EFFECTS OF ANTI-TRANSPIRANTS ON TRANSPIRATION AND ENERGY USE IN GREENHOUSE CULTIVATION

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Abstract

Greenhouse production in North-Western Europe consumes a lot of energy. The energy is needed for heating the greenhouse and controlling air humidity. Transpiration of a crop increases the energy use. Transpiration of 15 liters of water which has to be removed from the greenhouse to control humidity, results on average in an energy use of about 1 m3 natural gas in The Netherlands. Therefore, if crop transpiration could be reduced without reducing crop yield, this could be very profitable for growers. Anti-transpirants that increase the leaf resistance (sum of stomatal and boundary layer resistance) for gas diffusion may reduce transpiration.

The aim of this study was to explore the potential of saving energy by lowering transpiration by means of anti-transpirants and assess the risk that this may reduce yield. Literature and model calculations were used to explore the effects of increased leaf resistances on transpiration, energy use and production in tomato, cucumber and sweet pepper.

In literature a large number of compounds have been described that act as anti-transpirant. A two-to-fivefold increase in stomatal resistance can be expected from treatment with anti-transpirants. Model calculations showed that increasing the stomatal resistance throughout the whole year leads to substantial yield reduction: yield was reduced by 6-20%, while transpiration by 15-42% and consequently energy use by 9-16%, all figures respectively for a doubling and fivefold increase of the stomatal resistance. However, application only in the winter period (October - March) the yield reduction was only 0.3-1.3% in tomato, as in this period light levels are low and CO2 concentrations in the greenhouse are relatively high. Raising the (maximum) set-point for CO2 concentration from 1000 ppm to 3000 ppm, increased the actual concentration during day-time from 892 to 1567 ppm (flue gases were the only source of CO2). When the application of anti-transpirants was combined with raising the set-point for CO2 concentration, the model showed no yield reduction due to the application of anti-transpirants, while the annual energy use was reduced by 5.5-

10.4% in tomato. Similar results were obtained for sweet pepper (5-9% energy saving) and cucumber (2-5% energy saving).

These model calculations show that increasing the stomatal resistance by anti-transpirants during the winter period may potentially save a substantial amount of energy (2-10%), without affecting yield of vegetables such as tomato, cucumber and sweet pepper.