

REDUCING FIELD-SCALE EMISSIONS OF 1,3-D WITH COMPOSTED MUNICIPAL GREEN-WASTE

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Summary. A field experiment was conducted to measure subsurface movement and volatilization of the 1,3-dichloropropene (1,3-D) after shank injection to an agricultural soil. Aerodynamic, integrated horizontal flux and theoretical profile shape methods were used to obtain fumigant flux density and cumulative emission values. The volatilization rate was measured continuously for 16 days and the range in the daily peak volatilization rates for the three methods ranged from 4 to 23 $\mu\text{g m}^{-2} \text{s}^{-1}$. The total 1,3-D mass that volatilized to the atmosphere was approximately 15–36 kg ha^{-1} , or 3–8% of the applied active ingredient. This represents approximately 10–25% of the total emissions observed in recent field and laboratory studies. Significant reductions in volatilization of 1,3-D are possible when composted municipal green-waste material is incorporated into the surface soil.

Approach. A field experiment was conducted to measure the volatilization rate of 1,3-dichloropropene (1,3-D) after shank injection. 1,3-D has relatively high volatility and water solubility and relatively short field half-life. After fumigation, residual 1,3-D may be detectable in soil for several weeks. There are few published field experiments that measure field-scale emissions of 1,3-D after shank injection. A literature search could not find any reference to studies where emission of 1,3-D were measured in a field where composted municipal green waste was incorporated into the surface soil. The experimental data reported from this study provides state regulators and the scientific community with important information on emissions from soils.

Location. The field site was located in near Buttonwillow, CA. The soil type was a Milham sandy loam (fine-loamy, mixed, thermic Typic Haplargids). The field experiment began on August 31, 2005 and ended September 16, 2005. Two weeks prior to the start of the field experiment, the soil was plowed and disked to break up large soil aggregates. Then, the field was sprinkler-irrigated and allowed to drain so that the initial soil water content was approximately 0.2 ($\text{cm}^3 \text{cm}^{-3}$). The 1,3-D was applied by a commercial applicator using a rig containing 9 shanks on a 4.5 m tool bar (50 cm spacing). Telone II ® was applied to 8.3 acres (178 m x 188 m) at a depth of 46 cm (i.e., 18 inches) and application rate of 12 gal/ac. The total applied mass was 447 kg.

Results. Figure 1 shows a time series of the volatilization rate during the experiment. Three methods were used to calculate the volatilization rate including the aerodynamic, integrated horizontal flux and the theoretical profile shape methods. The three methods demonstrate a similar temporal pattern throughout the experiment. The maximum daily volatilization rate for each method occurred on the 3rd day ($t = 3.54 \text{ d}$) and ranged from approximately 4 to 23 $\mu\text{g m}^{-2} \text{s}^{-1}$. From Figure 1 it is clear that for several measurement periods the ADM method produces

much higher volatilization rates compared to the IHF and TPS methods and that the IHF and TPS methods agreed more closely throughout the experiment.

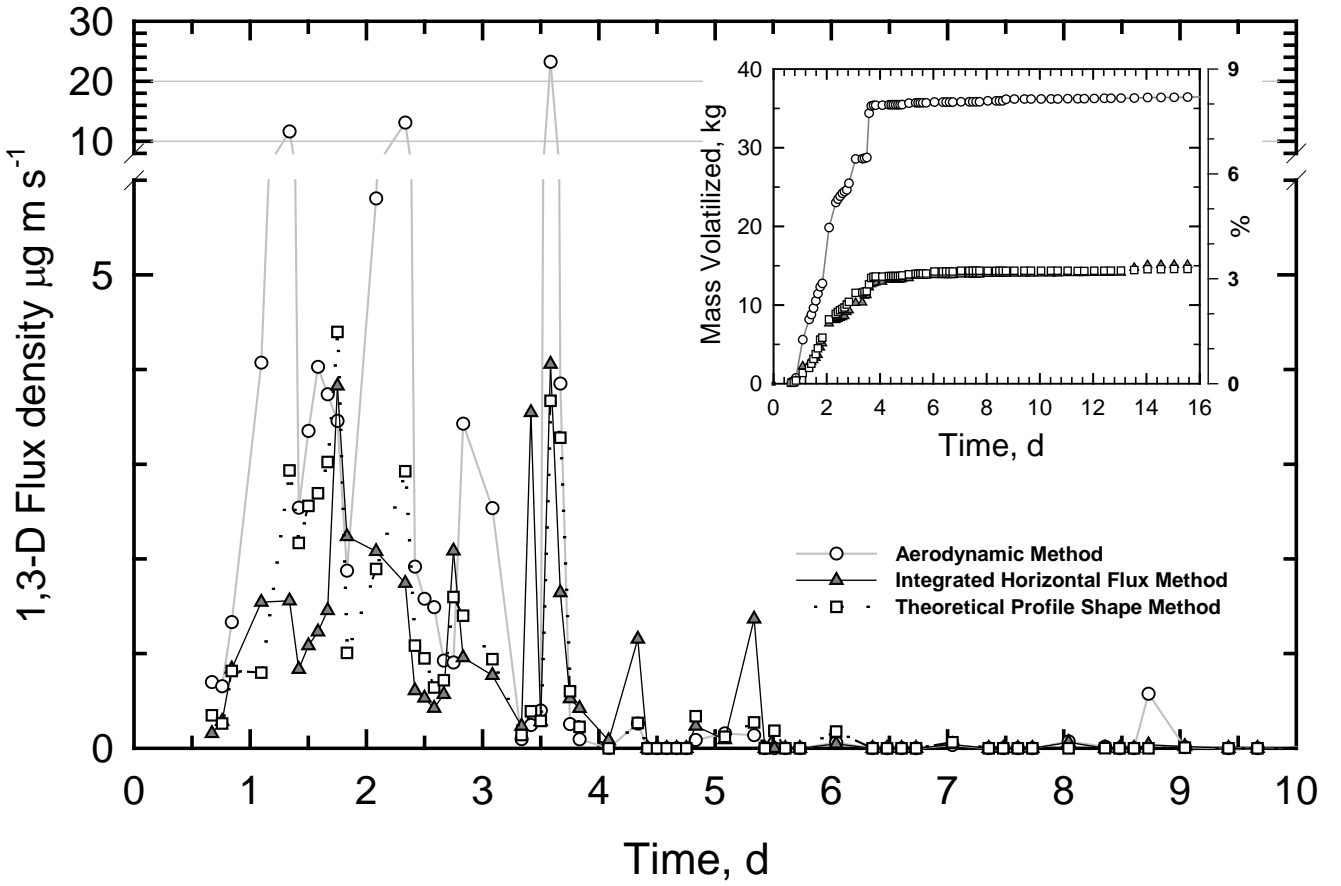


Figure 1. Emissions of 1,3-D as a function of time (day) after application

Table 1 provides shows the total 1,3-D mass (kg) lost to the atmosphere and the percent of applied Telone (parentheses). This information was obtained by integrating the volatilization rate over time and multiplying by the total field area. It is clear that the IHF and TPS methods provide estimated volatilization rates that are very similar. The total emission estimates from the IHF and TPS methods were found to be approximately 3% of the applied material, while the cumulative emission estimate from the ADM method was approximately 8%. This represents reductions in emissions from 75–90% compared to standard fumigation practices (1).

Table 1. Total 1,3-D emissions in (kg) and percent of applied (in parentheses).

	<i>cis</i> -1,3-D	<i>trans</i> -1,3-D	1,3-D
Aerodynamic Method	21.7 (9.7%)	14.8 (6.6%)	36.5 (8.2%)
Integrated Horizontal Flux Method	8.7 (3.9%)	6.4 (2.9%)	15.1 (3.4%)
Theoretical Profile Shape Method	8.5 (3.8%)	6.2 (2.8%)	14.6 (3.3%)

Laboratory Study. For comparative purposes, a laboratory study (1) was conducted using soil collected from the field site, and that simulated the observed experimental temperature conditions during the experiment. This study reported that the total emissions of *cis*-1,3-D after 14 days were 5.7% for a non-irrigated treatment using soil from the field plot. This estimate is somewhat smaller compared with the estimated total *cis*-1,3-D emission (Table 1) using the aerodynamic method (i.e., 9.7%; *cis*-1,3-D) and is slightly larger than the total *cis*-1,3-D emissions estimates from the TPS and IHF methods (i.e., 3.8–3.9%). Overall, the results appear to be in agreement and are well within typical experimental error.

References

(1) Ashworth, D.J., and Yates, S.R., Surface irrigation reduces the emission of volatile 1,3-D from agricultural soils, *Environmental Science and Technology*. 41:2231-2236. 2007.