Phosphine as an alternative to MBr in the dried fig sector in Turkey

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Turkey is one of the most important dried figs producing and exporting country, with a production amounting to some 50.000 tonnes annually, comprising from 60 to 75% of the international market. Main pests of dried fig in the processing and storage are *Ephestia cautella, Carpoglyphus lactis, Oryzaephilus surinamensis, Carpophilus spp.* To control storage pests which infest dried figs in the processing and storage, methyl bromide (MBr) has been used to disinfest for many years in Turkey. In Turkey, it was reported by The Ministry of Agriculture that 964 tonnes of MBr had been imported in 1996; of which 50 tonnes were mainly used for dried fruits including dried figs fumigation and 7 tonnes were used for quarantine procedures of dried fruits. The phase-out schedule of methyl bromide in Turkey has increased the urgency to search for alternatives.

As MBr alternatives, beside phosphine, other control methods mainly, high CO_2 based MA applications, deep freezing, high pressure-CO2, cold storage are effective in controlling dried fig pests in Turkey. For conventional dried fig processing sector (95% of the total production) in Turkey, phosphine is the leading alternative.

The purpose of the study was to evaluate the use of solid and cylindirised formulation of phosphine to effectively control given populations of dried fig pests. Fumigants for this study were FUMI-CEL™, a magnesium phosphide formulation in a solid plate form and 1.5% phosphine gas dissolved in compressed N_2. For this purpose a series of fumigations in the flexible storage units (36 tons capacity PVC storage unit) were conducted to test the effectiveness against *Ephestia cautella* (eggs, larvae, pupae), *Carpophilus* spp. (larvae), *Carpoglyphus lactis* (mixed stages) and *Oryzaephilus surinamensis* (eggs, larvae, pupae and adults) at the dried fig processing & storage facility of TARIS. For fumigations, the flexible units were loaded 15 tons of dried figs in the perforated plastic boxes. Test insects introduced in perforated plastic containers and retrieved at the end of the fumigations. All insect bio-assays were retained for two weeks at the lab. conditions.

Dosage rates of 0.5 g PH_3 gas per ton of dried fig were used for 5 days of exposure periods. During the experiments gas concentration were monitored by an analyzer equipped with an electrochemical detector for the exposure periods from the different locations, and temperature was recorded inside the stacks using T-type thermocouple (Hobo®). The daily temperatures during the experiments ranged from 26 to 28°C.

In the experiment, the liberation of phosphine from the solid plate was realized in a short time (14-18 h) due to high moisture content of the dried fig (~20-23%) in the flexible units and the peak concentration was noticed only at the end of 14-18 h (Fig. 1). For cylindirised formulation of

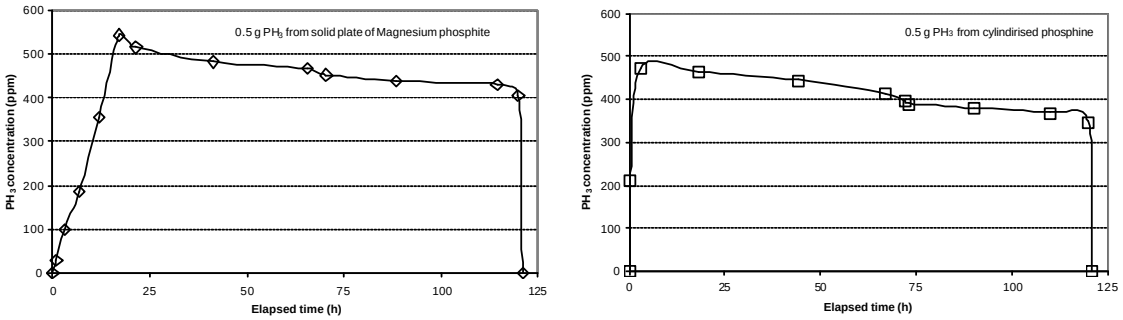

Fig 1. Phosphine concentration for 5 days of outdoor stacks fumigations of dried figs in flexible storage units.

phosphine gas makes up in a small stack used in these tests takes 5-10 minutes. The decay in gas concentration has slow and attributed predominantly to sorption of the fumigant by the commodity. Results showed that 100% mortality of insects was observed at the end of 5 day of exposure period both for solid and gas form of phosphine applications.

In summary, the retention of phosphine during treatment of dried fig in the flexible storage units outdoor is high enough for fumigation. The present data reveals that application rate of 0.5 g PH_3/ton during 5 days of exposure was found to be enough to control of dried fig pests at prevailing temperatures in dried fig harvesting season in the Aegean region of Turkey. Increased application rate is necessary to compensate against gas losses by permeation and leakage through the fumigation covers.

According to the results, phosphine holds promise as a replacement for methyl bromide fumigations for the dried fig pests. This work is the first report on the use of phosphine for dried fig disinfestations in Turkey. Phosphine fumigation instead of MBr is yet in the beginning to be adopted by dried figs processing sector. In practice we strongly recommend that fumigation applicators should do phosphine fumigation not less than 5 day of exposure not to cause an pests resistance problem.

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