

THE COMBINED EFFECT OF COVER DESIGN PARAMETERS ON PRODUCTION OF A PASSIVE GREENHOUSE

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Abstract

The objective of this paper is to demonstrate the need of a multiple design parameter approach to greenhouse design. To illustrate this need, we determined the combined effect of cover design parameters on production of a passive greenhouse. This is a greenhouse with only natural ventilation and seasonal whitewash for climate management. The cover design parameters investigated in this research were the transmission of the cover for photosynthetically active radiation (PAR) and near infrared (NIR) radiation, the emission coefficient for long wave radiation of the cover and the ventilation area.

First we developed a model to link the tomato production to the cover design parameters, through their effect on greenhouse climate. The inputs of the model were management of the ventilation windows and the whitewash, climate data and the cover design parameters. The outputs of the model were the greenhouse climate and the tomato production. The model was validated by comparing the simulated greenhouse climate and production with data obtained from field studies conducted in Almería, Spain. Thereafter, the sensitivity of the production to the cover design parameters was analysed for three greenhouse configurations. The sensitivity analysis gave insight into the effect of the cover design parameters on production.

Results show that the sensitivity of the production to a single design parameter depends on the absolute values of the other ones. For example, the production in a greenhouse

with a high ventilation capacity is most sensitive to PAR transmission (0.45% more production for each 1% increase of PAR transmission) while in a greenhouse with a low ventilation capacity the crop yield is most sensitive to the ventilation area (0.63%) and NIR transmission (-0.56%). In addition, the sensitivity of the production to the design parameters also depends on time due to changing outdoor climate conditions. In conclusion, these results imply that indeed greenhouse designs can further be improved by changing the most sensitive design parameters which depend on the absolute values of the other design parameters and on the outdoor climate conditions.