Abstract

Scald is a pervasive physiological disorder of apples and pears induced by storage at refrigerated temperatures in air or long term controlled atmosphere (CA). Scald has the potential to destroy the market value and utility of millions of tons of apples and pears annually unless the fruits are treated with a postharvest drench with diphenylamine (DPA) or ethoxyquin along with a fungicide. Numerous countries have banned the use of DPA and prohibited importation of fruits so treated. The objectives of these studies were to develop alternative strategies to control scald of apples to avoid applying postharvest treatment with the scald inhibitor DPA and to ensure fruit quality and food safety. The physiological and biochemical bases of apple scald were also investigated.

Granny Smith and Law Rome apples were placed under hypobaric storage immediately after harvest or after 0.5, 1, 2, 3, 3.5, 4, 4.5, 5 or 6 months storage in air at 1°C to determine the effects of delaying imposition of hypobaric storage on ripening and scald development and production of α-farnesene and its oxidation product 6-methyl-5-heptene-2-one (MHO). Fruits did not scald during hypobaric storage or afterwards when transferred to static air at one atmosphere continuously for 4 months if they were placed under hypobaric conditions within one month after harvest while held in air at 1°C; after 3 months delay, scald development was similar to that for fruits stored in air. MHO accumulated in the epicuticular wax when fruits were placed under hypobaric storage after one month delay in air. MHO in the epicuticular wax of fruits stored hypobarically after 2 or more months delay was released upon transfer of fruits to 20°C; MHO accumulated in direct proportion to the duration of the delay to hypobaric storage. Hypobaric ventilation apparently removes scald-related volatile substances including α-farnesene and MHO that otherwise accumulates and partitions into the epicuticular wax of fruits stored in air at atmospheric pressure.

Scald susceptible and not susceptible cvs. fruits were treated with different concentrations of ethanol vapor and different durations. Fruits were then stored in 3% O_2 with 0% CO_2 in flow-through CA and in air at 1°C. The treatments with 6000 μL.L-1 ethanol vapor for 2 weeks were more effective for scald control than the other treatments; higher levels of ethanol for over 2 months caused fruit injury and off-flavor. Ethanol vapor treatments reduced the rate of MHO production.

Fruits were treated with initial low O_2 stress (ILOS) at different levels of low O_2 and various durations and then stored in different CA storage conditions and air at 0.5-1°C. Superficial scald was markedly reduced by ILOS at 0.5% O_2 for up to two weeks followed by air storage. With CA storage at 3% O_2 with 0% CO_2,

following 0.5% and 0.25% ILOS for 2 weeks reduced scald; and with CA at 1.5% O_2 with 3% CO_2, scald was prevented. ILOS at 0.25% O_2 for two weeks or also when followed with an additional two weeks of low O_2 stress after 2 months of the storage were the most effective treatments regimens for scald control. The production of α-farnesene and MHO was inhibited by ILOS and CA at 1.5% O 2 . The 0.25% O 2 ILOS caused stronger inhibition on α-farnesene and MHO production than 0.5% O 2 ILOS. Collectively, this results suggest that the accumulation of MHO is highly related to scald development of apples. A commercial test of initial low O 2 stress confirmed the efficacy of ILOS for controlling scald.