ESTIMATING PLASTIC FILM PERMEABILITY UNDER FIELD CONDITIONS

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Fumigant emission is an important air quality and human health concern. Plastic films are used to reduce emissions. Laboratory tests have shown large differences in permeability between various films, including the typical polyethylene films (PEs), virtually impermeable films (VIFs), and semi-impermeable films (SIFs). How film permeability would change under field conditions, when subjecting to wear and tear during film placement, diurnal temperature changes, weathering from UV radiation, and variations in film thickness or inconsistency in gluing the joining film sheets, has been a main concern for field adoption. In this study, transfer coefficients of soil fumigants through various plastic films were estimated using field measured fumigant emission and gas concentration data reported in the literature. Results indicated that field extrapolated transfer coefficients of plastic films were two to ten times greater than the laboratory reported values (Figure 1). The VIF films, e.g., Bromostop and Hytibar showed consistently lower permeability (0.01 to 0.46 cm/h) to fumigant emissions than the PE films (0.82 to 9.13 cm/h). The actual transfer coefficient or permeability of a particular film to a fumigant chemical is also temperature dependent. Higher temperature caused film permeability to increase under both laboratory and field conditions. No significant field aging effect (an increase or a decrease in transfer coefficient) was found for the PE films against chloropicrin or 1,3-dichloropropene. VIFs such as Bromostop or Hytibar appear to be most promising options for plastic films that will provide consistent result in reducing fumigant emissions.

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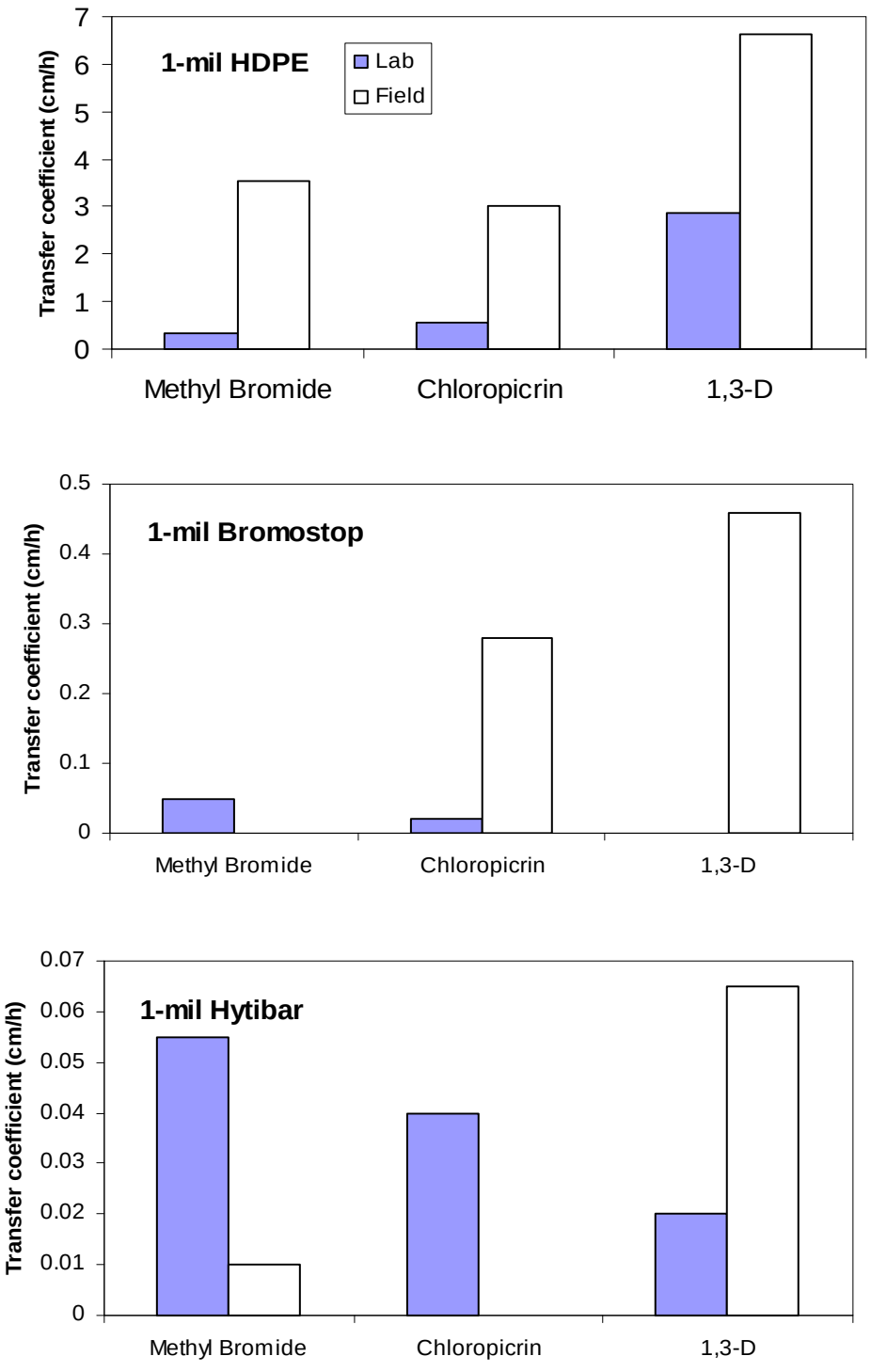

Figure 1. Transfer coefficients of HDPE (Yates et al. 1996abc; Wang et al. 1997, 2005, 2006; Gao and Trout 2007; Papiernik et al. 2004), Bromostop (Ajwa 2007; Yates 2007; Gao and Trout 2007), and Hytibar (Yates et al. 1996c, 2007; Wang et al. 1997; Thomas et al. 2003) based on lab tests (shaded) and field measurements (open bars).