Field application of ultraviolet-C (UVC) radiation for management of thrips and mites in Florida strawberries

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Summary

Biweekly application of UVC at 200 J/m^2 and 350 J/m^2 is useful for controlling twospotted spider mites by reducing their egg hatchability by 57 times compared to non-treated strawberry plants. However, chilli thrips and western flower thrips were not suppressed. UVC does not negatively impact strawberry yield at these doses.

UVC and Thorvald

The Thorvald unit (Fig. 1) is an autonomous robot designed by Saga Robotics (Oslo, Østlandet, Norway) to irradiate strawberry beds with high-energy ultraviolet-C (UVC) light. The application of UVC occurs at night for maximum efficacy. The purpose of UVC in this experiment is to control twospotted spider mites (TSSM), chilli thrips, and western flower thrips on strawberries and reduce the need for conventional pesticides.

Figure 1. Thorvald unit treating strawberry beds after sunset, during the 2019-2020 strawberry season.

Methods

Field Trials for Thrips and Adult Mite Suppression

'Radiance' and 'Brilliance' variety strawberries were planted for the experiments at the GCREC on Sept. 30 and Oct. 18, respectively. Plots were 15 ft long and consisted of 20 plants each. Strawberry plots were maintained following local crop production protocol. There were four treatments consisting of 1) the pesticide spinetoram (Radiant®SC), 2) UVC treatment - 200 J/m^2, 3) UVC treatment - 350 J/m^2, and 4) control. Ten, twospotted spider mites were also released twice on each plot to establish a population due to lack of a natural infestation. No miticide was applied in this experiment. Two spinetoram applications were conducted. The first application was on December 4, 2019 and the second on January 9, 2020.

UVC applications were conducted twice a week after sunset. Each treatment was replicated 5 times for 'Radiance' and 4 times for 'Brilliance' plots. Leaf, flower samples, and fruits were collected from each plot on a weekly basis to assess thrips and mite population suppression. Weight measurements and insect damage inspections on harvested fruit were also done.

Mite Egg Hatchability

TSSM females were placed on bean leaf discs in the laboratory, to lay eggs on the underside of the leaf disc for 24 h. Leaf discs were then attached to 5 strawberry plants in the center of each plot, in the above-mentioned field plots. There were three

treatments: 1) UVC treatment - 200 J/m^2, 2) UVC treatment - 350 J/m^2, and 3) control. After treatment application, leaf discs were collected immediately, and eggs were held in a dark box for at least 4 h. The percent egg hatch was assessed after 24 h.

Results

Field Trials for Thrips and Adult Mite Suppression

Both doses of UVC were ineffective in suppressing chilli thrips and western flower thrips on both strawberry varieties. In 'Brilliance' plots, only spinetoram application was effective in suppressing chilli thrips adults and nymphs. Control plots had 18 times higher chilli thrips adults and 64 times higher nymph numbers when compared to spinetoram (Radiant®SC) treated plots. In 'Radiance', the UVC treated plots had ~ 4 – 5 times higher chilli thrips numbers when compared to the control plots. In 'Radiance', even spinetoram application was barely effective to suppress chilli thrips adults and nymphs.

In the 'Brilliance' plots there was no impact of UVC application on TSSM adults and nymphs. However, in 'Radiance' plots, the TSSM adult and nymph counts in spinetoram treated plots were twice that of UVC and control plots.

Mite Egg Hatchability

UVC had a significant impact on the hatchability of TSSM eggs (Fig. 2). In control plots of 'Brilliance' and 'Radiance', the % egg hatch was 57 and 26 times higher compared to plots receiving 350 J/m^2, respectively. In control plots of 'Brilliance' and 'Radiance', the % egg hatch was 20 and 3 times higher, when compared to plots receiving 200 J/m^2, respectively.

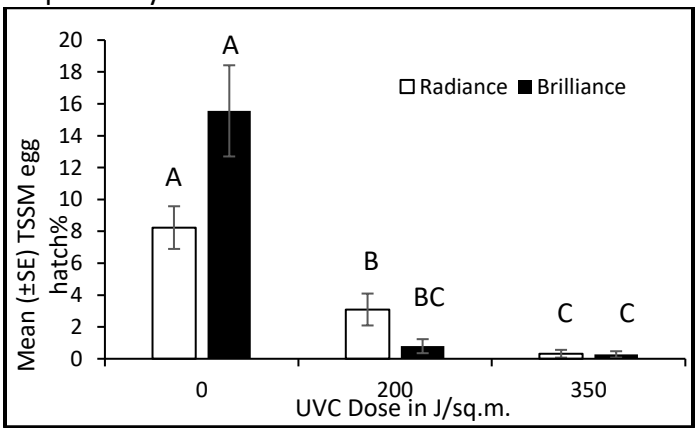

Figure 2. Hatchability of twospotted spider mite eggs after UVC treatment.

Yield

UVC had little to no impact on strawberry harvest (**Table 1**). The number of total fruits produced and the number of damaged fruits in each plot were not significant. 'Brilliance' plots treated with spinetoram had ~20-25% fewer damaged fruits than other treatments. 'Radiance' plots treated with 350 J/m^2 had ~13% more damaged fruits than control plots. This is consistent with some 'Radiance' plots showing higher numbers of thrips when treated with 350 J/m^2.

Table 1. Effect of UVC and spinetoram application on strawberry marketable fruit yield.

Variety	Treatment	Marketable Yield per Plot (g)	% Fruit Damage from Pests
Brilliance	0 J/m^2	5.02	75.86
	200 J/m^2	7.04	71.66
	350 J/m^2	7.54	72.12
	Insecticide	17.23	51.32
Radiance	0 J/m^2	4.32	75.69
	200 J/m^2	1.96	83.17
	350 J/m^2	1.80	88.36
	Insecticide	3.42	82.25

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