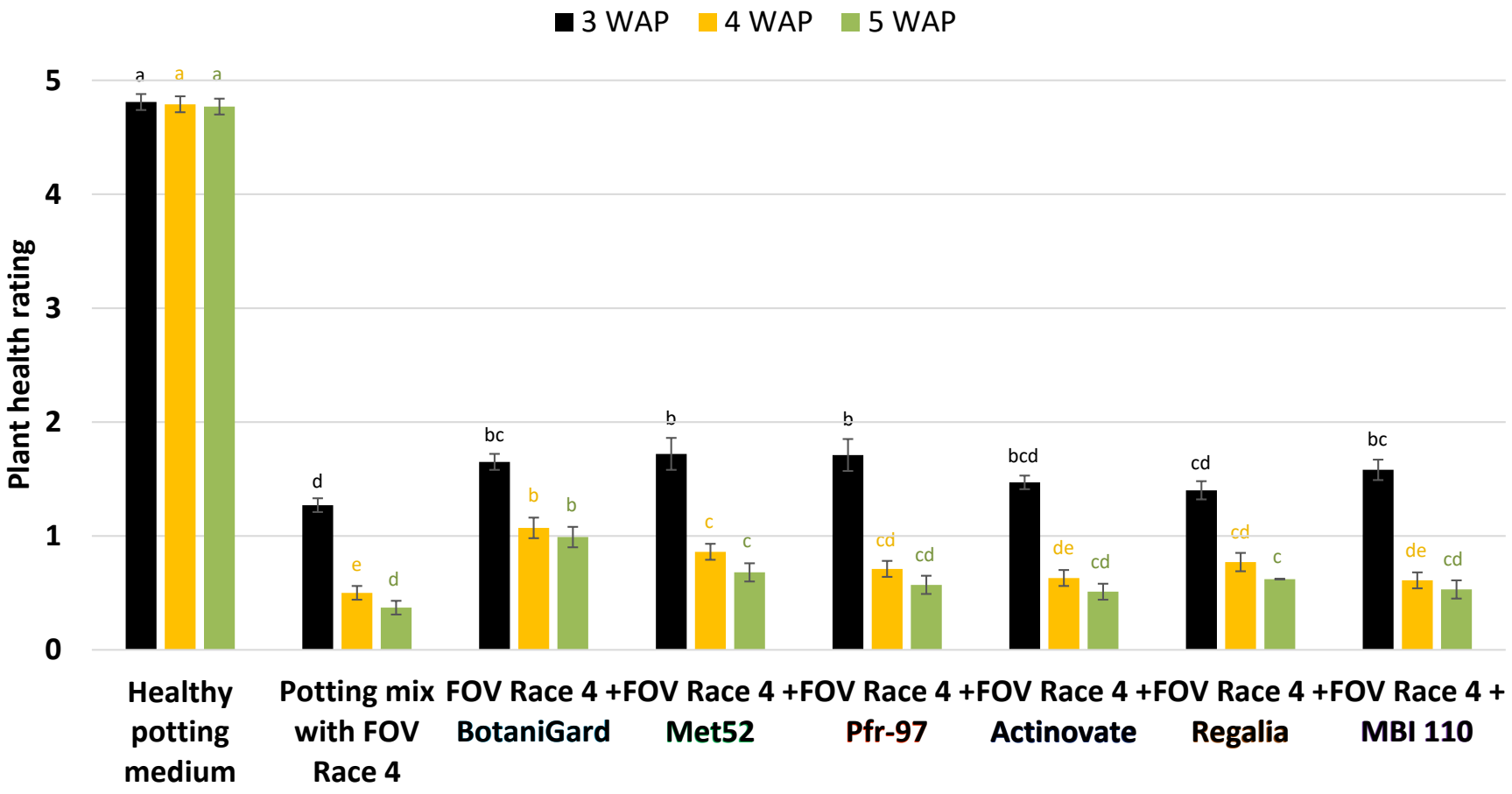


Results-Efficacy of treatments including control

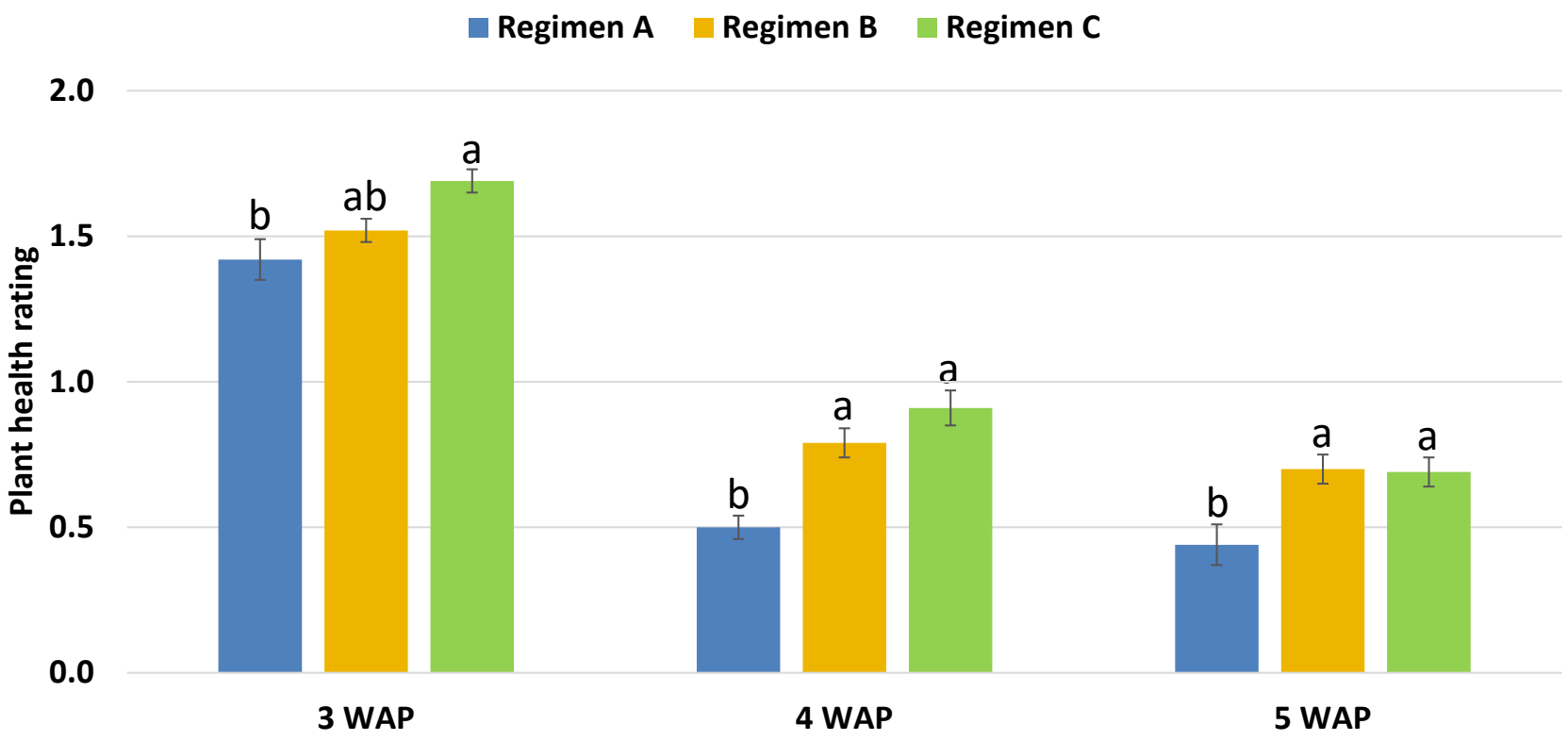
Treatments	3 weeks after planting			4 weeks after planting			5 weeks after planting		
	A	B	C	A	B	C	A	B	C
1. Healthy potting medium	4.84±0.11a*	4.83±0.11a	4.77±0.13a	4.84±0.10a	4.76±0.12a	4.78±0.12a	4.76±0.13a	4.75±0.13a	4.78±0.12a
2. Potting mix with FOV Race 4	1.05±0.11d	1.26±0.10d	1.52±0.08cd	0.38±0.10b	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.

Results-Efficacy of treatments across all regimens



Efficacy of different regimens



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

Overall Conclusions

- In addition to controlling invertebrate pests, entomopathogenic fungi can be used for multiple purposes, such as promoting plant growth and health
- By studying the versatile applications, these products can be used for promoting sustainable agriculture in numerous roles

Acknowledgements

- BioWorks, Inc., Certis USA, Marrone Bio Innovations, and Valent BioSciences for providing product samples
- Plantel Nurseries, Santa Maria, CA for the cabbage transplants