Thermochemical Fluids in Greenhouse Farming

Possibilities and requirements of the use of thermochemical fluids in greenhouses climate control

Greenhouses are a production system that try to control the environmental conditions in which crops develop. Photosynthesis is the main physiological process that drives plant growth and crop productivity, being strongly influenced by environmental conditions[1]. The indoor climate is mainly defined by the level of net radiation, photosynthetically active radiation (PAR), air temperature and velocity and its concentration in water vapor (moisture) and CO_2. These factors directly or indirectly affect the photosynthesis of horticultural crops [2,3]. Therefore, one of the main objectives in the management of greenhouses should be to enhance those environmental conditions that improve photosynthesis and the productive of crops [4].

Thermochemical fluids (TCF) are solutions with high hygroscopicity that can be used in greenhouses to reduce the air humidity. The TCF can also be used to heating during the absorption process when the water vapour is converted in liquid and for cooling during the hot period of the day using the phase change between vapor and liquid water.

Although there are multiple options for climate control in greenhouses, active systems require high energy use and passive systems are limited by external weather conditions. The TCF could be used as a complement to other systems to reduce energy or as safety systems to avoid extreme temperature and humidity conditions that endanger the survival of crops and auxiliary insects. The climate control system with TFC can help to maintain adequate temperature and humidity, incorporate CO_2 from the outside environment and achieve greater homogeneity of these climatic parameters. However, the design of the air distribution system must prevent radiation loss at the crop level due to shading.

[1] Yin X., Harbinson J. Struik P.C., 2009. Mathematical Review of Literature to Assess Alternative Electron Transports and Interphotosystem Excitation Partitioning F Steady-State C3 Photosynthesis under Limiting Light. *Plant. Cell Environ.* **29**, 1771–1782. https://doi.org/10.1111/j.1365–3040.2006. 01554.x

[2] Zhang J. and Wang S-X. 2011. Simulation of the canopy photosynthesis model of greenhouse tomato. *Procedia Engineering*. **16**: 632-639. https://doi.org/10.1016/j.proeng.2011.08.1134

[3] Li G., Lin L., Dong Y., An D., Li Y., Luo W., Yin X., Li W., Shao J., Zhou Y., Dai J., Chen W. and Zhao C., 2012. Testing two models for the estimation of leaf stomatal conductance in four greenhouse crops cucumber, chrysanthemum, tulip and lilium. *Agricultural and Forest Meteorology*, **165**, 92-103. https://doi.org/10.1016/j.agrformet.2012.06.004

[4] Sales C.R.G., Wang Y., Evers J.B. and Kromdijk J., 2021. Improving C4 photosynthesis to increase productivity under optimal and suboptimal conditions. *Journal of Experimental Botany*, **72** (17): 5942–5960. https://doi.org/10.1093/jxb/erab327

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