

High-temperature Dip and Low Temperatures for Storage and Disinfestation of Avocados

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Australian-grown 'Hass' avocados (*Persea americana* Mill.) will be in oversupply, domestically, within 10 years (Schoorl et al., 1988). A solution is to increase exports. Since Australia is distant from overseas markets, avocados shipped by sea must tolerate extended periods in storage.

An initial study (unpublished data) showed that avocados would tolerate a fungicidal dip (0.5% benomyl at 50C) for 3 min before being stored at 1C for at least 20 days. These fruit ripened normally with no evidence of chilling injury (CI). Storage at 1C for this duration will provide quarantine security against Queensland fruit fly (Qff) (U.S. Dept. Agriculture, 1985), a priority pest in some markets.

This note reports a more detailed study of the effectiveness of long-term storage of 'Hass' avocados at 1C, with or without a prior 50C fungicidal dip, for quarantine security against Qff.

Fruit quality. One-hundred fruit at commercial harvest maturity were collected from five geoclimatic areas in New South Wales and Queensland. Sixty fruit from each location were dipped, 20 at a time, for 3 min in 0.5% benomyl at 50C in a 29-liter, stainless-steel container. They were then allowed to dry at 18 to 22C for 2 to 4 h before being placed at 1C for up to 30 days. The 40 remaining fruit from each location were stored at 1C for up to 30 days without a prior 50C dip. Afterward, fruit were allowed to ripen at 18 to 22C. The period required to reach the edible-ripe stage was recorded. Qualitative measurements were made of skin color, fruit firmness, vascular browning, flesh graying, shrivelling, and internal rot.

Fruit fly mortality. Five-hundred fruit from one orchard on the northern coast of New South Wales were placed on mesh cages housing =20,000 fertile Qff each. Flies were allowed to oviposit into the fruit through the mesh for 4 to 5 h, after which the fruit were removed and stored at 26C for larval development. Four-hundred of these fruit, containing one of four life stages (egg, first instar, second instar, or third instar), were

subjected to a 50C fungicidal dip and then 1C storage for 0, 2, 3, 4, 5, 6, 7, or 8 days. These fruit and the remaining 100 infested fruit, which were not 50C dipped or stored at 1C, were stored over sand at 26C until larval pupation. The criterion for survival was the formation of a normal puparium. The number of survivors from 50C-dipped, 1C-stored fruit were compared with the number from nondipped and non-cold-stored fruit to estimate insect mortality at each period of storage at 1C. Data for the four lifestages were compared by probit analysis (Alvey et al., 1983) to determine the lifestage that was most tolerant of 50C dipping and storage at 1C.

There was little evidence of chilling injury (vascular browning, flesh graying, or uneven ripening) in either the 50C-dipped or the nondipped fruit stored at 1C; however, the 50C fungicide-dipped, cold-stored fruit were significantly more acceptable ($P < 0.05$) due to the lack of rotting caused by *Colletotrichum gloeosporioides* (anthracnose). Dipped fruit scored 7 out of 10 for acceptability. Fruit that were neither dipped nor stored at 1C scored 4. Nondipped, 1C-stored fruit remained at the edible-ripe stage for only 3 to 4 days before rotting, whereas fruit dipped at 50C and stored at 1C remained in acceptable condition for 7 to 8 days.

Third instar larvae were more tolerant of 50C dipping and 1C storage than the other infesting lifestages. Probit 9 (99.99683%) mortality was estimated to occur after a period of 11 days in storage at 1C, although there were no survivors following storage at 1C for 7 or 8 days in this experiment.

Storage of 'Hass' avocados at temperatures below those currently recommended (Debney et al., 1980) appears to be feasible, provided there is adequate control of spoilage organisms. In these experiments, 'Hass' avocados tolerated storage at 1C for 30 days after a 50C fungicidal dip. Such a treatment would also provide quarantine security against Qff. The maximum tolerable storage period at 1C still needs to be determined.

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