Determine Fumigant Emission Reduction Using Totally Impermeable Film and Waiting Period for Tarp Cutting in a Large Field Trial

Husein Ajwa[1], D. Sullivan[2], S. Gao[3], R. Segawa[4], and M. Stanghellini[5]

[1]Department of Plant Sciences, University of California, Davis, CA 93905 (831) 755-2823, haajwa@ucdavis.edu;
[2]Sullivan Environmental; [3]USDA-ARS; [4]California EPA-DPR; [5]TriCal, Inc.

Introduction

Soil fumigants, such as 1,3-dichloropropene (1,3-D) and chloropicrin, are used for pre-plant soil disinfestation. Current methods of soil fumigation can result in unintended fumigant escape into the atmosphere and stringent regulations are being imposed by the USEPA to reduce fumigant emissions.

Fumigant practices and methods that can reduce fumigant volatilization losses are needed to ensure the continued use of soil fumigants. The use of less permeable film (such as totally impermeable film, TIF) instead of standard tarpaulin can reduce fumigant volatilization losses into the atmosphere. However, there is concern about worker exposure when cutting the tarps, and whether the cumulative emissions are really reduced in terms of reducing VOC emissions.

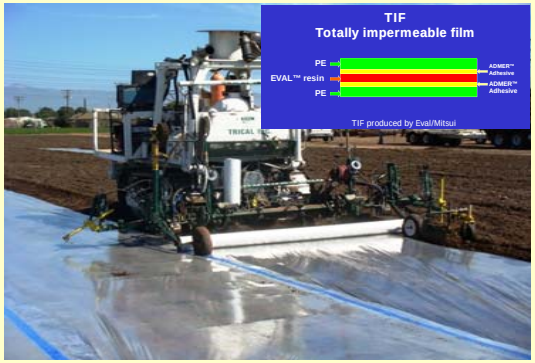
Earlier research found that TIF can reduce or eliminate early emission rates for shank-applied 1,3-D (Figures 1 and 2). However, total mass loss was the same under TIF and standard film due to cutting the tarp too early (after 5 days). Research is needed to determine the optimum waiting time for tarp cutting to avoid large emissions rates.

The objectives of this study were to:

- Determine the emissions of soil fumigants when using a totally impermeable film (TIF) to cover treated fields.
- Determine when the tarp can be cut to avoid high worker and by-stander exposures to off-gassed fumigant(s) collected under tarp.
- Compare the ambient air monitoring method with the flux chamber monitoring method.
- Provide data to regulatory authorities to assess whether TIF tarps can be used to reduce fumigant emissions and protect workers and by-standers.

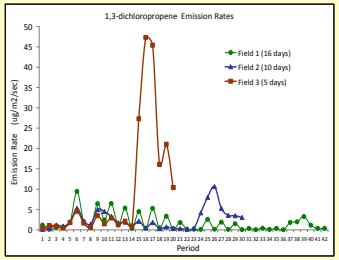
Materials and Methods

- Studies were conducted on 3 separate fields (2 or 8 acres) in Lost Hills near Bakersfield in June, 2011.
- Pic-Clor 60 soil fumigant (60% chloropicrin and 40% 1,3-D) was applied by shank injection under TIF at 12 inches deep. Target application rate was 588 lbs/ac of Pic-Clor60 (350 lbs of chloropicrin plus 238 lbs of 1,3-D).
- Eight air sampling stations were used to continuously sample the air at a 1.5 m height around each field.
- TIF was cut after 5 days (Field #3), 10 days (Field #2), and 16 days (Field #1).
- Charcoal (ORBO-32) and XAD-4 (ORBO-613) sorbents were used to trap 1,3-D and chloropicrin, respectively. The sorbent tubes were replaced every 6 or 12 hours, extracted in the lab, and analyzed by gas chromatography for fumigants.
- The Industrial Source Complex Short Term dispersion model (ISCT3) was used to back-calculate emissions rates from each field.
- Flux chambers were installed on Field #1 to measure fumigant concentrations above the film.



Shank application of fumigants at 12 inches under TIF.

Results



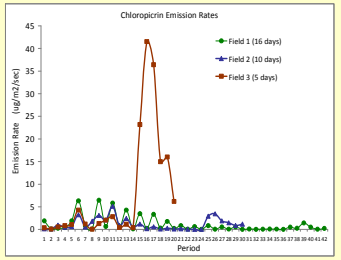
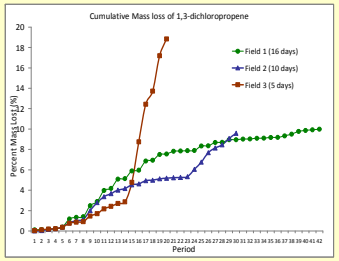


Figure 1. 1,3-Dichloropropene and chloropicrin emissions rates.



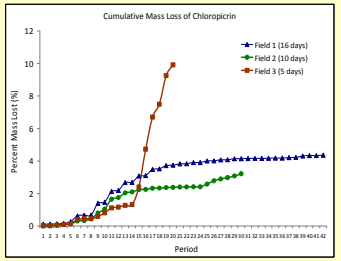


Figure 2. 1,3-Dichloropropene and chloropicrin mass losses.

Conclusions

- ✓ Atmospheric peak and total emissions of chloropicrin and 1,3-dichloropropene under TIF were negligible when tarp splitting was extended to ten days for chloropicrin and 15 days for 1,3-dichloropropene.
- ✓ Relative to other flux studies with standard PE tarp, TIF reduced total emissions by more than 5 times.
- ✓ Fumigant concentrations under TIF were higher and more uniform than concentrations found under standard tarp, which provides better and more consistent efficacy to control soil-borne pests and weeds.
- ✓ Emissions results obtained with the flux chambers were similar to results of the ambient air monitoring method.

Acknowledgments: USDA-ARS, Pacific West Area Wide Project, Almond Board of California, California Strawberry Commission, Air Monitoring Group – Cal EPA-DPR, TriCal, Inc.

Project No: 10-AIR9-Ajwa