CRITICAL pO_2 AS A DIAGNOSTIC OF WHEN MODIFIED ATMOSPHERES AFFECT PHYTOSANITARY IRRADIATION

Catriona H. Condon, Department of Entomology and Nematology, University of Florida
Chao Chen, Department of Entomology and Nematology, University of Florida
Laura A. Jeffers, USDA-APHIS-PPQ CPHST, Raleigh, NC
Woodward D. Bailey, USDA-APHIS-PPQ CPHST, Miami, FL,
Robert L. Meagher, USDA-ARS, CMAVE, Gainesville, FL
Daniel A. Hahn*, Department of Entomology and Nematology, University of Florida

Ionizing irradiation can be used as a phytosanitary treatment to kill or sterilize invasive pests that arrive in imported agricultural products. Irradiation is a chemical free alternative to fumigation and the doses required to kill or sterilize pest species are well tolerated by many fresh fruit and vegetables. However, the irradiation of insects in anoxia is known to buffer the damaging effect of radiation when compared to the same radiation treatment applied under normal atmospheric conditions. Because commodities are often transported in low-oxygen environments, difficultly has arisen in developing a generic radiation dose for insect disinfestation under these conditions. We have previously shown that radiotolerance increased over normoxia at moderate radiation doses in atmospheres of 0 and 5 kPa pO_2 in larvae of the Cabbage Looper moth (*Trichoplusia ni*). However, the increased radiotolerance at 5 kPa pO_2 was much smaller than the radiotolerance effect observed at 0 kPa pO_2. We hypothesized that the protective effects of low oxygen conditioning would be induced as animals reached their critical pO_2, the level at which low oxygen levels impaired metabolism, as reflected by a drop in CO_2 production from mitochondrial respiration. We estimated the critical pO_2 of Cabbage Looper larvae to be 3.2 kPa pO_2. To test whether this critical pO_2 level is associated with increased radiation resistance we treated larvae at a range of radiation doses at 0, 3, 6, and 21 kPa pO_2, showing that the greatest increase in radiotolerance was induced by 0 and 3 kPa pO_2 treatments, as expected from our critical pO_2 data. This work must be expanded to more pest species, but suggests that identifying a species critical pO_2 may be a useful diagnostic tool for what modified atmospheres will be of the most concern for altering radiotolernace in the context of phytosanitary irradiation.