Greenhouse Ventilation Rate: Theory and Measurement with Tracer Gas Techniques

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Abstract

Leakage and ventilation rates were measured in a four span glasshouse at Silsoe Research Institute. Two tracer gas techniques were used, a decay rate method with different positions of the leeward ventilator (0, 10 and 20% of the maximum opening) and a continuous injection method with the leeward ventilators open 10%. The influences of wind speed, wind direction and temperature difference between inside and outside were analysed for each ventilator position. It was found that wind speed had a strong influence on leakage and ventilation rates. Some influence of wind direction occurred with northeast and southeast winds but no significant conclusions can be drawn because of insufficient data. Temperature difference affected ventilation rates under low wind speeds. For each ventilator position, the air exchange rate was linearly related to wind speed. A dimensionless function was calculated to express the ventilation flux per unit ventilator area and unit wind speed as a function of the angle of ventilator opening. With a 10% opening, the results obtained with the decay and continuous methods were compared and showed good agreement for wind speeds greater than 1 m/s.

The results for 10 and 20% ventilator openings obtained by using the decay method were compared with those obtained by applying the theory of convection, using pressure differences generated by wind forces and temperature differences. It was found that the combined effect of wind and temperature difference gave satisfactory predictions of ventilation rates. Also, the values obtained by measurement and prediction based on pressure difference were in close agreement, with a global wind effect coefficient similar to that found in the literature.

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