Evaluating the efficacy of biorational products on TSSM and their effect on predatory mites in HTs.

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INTRODUCTION

High tunnels (HTs) are a protected culture tool for specialty crop farmers. Cucumbers (*Cucumis sativa* L.) are well suited for HT production because their vertical growth pattern allows for space optimization and repeated flowering offers multiple harvest opportunities. However, twospotted spider mite (*Tetranychus urticae* Koch; TSSM; **Fig. 1A**) limit production in HT systems; they often go unnoticed by farmers until the damage is irreversible and difficult to control. Management recommendations are based on field or greenhouse experiences and rely on conventional miticides; options for organic growers are especially limited. Recommendations for organic products (**Fig. 1B**) and predatory mites (**Fig. 1C**) in HTs are needed.

Figure 1. TSSM adults and egg, photo by John Obermeyer (A); Example of biorational product (Insecticidal soap, B); Adult predatory mite and TSSM eggs (C).

OBJECTIVES

1. Evaluate the mortality effect of biorational products on TSSM.
2. Evaluate the effect of biorational products on TSSM oviposition
3. Assess the mortality effect of biorational products on predatory mites.

REFERENCES

1. Döker, İ., Kazak, C. and Karut, K., 2016. Functional response and fecundity of a native *Neoseiulus californicus* population to *Tetranychus urticae* (Acari: Phytoseiidae, Tetranychidae) at extreme humidity conditions1. Systematic and applied acarology, 21(11), pp.1463-1472.
2. McMurtry, J.A., De Moraes, G.J. and Sourassou, N.F., 2013. Revision of the lifestyles of phytoseiid mites (Acari: Phytoseiidae) and implications for biological control strategies. Systematic and Applied Acarology, 18(4), pp.297-320.

RESULTS

TSSM mortality bioassay using biorational pesticides

Adults treated with Neem oil, Bioceres, and Grandevo died at a faster rate compared to the water control treatment (**Fig. 2**).

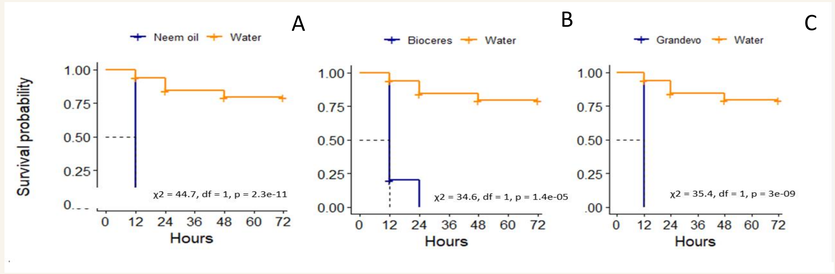


Figure 2. Survival probability of water (control) and neem oil on adult TSSM (A); Bioceres (B); Grandevo (C) over a 72-hours observation period.

TSSM adult oviposition when using biorational pesticides

Adults laid more egg on the control compared to all the treatments (Poisson GLM, $\chi 2 = 5.67$, df = 8, p =1.201e-06 ; **Fig. 3**).

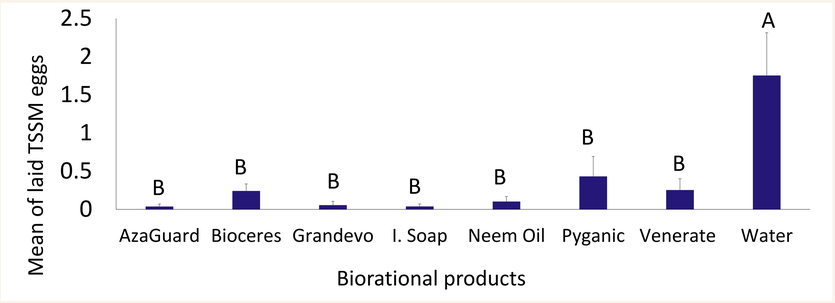


Figure 3. Bar plot of the mean of laid TSSM eggs when using biorational product.

Predatory mite mortality bioassay using biorational pesticides

No spray effects were observed in any treatments for *N. cucumeris, N. californicus, and P. persimilis. Amblyseius andersoni* sprayed with Pyganic and AzaGuard died at faster rate compared to the control (**Fig. 4**). *Neoseiulus Fallacis* treated with AzaGuard exhibited a more rapid mortality rate when compared with the control (**Fig. 4**).

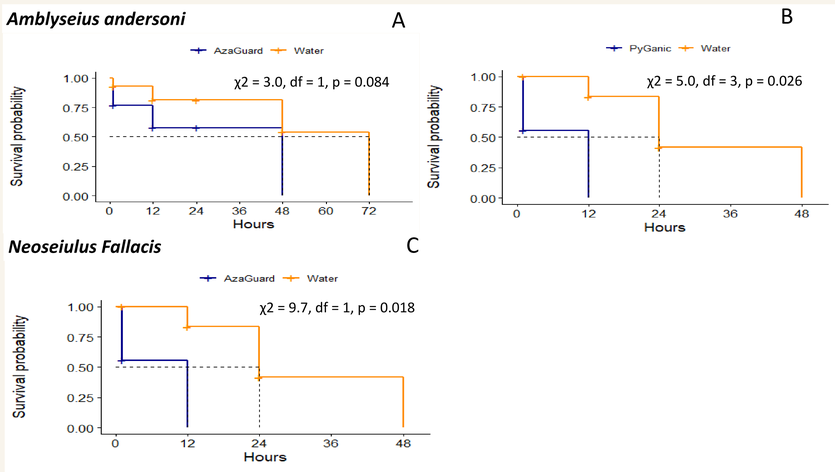


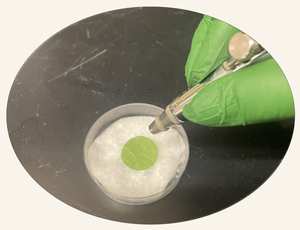
Figure 4. Survival probability of water (control) with AzaGuard (A); and with Pyganic (B) on *Amblyseius andersoni*. Survival curves of water and AzaGuard on *Neoseiulus Fallacis* (C) over a 72-hours observation period.

METHODOLOGY

TSSM mortality

TSSM female

Clean leaf dish



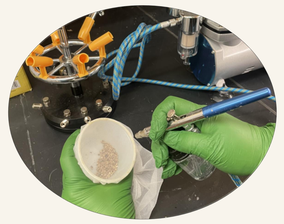
Application to Petri dish with TSSM

Growth chamber

Predatory mites' mortality

Amblyseius andersoni
Neoseiulus californicus
Neoseiulus cucumeris
Neoseiulus fallacis
Phytoseiulus persimilis

Leaf dish with TSSM



Application directly to the predators

Growth chamber

Table 1. Biorational product, commercial names and actives ingredients.

Commercial Name	Active ingredient
AzaGuard®	Azadirachtin
Bioceres®	*Beauveria bassiana*
Cpt. Jack Neem Oil®	Clarified hydrophobic extract of neem oil, 70%)
Grandevo®	*Bacterium Chromobacterium*
Insecticidal Soap®	potassium salt of fatty acids
Pyganic®	Pyrethrin's
Venerate CG®	*Burkholderia* spp. strain A396
Water	Water

Table 2. Temperature and relative humidity of the growth chamber were set to mimic the growth conditions in a high tunnel in August.

Description	T °C	RH %	Time range
step 1	15	60	9:00 pm – 8:00 am
step 2	25	50	8:00 am – 10:00 am
step 3	30	40	10:00 am – 12:00 pm
step 4	32	40	12:00 pm – 2:00 pm
step 5	39	40	2:00 pm – 3:00 pm
step 6	32	40	3:00 pm – 5:00 pm
step 7	30	50	5:00 pm – 7:00 pm
step 8	25	60	7:00 pm – 9:00 pm

TAKE HOME-MESSAGE

1. Neem oil®, Bioceres®, and Grandevo® were the best products to kill twospotted spider mite and do not hurt predatory mites.
2. TSSM oviposition was effect by all the biorational products.
3. Just *A. andersoni* and *N. fallacis* were affected by AzaGuard.