Monitoring of Methyl Bromide Alternative Compounds in the Atmosphere

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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, 1,3-dichloropropene, chloropicrin, dazomet, *etc*. are seen as the best alternatives to CH_3Br for preplant fumigation, and their sales are increasing steadily in Japan (Fig. 1). In practice, however, they are not sufficient to take the place of CH_3Br, the impact of these chemicals on the environment and human is not well understood, and these are considered risky and unsuitable as long-term replacements.

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, dazomet that have been used in major CH_3Br use areas (Fig. 2). The reason is that both chemical and non-chemical alternatives have almost never been distributed, so the majority of growers have coped with it by reducing dosage of CH_3Br from over-dosage as before, and the amount of these soil fumigants have increased in other areas. Nevertheless, under the Protocol, from 1 January 2001 a 50% cut in production and consumption of CH_3Br, based on 1991 levels, was scheduled in Japan. Therefore, it is predicted that the consumption of these chemical alternatives will increase more.

The machinery injection methods can reduce the dosage of soil fumigants and its emission during exposure period. However, such injection techniques are not appropriate to Japanese horticulture, as fields are generally too small to employ those methods. Glowers themselves usually apply soil fumigants without depending on special applicators. Manual application methods are currently in vogue. Besides agricultural fields and residential areas coexist, so it is impossible to enough buffer zone around occupied structures.

Restrictions on CH_3Br use in Japan due to air quality concerns prompted air monitoring and improved application methods of soil fumigants in horticultural areas. The air monitoring method was optimized as below. Air concentrations were measured at a 1.2-m height above the soil near the occupied structures in horticultural areas, Ibaraki Prefecture. Air samples for these chemicals were collected using 4 STS-25 air samplers (Perkin Elmer) and multi-bed absorbent tubes packed with graphite carbon black (100 m^2/g, 60/80 mesh, 190 mg) and carbon molecular sieve (1200 m^2/g, 60/80 mesh, 100 mg) at a pumping rate of 20 ml per minute. Each sampling periods were 8 or 12 hours. These air samples were analyzed by ATD-GC-MS (automatic thermal desorption system-gas chromatography-mass spectrometry). The result of air monitoring during several months will also be reported on the conference.

Table 1. Historical Soil Fumigant Sales in Japan (active ingredient, t)

Year	CH_3Br	Chloropicrin	1,3-D	Dazomet	MITC	metam-sodium, metam-ammonium
1990	9881.0	7800.0	7808.0	73.0	223.0	0.0

1991	10418.0	7178.0	8343.0	107.0	257.0	0.0
1992	10312.0	6951.0	7604.0	205.0	214.0	0.0
1993	10623.0	8695.0	6932.0	1064.0	202.0	0.0
1994	11414.0	7656.0	11285.0	1152.0	222.0	10.0
1995	10659.0	8627.0	10311.0	1272.0	209.0	145.0
1996	9330.0	8408.0	8696.0	1615.0	219.0	1183.0
1997	8384.8	9989.0	8122.4	1932.0	222.6	670.2
1998	7755.6	8746.7	13892.1	2620.1	183.2	463.0

Table 2. Historical Soil Fumigant Sales in Major CH_3Br Use Areas (formulation, t)

Year	CH_3Br	Chloropicrin	1,3-D	MITC*	CH_3Br	Chloropicrin	1,3-D	MITC*
	Kochi Pref.				**Chiba Pref.**			
1994	122.1.9	56.5	25.9	44.3	464.3	345.7	1983.7	83.3
1995	1194.4	114.0	27.6	38.5	486.5	418.5	1807.0	72.3
1996	1184.6	36.8	19.1	33.6	448.7	402.4	1896.7	87.9
1997	1217.6	90.0	18.7	43.7	396.3	443.3	1810.1	94.0
1998	1080.4	116.9	18.7	60.3	369.7	396.3	2015.7	103.9
	Kumamoto Pref.				**Aichi Pref.**			
1994	521.1	307.5	666.9	36.4	643.9	209.5	614.1	62.5
1995	485.1	256.0	538.0	47.3	579.1	192.4	558.1	61.9
1996	351.5	257.5	696.1	57.5	547.9	178.2	631.6	78.1
1997	458.5	270.1	734.6	56.3	500.9	177.2	598.2	107.1
1998	569.1	468.7	747.9	79.0	415.6	237.5	606.5	144.5
	Miyazaki Pref.							
1994	570.6	423.4	1222.0	31.8				
1995	611.8	547.3	1136.0	32.6				
1996	557.8	522.5	1076.1	29.4				
1997	524.0	485.1	1022.0	36.4				
1998	487.0	450.4	980.3	48.0				

*MITC = Dazomet + MITC + metam-sodium + metam-ammonium