Ultrasound and LEDs for sustainable management of chilli thrips and spider mites in strawberry.

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Summary

Ultrasound waves were applied to heavily infested strawberry plants testing 40 kHz at four pulse rates and comparing to non-treated control plants. Plants were treated for 5 min every week during observation period. Results indicate no effect on chilli thrips and spider mite populations at current application rates. Since this is a new avenue of investigation, this does not imply that ultrasound doesn't have the potential to suppress these serious economic pests at immature life-stages. Continuation of this research with 50 kHz and 40 kHz applied at longer durations per week needs to be done to further explore the potential of ultrasound as a pest management tool.

Objectives

The objective of this proposal was to evaluate four different ultrasound frequencies for suppression of chilli thrips and spider mites in strawberry plants.

Methods

Finalizing protocol for use of ultrasound machine:

The greenhouse study was conducted at Gulf Coast Research and Education Center (27.712490º, -82.302322º) during the strawberry season 2023-2024. Strawberry cultivar, Florida Brilliance was planted and maintained in a greenhouse under nylon mesh caged conditions to prevent pest incidences for 4 weeks. On the 5th week, a total of 15 healthy plants that were individually caged, were inoculated with 10 adult female chilli thrips *Scirtothrips dorsalis* Hood and 10 adult female twospotted spider mites *Tetranychus urticae* Koch using our previously established lab colonies of susceptible individuals. Plants were left caged and undisturbed for 7 days to encourage pest infestation and watered (900 ml) 3 times a week. Five treatments applied included: 1) 40 kHz ultrasound at 3 Hz pulse rate/width, 2) 40 kHz at 5 Hz pulse rate/width, 3) 40 kHz at 10 Hz pulse rate/width, 4) 40 kHz at 25 Hz pulse rate/width, and 5) non-treated control. Ultrasound treatments were applied weekly for 3 weeks for 5 min and treatments were replicated 3 times. Ultrasound was applied to plants individually to follow safety protocols and prevent accidental exposure to wrong dosage in surrounding plants. Plants were kept 10 inches away from ultrasound emitter and was surrounded by a plexiglass cage to avoid ultrasound dissipation. The emitter was placed at the height of plant foliage using Styrofoam blocks to adjust height to account for the limitations of distance and direction that ultrasound can travel.

Sampling: The total number of *S. dorsalis* larvae and *T. urticae* were sampled before ultrasound application, and then at 24 hours after ultrasound treatment, 7 days after treatment (DAT), and 14 DAT. Strawberry trifoliates (2-3) were randomly collected from each plant and washed with 70% ethanol to collect thrips and mite at all life-stages, which were counted under microscope.

Data analysis was done by analysis of variance to identify differences in means (PROC MIXED, alpha: 0.05; SAS Version 9.4, SAS Institute, Cary, NC). Main effects of ultrasound dosage and day of sampling along with their interaction effects were tested.

Results

No effect of the ultrasound dosages was seen on *S. dorsalis* and *T. urticae* population at the ultrasound doses tested in the above-mentioned protocol (Fig. 1). Interaction effects between ultrasound dosage and day of sampling clearly showed that there were no effects of either on the thrips and mite populations (F = 0.6, df = 12, 0, P = 0.8212; F = 1.29,

df = 12, 30, P = 0.2754, respectively).

Ultrasound (Hz pulse rate/width)	*S. dorsalis* larvae	*T. urticae* adult and nymph
0	5.25 ± 2.25	162.75 ± 31.63
3	2.67 ± 1.38	280.42 ± 49.61
5	3.08 ± 1.01	132.25 ± 24.29
10	5.83 ± 1.85	249.25 ± 38.70
25	7.33 ± 1.97	281.08 ± 44.55

Fig. 1. Mean (±SE) count of *Scirtothrips dorsalis* larvae and *Tetranychus urticae* adult and nymphs after application of 40 kHz ultrasound for 5 min on infested strawberry plant once every week at four different pulse rates.

Current Project Status:
A no-cost extension of this project has been requested to continue the testing of permutation and combination of 40 kHz (± 4%) at these frequencies and pulse rates but for longer periods of time per week. Additionally, ultrasound device was sent to manufacturer to confirm correct operation and addition of feature that can facilitate the application of 50 kHz (± 4%) transducer emitter. The originally proposed ultrasound doses for this project were modified to meet the limits of available technology and literature review showed best results on other soft-bodied arthropods within the range of 40 – 60 kHz. Since previous studies in Lahiri lab have shown that UV-C light works effectively for *T. urticae* egg suppression, this project is aiming to first rule out the possibility of ultrasound waves causing pest suppression at certain frequencies, before combining treatments with UV-C emitting LEDs. This step is important to verify the role that ultrasound can play as a stand-alone physical control tools for pest management.

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