CULTIVATION STRATEGIES FOR A CLOSED GREENHOUSE

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Abstract
The so-called closed greenhouse (closed ventilation windows) is a recent innovation in Dutch greenhouse industry. The technical concept consists of a combined heat and power unit, heat pump, underground (aquifer) seasonal energy storage as well as daytime storage, air treatment units, and air distribution ducts. Savings of up to 30% in fossil fuel and production increases by 20%, mainly because of the continuous high CO2 concentration, have been reported. Economic feasibility of this innovative greenhouse highly depends on the yield increase that can be obtained. In this simulation study effects of different climate and cultivation strategies on tomato yield in a closed greenhouse are presented. The explanatory model INTKAM was used, which has several submodels e.g. for light interception, leaf photosynthesis, organ formation and abortion and biomass partitioning. The closed greenhouse offers possibilities for combinations of light, temperature and CO2 concentration that are impossible in a conventional greenhouse. At high CO2 concentration and high light intensity, leaf photosynthesis shows a steeper optimum for temperature than at ambient CO2 and high light intensity. However, the response of crop photosynthesis to temperature is much flatter than that of leaf photosynthesis. Besides photosynthesis, temperature also influences aspects like partitioning, leaf area development and fruit development. Yield potential reduces at temperatures above 20oC as increase in crop photosynthesis with temperature is small compared to increased maintenance respiration. In a closed greenhouse a higher stem density and a different temperature regime should be maintained compared to a conventional greenhouse. Based on actual climatic conditions in a conventional and a closed greenhouse (same crop management) measured in 3 different years, INTKAM predicts an increase in yield by about 17%.