UV-B as a means to control powdery mildew in strawberry

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Introduction
Powdery mildew (*Podosphaera aphanis*) is an important disease of strawberry (*Fragaria × ananassa*), especially if grown in high plastic tunnels or greenhouses. We have previously demonstrated suppression of powdery mildew in rose and cucumber strawberry following brief exposures to red light and UV-B radiation during night hours (Suthaparan et al. 2010a, 2010b, 2012, 2013). Here we report results from experiments with UV-B against strawberry powdery mildew.

Materials and Methods
All experiments took place in research greenhouses. To reveal if we could vary the interval between UV-B treatments, without changing the total amount of UV-B, strawberry plants of cv. Korona with two developed leaves at time of inoculation were treated as follows: i) Natural growth supplied HPS-lamps (230 ± 20 µmol/m^2/s) if solar radiation went below 200 W/m^2. Day length was 16 h (from 06:00 to 22:00). The other treatments were given the same light conditions during the day phase and received additional UV-B during night; ii) 0.8 W/m^2 UV-B for 18 min every third night; iii) 0.8 W/m^2 UV-B for 6 min every night; iv) 0.8 W/m^2 UV-B for 2 min three times per night; v) 1.6 W/m^2 UV-B for 9 min every third night; vi)1.6 W/m^2 UV-B for 3 min every night; vii) 1.6 W/m^2 UV-B for 1 min three times per night. There were two replicated trials over time and six plants per treatment. Disease severity was assessed 12 days after inoculation.

Currently the UV-B technology is being adapted for use in commercial greenhouses, and we have devised a robotic system with a boom containing UV-B fluorescent lamps moving horizontally over potted plants. Strawberry plants of cv. Korona were used to test the system. Inoculation of the test plants was achieved by placing plants with powdery mildew next to healthy test plants. The speed at which the boom traversed the plants was adjustable, and it was equipped with a blower to move the leaves for more uniform exposure on both leaf sides.

Result and Discussion
All treatments with UV-B reduced powdery mildew significantly, and there was no significant difference between the UV-B treatments. Reduction in disease severity was 90 % or higher for the different UV-B treatments. These results show that it is possible to reduce powdery mildew in strawberry substantially with the use of UV-B. We may also conclude that extending or shortening the treatment intervals from once per night to either once every third night or three times per night, does not change the efficacy as

long as the dose rate is kept constant. There was no negative effect on plant growth by any of the treatments.

When using the mobile boom, total UV-B energy at the topmost leaf of each plant was 390 or 214 J/m^2/day at boom speeds of 25 or 50 cm per min, respectively. Relative to the untreated control, UV-B during night reduced disease severity on the adaxial and abaxial leaf sides to 0.05 and 4.2 % or 0.4 and 3.0 % if the speed was 25 or 50 cm per min, respectively. We are currently adapting the above technology for use on horizontal and vertical booms of commercially-available spray equipment for use against powdery mildews in several crops. To promote more uniform canopy exposure, additional refinements of lamp reflectors and use of reflective material beneath plant canopies are in progress..

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