

Laboratory tests with grape containers at Davis emphasized the severe vibration injury possible in shipment of loose-packed fruit. Least shipment injury appeared when tops were stapled onto boxes that had been left a little more than level full, following a few seconds of vibration settling by machine. The laboratory testing equipment developed at Davis closely reproduced the effects of a transcontinental rail trip on fruits and containers. Such tests can be run in less than an hour and at a small fraction of the costs of a test shipment.

**S**HIPPING INJURY to fruit varies considerably with its condition, but a good comparison of alternative containers or packing methods is obtained when both are packed with fruit from the same lot. However, there is considerable chance variation in fruit injury, even when identical containers are packed with fruit from the same lot. Enough containers should be tested to get a fair estimate of both the extremes of injury and of its general level. Quantities of fruit available for these tests were not sufficient by this standard. The results give an indication of what to expect, however, and they indicate the questions that should be answered by more extensive testing.

One striking disclosure has been the severe injury due to vibration. Juice leakage, wetness, and loss of color about the capstems or where berries touch each other are common results. These symptoms resemble sulfur dioxide injury. Loss of bloom and a dull appearance are noticed when the condition is less severe.

Vibration injury may develop in standard lidded lugs if the pack is not originally tight or if it is loosened by settling or shrinkage. Grapes in open containers may be severely injured by vibration if they are subjected to a rough ride. Grapes

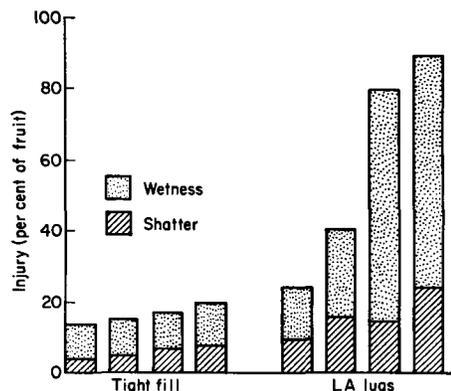


Figure 1. Injury to Thompson seedless grapes in simulated transit.

# GRAPE CONTAINER

*in simulated transit laboratory shows severe vibration injury possible in loose-packed fruit*

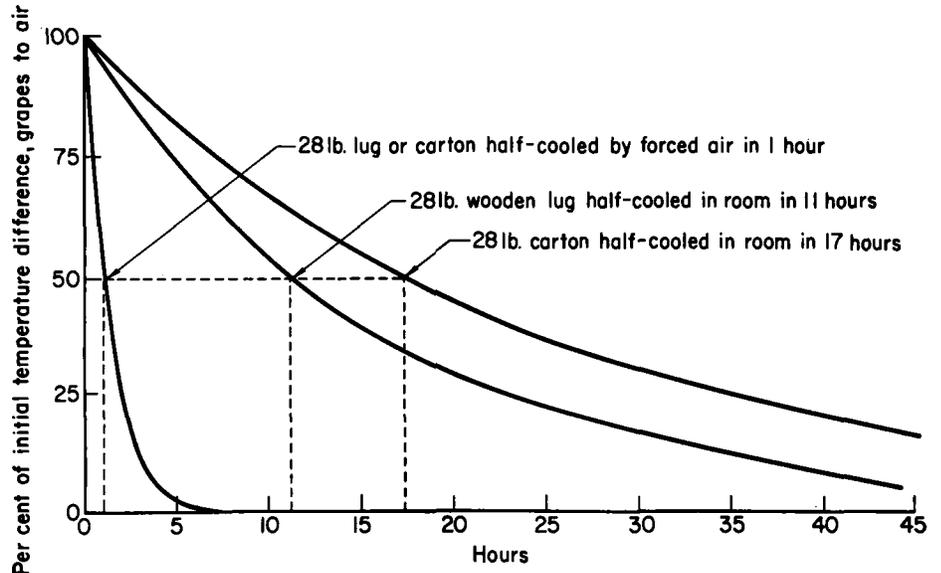
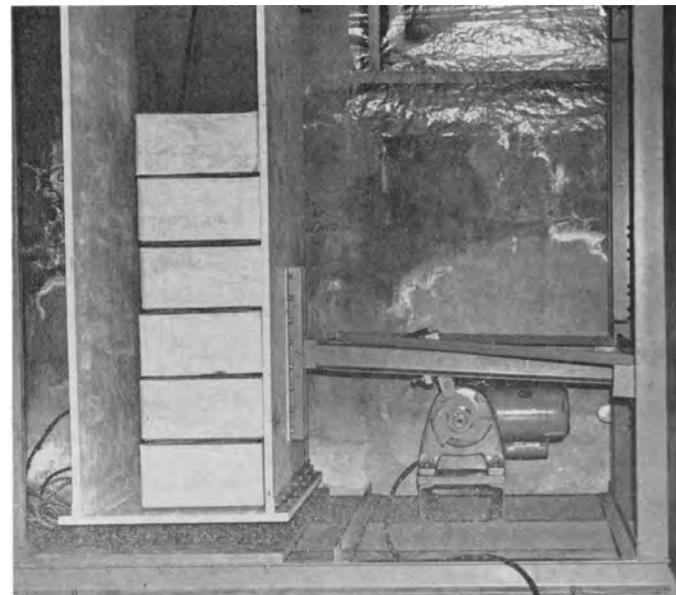


Figure 2. Cooling grapes in vented cartons compared with wooden lugs.

carry well in telescope cartons if they are slightly overfilled, settled by a few seconds of vibration, and held in place by stapling the covers down. Figure 1 com-

pares injury in cartons packed this way with injury in commercially packed wooden lugs. Injury in the wooden lugs might have been reduced if boxes had

Center photo shows high frequency vibration machine in the simulated-transit laboratory. Fruit containers are placed on the racks for 30 minute ride—equivalent to a cross country trip by rail, plus the horizontal and vertical shocks produced by racks illustrated in other photos. Twenty 2-inch drops in rack to left, and 20 horizontal impacts at 2 miles per hour in rack shown to right simulate freight car coupling and transcontinental starts and stops.



# TESTING

been slightly overfilled and then settled by a few seconds of vibration.

Tests of vibration settling are shown in Figure 2. A frequency of around 900 cycles per minute, with a stroke of  $\frac{3}{16}$  inch, produced the best settling. Direct operation with a 1750 rpm motor was definitely too fast. Eighty per cent of the settling occurred in the first five seconds and almost all of it in ten seconds. A light pressure on the top surface—about 15 pounds per square foot—improved the settling and did not injure the fruit. There was no noticeable injury from 20 seconds of vibration.

A few tests with different amounts of overfill or underfill showed least injury when boxes were a little more than level full after vibration settling. Less overfill increased vibration injury and more overfill increased splitting. Tests of padding in cartons indicated only that a top pad allowed more variation in fill without either vibration injury or splitting. Depths of pack up to 13 inches did not increase injury to Emperor grapes. Tests of deep packs with other varieties were

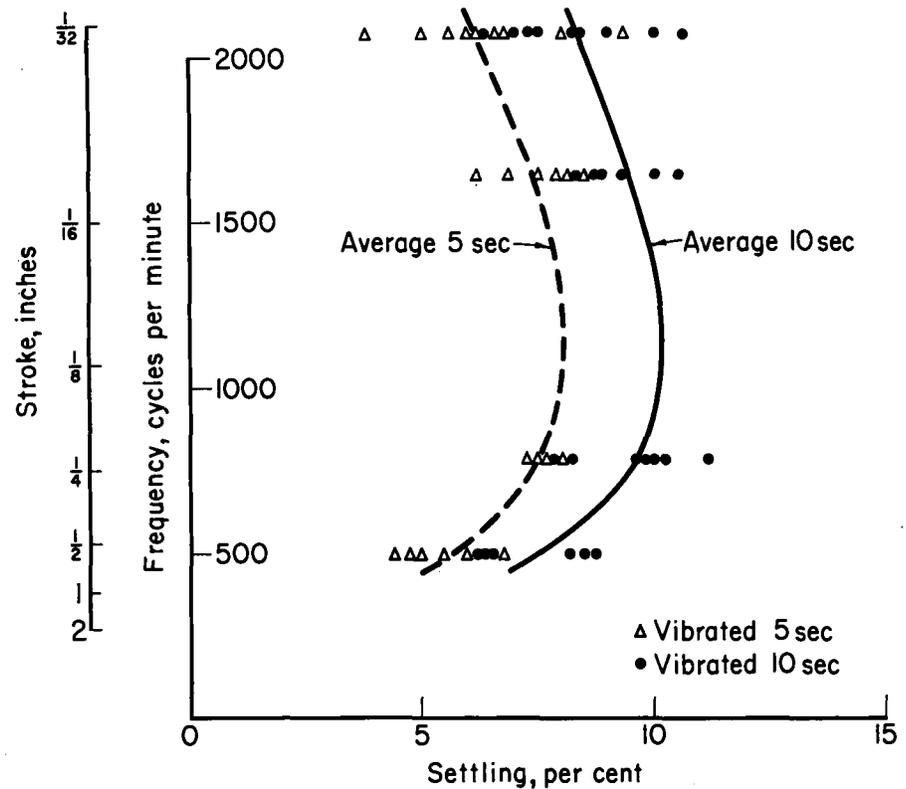


Figure 3. Settling packed grapes by vibration at different frequencies and strokes.

inconclusive due to presence of decayed berries in the available fruit.

Lidded lugs, due to their open construction and large exposed surface, were room-cooled in about two-thirds of the time required by cartons to reach the same temperature. Cartons were cooled at the same rate as lugs when air pressure was applied to force air through the stacked containers—commonly known as forced-air cooling. Cooling measurements are shown in Figure 3.

Tests of sulfur penetration and effectiveness of other fumigants as related to container dimensions and venting are planned for 1962, as well as additional measurements of transit injury as effected by tightness of fill, depth of container and padding.

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