Simulation of Fumigant Transport and Volatilization from Tarped Broadcast Applications

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ABSTRACT

We evaluated the ability of the HYDRUS 2D/3D model to simulate chloropicrin and 1,3-dichloropropene fate, transport and volatilization. Three fields with similar soil conditions were broadcast fumigated under a totally impermeable film (TIF). One field was used to calibrate HYDRUS by adjusting fumigant degradation rates, soil sorption coefficients and TIF tarp resistance factors. In comparisons of simulated and measured soil gas concentrations, soil temperature, soil-water contents, and inverse-modeled estimates of fumigant volatilization flux,

the model accurately simulated the basic individual processes of fumigant partitioning and degradation, heat transport, and soil-water dynamics in the calibration field. Subsequent flux simulations of the remaining two fields were performed using only measured, independently estimated or calibrated inputs with no further adjustments. The magnitudes of simulated cumulative fluxes, and both pre- and post-tarpcut discrete flux densities were within the estimated range of uncertainty (factor of ~ 2) of conventional inverse-modeled field-based flux estimates. However, the timing of maximum discrete flux densities was delayed by 1 – 2 days relative to inverse-modeled estimates. While HYDRUS provided reasonably accurate flux estimates, it was also evident that parameterization – particularly for TIF tarp permeability properties - generally requires field-based calibration due to a lack of representative field effective permeability data.