

# GREENHOUSE ENGINEERING

## Excerpts from the National Institute for Agricultural Engineering, 1983-85 Report Silsoe, Great Britain

### Light transmission

A mathematical model of greenhouse light transmission (Critten 1983a, 1983b and 1984a) showed that an E-W oriented multispans greenhouse with a vertical south roof (VSR) will have a 5% higher transmission in winter than a conventional symmetrically roofed house. This figure of 5% is an average over all sky conditions for the winter months in the UK. The VSR greenhouse will have a slightly larger roof area, but further calculations showed that for a double clad house the increase in light transmission is even higher, 7.5%, and more than compensates for the small extra heating costs. Indeed, a double clad VSR greenhouse has the same winter light transmission as a conventional single clad house, but requires only 67% of the energy to heat it. Two 'all-glass' scale models of a VSR and a conventional greenhouse have now been designed and will be exposed continuously through the winter of 1985 to test whether the light gains predicted by theory can be realised in practice.

A reflecting Venetian blind was developed as a means of increasing the light transmission of existing single span houses. A full-sized prototype was constructed; preliminary results showed an increase of winter light transmission of 25% when the sun is shining. Further measurements through the winter of 1985 will show what average gain can be achieved.

### Energy saving

An experiment was started to compare the energy saving and environmental modification caused by using various in-

ulating greenhouse covering materials. In addition to the design of a rolling mechanism for a thermal screen was completed, and it is hoped that commercial tests will confirm experimental observation that the design gives small light obstruction, and reduced wear and tear of the screen material.

### Environmental control

A distributed microprocessor control system was constructed and installed. It was used through the summer to test an adaptive control algorithm for ventilators. The results show that adaptive control gave only slightly less temperature variation than a conventional proportional-plus-integral control, but the amount of ventilator movement was substantially decreased to most occasions. Work has started to develop a mathematical model of the environment inside a greenhouse, and the effect of insulation on that environment.

### Nutrient film culture

Microcomputer controlled sensors successfully measured the concentration of  $\text{Na}^+$ ,  $\text{Cl}^-$ ,  $\text{NO}_3^-$ ,  $\text{Ca}^{++}$  and  $\text{K}^+$  ions and pH for periods of several weeks during the summer (in collaboration with Imperial College). These measurements will allow us to assess the commercial viability of selective ion electrodes for monitoring NFT solutions. Measurements of the time response for concentration changes in the nutrient gullies have prepared the way for automatic control of the concentration of individual ions (in collaboration with Lancaster University).