ESTIMATION OF EMISSIONS FLUXES FROM FUMIGATED FIELDS FOR ATMOSPHERIC SIMULATIONS

Y. Kobara[1]*, M. Nomura[2], M. Ichihara[2], N. Nakajima[1]

[1]National Institute for Agro-Environmental Sciences (NIAES),
3-1-3, Kannondai, Tsukuba, Ibaraki 305-8604, Japan
[2]Kochi Agricultural Research Center,
1100 Hataeda, Nankoku, Kochi 783-0023

1,3-dichloropropene (1,3-D), chloropicrin (CP) and methyl isothiocyanate (MITC) are major fumigants used in Japan to control soil-borne diseases in crops such as cucumbers, gingers, tomatoes, melons and green peppers. For now, these fumigants are seen as the best alternatives to CH_3Br. Therefore, it is expected that the consumption of these chemical alternatives will increase steadily in the future. Emissions during and after application represent a pathway for loses of fumigants to the atmosphere and subsequent movement to non-target areas. Because of this, there is concern over possible risks from exposure to these fumigants that might have acute or chronic human health or ecological impacts. The main purpose of this study was to offer simple estimation methods of the emission fluxes from fumigated fields to simulate the atmospheric concentrations.

The effects of temperature and film thickness on the permeability of fumigant vapors to films were determined by measuring the fumigants 1,3-D, CP and MITC by the cup method and the evaluation of mass transfer coefficients *(h*, a measure of permeability) of fumigant vapors across agricultural films was carried out. For instance, twice in 2015, 13 May at 6:30 and 4 June at 6:00 were treated with 300kg/ha of dazomet in green houses in Kochi. Each time topdressing application of dazomet was followed immediately by mixing the topsoil with a rototiller and the soil surface was covered with (i) a conventional polyethylene film (film thickness: 0.05mm) and (ii) the gas-barrier film (Barrier-star, film thickness: 0.05mm). In soil dazomet is transformed quickly to the active and volatile soil fumigant MITC. Between 0 to 14 d and 15 d after application, soil surface gases and the air around the fields were regularly taken to measure the profile of MITC in soil and the atmospheric environment. The temperature of ambient air, covering films and soil at 0 and 10 cm depth were measured with thermocouples and data loggers at 10 min intervals.

The measured temperatures of ambient air, films and soil are presented in Fig.1-1 and 1-2. Ranges of MITC gas concentrations between the soil surface and the film are summarized in Fig 2-1 and 2-2. The masses of MITC emitted from the soil into the air were estimated by mass transfer coefficients *h* and the concentration difference of MITC of the film opposite sides in Fig. 3-1 and 3-2. The estimation is based on the assumption that the MITC concentrations of the upper side of the film are negligibly small compared with the below side. The MITC concentrations covered with the gas-barrier and conventional films were about the same level through the covering durations. When the film temperatures were high, short-term fluxes might become the same level, but 26.9 % cumulative loss with the PE film reduced to the 0.045 % loss with the gas-barrier film. This simple proposed method provides useful for emission loss estimates of fumigants.

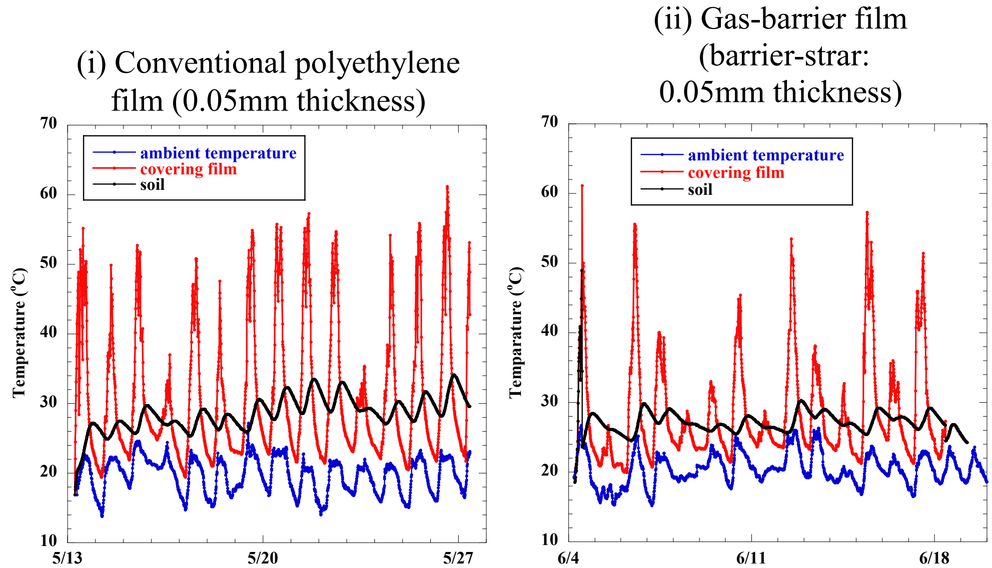

Fig. 1-1 and 1-2. The measured temperatures of ambient, covering films and soil surface after dazomet application.

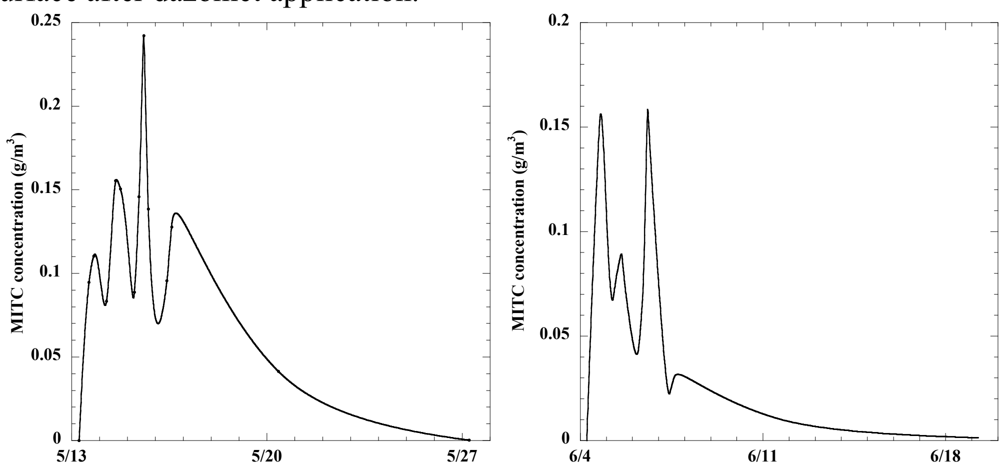

Fig. 2-1 and 2-2. The measured gas concentrations of MITC between the soil surface and the covering film.

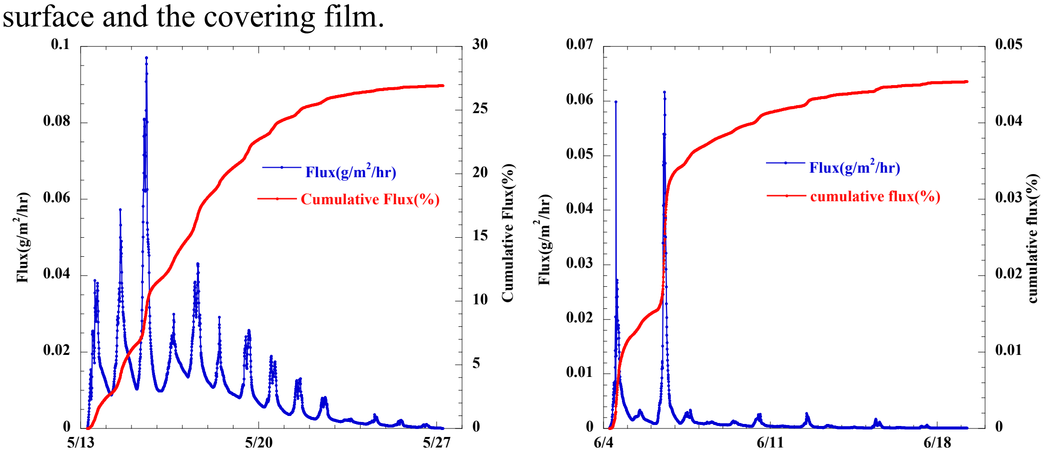

Fig. 3-1 and 3-2. Estimation results of MITC emission fluxes and cumulative losses.

This study was supported by a grant "The Environmental Research and Technology Development Fund" from the Japanese Ministry of the Environment.