PHOSPHINE FUMIGATION WITH SPEEDBOX: EFFECTIVENESS AND ADVANTAGES

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Today Phosphine (Hydrogen Phosphide) is a major fumigant for controlling insects in stored products. However there are few limitations in Phosphine use, such as low temperatures and relatively longer exposure time. To improve Phosphine application, a special devise, called "Speedbox" has been developed by Detia Degesch GmbH Germany. The Speedbox is a waterproof aluminium box containing a heater and a ventilator. The Speedbox has been designed to be used exclusively with Degesch Plates®.

In this study, the effectiveness of Phosphine fumigation of commercial stack in controlling stored product insects at low temperatures using Speedbox, was investigated.

The fumigation was carried out in a commercial warehouse in the South of Israel. Bags of rice, sunflowers, beans, peanuts, pistachio and nuts, each one of 40-50 kg weight, were hermetically sealed by plastic sheets. The stack volume was about 15 m3. The outdoor temperature was 15˚C at the beginning of the experiment and 8-16˚C during the experiment. The temperature of the above mentioned stored products was 6˚C at the beginning of the experiment and 6-8˚C during the experiment. The Degesch Plate used contains 56% of magnesium phosphide, weighs 117 grams and evolves 33 grams of Phosphine gas. The Speedbox was connected to the stack. One Degesch Plate was put into the Speedbox and was heated to 36˚C. The produced hydrogen phosphide was blown into the stack and was pump out from the stack to the Speedbox for recirculation. The Speedbox was disconnected from the stack 22 hours after the beginning of the experiment. The dosage of the Phosphine gas was 2 gram/m3. During the experiment the concentration of Phosphine was monitored by Bedfont device model 415. The exposure time was 4 days. The test insects were rise weevil Sitophilus oryzae (adults); saw-toothed grain beetle *Oryzaephilus surinamensis* (adults); red flour beetle *Tribolium castaneum* (larvae, pupae and adults); tropical warehouse moth *Ephestia cautella* (larvae and pupae). The test insects were inserted into the stack in three replications. The control insects were outside of the stack in the same warehouse. Mortality of adults and larvae-pupae stages was counted 24 hours and a week after treatment, respectively.

The results showed, that the Speedbox allows the degassing of the Degesch Plate and getting the effective concentration of Phosphine in a short period of time. Just

45 minutes after the beginning of the fumigation 100 ppm of Phosphine was recorded. After 2, 3 and 22 hours the concentration of the gas has reached 216, 298 and 335 ppm respectively.

At the dosage of 2 gram/m3 and exposure time of 4 days, the total mortality of the adults of all tested insects was recorded 24 hours after the treatment. By visual evaluation (without counting) it was possible to notice a lot of dead larvae of T. castaneum and *E. cautella*. A week after treatment, 100% mortality of all tested stages, including larvae and pupae of *T. castaneum* and *E. cautella* was recorded.

It is worth noting that the temperatures of the outdoor and treated products were as low as 8-16˚C and 6-8˚C, respectively. It is well known that the absorption and adsorption of the gases by treated products under those conditions are much stronger compared with higher temperatures. In addition, certain kinds of the treated products, such as sunflowers, peanuts, pistachio and nuts are characterized by high level of lipids content, that also increase the gas sorption. Despite these negative factors for effective fumigation, the concentration of Phosphine during the treatment was high enough and total mortality of tested insects was achieved.

To conclude, the current study showed that the Speedbox allowed optimizing the Phosphine fumigation of stacked bags in controlling adult, larval and pupal stages of major stored product insects. The Speedbox allows the heating of the Degesch Plates that cause drastic decrease in the Plates degassing and exposure time. In addition, this device allows recirculation of the gas and its event distribution in the treated stack. The advantages of the Speedbox enable effective Phosphine fumigation at low temperatures and for significantly shorter time. The Speedbox opens novel possibilities for Phosphine fumigation also in quarantine treatments.