CHARACTERIZING COOLING EQUIPMENT FOR CLOSED GREENHOUSES

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Abstract

The application of air conditioning devices for cooling greenhouses in summer is becoming increasingly popular in Dutch horticulture. Cooling reduces the ventilation requirement increasing thereby the benefits of carbon dioxide fertilisation. The combination of a high radiation level, high CO2-levels and a limited ambient temperature is very favourable for vegetable production, Increments in production levels to even 20% are possible. There is also a quality aspect to be considered: a better control of day- and nighttime temperature can help to steer the morphological development of ornamentals and it is known that the quality of strawberry is boosted when the night-time temperature is kept around 12 °C. However, in commercial greenhouse industry, all these benefits must more than balance the costs associated with the cooling equipment. An informed decision about the most apt equipment must rely on the computation of these costs, which is not a trivial issue. This because there are a lot of variables that determine the performance of an air conditioning unit in terms of the use of resources (e.g. cold water and electricity) in relation to the resulting cooling power. For instance, it is not difficult to double the cooling capacity of an air conditioning unit at the same resource requirement: in many cases, an increment of greenhouse air humidity and a small increment of the tolerated air temperature would do the job. Since the specifications of air conditioning units are commonly available for only a small number of benchmark points, usually based on quite different applications from greenhouse horticulture, Wageningen UR has developed a software tool that translates arbitrary benchmark points to performance characteristics in a specified horticultural context. The tool relies on a mechanistic simulation model, based on solving heat and mass balances in a counter- or cross flow heat exchanger. This model, and some results are presented in this paper. However, in a (semi) closed greenhouse, much more factors than the air conditioning

devices determine the overall performance. Another paper "Overall energy analysis of (semi) closed greenhouses" deals with the influence of factors such as: the growth characteristics, screening policy, the characteristics of seasonal heat storage systems, the performance of chillers and heat pumps; the applicability heat surpluses on the overall costs of conditioning.