Shade netting reduces sunburn damage and soil moisture depletion in 'Granny Smith' apples

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Background

East of the Cascade Mountain range, where most of the commercial apples are grown in Washington, environmental conditions in the summer include long hot days, minimal precipitation and very high light intensities. As a result, significant tree stress can occur and a high incidence of fruit physiological disorders, such as sunburn damage occur. It was estimated that sunburn damage costs Washington growers over $100 million per year (Racsko and Schrader, 2012). Growers primarily use overhead cooling to reduce the fruit surface temperature during the hot parts of the day to limit the occurrence of sunburn, but this practice could be eliminated from use in the future because of food safety concerns and future regulations from the U.S. Food Safety and Modernization Act.

Fig. 1. Fruit sunburn damage

Objective

To assess the effect of shade anti-hail nets on orchard microclimate, soil moisture depletion and fruit sunburn incidence in 'Granny Smith' apple.

Materials and methods

- At WSU Sunrise orchard (Rock Island, WA), seven year-old 'Granny Smith'/M9 T337 apple trees were covered in 2014 after bloom with 22% white shade net by installing four pods (Fig.2). Each pod covered a rectangular area of 7 tree rows by 12 trees per row (18 m × 11 m × 5.2 m high). Uncovered trees of equal plot size served as control.
- All trees in the trial received the same irrigation, irrespective of the treatment.

Fig. 2. Shade net pods.

- Canopy air temperature was recorded continuously at 10 minute intervals from 1 to 31 August, 2014 (Hobo Pro v2, Onset Computer Corp.).
- Photosynthetically active radiation (PAR) was recorded hourly (6 am to 4pm) on August 21 and 27, 2014 (QSO-S, Apogee Instruments Inc.).
- Soil moisture at 10, 20, 30, 40 and 60 cm depth was measured periodically throughout July and August, 2014 (PR2, Delta-T Devices Ltd.) .
- Prior to harvest, sunburn damage was assessed visually on 200 sun exposed fruits per replicate following Schrader et al. (2003), (Fig. 3).

Fig. 3. Sunburn scale for visual assessment of damage (Schrader et al., 2003). Original scale was for 'Fuji' apple. Scale was modified for 'Granny Smith' by I. Hanrahan and M. Mendoza (WA Tree Fruit Research Commission, personal communication).

Results

- Shade net reduced maximum daily PAR by 32% ± 4.92. Maximum value on a sunny day was 1649 μmol/m²s in non-covered control and 1222 μmol/m²s under net.
- Canopy daily maximum air temperature was significantly lower under the net (30.96 °C ± 3.21) compared to the control (31.92 °C ± 3.36) (Fig. 4).
- Shade net significantly reduced soil moisture depletion at 0-30 cm depth, resulting in 20% higher soil water content compared to the non-covered control (Fig. 5). No significant differences were observed deeper in the soil profile.
- Netting also significantly reduced fruit sunburn (Fig. 6).

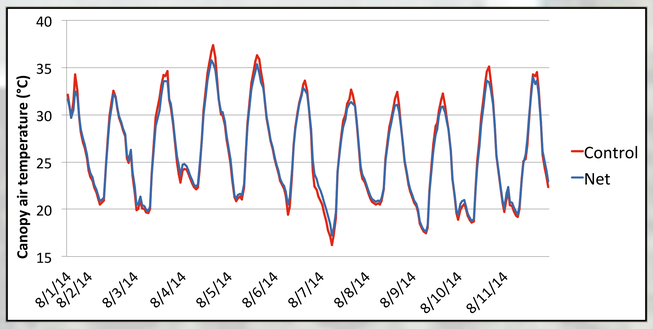

Fig. 4. Canopy air temperature under the net and in the control, 1-11 August, 2014.

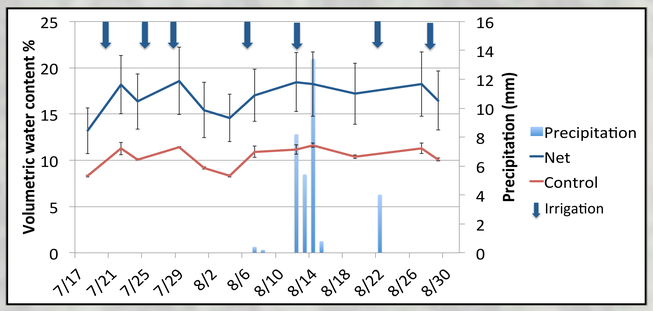

Fig. 5. Soil volumetric water content at 20 cm depth under the net and in the control, July and August, 2014.

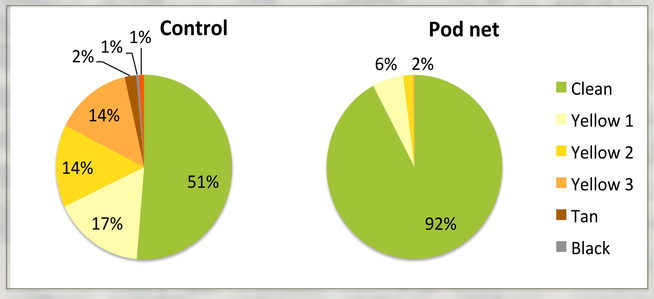

Fig. 6. Fruit sunburn damage observed under the net and in the control (n=1600).

Conclusions

Shading by as little as 22% alters orchard microclimate and reduces stressful conditions due to excessive light and heat load. Shade nets reduced sunburn damage and soil moisture depletion for 'Granny Smith' apple in the semi-arid environment of central Washington. Overhead netting represents an important tool for increasing yields of high quality fruit.

References

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