

**Title** CFD model development and validation of a thermonebulisation fungicide fogging system for postharvest storage of fruit

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### **Abstract**

Postharvest treatments of fruits in storage rooms using a fogging system is a recent development that offer a promising means to reduce the use of fungicides in the orchards, where ecological and environmental risks are higher than in the closed environment of the storage room. To investigate the effectiveness of postharvest storage fungicide fogging systems, a computational fluid dynamics (CFD) model was developed and validated. A discrete element (DE) method was applied to generate a random stacking of spherical fruits in a typical bin. The CFD model was then employed to study explicitly the air and fungicide particle flow through the bin vent holes and through the voids of the stack, and to predict the deposition behaviour of the fungicide particle on the products. For model validation purposes, a standardized set-up was used with a single fruit bin positioned in a cold store that was operated at different air flow rates. Good agreement was found between measured and predicted results of deposition profiles of fungicide particles. The deposition on the top layer of the fruit stack was higher than the bottom one, and higher deposition was observed on the top sides than on the bottom sides of the fruit.

The effect of air flow rates and different bin handling parameters on fungicide particles flow and deposition were investigated. Air circulation rates of  $0 \text{ m}^3 \text{ h}^{-1}$  (no air circulation),  $4080 \text{ m}^3 \text{ h}^{-1}$  and  $6800 \text{ m}^3 \text{ h}^{-1}$  and  $952 \text{ m}^3 \text{ h}^{-1}$  were used. The highest fungicide deposition on the fruit was observed during fogging without air circulation while the lowest deposition corresponded to fogging with the highest air circulation rate. Covering the top of the bin with foil and removing the bottom plastic foam that is usually placed on the bottom floor of the bin improves the uniformity of fungicide deposition throughout the bin. Removing the bottom plastic liner increased the average deposition of the fungicide particles, while covering the top of the bin decreased the average deposition.