ATMOSPHERIC I,3-DICHLOROPROPENE IN THE KANTO AREA (JAPAN) AFTER A BAN ON METHYL BROMIDE

Y. Kobara*, S. Endo, S. Ishihara, T. Horio, and K. Ohtsu
Environmental Pesticide Assessment Unit,
National Institute for Agro-Environmental Sciences (NIAES),
3-1-3, Kannondai, Tsukuba, Ibaraki 305-8604, Japan

Methyl Bromide (CH_3Br) is a major fumigant used in Japan to control soil-borne diseases in crops such as cucumbers, gingers, tomatoes, melons, green peppers, etc. The use of CH_3Br as a soil fumigant is to be phased out by 2005, but no new chemical or non-chemical alternative has yet emerged as its substitute. For now, chloropicrin, 1,3-dichloropropene and dazomet are seen as the best alternatives to CH_3Br. It is already difficult to satisfy demand for CH_3Br as a soil fumigant adequately, whereas there are not remarkable changes in the amount of 1,3-dichloropropene, chloropicrin and dazomet that have been used in major CH_3Br use areas. Under the Protocol, from 1 January 2003 a 70% cut in production and consumption of CH_3Br, based on 1991 levels, was done in Japan. Therefore, it is predicted that the consumption of these chemical alternatives will increase more.

Our monitoring results of fumigants in the atmosphere during several months in horticultural areas showed that even under the current situation, fumigants such as 1,3-dichloropropene, chloropicrin, methyl isothiocyanate (MITC) and CH_3Br of high concentration (over several hundred $\mu g/m^3$) were detected frequently, but these high concentrations were temporary, and most air samples contained several $\mu g/m^3$ of fumigants. Restrictions on CH_3Br usage required an intensive search for improved technologies to reduce both dosage and emission of alternative chemicals from fumigated plots into the atmosphere, while maintaining its effectiveness for disease and weed control and providing adequate safety for people who live and work in areas where soil fumigations occur in multiple fields.

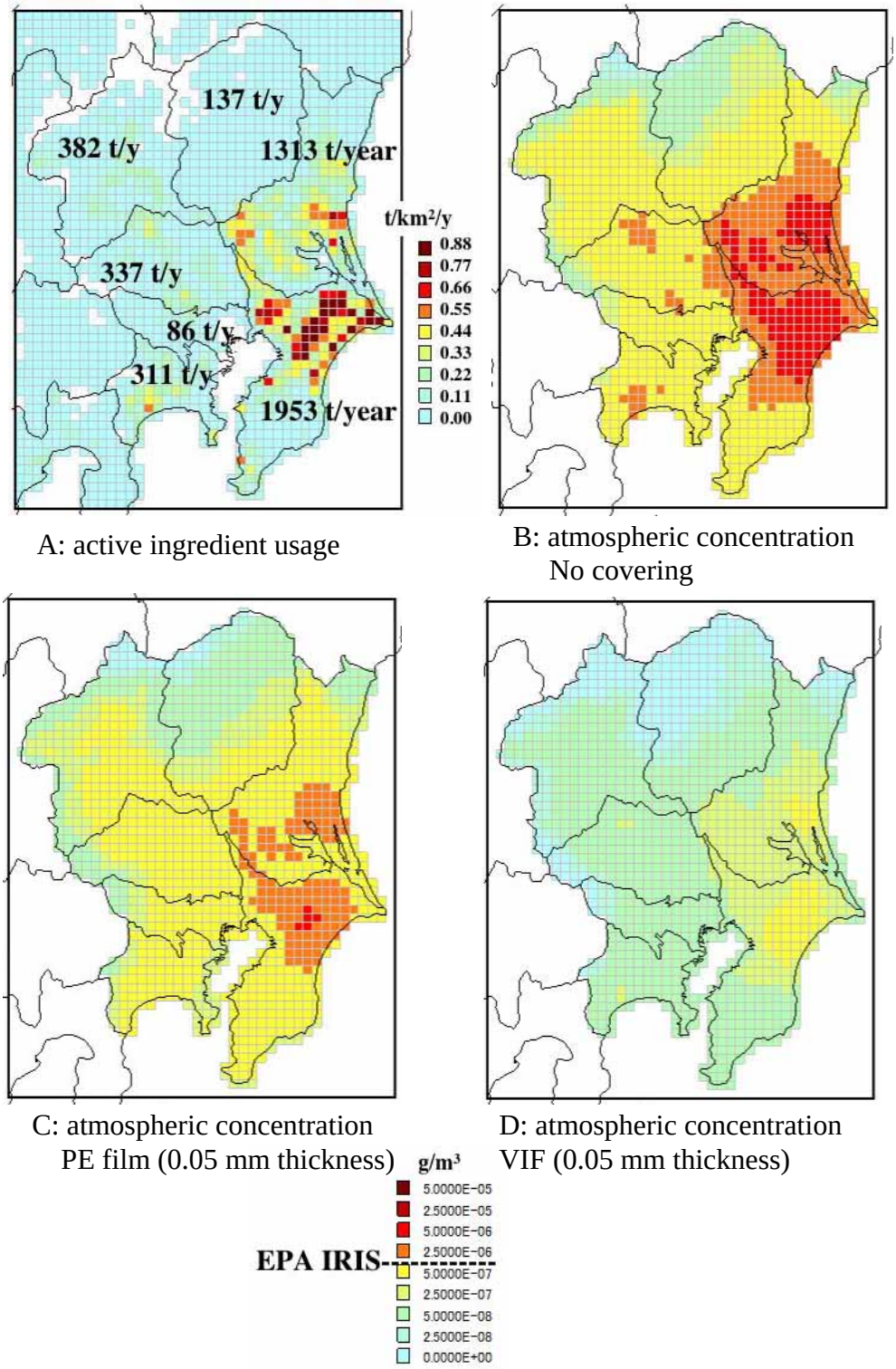
The purpose of this study was to evaluate atmospheric concentrations of 1,3-dichloropropene in the Kanto area under different soil fumigation methods such as no covering film, a conventional PE (polyethylene) film and VIFs (Very Impermeable Films), by AIST-ADMER (National Institute of Advanced Industrial Science and Technology - Atmospheric Dispersion Model for Exposure and Risk Assessment). AIST-ADMER is a computer software program that enables estimation of average atmospheric concentrations of chemical substances by distributing chemical emissions in 5-km meshes, if the unit emission rate data or the information on chemical emissions at a source point is available.

Emission losses of 1,3-dichloropropene and chloropicrin were evaluated in field experiments from 11 June in 2001 on a volcanic ash soil (Hydric Hapludand) at the

National Institute for Agro-Environmental Sciences, Tsukuba, Japan. "Manual injection method" was used for applying the “Dorochlor (80% chloropicrin, 20.2 g/m^2)”-“D-D (92 % 1,3-dichloropropene, 17.2 g/m^2)” mixture (in a volume ratio 1:1) into soil depth of ca. 17cm. Treated areas were 15 m^2 (2.5 m x 6 m), which were immediately covered with a VIF (Barrier-Star®: ethylene-vinylalcohol copolymer, 0.05mm thickness, Tokankosan Co, Ltd.) and a conventional PE film (0.05mm thickness) respectively, then removed after 7 days (11 June). An automated gas chromatography system, equipped with flame ionization detectors (GC-FID) and four 7.5 L chambers (diam. 24.5 cm) was used to determine emission flux. The chambers were placed directly on the film or soil surface. Concentrations of chloropicrin, cis- and trans-1,3-dichloropopene in the air below the film and at soil depths of 30, 60, 90, 120, 150 cm were measured.

Our experiments showed that emission losses reached, respectively, about 42.7 % and 49.3 % of the applied amounts for chloropicrin and 1,3-dichloropropene with a PE film. However, in the case of a VIF, emission losses reduced to 7.8 % and 6.6%, respectively. However, Japanese growers generally don’t use covering materials in the case of D-D fumigant, it is predicted that actual loss of 1,3-dichloropropene to the atmosphere is bigger than this estimate. The emission loss of 1,3-dichloropropene resulted 97 % of the applied amount with Fugacity Model (Level II).

We present average atmospheric concentrations of 1,3-dichloropropene calculated based on experimental emission loss values with AIST-ADMER in Fig. 1. The computed result under no covering condition is approximately equal level to our monitoring data. This result shows areas over the atmospheric monitoring basis of 2.5 μg/m^3 (US EPA IRIS, Integrated Risk Information System) reached 63%.
It will not be allowed to increase 1,3-dichloropropene under conventional no covering method. If growers choose to use covering materials such as PEs and VIFs, areas over the concentration basis is estimated to decrease to 26 % and 0 %, respectively. These fumigation techniques can be simple but effective methods in reducing emissions of alternative fumigants such as 1,3-dichloropropene into the atmosphere in Japan.



A: active ingredient usage

B: atmospheric concentration
No covering

C: atmospheric concentration
PE film (0.05 mm thickness)

D: atmospheric concentration
VIF (0.05 mm thickness)

Fig.1 Estimation of Usage and Atmospheric Concentration of 1,3-dichloropropene by AIST-ADMER calculation (Daily Mean Concentration of March and April, 2000)