

A-2.2.7 Exposure and Risk Evaluation of Methylbromide and Related Chemicals in Human

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Summary

Methylbromide has been used as a soil fungicide and nematocide in Agriculture. Since methylbromide is one of the chemicals that endanger the stratospheric ozone layer, pollution and exposure of methylbromide have been studied. Inside the green houses, many farmers use methylbromide as a main chemicals for fumigation. The protection procedures for methylbromide exposure are insufficient, therefore overdose and acute intoxication of pesticides have happened frequently.

In order to prevent the health hazards in fumigation process with methylbromide in greenhouses, environmental monitoring, occupational exposures, and a questionnaire study were conducted in 1997~1998. Since the concentration of methylbromide was extremely high in fumigated greenhouses, it was necessary to concern the risks of acute poisoning. Average value of occupational exposures in fumigated greenhouses was 57ppm (25-151ppm), which exceeded ACGIH/TLV-TWA (1ppm)¹⁾ and OSHA/PEL-C (20ppm). After improvements in fumigation processes, occupational exposure markedly decreased from 57ppm to under 0.1ppm.

According to the results of questionnaire study, about 80% of pesticide applicators have fumigated a whole greenhouse without vinyl sheet. Above 90% of applicators have opened the greenhouses within 5 days, average amounts of methylbromide in fumigation process were 40kg/10a, and only 10% of applicators have worn effective gas masks and clothes at the fumigation process.

Main subjective symptoms of applicators were irritating in eyes, respiratory tracts, nausea, headache and sometimes skin injury. Two to six percent of applicators complained bad at the time to open the coversheets of greenhouses. The rate of wearing of gas masks among applicators increased from 13.0% in 1997 to 34.1% in 1998 after the education on occupational safety and health of methylbromide. In order to avoid the high methylbromide

dose and prevent health hazards, educational programs on hazards and health effects of methylbromide, and safety training in fumigation process should be taught to farmers.

The most important indicator for exposure assessment is bromide ion excretion in urine. Many workers in green houses are exposed highly toxic methylbromide, the syndrome of intoxication is very serious in the rural areas of Japan. Since pollution and exposure of methylbromide is serious for human health, it is necessary to prevent the overdose and intoxication to methylbromide.

1. Introduction

Methyl bromide has been widely used as a soil fungicide and nematocide in agriculture. Recently, methylbromide is evaluated as one of the important chemicals to contribute for ozone depletion. Methylbromide is not only the chemical inducing to ozone depletion in environment but also the hazardous chemical in occupational health. To evaluate the health effect of methylbromide, the field survey and the experimental study have been carried out.

Since there are many greenhouses in Kochi prefecture, 13~14 % of annual amount of methylbromide produced in Japan is shipped to Kochi prefecture. As the agriculture works are not obligated to be regulated by Japanese Occupational Safety and Health Acts, there have been many reports methylbromide poisoning among farmers.

2. Research Objective

In order to prevent health hazards in fumigation process of methyl bromide in greenhouses, monitoring, exposure assessment, questionnaire study, health risks, and personal protection were conducted in 1997~1998.

3. Research Method

After a whole greenhouse was fumigated by methylbromide, environmental monitoring of methylbromide was conducted in cooperation with applicators using multiple-gas monitoring system (Innova type-1312, B&K type-1302, 1303 and UA-0987). Two environmental monitoring points were set in respiratory areas of standing position and sitting work place. The sampling interval of air was every one hour. The farmers applied an average amount of 45kg/10a of methylbromide, and then covered the vinyl sheets during three days after application of methylbromide in greenhouses. Occupational exposures of whole greenhouse were conducted in cooperation with farmers, and measured in spraying methylbromide, opening the coversheets of greenhouses, setting pipes in greenhouses and planting seedlings.

Air of respiratory areas was sampled by personal sampler (Dupont ALPHA2 and Gilian LFS-113, sampling rate:100~150ml/min) with charcoal tubes(SKC), and these samples were analyzed by gas-chromatography (Hewlet Packard HP-5890). In order to assess intakes

into human, biological monitoring were conducted in cooperation with applicators.

First questionnaire study was conducted to 165 farmers in six areas of Kochi in 1997, and items of questionnaire study working conditions, health effects and personal protection. Because the subjects in 1997 were not selected randomly, second questionnaire study was conducted to all farmers (n=115) in another two rural areas in 1998. These questionnaire data were analyzed by SPSS 9.0J for Windows.

Finally, the effects of improvements of fumigation in environmental monitoring and occupational exposures were examined.

4.Result and Discussion

Environmental concentrations of methylbromide in greenhouse gradually decreased from 2200ppm at the spraying time to 1100ppm at the opening coversheets of greenhouses for three days. The results on occupational exposures of workers in fumigation process were as follows; less than 0.1ppm in spraying methylbromide, as high exposure as 57.2ppm (25-151ppm) in opening coversheets of greenhouses, less than 0.1ppm in setting pipes in greenhouses and less than 0.1ppm in planting seedlings. Occupational exposures in opening coversheets of greenhouses exceeded ACGIH/TLV-TWA (1ppm)¹⁾ and OSHA/PEL-C (20ppm). Considering with NIOSH/IDLH²⁾ value (the value at the level of immediately dangerous for life or health; 250ppm), there might be happened acute poisoning accidents.

The most important indicator for exposure assessment is bromide ion excretion in urine. Many workers in green houses are exposed highly toxic methylbromide, the syndrome of intoxication is very serious in the rural areas of Japan. For evaluate the relationship between the urinary bromide ion excretion and the inhalation of methylbromide, various concentration of methylbromide were exposed to model animals. As the results of biological monitoring, highly positive relationships were observed between occupational exposures to methylbromide and bromine in urine.

Environmental concentrations of methylbromide decreased in the improved greenhouse from 2200ppm (several hours after spraying methylbromide) to 20ppm (opening up sheets of greenhouses) gradually. The occupational exposure was less than 0.1ppm, which was 57ppm before improvements in opening coversheets of greenhouse. These results suggested that improvements in fumigation could decrease occupational exposure to methylbromide among farmers.

According to the results of first questionnaire study (n=164), about 80% of respondents have fumigated in whole greenhouse without coversheet and above 90% have opened greenhouses within 5 days. The average amounts of methylbromide in fumigation were 38.3kg/10a without coversheet and 47.0kg/10a with coversheet. Only 10% of applicators have worn effective gas masks and clothes in fumigation process.

Subjective symptoms of irritating in eyes, respiratory tracts, nausea, headache were

complained among 2~6% of applicators at opening coversheets of greenhouses. The results of questionnaire study in 1998 (n=85, valid response rate:73.9%) were almost same as former questionnaire study. After the education on the occupational safety and health to the applicators before conducting questionnaire study, the rate of wearing of gas masks among farmers increased from 13.0% in 1997 to 34.1% in 1998. The results suggested that information of methylbromide and risk of fumigation could increase farmers' concern of safety and health and protect health hazards of methylbromide among them.

5.Conculsion

The results suggest that farmers might be exposed to high concentrations of methylbromide in opening coversheets of greenhouses. In order to protect health hazards of methyl bromide, education programs on information and health effects of methylbromide, and safety training in fumigation process should be provided for farmers.

Since methylbromide contributes for ozone depletion and easily absorbed in agriculture workers, it is necessary to reduce atmospheric methylbromide for the prevention of serious damage on humans and environment.

5.Publication

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