

Phytopsanitary treatments
Traitments phytosanitaires**Phosphine fumigation of stored products to control stored product insects in general****Specific scope**

This standard describes the phosphine fumigation of different stored products to control stored product insects in general. To control *Trogoderma granarium*, see the specific standard (PM 10/22). For dried fruits and nuts, see PM 10/23.

Specific approval and amendment

First approved in 1984–09 as PM 3/18 and revised in 1992. Revised and transferred to series PM in 2012–09.

Introduction

Stored products e.g. cereals, seeds, herbs, etc. are often infested by a wide range of stored product pests. Experience from across the world has shown that using phosphine products for stored products treatment to control pests is effective. Most of the insects listed below are cosmopolitan and all of them should be removed from consignments.

Commodities/regulated articles

Stored products in general, including seeds.

Pests

Stored product pests in general (see Table 1). If resistant strains of any of these species have been found or are believed to be present then the highest dose coupled with the longest exposure should be used.

Treatment schedule

Treatment name: phosphine fumigation

Treatment type: chemical

Formulation: fumigant, packed as a bag, plate or pellets, tablets

Active substance: aluminium phosphine 56% or 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 re-infestation 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. Fumigation of stored products with phosphine products as prescribed by the label does not contaminate the commodity.

The schedules described in Table 2 are the result of many years' experience. The trials carried out showed that phosphine treatment helps to provide non-infested material for the food industry with a relatively quick treatment time (Ducom *et al.*, 2004; Zakladnoi & Ratanova, 1973). The schedules provided in Table 2 were tested at the All-Russian Plant Quarantine Centre. The results show that these schedules are acceptable (100% mortality of the pests in

Table 1 Important stored product pests which can be controlled with phosphine

Coleoptera	<i>Acanthoscelides obtectus</i>	ACANOB
	<i>Anthrenus museorum</i>	ANTRMU
	<i>Araecerus fasciculatus</i>	ARAEFA
	<i>Attagenus pello</i>	ATTGPE
	<i>Callosobruchus chinensis</i>	CALSCH
	<i>Caryedon serratus</i>	CARESE
	<i>Cryptolestes ferrugineus</i>	CRYLFE
	<i>Dermestes lardarius</i>	DERMLA
	<i>Gnathocerus cornutus</i>	GNATCO
	<i>Lasioderma serricorne</i>	LASDSE
	<i>Necrobia rufipes</i>	NECRRU
	<i>Niptus hololeucus</i>	NIPTHO
	<i>Oryzaephilus surinamensis</i>	ORYZSU
	<i>Prostephanus truncatus</i>	PROETR
	<i>Ptinus fur</i>	PTINFU
	<i>Ptinus tectus</i>	PTINTE
	<i>Rhizopertha dominica</i>	RHITDO
	<i>Sitophilus granarius</i>	CALAGR
	<i>Sitophilus oryzae</i>	CALAOR
	<i>Sitophilus zeamais</i>	CALAZM
	<i>Stegobium paniceum</i>	STEGPA
	<i>Tenebrio molitor</i>	TENBMO
	<i>Tenebriodes mauritanicus</i>	TEBRMA
<i>Tribolium castaneum</i>	TRIBCA	
<i>Tribolium confusum</i>	TRIBCO	
Lepidoptera	<i>Corcyra cephalonica</i>	CORRCE
	<i>Ephestia cautella</i>	EPHECA
	<i>Ephestia elutella</i>	EPHEEL
	<i>Ephestia kuehniella</i>	EPHEKU
	<i>Nemapogon granella</i>	TINEGR
	<i>Plodia interpunctella</i>	PLODIN
	<i>Sitotroga cerealella</i>	SITTCE

Table 2 Application rate per treatment (gas dose)*

Active substance	Dose, g PH ₃ m ⁻³	Minimum exposure time		Minimum temperature
		Bag-stacks (seeds, stored products)	Bulk storage, silo (stored products)	
Aluminium phosphine	3	10 days	12 days	10°C
Magnesium phosphine	3	9 days	11 days	10°C
Aluminium phosphine	3	7 days	9 days	20°C
Magnesium phosphine	3	5 days	8 days	20°C

*The table above gives the minimum exposure periods in days for a dosage of 3 g PH₃ per m³. One day should be added to the exposure times to allow for development and distribution of the fumigant. The dose may need to be increased to 5 g PH₃ per m³ if the fumigation conditions are poor (e.g. not very gas tight conditions, or low relative humidity) or if resistant species are found or believed to be present. However, good practice is to perform phosphine fumigation only in gas-tight conditions.

Table 1 was achieved). Fumigation to control *Trogoderma granarium* should follow EPP/EPPO Standard PM 10/22. Because of the high level of resistance of diapausing larvae of this pest, treatments require a longer exposure time (Shamilov and Mordkovich, 2012).

In the case of certain commodities in long-term storage, re-infestation may occur. Additional fumigation may be required to treat these commodities.

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 the fumigation with phosphine was carried out at 60% humidity and at 20°C. Fumigation should not be performed below a temperature of 10°C.

The longer the fumigation time is, the more effective the fumigation. Exposure time should be lengthened to allow for penetration of gas throughout the commodity in particular, 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). Exposure periods of more than 10 days are not normally recommended because of the difficulty of retaining the fumigant for long periods. However in some cases, e.g. with careful sealing or polythene-wrapped goods, longer exposure periods may be possible. Above 12% humidity problems of phytotoxicity can appear.

Notes

- To prevent the development of resistance, it is essential to avoid applications with sub-lethal doses (Fields & White, 2002). Depending on fumigation circumstances, in particular low temperature and poor gas-tightness of the building/container, it is important to use longer exposure to achieve pest mortality in all parts of the fumigated commodities.
- Additionally, 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 as well as reduce hazards in the disposal of partially spent phosphide products remaining after space fumigation.

Enquiries

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

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