

PC2) Fate of 1,3-dichloropropene Fumigant on the column

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Experimental

Volatilization of 1,3-D was simultaneously determined from columns packed with the Ar soil at room temperature. The columns were made of stainless steel and had a dimension of 70 cm (length) x 12 cm (i.d.). Columns were packed with fresh soil at a bulk density of 1.55 g cm^{-3} and a moisture content of 4.75% (w/w). A sampling chamber of 4 cm (length) x 12 cm (i.d.) was sealed onto the top of the soil column.

The 284.8 μL of Telone II is injected at the 30 cm below the surface by gastight syringe. The application rate of 1,3-D was equivalent to 300 kg ha^{-1} with *cis*-1,3-D of 153.8 kg ha^{-1} and *trans*-1,3-D of 146.2 kg ha^{-1} . A constant air flow of 100 mL min^{-1} was established by connecting the outlet to a stable vacuum source into a HP 5890 GC.

A computerized relay system was used to automate the introduction of a 1,3-D from the headspace from each column into the GC at an 11-min interval during 10 days. The GC conditions used for on-line monitoring were as follows: 100 μL gas sampling valve, 60 m x 0.53 mm x 3.0 μm AT624 capillary column (Ailtech, Deerfield, IL), 20 mL min^{-1} column flow (N_2), 100°C isothermal oven temperature, and 280°C detector temperature. Volatilization fluxes were calculated as $\text{mg min}^{-1} \text{ m}^{-2}$ and cumulative volatilization losses as percentage of applied 1,3-D.

To experiment the diffusion of 1,3-D, soil air was withdrawn from the soil columns at different depths using a gastight syringe at 1, 2, 4 and 8 h after application. To transfer 1.0 mL soil air by gas tight syringe into 8.7 mL headspace vial and analyzed with GC-ECD equipped with automated headspace sampler (Tekmar Co., Cincinnati, OH). The conditions of headspace sampler were set as follows: equilibration temperature at 90°C valve temperature at 90°C line temperature at 90°C equilibration time at 2 min sample loop of 1.0 mL vial pressurization pressure at 0.25 psi press equilibrium of 0.1 min. The conditions of GC-ECD were set as follows: capillary column, 30 m x 0.25 mm x 1.4 μm RTX-624 (Restek Co., Bellefonte, PA); carrier gas, N_2 , 0.71 mL min^{-1} oven temperature, isothermal at 120°C; inlet temperature, 230°C; and detector temperature, 280°C.

Results

Column experiment of *cis*-1,3-D and *trans*-1,3-D as different isomer shown in Figure 1. Volatilization fluxes of 1,3-D were determined for 10 d (240 h) from soil columns that 1,3-D was injected at the 30 cm depth. The *cis*-1,3-D in the vapor phase reached peak concentrations on 13.9 h after injection compared with a peak on 19.0 h in the *trans*-1,3-D. The maximum flux was $2.82 \text{ mg m}^{-2} \text{ min}^{-1}$ for the *cis*-1,3-D and $1.86 \text{ mg m}^{-2} \text{ min}^{-1}$ for the *trans*-1,3-D. The flux of *cis* and *trans* -1,3-D was $2.73 \text{ mg m}^{-2} \text{ min}^{-1}$ and $1.33 \text{ mg m}^{-2} \text{ min}^{-1}$ on 12 h after injection, respectively. The flux was $1.85 \text{ mg m}^{-2} \text{ min}^{-1}$ for the *cis*-1,3-D and $1.61 \text{ mg m}^{-2} \text{ min}^{-1}$ for the *trans*-1,3-D on 24h after injection.

The volatilization losses of applied 1,3-D are given for both isomers in Figure. 2. In comparison, 29.2, 40.4, 46.7, 49.9 and 51.8% of *cis*-1,3-D was emitted via volatilization after 2, 4, 6, 8, and 10 d, respectively. The 21.8, 32.6, 38.5, 41.6 and 43.5% of *trans*-1,3-D was emitted via volatilization after 2, 4, 6, 8, and 10 d, respectively. The total losses of *cis*-1,3-D was significantly greater than that of *trans*-1,3-D.

After shank injection, a fumigant rapidly vaporizes and the vapor diffuses through unfilled air pores in soil. This process allows the fumigant to quickly emission throughout the soil. Therefore, 1,3-D emission is likely determined by isomer of 1,3-D. The rapid emission may be attributed to the rapid diffusion with *cis*-1,3-D than *trans*-1,3-D. This result showed that *cis*-1,3-D in ambient air were higher than *trans*-1,3-D, owing to differences of isomer. The differences may be explained by their different physical-chemical properties of 1,3-D isomer. In comparison to *trans*-1,3-D, the *cis*-1,3-D isomer has a lower boiling point (*cis* vs *trans* : 104.1 vs. 112. 6°C) and solubility (*cis* vs *trans* : 2180

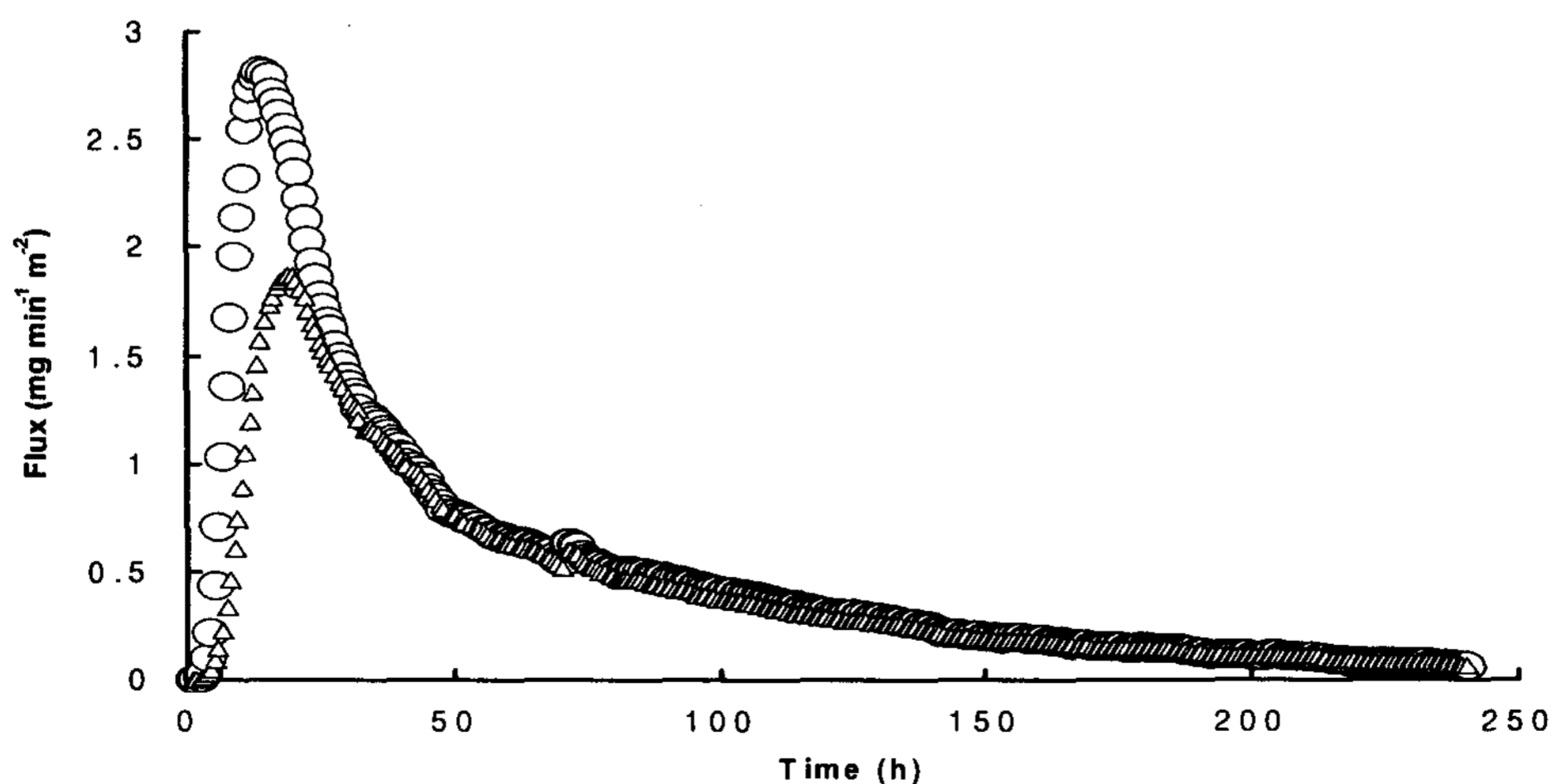


Fig. 1. Emission flux of *cis*- (○) and *trans*- (△) 1,3-dichloropropene in soil column applied with 30 cm depth.

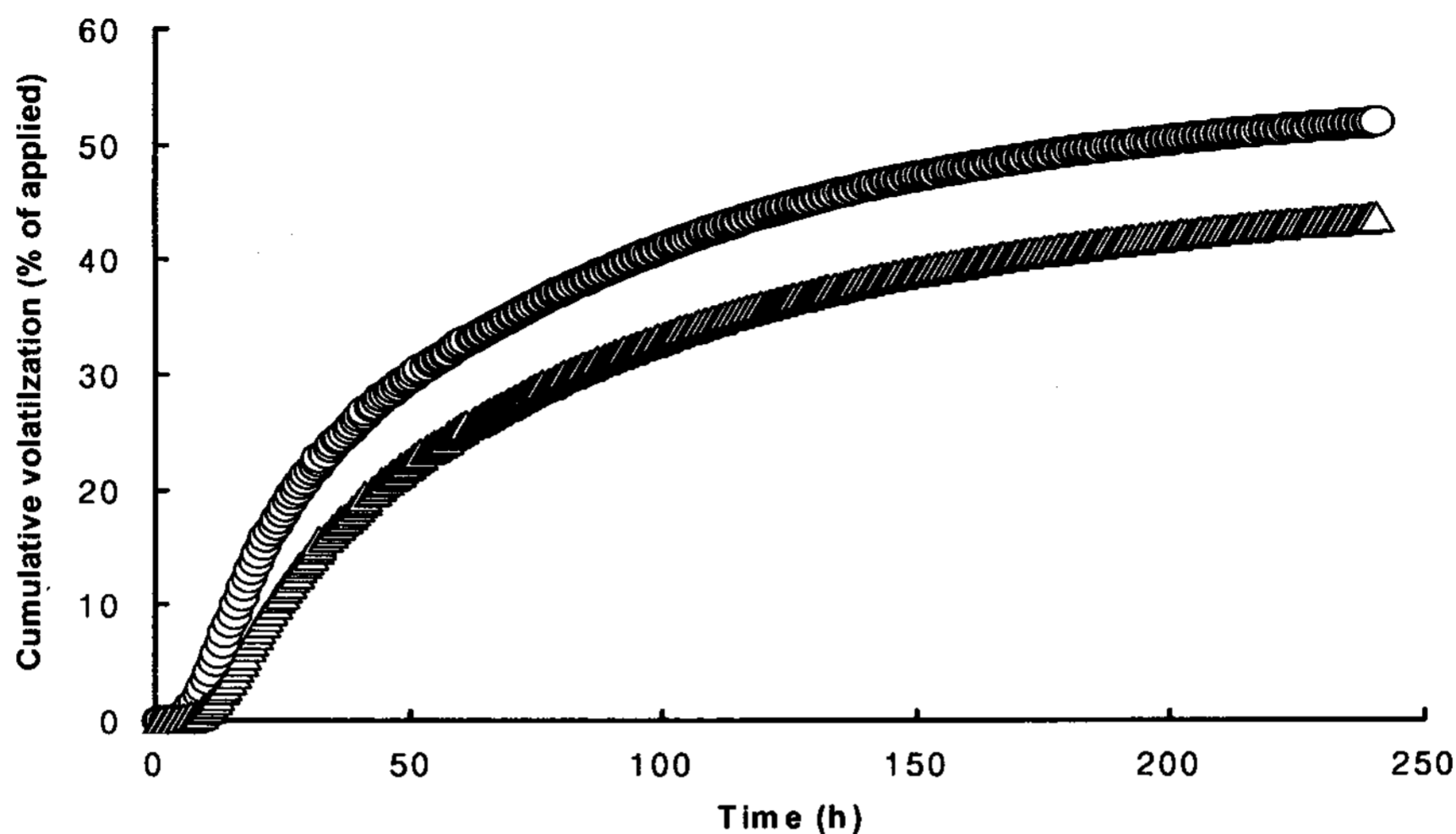


Fig. 2. Cumulative volatilization losses of *cis*- (○) and *trans*- (△) 1,3-dichloropropene in soil column applied with 30 cm depth.

vs. 2320 mg L⁻¹ at 25°C), but a higher vapor pressure (*cis* vs *trans* : 5700 vs. 4500 Pa at 25°C) and Henry's Law constant (*cis* vs *trans* : 0.058 vs. 0.037 at 20°C in this study). The different physical-chemical properties of 1,3-D isomer was also evident that volatilization of 1,3-D was increased with *cis*-1,3-D than *trans*-1,3-D.

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