Comparison of measured and simulated flow through screens: Effects of screen inclination and porosity

M. Teitel, D. Dvorkin, Y. Haim, **J. Tanny**, I. Seginer

Biosystems Engineering, 104, 404-416 (2009).

The use of screens to reduce insect entry into greenhouses has become a common practice. Screens act as mechanical barriers that prevent migratory insects from reaching the plants. However, they impede ventilation thereby increasing air temperature and humidity within the enclosures. In an attempt to explore ways by which ventilation can be improved, the effect of screen inclination on flow parameters downstream the screen was investigated experimentally and by computational fluid dynamics (CFD) simulations. Experiments were done in a wind tunnel and CFD simulations were conducted by using the ANSYS-CFX 11 software package. The CFD code was first validated by comparing between the numerical and experimental velocity profiles downstream inclined screens with different porosities. In the validation stage the screens were inclined at 45_, 90_ and 135_ , (angle measured between the floor upstream and the screen plane). The validated code was used to determine the effect of screen inclination on mass flow rate through the screen and on airflow-induced forces that act on the screen. The effect of screen porosity was examined by using screens of different porosities (0.4, 0.52 and 0.62). The experimental and CFD results were in good agreement with respect to the velocity magnitude for a screen placed at 90_. Fair agreement was observed with an inclined screen that is placed at either 45_ or 135_. However, at both 45_ and 135_ the agreement with respect to trends in air velocity vertical distribution downstream the screen was good. When the screen was placed at 90_ to the floor, the air velocity downstream the screen was almost constant with height. With inclined screens the velocity increased with height for 45_ and decreased with height for 135_ inclination. A wider range of inclinations (30–150_) was used in the simulations to systematically study the effect of inclination on the mass flow rate through the screens and on the forces on the screens. The CFD results show that for all porosities the mass flow rate through screens that are inclined 45_ was higher than through screens inclined at 135_. The higher mass flow rate at 45_ was associated with larger force acting on the screen. The force acting at 45_ was always greater than at 135_ .