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Heat Transfer in Greenhouses

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Greenhouses have been used for centuries to protect plants from adverse weather conditions and insects. Ventilation of greenhouses are of vital importance to ensure quality crop production. If temperatures in a greenhouse is too high, poor plant growth may result, and an increased need for frequent watering. A mechanical ventilation system might be required to cool the inside of the greenhouse. Natural ventilation is an alternative option used to ventilate greenhouses. Natural ventilation uses temperature and wind to control the indoor climate of greenhouses. Unfortunately greenhouses are extremely energy intensive. Energy costs are the third highest cost related to greenhouse crop cultivation. Reducing the operating costs of energy associated with greenhouse cultivation may result in a price reduction of greenhouse cultivated crops. Conducting experimental work on ventilation of greenhouses can be costly and cumbersome. Using computational methods such as CFD (Computational Fluid Dynamics) to obtain qualitative and quantitative assessment of greenhouses can reduce costs and time involved. The computer cluster at the Centre for High Performance Computing has been used since 2017 to conduct these numerical investigation using StarCCM+. Specifically heat transfer in single span greenhouses has been investigated as regards to various parameters. Aspects such as ventilator position, differences between two and three-dimensional simulations, and the effect of benches inside the greenhouse were investigated.

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