한국환경과학회 봄 학술발표회지 제15권(제1호), 84~85, 2006
Proceedings of the Korean Environmental Sciences Society Conference, May, 19~20, 2006

PA4)

Isomeric effects on Volatilizaion of 1,3-dichloropropene Fumigant

김정호*, 박문기, 문영수[1], 김정배[2]
[1]대구한의대학교 보건환경학과, [2]계명대학교 환경과학과

1. Introduction

The California Air Resources Board conducted ambient air monitoring of pesticides near application sites in California and found potentially unsafe levels of methyl bromide (MeBr), methyl isothiocyanate (MITC) and 1,3-dichloropropene (1,3-D). Atmospheric emission of MeBr has been linked to the depletion of stratospheric ozone. The specific purpose was also to research the isomeric effect of 1,3-D on volatilization. This knowledge will be used to design application protocols that will achieve more consistent and uniform pest control while minimizing intrinsic emissions.

2. Results

The volatilization losses of applied 1,3-D are given for both isomers in Figure. 5. 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(Table 1). 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℃) and solubility (*cis* vs *trans* : 2180 vs. 2320 mg L^{-1} at 25℃), but a higher vapor pressure (*cis* vs *trans* : 5700 vs. 4500 Pa at 25℃) and Henry's Law constant (*cis* vs *trans* : 0.058 vs. 0.037 at 20℃). 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.

3. Conclusion

The fumigant 1,3-D is a major replacement for MeBr that will be phased out by the year 2005. In order to develop practices that are more environmentally compatible, the distribution of 1,3-D among the air, water, and soil phases needs to be better understood. The isomeric effects of 1,3-D were reported in this study.

There was identical rates of transformation for the *cis*-1,3-D and *trans*-1,3-D in aqueous, which suggests the transformation for the 1,3-D isomer may be ignored for characterizing the volatilization of 1,3-D isomer. But factors such as isomer of *cis*-1,3-D and *trans*-1,3-D can affect K_H, and thus play great roles in fumigant volatilization. Diffusion and volatilization of *cis*-1,3-D was found to be higher than the *trans*-1,3-D in soil columns.

Finally, the *cis*-1,3-D and *trans*-1,3-D, such as isomer are dominant of the environmental fate and transport of 1,3-D. Distribution of 1,3-D isomer will affect its mobility in soil and thus its potential for offsite movement as the pollution of ambient air.

Table 1. Emission flux and cumulative volatilization of *cis*-1,3-D and *trans*-1,3-dichloropropene in soil column applied with 30 cm

Time(d)	Emission flux ($mg\ min^{-1}\ m^{-2}$)		Cumulative volatilization (% of applied)	
	cis-1,3-D	*trans*-1,3-D	*cis*-1,3-D	*trans*-1,3-D
0.5	2.733	1.335	5.89	2.15
1	1.857	1.610	17.52	10.53
2	0.789	0.785	29.21	21.82
4	0.433	0.393	40.42	32.67
6	0.214	0.208	46.74	38.52
8	0.119	0.117	49.98	41.66
10	0.063	0.066	51.82	43.54

Reference

D. Wang, J. A. Knuteson, and S. R. Yates, 2000, *J. Environ. Qual.*, **29**, 639.

J. H. Kim, J. Gan, W. J. Farmer, S. K. Papiernik, R. S. Dungan, and S. R. Yates, 2003, *J. Agric. Food Chem.*, **51**, 165.

J. H. Kim, S. K. Papiernik, W. J. Farmer, J. Gan, and S. R. Yates, 2003, *J. Environ. Qual.*, **32**, 2223.

P. J. McCall, 1987, *Pestic. Sci.*, **19**, 235.

J. Peng, and A. Wan, 1997, *Environ. Sci. Technol.*, **31**, 2998.