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MINIMUM USE OF METHYL BROMIDE IN QUARANTINE PHYTOSANITARY MEASURES IN JAPAN

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Abstract: Japan has made much effort to put into practice for the minimum use of methyl bromide in plant quarantine treatment. Fumigation chambers are expected to keep high gas retention capability and air tightness. Dose rates are set in fumigation schedule in view of the most fumigation efficacy with minimum use. It is consisted of various factors such as gas retention capability, loading type of commodity of bag and bulk, fumigation duration time, plant article for gas absorption, grain temperature for pest insect sensitivity, loading rate and gas circulation system. Furthermore various means to reduce methyl bromide use are taken in every aspect. Size of fumigation chamber should be in accordance with the size of commodity. A big space of fumigation chamber should not be used to the small size of commodity. List of non-quarantine pest insects has been improved by the application of International Standards For Phytosanitary Measures (ISPM)-2 of International Plant Protection Convention (IPPC). Methyl bromide use for non-quarantine pest insects is not allowed by the regulation at all. Pest control operator observes this regulation very strictly.

Key words: Plant quarantine treatment, IPPC, fumigation schedule, dose rate, gas retention capability, air tightness of fumigation chamber.

Introduction

When plant and plant products are imported in Japan, they are subject to plant quarantine inspection at the entry. If quarantine pest insects are intercepted by plant quarantine inspector, they are subject to Quarantine Phytosanitary Measures such as fumigation treatment by methyl bromide, hydrogen cyanide or aluminum phosphide. Methyl bromide fumigation is applied to the quarantine pest insects which are found intercepted in many kinds of plant articles such as grain, legume, bulb, cutting flower, fresh fruit, vegetable, cooking spice, forage, edible oil materials and un-sawn timber.

Japan has made much effort to use minimum amount of methyl bromide. Amounts of methyl bromide use for the quarantine treatment are shown in table 1[*1]. In this paper, dose rates are referred to the plant articles such as grain, forage, edible oil materials and coffee beans fumigated in warehouse and silo. Fumigation chambers are expected to keep high retention capability of methyl bromide and high air tightness. Dose rates are prescribed very in detail in fumigation schedule in terms of various factors for ensuring fumigation effectiveness and for minimizing use and emission of methyl bromide. Factors are included gas retention capability and airtightness of fumigation chamber, loading type of

bagged commodity in warehouse or bulk commodity in silo for gas diffusion, fumigation duration time, plant article for gas absorption, grain temperature for pest insect sensitivity, loading rate and gas circulation system. Extracts of prescribed dose rates are shown in table 2[*2]. In addition, very many ways of fumigation practices are actually implemented to minimize methyl bromide use.

Import plant inspection

When plant is at the entry, consignee should submit import plant inspection application form No. 4 to plant quarantine inspector. Then consignment is inspected by plant quarantine inspector. If quarantine pests are found intercepted, names of the pests are entered in the form. Consignee is required to undertake Phytosanitary Measures to the consignment.

Phytosanitary treatment

Being entrusted by consignee, pest control operator submits Phytosanitary treatment plan for seeking the approval of plant inspector. When it is approved by the inspector, consignment is loaded in the fumigation chamber. Pest control operator to undertake quarantine treatment is licensed by plant quarantine stations. Fumigation chamber for quarantine treatment is also designated by plant quarantine stations. When treatment completed, fumigation success or failure is checked by plant quarantine inspector with the confirmation of the test insect of life or death and/or with the level of remaining gas concentration. When fumigation treatment is judged success, consignment is subject to custom clearance.

Various efforts to minimize use and emission of methyl bromide

Methyl bromide fumigation as Phytosanitary treatment of plant quarantine is strictly put into practice for the exclusive consignment in which quarantine pest insects are found intercepted. Quarantine pests of 780 species and non- quarantine pests of 226 species have been clearly listed[*3] as of July 25th 2012 by the pest risk analysis (PRA) based in ISPM- 2. However, in the further progress of PRA, those numbers should be increased. Pest insects, which are put in the list of neither quarantine pest insects nor non-quarantine pest insects, are dealt as quarantine pests. Many species of grain insect pests have been put into the list of non-quarantine pest in very earlier time, so methyl bromide use has been reduced significantly. This is one of the big factors to decrease methyl bromide use in quarantine treatment. In recent years, plant commodities, in which quarantine pest insects are not found intercepted, have been getting increased. And as another reason, import of un-sawn timber, which is subject to plant quarantine, has been getting significantly decreased. Those factors contribute to reduce methyl bromide use in quarantine treatment.

Registration of methyl bromide for exclusive quarantine use

Methyl bromide for exclusive use of quarantine treatment was specifically registered in December 24th, 1994 which was independently registered away from methyl bromide for general regulated use. Therefore, methyl bromide for quarantine use is not allowed to use for the general regulated use such as soil

treatment or post harvest treatment. It has been clearly specified with the red label put on the cylinder or the cartridge, so that it is easily recognized as quarantine use. Pest control operator engaged in quarantine treatment is strictly required to use methyl bromide for disinfestation of quarantine pest insects and not to misappropriate it to the regulated use.

Dose rates in grain fumigation schedule

Dose rates are definitely set in the fumigation schedule to ensure complete disinfestation under various fumigation conditions[*2]. They are respectively set under consideration of different factors. Factors related to fumigation conditions are mentioned below.

(1) Gas retention capability and air tightness of fumigation chamber: In Japan high gas retention capability and air tightness is extremely expected to fumigation chamber owner because it should be kept higher level of gas with less leakage outside. Fumigation chambers for quarantine use are designated by plant quarantine stations. It is designated by the determination of gas retention capability or air tightness for the classification of category class super A, class A, class B and class C.

(2) Fumigation duration: Dose rates are set differently in view of fumigation duration time of 24, 48 and 72 hours. The longer fumigation time is taken, the less dose rate is set.

(3) Grain loading of bagged type in warehouse or bulk type n silo: Usually, grain bags are piled up in the warehouse and grain in bulk is put in the silo. Fumigant gas penetrates and spreads easier in the grain put in bags rather than in bulk, so dose rate for grain bag in warehouse is set less than grain bulk in silo.

(4) Plant article with gas absorption: Dose rate is set in view of plant categories of methyl bromide gas absorption. To the plant articles with less absorption of methyl bromide gas, the less dose rate is set. Dose rate for soy bean is more than wheat because soy bean absorbs more methyl bromide gas than wheat due to more protein contents in soybean. Flour absorbs more gas than grain, so dose rate of wheat flour is set more than wheat grain.

(5) Grain temperature: When grain temperature is higher, pest insect is more sensitive to the fumigant gas. So the higher grain temperature is found, the less dose rate is set. Dose rates are set differently with the grain temperature of $T<10℃$, $10℃\leqq T<20℃$, $T\geqq 20℃$.

(6) Loading rate of consignment in the chamber: It is expressed by tones/m3. More volume of grain is loaded, more methyl bromide gas is absorbed and more dose rate is necessary for pest insect disinfestation. Dose rates are set with loading rates in chamber of $LR<0.3$ t/m^3, 0.3 t/m^3 $\leqq LR<0.5$ t/m^3, $LR\geqq 0.5$ t/m^3.

(7) Circulation system in the fumigation facility: Dose rate is set less with the existence of air circulation apparatus in the chamber. Gas is easily distributed with circulation system. So dose rate is set less for the chamber with the installation of circulation system.

Designation of fumigation chamber for quarantine use

Fumigation chambers for the plant quarantine treatment are designated by plant quarantine stations. Chamber is designated in view of gas retention capability. Designation is ranked into class Super A, class A, class B and class C. Gas retention capability is determined by the level of remaining gas concentration at 48 hours later of dose application. When remaining gas is determined more than 85%, chamber is categorized as the class Super A. With the remaining gas of more than 70%, chamber is categorized as the class A. With more than 55%, chamber is categorized as the class B. With more than 40%, chamber is categorized as the class C. Chamber with the remaining gas of less than 40% is not allowed to the use for quarantine treatment.

Determination of air tightness of fumigation chamber

Check of air tightness of the chamber could be applied by the request by chamber owner. Method is different between warehouse and silo.

For the warehouse, air is sent inside and air pressure gets raised up to 55 mm Aq. and then it is left to lower to the height of 50 mm Aq. Chamber, to which gauge shows higher than 45 mm Aq. at five minutes later, is categorized as class Super A. Chamber, to which gauge shows between 5 and 45 mm Aq., is categorized as class A.

For silo, air pressure is raised up to 550 mm Aq. by sending air to the silo and then it is left to lower to the height of 500 mm Aq. Silo, to which gauge shows higher than 400 mm Aq. at twenty minutes later, is categorized as class Super A. Silo, to which gauge shows the height between 200 mm Aq. and 400 mm Aq. at twenty minutes later, is categorized as class A.

Various measures for the minimum use and emission of methyl bromide

Various measures have been taken to minimize use and emission of methyl bromide for quarantine use as follows.

(1) Improvement of gas retention capability: Fumigation chamber facility owners have been much encouraged to improve gas holding capability. 99.8 % of designated fumigation chambers for the use of quarantine treatment are included in super A and class A in 2013(Yokohama Plant Protection Station 2013). No chambers of class C is designated currently.

(2) Operation by licensed fumigation expert: Licensed fumigation expert is required in the quarantine fumigation treatment for the secure safe and reliable operation to ensure complete disinfestation of pest insects in the consignment.

(3) Effort to avoid fumigation failure: If fumigation treatment by methyl bromide should be confirmed failure by plant quarantine inspector, it is not allowed to repeat methyl bromide fumigation. Failure of fumigation treatment is confirmed by surviving test insects or with lower level of remaining gas concentration than the standard level. In this case it is usually to use aluminum phosphide or carbon dioxide which takes longer time and more cost. People do not prefer those treatments to methyl bromide treatment.

(4) Encouragement of the use of fumigation chamber appropriate to the size of commodity:

Methyl bromide application dose amount is set in accordance with the size of fumigation chamber, not with the size of consignment volume. To small size of

consignment, small size of fumigation chamber should be appropriately used. It should not be used big chamber to the small size of consignment.

(5) Non mix loading of the commodity with bigger absorption: If plants of different category of the absorption are loaded together, dose rate is set adaptable to the plant category of which absorption is bigger no matter how small size of consignment is loaded. For example, maize absorbs more methyl bromide than wheat. If maize is put loaded together with wheat in the warehouse, dose rate is set one to maize no matter how small size of maize. So small consignment size of maize is suggested to be separately fumigated.

(6) Encouragement to apply heat treatment for wood packing materials instead of methyl bromide fumigation treatment: Heat treatment is much more encouraged than methyl bromide fumigation unless treatment is done under unavoidable circumstance. For instance, if size of consignment is too big to put in the facility of heat treatment or consignment is already put in the wood packing materials, methyl bromide fumigation could be approved. In 2012, only 2,705 kg[*5] of methyl bromide was reported to use for the treatment of exporting wood packing materials which is only 0.54% of total amount of methyl bromide for quarantine treatment use of 498,120 kg. Treatment number was reportedly amounted only 532[*5] of 2.2% with methyl bromide fumigation compared to 23,508 with heat treatment.

(7) Improvement of list of non-quarantine pest insects and diseases: List of non quarantine pest insects has been elaborated by pest risk analysis based on ISPM-2. At present non quarantine pest insects and diseases were listed 334(226) species[*3] as of July 25th 2012. Pest control operator is strictly required not to use methyl bromide to the treatment of non-quarantine pest insects. That had led significant reduction of methyl bromide use in accordance with the increased number of species of non-quarantine pest insects. Improvement of the list of non-quarantine pest is thought to be one of the big contributors to make less use of methyl bromide.

(8) Development of phosphine gas generator from aluminum phosphide: Tablet or small pellet formulation are used in the quarantine treatment as alternative to methyl bromide, however, people prefer methyl bromide fumigation to aluminum phosphide because it takes much longer time and resides of aluminum hydrates are remaining in the commodity. Recently, some installation unit of phosphine gas generator, which is set outside attached to the chamber, had been developed. Use of this unit saves dose rate of aluminum phosphide and shorten fumigation duration time.

Reference

1. Methyl Bromide QPS Consumption in ODP Tonnes (2013) Data Center of Ozone Secretariat
2. Ministry of Agriculture, Forestry, and Fisheries (1971) The Quarantine Guideline for Grain Import. No. 2628 February 6th 1971.
3. Ministry of Agriculture, Forestry, and Fisheries (1950) Enforcement Ordinance of the Plant Protection Act. No.73 June 30th, 1950 (Revised latest in April 20th, 2012)
4. Yokohama Plant Protection Station (2013)
5. Japan Plant Quarantine Association (2013)

Table 1 Methyl bromide QPs Consumption in ODP tonnes*[1]

Year	2007	2008	2009	2010	2011	2012
Amount	664.3	509.6	418.4	362.1	434.3	356.9

Table 2 Extract of methyl bromide dose rates in fumigation schedule *[2]

Fumigation facility	Commodity	Loading rate of tones /m^3 with forced air circulation apparatus	Methyl bromide dose rate (g/m^3) for the respective category of designated fumigation chamber for gas retention capability under the fumigation duration time of 48 hour at the grain temperature of T ≧20℃			
			Super A	A	B	C
Warehouse	Bagged rice, wheat and coffee bean	0.3< LR	8	9	10	12
		0.3≦LR <0.5	10	11	13	15
		LR≧0.5	12	13	15	18
	Bagged maize and millet	0.3< LR	10	11	13	15
		0.3≦LR <0.5	12	13	15	18
		LR≧0.5	15	17	21	24
	Bagged soybean, kidney bean, pea nuts	0.3< LR	12	13	15	18
		0.3≦LR <0.5	13	15	18	21
		LR≧0.5	19	21	26	30
Silo	Bulk rice and wheat	0.3< LR	11	12	14	17
		0.3≦LR	16	18	21	25
	Bulk maize and millet	0.3< LR	14	15	17	21
		0.3≦LR	22	24	28	34
	Bulk soybean, kidney bean, pea nuts	0.3< LR	15	17	20	24
		0.3≦LR	23	25	29	35

Table 3 Existing number of designated fumigation chambers in 2013 *[4]

Category	Super A	A	B	C	Total
Warehouses	598	668	19	0	1,285
Silos	2,633	7,056	5	0	9,694
Total	3,231	7,724	24	0	10,979
Number of chambers per-cent	29.4%	70.4%	0.2%	0	100%
Size of chamber space (m3) per-cent	39.0%	60.7%	0.3%	0	100%