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Improving two-spotted spider mite management in high tunnel cucumbers

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INTRODUCTION

High tunnels (HT) are a tool used for protected cultivation of food crops. Their popularity falls on the low cost of construction and increased profitability by extending the growing season and protecting crops against adverse weather conditions (Foust-Meyer and O'Rourke 2015). Cucumber (*Cucumis sativa* L.) are suitable for HT production because of their vertical growth pattern which optimizes space and repeated flowering, offering multiple harvest opportunities **(Fig. 1a).** However, two-spotted spider mite (*Tetranychus urticae* Koch; TSSM; **Fig. 1b**) is a primary pest of cucumbers in HT systems that decreases production. TSSM suck essential plant nutrients from the leaves, causing yellowed stippling symptoms and eventual leaf death (Park and Lee 2002). TSSM often goes unnoticed until the damage is irreversible, and the pest is difficult to control without conventional insecticides, which are limited in high tunnels.

Figure 1. Cucumber plant vertically trellised inside high tunnels (A); TSSM adult and egg; photo courtesy John Obermeyer (B).

OBJECTIVES

- Evaluate susceptibility to TSSM in high tunnel production systems.
- Examine the efficacy of biopesticides to control TSSM in high tunnels.

MATERIALS AND METHODS

Cultivar susceptibility was evaluated using the Horsfall-Barret scale (Horsfall and Barratt 1945; **Fig. 2**) using 10 varieties **(Table 1)** replicated within a single tunnel in a RCB design across Indiana **(Fig. 3).**

H-B Scale	% Affected
1	0
2	>0 to 3
3	3 to 6
4	6 to 12
5	12 to 25
6	25 to 50
7	50 to 75
8	75 to 87
9	87 to 94
10	94 to 97
11	97 to 100
12	100

A

B

Figure 2. Horsfall-Barratt mite infestation rating scale (A); Severe leaf symptoms of infestation of TSSM (B)

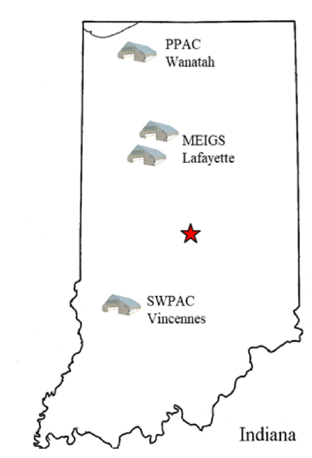

Figure 3. Location of the variety trials.

Variety	Seed source
Adam Gherkin	Johnny`s Selected Seed
China long	Kitazawaseed
Corinto	Johnny`s Selected Seed
Excelsior	Johnny`s Selected Seed
Itachi	Johnny`s Selected Seed
Poniente	Johnny`s Selected Seed
Quirk	Johnny`s Selected Seed
Socrates	Johnny`s Selected Seed
Tasty Jade	Reimer Seeds
Taurus	Harris Seed

Table 1. Cultivar and seed source for trial

Population density of TSSM were evaluated by commercially biopesticides such as Bioceres (*Beauveria bassiana*) , Insecticide's soap (potassium salts), Venerate (*Burkholderia rinojensis*), AzaGuard (azadirachtin), Neem Oil) in separate plantings within single tunnel in a RCB design across Indiana **(Fig. 3)**. Predator's mites were evaluated just in MEIGS location.

RESULTS

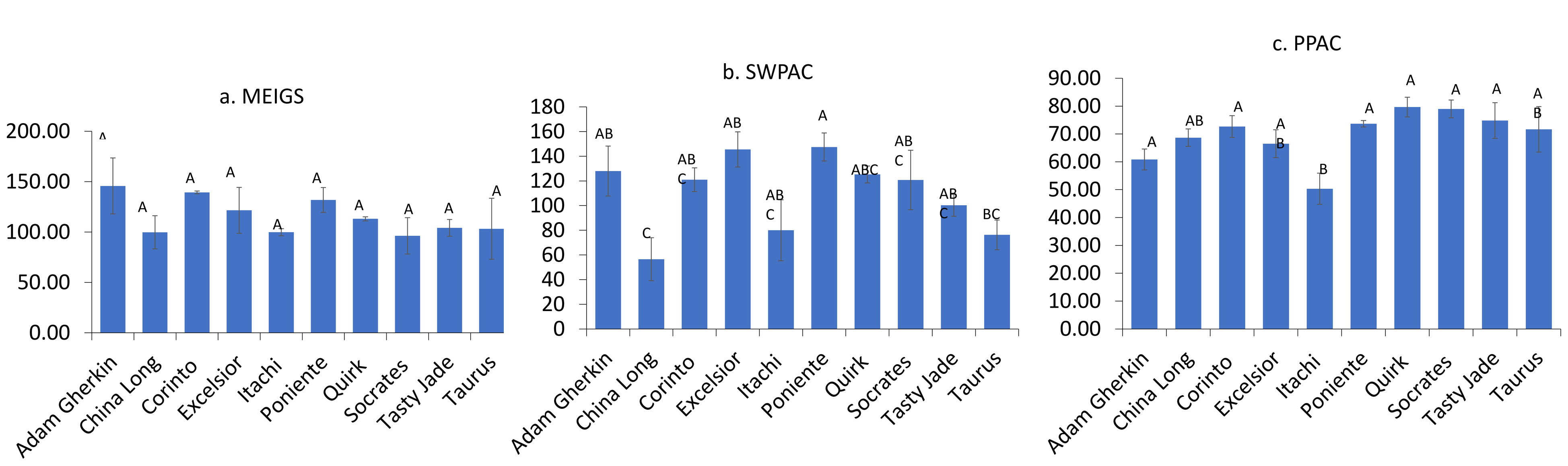

Figure 4. TSSM susceptibility as measured by the AUDPC at MEIGS (a), SWPAC (b) and PPAC (c).

TSSM Susceptibility

Using the H-B ratings over time we calculated the Area Under the Disease Progression Curve (AUDPC), a quantitative summary of TSSM pressure over time, to compare varietal susceptibility to TSSM. There were no differences between varieties at the MEIGS location ($F_{9,70}$ = 1.07; P = 0.39; **Fig. 4a**) and overall mite pressure was low. At SWPAC we observed differences between Poniente, and other varieties ($F_{9,29}$ = 3.91; P = 0.002; **Fig. 4b**); and PPAC Itachi contained the lower pressure ($F_{9,50}$ = 3.46; P = 0.002; **Fig. 4c**).

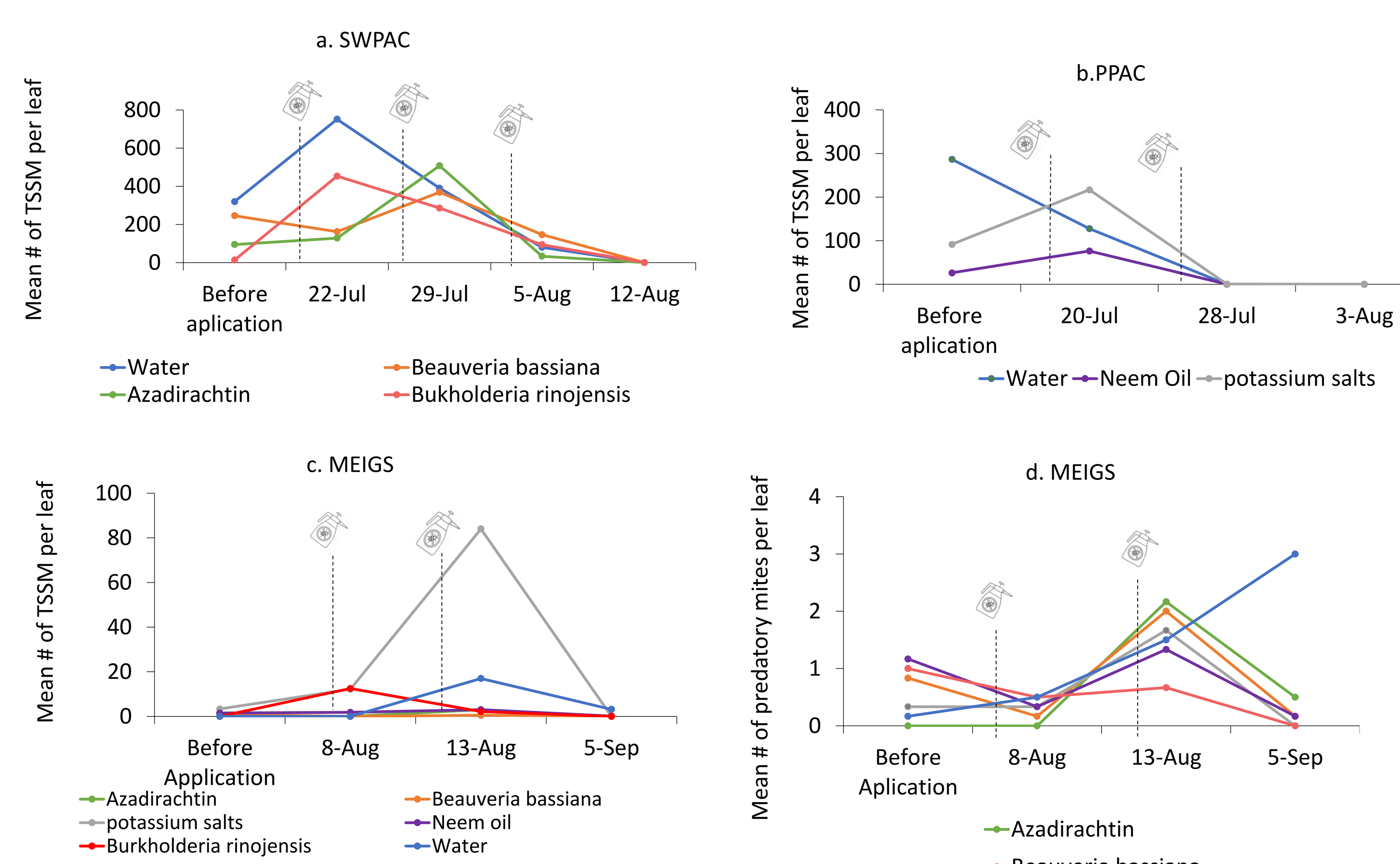

Figure 5. TSSM populations post-pesticide applications at SWPAC (a), PPAC (b) and MEIGS (c-d).

Efficacy Trial

There were no differences in the mean # of TSSM per leaf among the commercial biopesticides at the SWPAC ($F_{1,78}$ =1.09; P = 0.30**; Fig. 5a**), PPAC ($F_{2,69}$ =0.56; P = 0.57; **Fig. 5b**), or MEIGS ($F_{5,65}$ =2.17; P = 0.068; **Fig. 5c**) locations.

At MEIGS we found no difference in the # of predatory mites per leaf among the commercial biopesticides ($F_{5,65}$ = 0.83; P = 0.53; **Fig. 5d**).

CONCLUISON AND FUTURE DIRECTIONS

- China long and Taurus were more resistant to TSSM compared to the most susceptible Poniente at SWPAC and Itachi was most resistant at PPAC.
- TSSM and predatory mite susceptibility results were inconclusive because the population of TSSM in our control (water) plots declined in the same response of all biopesticide treatments. One reason could be that we did not successfully prevent drift between treatments within the high tunnel.

REFERENCES

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- Park, Y.L. and Lee, J.H., 2002. Leaf cell and tissue damage of cucumber caused by twospotted spider mite (Acari: Tetranychidae). Journal of Economic Entomology, 95(5), pp.952-957.