

FILM PERMEABILITY MEASUREMENTS IN SUPPORT OF USDA-ARS AREA-WIDE RESEARCH

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Plastic tarps currently used to control emissions of soil fumigants have been shown to be permeable to fumigant gases, resulting in appreciable losses to the atmosphere. New films are being developed with improved physical properties and low permeability to help reduce fumigant emissions and increase efficacy.

There is a need to have accurate film permeability values so that research scientists, producers and regulators can better understand the relationships between different types of film, agricultural practices, pest management, emissions and crop production. The use of generic labels, such as “low-density”, “high-density”, “high barrier”, “semi-impermeable”, “virtually-impermeable”, do not quantitatively characterize the performance of an agricultural film and, therefore, can be misleading. For example, if the actual permeability of a high-density film happens to be lower than a “semi-impermeable” film, the generic labels could lead to confusion when describing experimental results. Further, experiments have been conducted that have produced counterintuitive emission results and a simple explanation would be that the actual film permeability did not follow the film’s generic labels.

Therefore, a rapid, reliable, and sensitive method is required to measure the permeability of various films that may be used in new pesticide management practices. The method should be reliable, accurate, and independent of extraneous experimental conditions. A new approach has been developed for estimating the mass transfer coefficient (h) of fumigant compounds across agricultural films. A measure of the resistance to fumigant diffusion, h , is a function of the films chemical properties in combination with a fumigant and independent of the concentration gradient across the film. Therefore, each chemical-fumigant-temperature combination produces a unique h value, which is quite unlike typical permeability. This method uses static sealed cells and fumigant vapor is added to one side of the film. The concentrations on both sides of the film are then monitored until equilibrium is reached. An analytical mathematical model is used to obtain a value for h by fitting the model to the observed data. This model relies on a mass balance approach and includes sorption onto and diffusion across the film membrane. The method has been tested using various polyethylene and virtually impermeable films and has been shown to produce a sensitive and reproducible measure of film permeation.

The objectives of this presentation are to:

- a) Describe the new method to obtain accurate film permeability (i.e., mass transfer coefficient) values.
- b) Provide a description of the similarities and differences between competing methodologies.
- c) Provide measured mass transfer coefficients for films used in the Area-wide research project.
- d) Provide an estimate of total emissions for each film type, given a standard scenario.

For a more detailed summary of this research, please see the Power Point presentation at <http://www.mbao.org/>.