Pulsed UV Light for Decontamination of Cold Storage Facilities

Y. Saks¹, G. Ward¹, S. Erdman¹, Y. Goldstein¹, A. Lichter² and V. Rodov²
¹StePac L.A. Inc., Tefen, Israel AND ²Dept of Postharvest Science, ARO, the Volcani Center, Bet Dagan, Israel

Introduction

Periodic decontamination of post-harvest handling facilities is necessary to prevent the accumulation of pathogenic inoculum on surfaces, equipment and circulated air, that may compromise produce storage life.

Some potential benefits of ultraviolet light (UV) treatment for decontamination are: i) no chemicals; ii) instantaneous and specific biocidal action; iii) equipment is compact and relatively maintenance-free; iv) low capital costs.

Pulsed UV light (PUV) treatment uses radiation from a xenon flash lamp with a broadband emission spectrum, providing high-energy UV output in short pulses. PUV possesses a higher decontamination capacity and results in less microbial photo-reactivation than low-pressure UV lamps (Otaki et al., 2003).

The current research examines the efficacy of the Xtend® DeContam™ PUV device (Fig.1) in comparison to ultrasonic fogging with H₂O₂ for decontamination of post-harvest cold storage rooms (SR). The Xtend® DeContam™ is FDA approved and environmentally friendly and offers the benefits of being compact, portable, easy to use and chemical free.

Results

The Effect of PUV on Spore Germination of Botrytis cinerea In Vitro

A 30s exposure of B. cinerea spores on potato-dextrose agar (PDA) medium to 10MW PUV at a distance of 0.4m prevented germination of 10⁵ spores. Exposure for 60s was sufficient for complete eradication of 10⁶ and 10⁷ spores (Fig. 2).

Cold Storage Room Decontamination Trials

PUV treatment for 66s resulted in a 5-10 fold decrease in the airborne microbial population of 11m² SRs as counted on PCA and PDA media, both immediately and 24h after treatment (data not shown). Treatment time was increased to 1000s to determine if the airborne microorganisms could be completely eradicated by prolonged exposure, however similar results were obtained (Fig 3A).

To determine if the residual airborne contamination after PUV treatment (Fig 3A) resulted from entering the SR for sampling, the SRs were sealed with solid polycarbonate sheets and the Petri dishes were opened and closed after treatment without entering. The lids of the Petri dishes were mounted with a ring and removed and re-positioned from outside of the SR using a thin metal rod, inserted through a 4 mm hole in the polycarbonate sheet. This method resulted in a 74 and 32-fold decrease in airborne counts on PCA and PDA, respectively, 24h after treatment (Fig 3B).

Fogging was conducted for 1h with silver-stabilized H₂O₂ using an ultrasonic fogger releasing 2 l/h of fog. The cooling unit was switched off before fogging to prevent condensation on the unit, but the fans were left on. A 1.5-10 fold reduction of airborne counts was noticed 4h after fogging in different SRs, but microbial populations increased 24h after fogging (Fig. 3C). Removal of the Petri dish lids without entering the SR did not alter this trend, suggesting that the fogging treatment was not sufficiently effective.

Both the PUV method and the fogging method effectively reduced SR wall contamination as measured using contact plates for detection of molds (Fig. 4).

Conclusions

The current research demonstrates the potential of PUV as a more rapid and efficient means than fogging for eradicating post-harvest pathogen populations (airborne and surface) in post-harvest cold storage rooms. Residual airborne microorganisms after treatment were primarily from external re-contamination rather than survival of indigenous populations.

Literature Cited