



Light and energy effects of condensation on greenhouse covers

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Background

Greenhouse covers are often wet from condensation, which has consequence for both light transmission and heat transfer. Light loss by condensate is determined by the form of the droplets on the cover, which, in turn is determined by the surface properties of the material. Energy fluxes depend on internal and external conditions of the greenhouse, and on the cover properties.

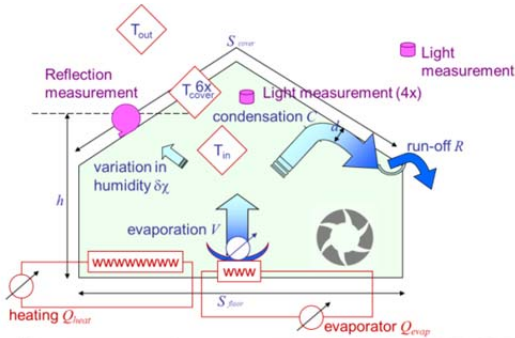


This project aimed at investigating the effects of condensate on the:

- light transmission of different greenhouse covers
- heat transfer of a greenhouse cover when wet, under various internal/external conditions.

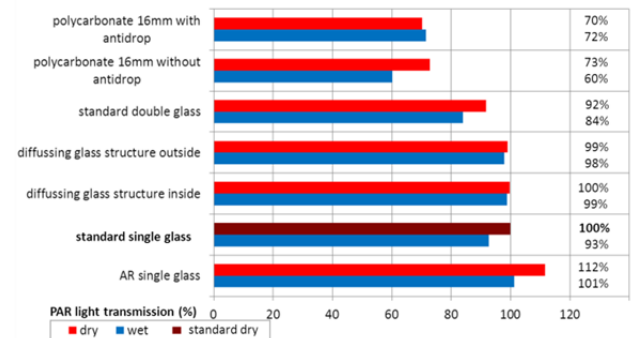
The experiments:

Therefore we built a 4 x 3.2m (one span) greenhouse and placed it in a large climate room, so that we could control and log climate conditions inside and outside the greenhouse. Condensation on the covers was investigated for $\Delta T_{in-out} = 10$ or 20°C and internal air velocities of 7 or 15 cm/s, and then repeated for 7 cover materials.



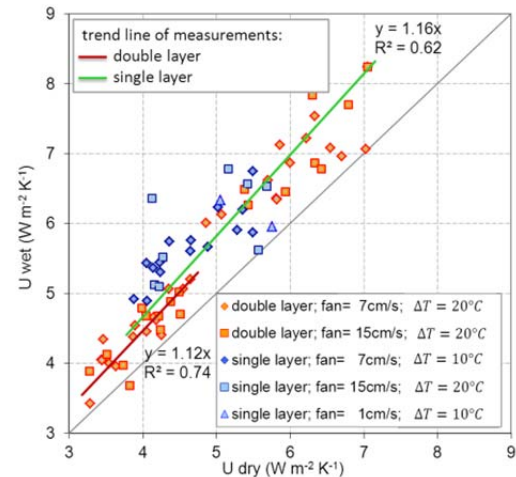
Results

Light:



Transmission for PAR light of the tested cover materials, dry and wet; 100% is the standard single cover dry = 100% PAR light transmission

Energy:



Ratio of the heat transfer coefficient (U factor) of the wet cover vs the corresponding value when dry

Conclusions

- Condensate reduced light transmission by 9% on average, with large differences among materials.
- Anti-drop coatings did suppress the effect of light loss, as did a surface structure meant to increase diffusivity of the material.
- As far as energy is concerned, the heat transfer (U-value) of the greenhouse increased by an average of 16% (single layers) or 12% (double layer covers) when wet.
- There was an effect of the temperature difference on the U-value, which was consistent with the heat transfer theory, whereas little effect was found on the air movement within the greenhouse.

