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Phytosanitary treatments
Traitments phytosanitaires

Phosphine fumigation of stored products to control *Trogoderma granarium*

Specific scope

This Standard describes the phosphine fumigation of stored products to control *Trogoderma granarium*.

Specific approval and amendment

First approved in 2012-09.

Introduction

Stored products are often infested by a wide range of stored-product pests. One of the most resistant of these pests is *Trogoderma granarium.* The larvae of this species cause important damage in over 100 stored products, including nuts and dried fruits, cereals, herbs and oilseeds.

Commodities/regulated articles

Stored products generally.

Pests

Trogoderma granarium (TROGGA).

Treatment schedule

Treatment name: phosphine fumigation.
Treatment type: chemical.
Formulation: fumigant, packed as a bag, plate or pellets, tablets.
Active substance: magnesium phosphine 56%.

Treatment conditions

Mode of action: fumigation at atmospheric pressure.
Growth stage: post-harvest pest control.
Number of applications a year: No regulation, the number of applications depends on reinfestation of the commodity.

Waiting period

Consumption of stored products is allowed after the product (phosphine) has completely dissipated.

Efficacy of treatment

Phosphine fumigation has been found to be effective in many countries in the EPPO region and worldwide. Phosphine fumigation is an effective method of eliminating insects in stored commodities (Bell, 2000). Fumigation of stored products with phosphine products as prescribed by the label does not contaminate the commodity (F&E Labor, 2005a,b).

The schedules described in Table 1 are the result of many years' experience. The trials carried out showed that phosphine treatment of a commodity ensures high mortality of *T. granarium* and helps to provide non-infested material for the industry (Zakladnoi & Ratanova, 1973; Ducom *et al.*, 2004).

The schedules provided in Table 1 were tested at the All-Russian Plant Quarantine Centre. The results show that these schedules are acceptable (100% mortality of the different stages of *T. granarium* including diapausing larvae). The trials carried out showed that the use of phosphine to control *T. granarium* requires a longer exposure time than for other pests of stored products (Mordkovich & Vashakmadze, 2001; Shamilov & Mordkovich, 2012).

The All-Russian Plant Protection Institute in the Leningraskaya area developed similar schedules to control *T. granarium*, and these schedules were recommended in 2000 in Russia when *T. granarium* was detected in import commodities.

Table 1 Application rate per treatment (gas dose)*

Pest stage	Dose (g PH_3 m^{-3}) Premises, containers	Bulk storage, silo, bag stacks	Exposure time, h (days)	Minimum commodity temperature (°C)	CTP (g m^{-3} h)
Adults and active larvae	7	9	336 (14)	10	366
	6	8	240 (10)	11–15	168
	5	6	168 (7)	16–20	84
	3	5	96 (4)	>20	48
Diapausing larvae	9	10	480 (20)	10	720
	8	9	336 (14)	11–15	336
	7	8	240 (10)	16–20	168
	6	8	120 (5)	>20	60

*The table lists minimum exposure periods. One day should be added to the exposure times to allow for development and distribution of the fumigant.

In Pakistan, three field strains of *T. granarium* were collected from different sites and were found to have significantly different levels of sensitivity to phosphine. A dose of 800 ppm (11.36 g) for 14 days was lethal at 34 ± 1°C and 65 ± 5% relative humidity for all three field-test strains. However, for effective (99–100%) control of relatively less resistant strains, a lower dose of 600 ppm (8.52 g) for an exposure period of 21 days was necessary (Muhammad *et al.*, 2000).

Other experiments, conducted in Pakistan, showed that the maximum 100% mortality was observed with phosphine doses of 525 ppm (7.42 g) and 719 ppm (10.2 g) at 120 h exposure periods. There was a positive correlation between larval mortality and phosphine concentration, and a negative correlation between phosphine concentration and required exposure time (Ahmedani *et al.*, 2007).

Fumigation conditions are important; consequently, the dose to be used depends on the conditions, in particular relative temperature and humidity; commodity temperature and moisture levels; and gas-tightness of the building/container. When these conditions are not acceptable during fumigation, it is important to use a longer exposure time. The exposure periods recommended in the schedule are minimum periods. Most data for fumigation with phosphine was obtained at 60% humidity and 20°C. Fumigation should not be performed below a temperature of 10°C.

The longer the fumigation time, the more effective the fumigation. Exposure time should be lengthened to allow for penetration of gas throughout the commodity, particularly when the fumigant is not uniformly added to the commodity mass, for example, by surface application or shallow probing. This is particularly important in the fumigation of bulk commodities contained in large storage areas. It should be noted that there is little to be gained by extending the exposure period if the structure to be fumigated has not been carefully sealed, or if distribution of gas is poor and insects are not subjected to lethal concentration of phosphine (Zakladnoi & Ratanova, 1973).

Notes

The fumigation period should be long enough to allow for almost complete reaction of phosphine products with moisture in the products so that little or no non-reacted phosphine products remain (Noack *et al.*, 1983). This will minimize worker exposure during future storage and/or processing of the treated bulk commodity and reduce hazards in the disposal of partially spent phosphide products remaining after space fumigation (F&E Labor, 2005a,b).

Enquiries

Further information may be obtained from the national authorities responsible for the registration of this fumigant.
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