

The use of FumBox[®] - mobile fumigation container for date treatment with phosphine

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Abstract: Stored product insect pests, mainly sap beetles and moths, attack dates during the storage period. Currently, after methyl bromide phases-out, phosphine fumigation, heat treatment, and modified atmosphere are used for date disinfestation. Each of these methods has advantages but also serious limitations. To improve phosphine fumigation for date disinfestation, FumBox[®] - a mobile fumigation container - was designed and tested in commercial conditions. The FumBox[®], modified dry 40 ft. HC standard container (76.4 m³), was equipped with a newly developed platform generating and constantly monitoring phosphine gas concentrations, air temperature and relative air humidity of the fumigated goods. Magtoxin[®] Plates 56% and Phostoxin[®] Tablets 56% (Detia Freyberg GmbH, Germany) were used. Dates of Medjool variety were treated. The phosphine was used at a dosage range of 1-3 g/m³ and the exposure time between 24-72 hrs.

Total date disinfestation was achieved in all fumigation treatments. The use of Magtoxin Plates with the D.G. provided more effective, quicker, and safer date disinfestation compared to Phostoxin tablets. The fumigated dates were phosphine residue-free. No changes in organoleptic properties were noted.

Keywords: date; fumigation; phosphine

1. Introduction

In the MENA region, the date sector has played a significant strategic, economic, social and environmental role. Stored product insect pests, mainly sap beetles and moths, attack dates during the storage period and may cause serious damage. Currently, after methyl bromide phases-out, phosphine fumigation, heat treatment and modified atmosphere are used for date disinfestation [1-3]. Each of these methods has advantages but also serious limitations. To improve phosphine fumigation of date disinfestation, some innovative technologies have been proposed [4-7]. FumBox[®], a mobile fumigation container was tested in commercial conditions for date disinfestation. FumBox[®] was designed and developed by Sunbula Environmental Solutions Co. Jenin, West Bank, Palestine.

2. Materials and Methods

FumBox[®], a modified dry 40 ft. HC standard container (76.4 m³), was equipped with a newly developed platform (P.G.) generating and constantly monitoring phosphine gas concentrations, air temperature and relative air humidity of the fumigated goods.

Two phosphine formulas were tested: Phostoxin Tablets 56% (Detia Degesch GmbH, Germany) and Magtoxin Plates 56% (Detia Degesch GmbH, Germany). The phosphine dosage range was 1 - 3 g/m³. The exposure time was between 24 - 72 hrs.

In each fumigation treatment, six date samples each of 0.5 kg were randomly collected; three samples were collected prior to the fumigation treatment and three samples were collected after fumigation treatment for organoleptic evaluation, phosphine residue lab tests & fumigation efficiency. Tests took place five days after the fumigation treatments. The prior-fumigation samples served as control samples. All fumigations were carried out on Medjool dates variety.

3. Results

Much higher and faster phosphine concentrations were obtained with Magtoxin Plates 2 g/m³ using FumBox[®] and P.G. for 24 hrs versus Magtoxin Plates 2 g/m³ using FumBox[®] only for 24 hrs (1,280 ppm after 9.5 hrs; 900 ppm after 17 hrs respectively - Figure 1). Fumigation with Magtoxin Plates 3 g/m³ for 24 hrs using FumBox[®] only, obtained very high phosphine concentration of 1470 ppm after 18 hrs. Fumigation with Magtoxin Plates 2 g/m³ using FumBox[®] and P.G. for the duration of 24 hrs versus 48 hrs showed slightly higher maximal phosphine concentrations (1,280 ppm after 9.5 hrs; 1,190 ppm after 9.5 hrs respectively - Figure 2). Fumigation with Magtoxin Plates 2 g/m³ for 72 hrs obtained similar results. Fumigation for 24 hrs using FumBox[®] only with Magtoxin Plates 2 g/m³ versus Phostoxin Tablets 2 g/m³ showed a significantly higher and faster maximum peak of phosphine concentrations (900 ppm after 17 hrs; 580 ppm after 21 hrs respectively - Figure 3).

Prior-fumigation date samples were naturally infested by moth's larva and adult sap beetles in a range of 4% to 28%. In all post-fumigation sample treatments, no live insects were detected. Fumigation with Magtoxin Plates 2 g/m³ for 24 hrs using FumBox[®] and P.G., resulted in date infestation with dead insects of 0 – 0.75%, and without P.G. was 1.8%. Fumigating with Phostoxin Tablets 2 g/m³ for 24 hrs using FumBox[®] only, resulted in date infestation with dead insects of 3 – 21%. Phosphine residue lab tests were carried out on all post-fumigation date samples. No residues were found in the fumigated dates five days after the fumigation treatments. In addition, no changes in organoleptic properties were noted.

Fumigation using FumBox® and P.G. vs Fumigation using FumBox® only

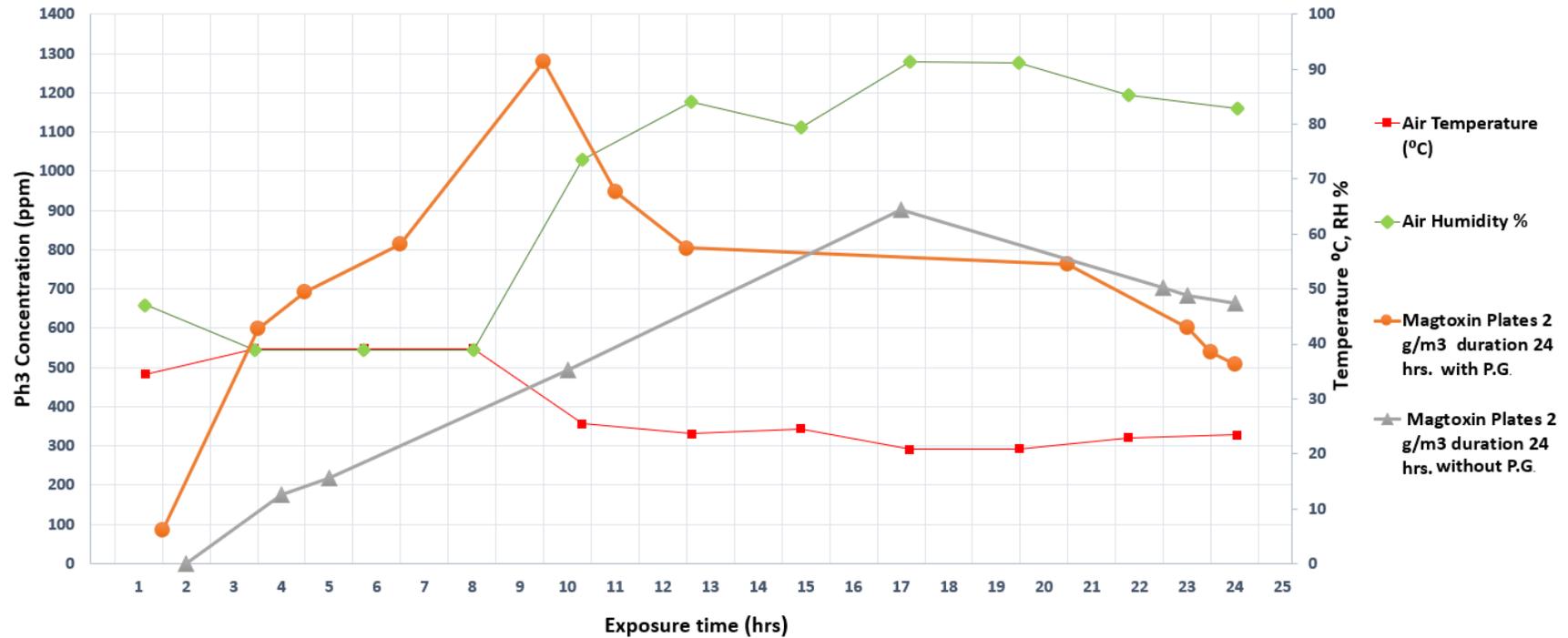


Figure 1. Phosphine gas concentrations, air temperatures & relative air humidity during fumigation. Fumigant Magtoxin Plates 56%, dosage 2 g/m³ duration 24 hrs, with FumBox® & Phosphine Generator (P.G) vs FumBox® only. Data of air temperatures & relative humidity refer to fumigation with FumBox® & (P.G). The second treatment was conducted under similar weather conditions.

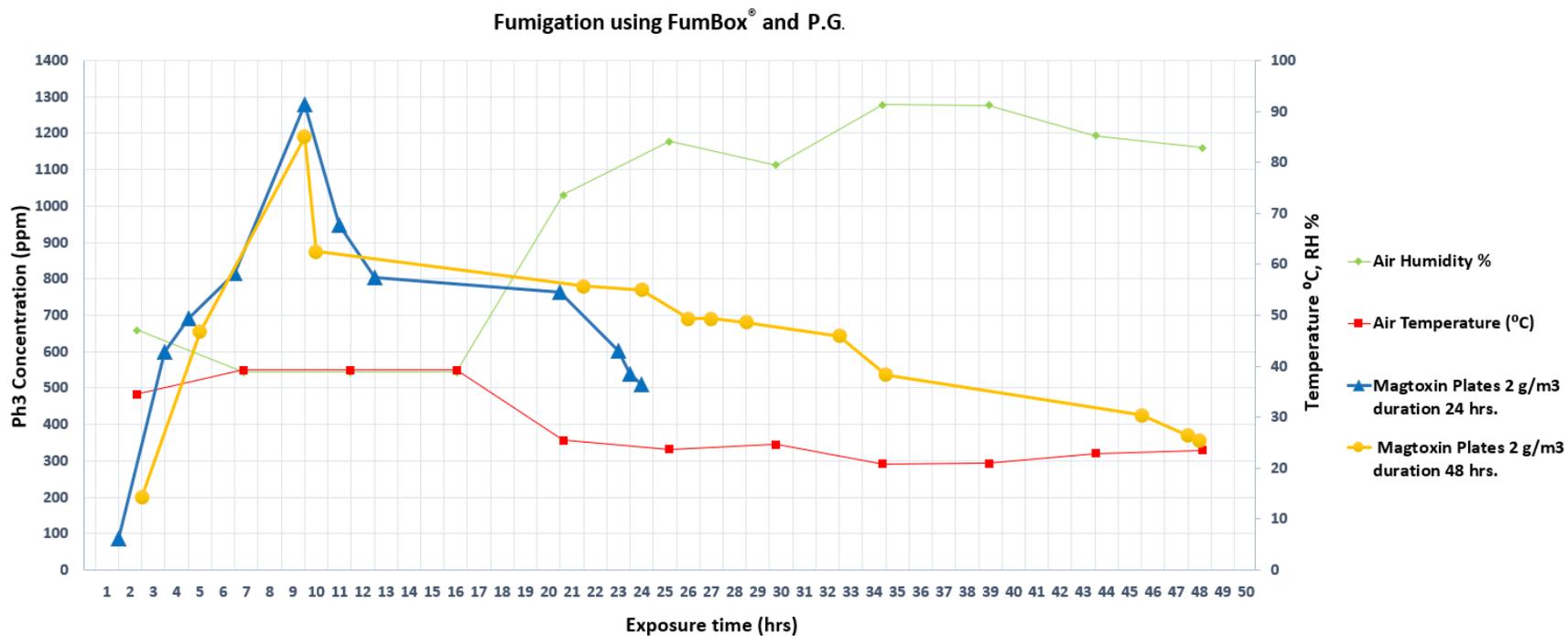


Figure 2. Phosphine gas concentrations, air temperatures & relative air humidity during fumigation. Fumigant Magtoxin Plates 56%, dosage 2g/m³ duration 24 vs 48 hrs, with FumBox® & Phosphine Generator (P.G). Data of air temperatures & relative humidity refer to 24 hrs fumigation. The second treatment was conducted under similar weather conditions.

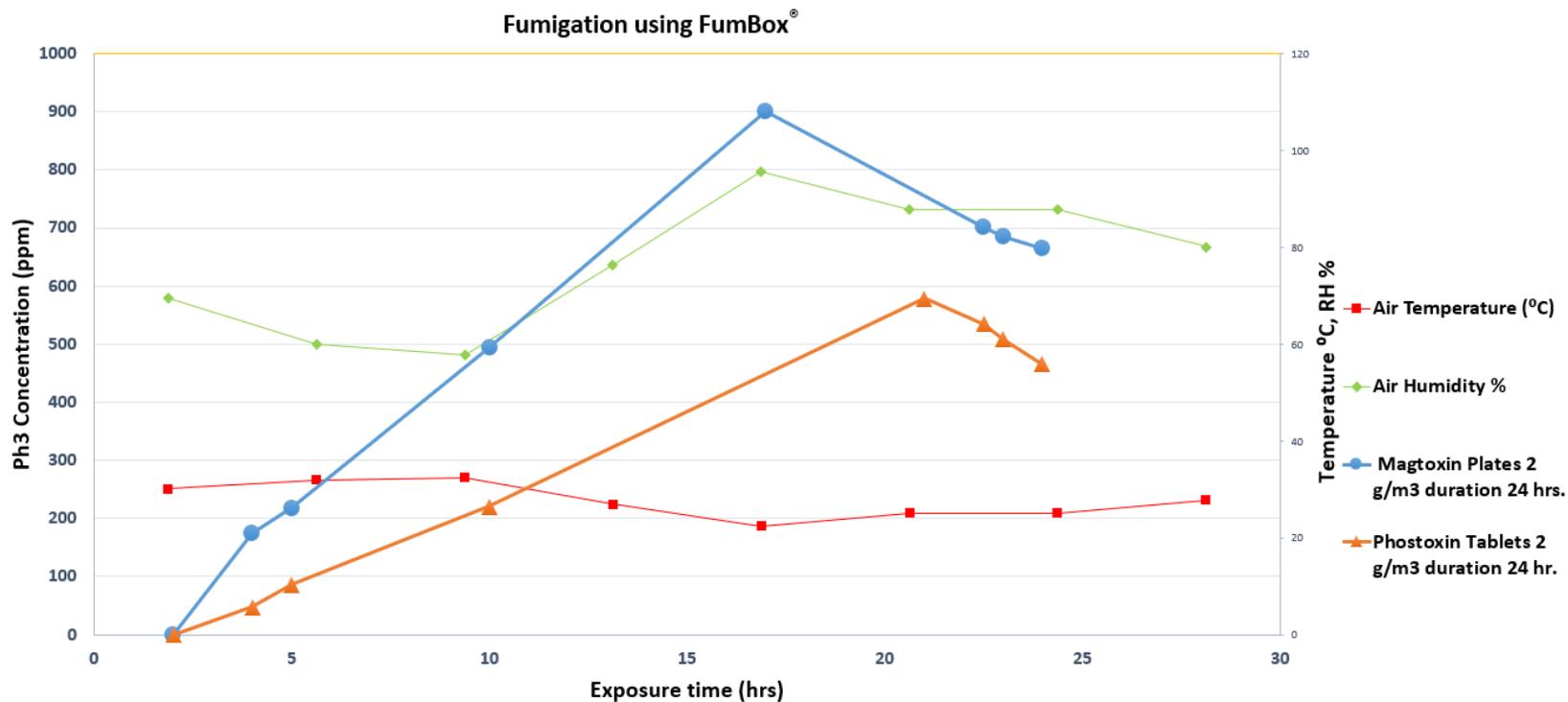


Figure 3. Phosphine gas concentrations, air temperatures & relative air humidity during fumigation. Fumigant: Magtoxin Plates 56% vs Phostoxin Tablets 56%, dosage 2g/m³ duration 24 hrs, both with FumBox®. Data of air temperatures & relative humidity refer to fumigation with plates. The second treatment was conducted under similar weather conditions.

4. Discussion

The efficacy of phosphine for date disinfestation was demonstrated in previous research studies [4-8]. Our current experiments, which used and incorporated the newly designed mobile fumigation container FumBox® and P.G., demonstrated that Magtoxin Plates 2 g/m³ for 24 hrs resulted in the best date disinfestation outcome. Higher concentrations and/or prolonged exposure time killed all insects at all stages of development, - the economic protocol was 2 g/m³ for 24 hrs. The fumigated dates were found to be phosphine residue-free. In addition, no changes in organoleptic properties were noted, which is consistent with earlier results published in previous studies [8-10]. The plate formula provided a maximal phosphine concentration much earlier and faster than phostoxin tablet formula. Furthermore, using Magtoxin Plates vs. Phostoxin Tablets, particularly with the FumBox® together with P.G. confers safety advantages to the fumigator, the fumigated goods as well as the environment.

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