Abstract

The overall goal of this research was to reduce or eliminate mancozeb residues in apples and apple products, determine the effectiveness of different postharvest treatments and processing on the reduction of mancozeb and ethylenethiourea (ETU) residues and elucidate possible degradation products and pathways of this pesticide when treated with various oxidation agents.

In the first part of the research, laboratory studies were conducted using a model system to determine the effects of calcium hypochlorite (50, 250 & 500 ppm), chlorine dioxide (5 & 10 ppm), ozone (1 & 3 ppm) and hydrogen peroxyacetic acid (HPAA) (5 & 50 ppm) at pH 4.6, 7.0, 10.7 and at 10°C and 21°C on the degradation of mancozeb in solution over a 30 minute period. Rate of mancozeb degradation was dependent on pH, with pH 7.0 being the most effective. Under controlled conditions, ETU residue concentrations increased up to 15 minutes reaction time and then decreased in all three pH ranges. Ozonation was effective in the degradation of ETU residue in mancozeb solution. Chlorine dioxide was an excellent degradation agent at low concentration.

The second part of this study included laboratory whole fruit studies. Mancozeb was spiked on the surface of apples at two different concentrations and the effectiveness of each oxidizing agent was determined on the reduction and degradation of mancozeb and ETU residues on actual fruit as compared to the solution experiments. The results showed similar patterns to the model system studies.

In the third part of this study, mancozeb was applied on orchard apples throughout the growing season at the recommended rate. Postharvest wash treatments were used, based on results of the model system study: (1) no wash, (2) water wash, (3) calcium hypochlorite wash @ 50 and 500 ppm, (4) chlorine dioxide wash @ 10 ppm, (5) ozone wash @ 3 ppm and (6) HPAA wash @ 50 ppm. Wash treated apples were processed as whole fruits, slices, sauce (peeled and unpeeled), juice and pomace and frozen at -20°C until residue analysis. When wash treatments were combined with processing, mancozeb and ETU were reduced by 100% (i.e., below detectable limits).

The last part of this study involved investigation of degradation products and possible pathways during chemical oxidation reaction. Samples were detected by Time-of-Flight Mass

Spectrometry (TOFMS) with an electron ionization source. Several degradation by-products were detected and identified.