PHOSPHINE TREATMENT OF APPLES FOR DISINFESTATION − RESIDUES AND EFFICACY AGAINST PESTS

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Introduction

Phosphine (PH_3) of high purity in mixtures with air has been proposed as an alternative fumigant to the ozone-depleting methyl bromide for the control of insect pests on perishable products like kiwifruit, apples and bananas. Unlike methyl bromide, PH_3 does not remain as a stable residue in fumigated fruit and is transformed into harmless amounts of phosphoric acid and phosphates by sunlight after its release into the atmosphere. The other potential advantages of PH_3 are that the treatment is less likely to damage fruit and that it can be applied during cold storage i.e. without reducing storage life if the fruit must be warmed for fumigation.
Phosphine fumigation was first developed and commercially applied to protect fresh fruit some years ago (Horn and Horn 2004; Klementz et al. 2005) by the Fosfoquim company in Chile. However, very few efficacy data for this fumigant used on fruit have been published in the literature. This presentation will cover two recent studies.

Residues of phosphine

Phosphine residues after fumigation were monitored in one study on apples (cv 'Royal Gala'). Apples were fumigated with PH_3 using magnesium phosphide (Mg_3P_2) with an average concentration in air of 1274 ppm for 48 h at 5°C. Treatments were carried out in a 0.5 m^3 fumigation chamber. Residue levels in fumigated apples were determined immediately after the fumigation and 24 and 48 h later. Phosphine contents immediately after the fumigation (0.25 mg/kg) significantly exceeded the maximum residue level (MRL) of 0.01 mg/kg. However, they dropped below the MRL during storage at 5°C within 24 h.

Efficacy of phosphine

Apples (cv 'Jazz') were infested with codling moth (*Cydia pomonella* L.*)* fifth instar larvae by drilling three holes (about 6 mm width and 30 mm depth) into each apple and introducing one larva per hole. Each hole was sealed with agar. About 100 eggs laid on plastic were placed into containers with gauze at each end. One container of eggs and 30 infested apples were placed in sealed chambers for fumigation treatment.
Gas concentrations were 1000 and 2000 ppm PH_3 in air. Fumigations were carried out at 0.5°C for 24, 48, 72 and 96 h.

The main results of the study were:

- fifth instar larvae were more difficult to kill than eggs at 0.5°C at both concentrations of PH_3,
- exposure time was more critical than the concentration for achieving high mortality rates amongst both eggs and larvae, and
- extrapolation of results predicts that 120 h or more exposure to PH_3 is required to kill 99% of larvae at 0.5°C.

Conclusion

These results show that PH_3 has potential to control codling moth in apples to an acceptable level to meet market access requirements but more work is needed.

Key words: pure phosphine, disinfestation, codling moth, fruit, quarantine

References

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