

TESTING OF GRAPE CONTAINER CHARACTERISTICS, AUGUST - DECEMBER 1961

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Summary

Continuation of the simulated transit tests begun early in 1961 with Emperors out of cold storage confirmed that most grapes can easily be damaged by vibration in transit. This vibration produces juice leakage, wetness and loss of color about the capstems or where berries touch each other--symptoms resembling sulfur dioxide injury. If prolonged bunch and berry movement occurred during simulated transit a wet, dull appearance resulted. Dullness was particularly notable in the red-colored varieties. Leakage from decayed, split or pulled berries also was increased and smeared through the pack by vibration.

Vibration injury in transit can be controlled by settling the packed grapes by a few seconds of vibration to reduce subsequent settling in transit, and by tight lidding. Control of transit vibration with least splitting resulted from a five per cent overfill before settling. Best settling was obtained by vibration at 900 cycles per minute, with a 3/16-inch stroke and about 20 pounds per square foot pressure on the top of the pack. There was less injury in tight-filled cartons than in standard lugs.

Scope of the Tests

This report covers laboratory study of grape container characteristics at Davis in 1961. Included is work in April with storage grapes which was reported to the California Grape & Tree Fruit League Container Committee in May. That report pointed out the need for funds to purchase reasonable quantities of fruit for testing. Continued dependence on solicited donations of fruit has limited tests undertaken and the numbers of containers in each test. The results should be taken only as indications until they can be checked by more adequate testing.

Testing Methods

A routine of impacts and vibration has been developed which closely simulates the condition of fruit as it arrives in eastern markets. The emphasis has been on duplicating the effects on the fruit at an actual transit, not on duplicating the complicated and prolonged motions of the transit itself. Alternative containers or packing methods can be compared by packing them with

the same fruit, subjecting them to the simulated transit routine, and then appraising their condition.

This method has been used successfully with other fruits, condition being appraised by scoring each fruit for injury and calculating an average. Little has been gained by efforts to separate different kinds of injury because of the difficulty of clearly distinguishing between them.

In work with grapes it has seemed impracticable to calculate an average by rating either bunches or individual grapes. On the other hand, transit injury to grapes seems to be clearly separable into three kinds--splitting, shatter and wetness. In these tests the percentages of splits and of wet grapes have been estimated by observation and the shattered grapes have been weighed. In some lots there has been considerable breakdown and wetness from decayed berries. An attempt to estimate only the injury to sound berries has been unsatisfactory. Decay in even two or three berries per bunch renders grapes unsuitable for tests of this kind.

Equipment developed for other fruits was used to impact and vibrate the test containers. Initial transcontinental rail trips were well reproduced by 50 2-inch drops and 15 minutes of vibration at 550 cycles per minute with a stroke of one-fourth inch. Equipment was later acquired for convenient production of horizontal impacts. Thirty 2-inch drops and 30 2-mile-per-hour horizontal impacts were then substituted for the original 50 drops. Later it seemed that this was not producing enough vibration injury for good observation and the period of vibration was increased to 30 minutes. These changes somewhat magnified the differences between different containers and packing methods but did not change their relative standing.

Vibration Settling

Preliminary tests indicated that vibration injury in transit is greatly increased by looseness in the pack, and that looseness may be reduced by vibration settling before lidding. Effects of duration and character of vibration settling are shown in figure 1. Eighty per cent of the settling occurred in the first five seconds and almost all of it in ten seconds. Stroke and frequency were adjusted to maintain a peak acceleration of 2g. Under this condition the best settling was attained with a stroke of about 3/16-inch at a frequency of 900 cycles per minute. This is a somewhat shorter stroke and higher frequency than is best for larger fruits.

Padding and Lidding

Tests with a few boxes showed no advantage from pads in fibreboard boxes, except that a top pad possibly allowed more variation in fill without either looseness or crushing of fruit. A cover held tightly in place appeared to be necessary to prevent serious injury from vibration.

Depth of Pack

Emperors repacked in a tight fill 12 inches deep after five months in storage showed no injury from simulated transit. Tests in December 1961 with packs from 5 inches to 13 inches deep showed no differences due to depth, because of decayed berries and resulting excessive wetness in all the boxes.

Overfill and Tightness

Measurements of injury as affected by overfill are shown in figure 2. Ribiers and Thompsons packed in cartons 8 1/2 inches deep inside were least injured when overfilled one-half inch or about 5 per cent. Apparently less overfill increased injury from looseness while with more overfill the splits were increased by excessive pressure.

Cooling and Sulfuring

As compared with grapes in a 28-pound lug, grapes tight-filled in a carton are more compact and less well ventilated. Results of cooling tests are shown in figure 3. It would apparently take about half again as long to cool 28-pound cartons as to cool 28-pound lugs in a room or in a rail car. Cartons can be cooled very quickly by use of pressure differences in a forced-air cooler, however.

There have been no tests of the penetration of sulfur into cartons.

Comparison of Tight-Fill with Standard 28-pound Lug

Observations of preliminary tests with storage Emperors in April indicated considerably less transit injury to grapes in tight-fill than to those in standard 28-pound lugs. Limited testing with freshly harvested fruit offered only one opportunity for direct comparison of tight-fills, properly overfilled and settled, with the same lot of fruit in 28-pound lugs. Results of this test are shown in figure 4.

Apparent superiority of the tight-fill should not be accepted until such tests are repeated with other varieties. Particularly the splitting of Ribiers in the tight-fill as shown in figure 2 requires investigation. Comparable measurements of splitting of Ribiers in standard lugs are not available.

Conclusion

These tests indicate that grapes may reach the market in considerably better

condition when tight-filled in cartons than when packed in standard lugs. Costs for containers, accessories and packing labor should be substantially less for the tight-fill. Installation of vibrators and carton-closing equipment would require an initial outlay, however.

There has been no investigation of sulfuring grapes in cartons or of possible alternatives. This, in connection with the known difficulty of high-stacking cartons in storage for long periods, suggests that the immediate value of tight-filled cartons may be for shipment shortly after harvest.

Experience indicates that buyers commonly question the merits of new containers or packing methods. Introduction of such developments by individual shippers may involve price discounts and years of selling effort. If grapes can be unpacked at destination in better condition from a tight-fill than from a standard lug, consideration should be given to a concerted industry effort to convince buyers of that fact.

Plans for the Future

At least one more season of tests would be required to establish a good design for a tight-filled grape carton and to demonstrate its merits as compared with other packs. The following steps are recommended if the industry wishes to continue this program.

1. A fund should be established for purchase of fruit to be used by the University for laboratory tests. The current program of solicited donations has worked well where small lots were needed. For conclusive results all the containers in one test should now be packed with fruit from a single, uniform lot. This will require larger lots than single packers should be asked to donate.
2. A cooperative survey should be undertaken by the industry and the University to determine a desirable quantity of fruit per container. Cost per pound of fruit for containers and packing is less for larger units, but units should not be larger than retailers wish to purchase, handle and display at one time. Other desirable functional characteristics should be studied also. Results of this survey should be available by the start of the harvest season.
3. A coordinated program of laboratory tests and test shipments should be arranged. The shipments should serve to check the laboratory results, the laboratory tests should attack any problems disclosed by the shipments. Containers could probably be donated by the manufacturers.

Experimental packs should be expected to sell for less than standard ones. The industry might underwrite the loss to cooperating shippers. The University can lend a settling vibrator and carton closing equipment suitable for half-car test shipments.

4. Merits of the proposed pack could be reappraised on a basis of these tests and the industry could then decide on further action.

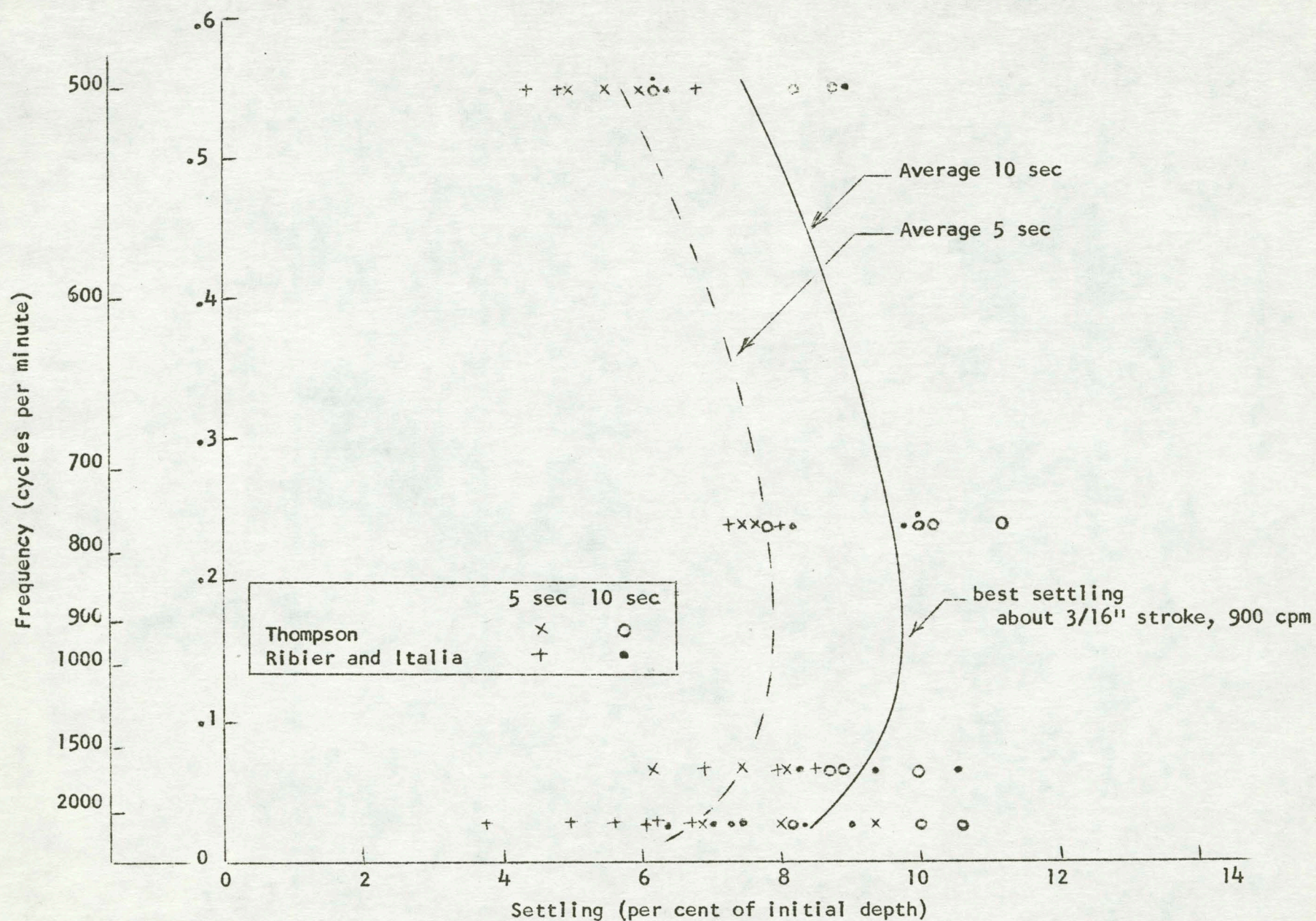


Figure 1. Vibration Settling of Grapes

Pack 10 inches deep, peak acceleration 2g. 20 pounds force down on cover.

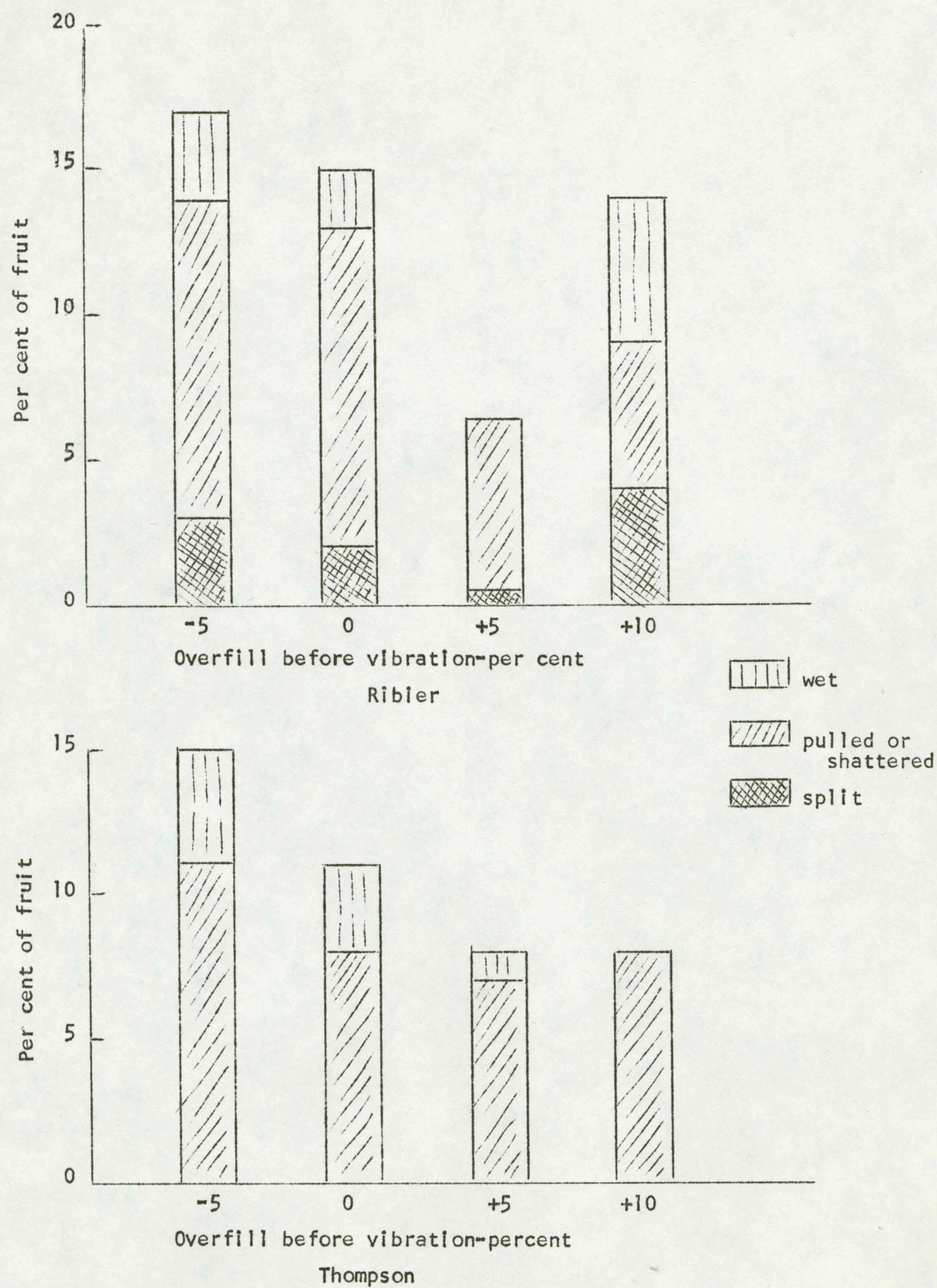


Figure 2. Simulated transit tests with grapes October 30, 1961

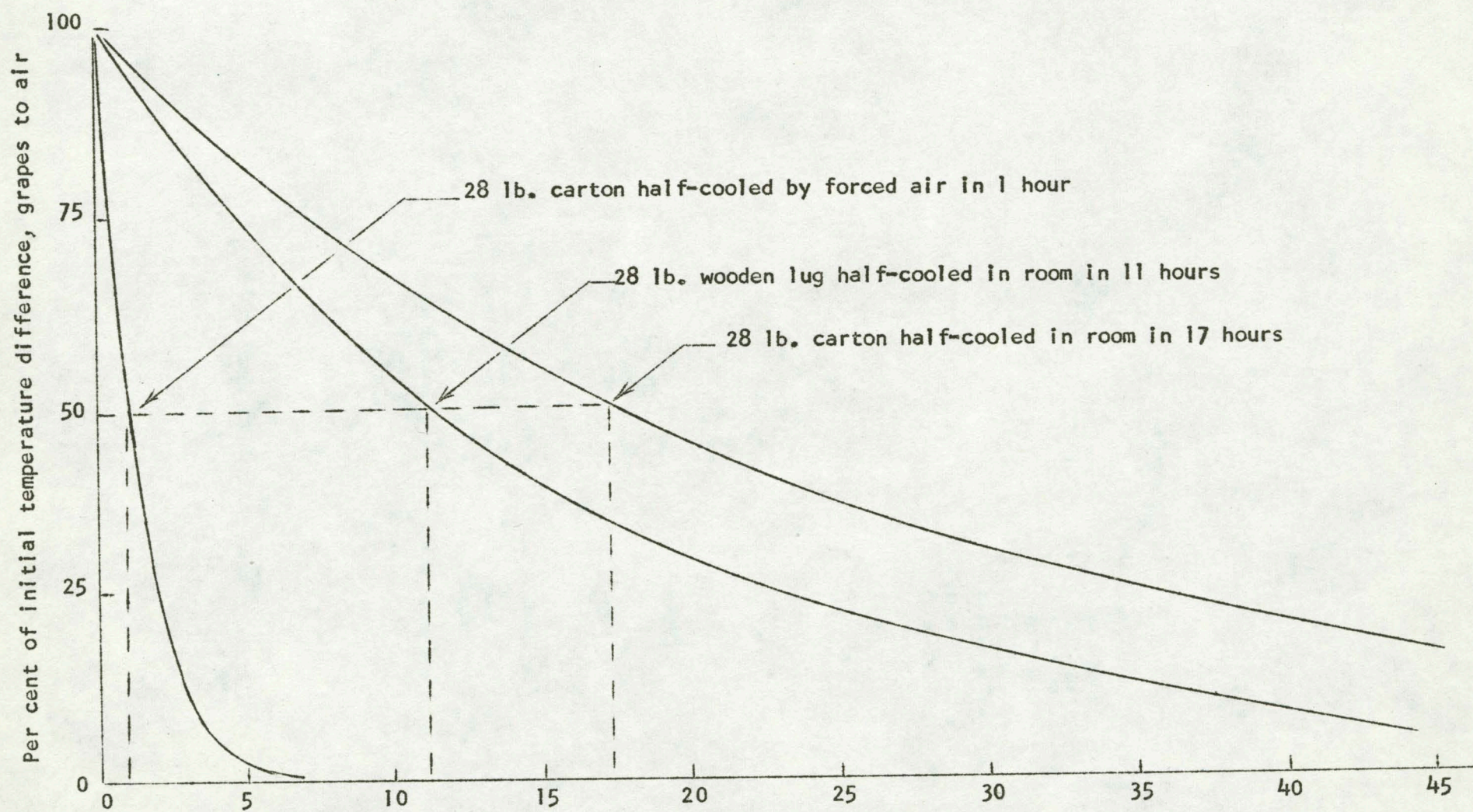


Figure 3. Cooling grapes in vented cartons compared with wooden lugs

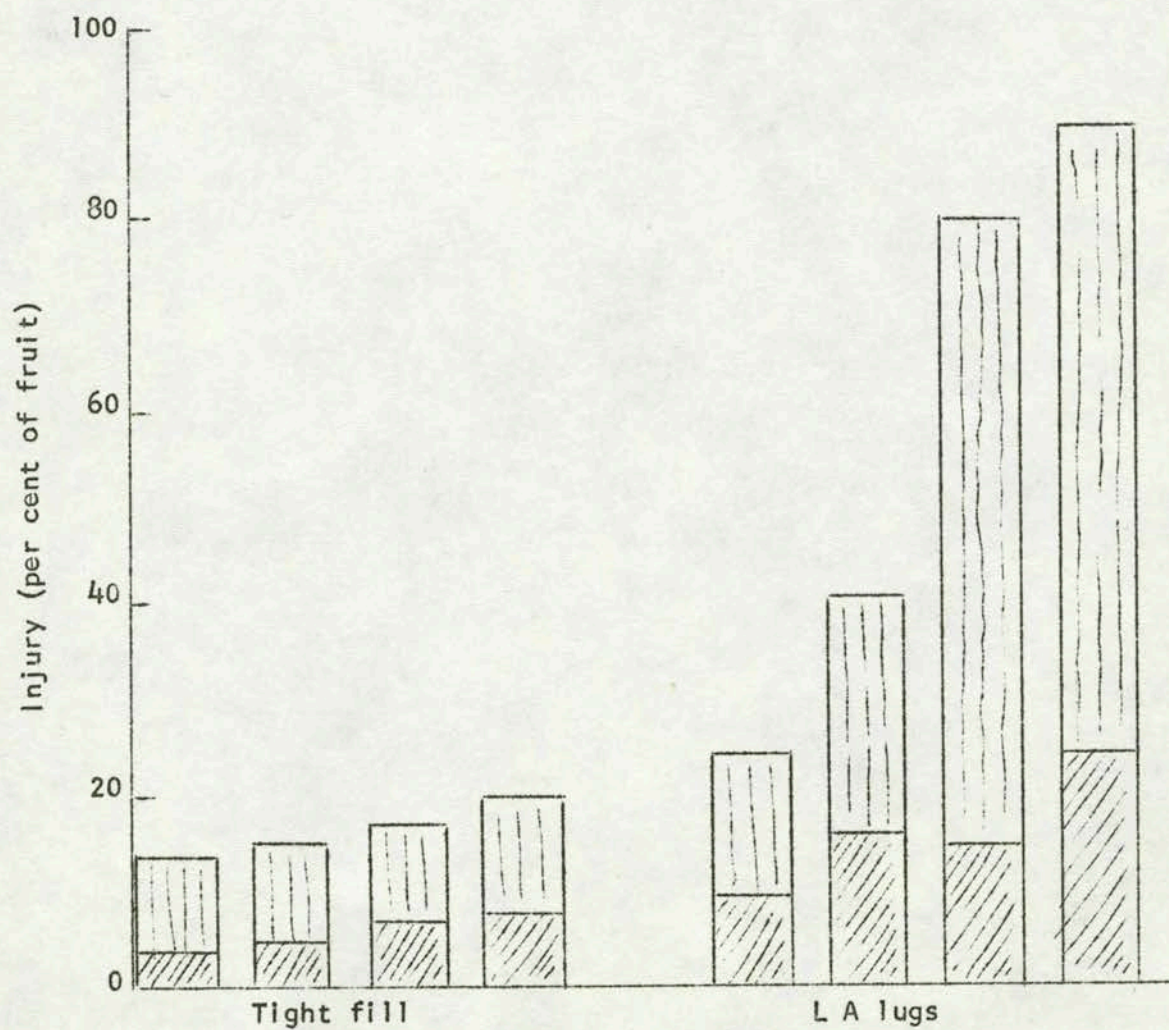


Figure 4. Injury to Thompson seedless grapes in simulated transit.

Diagonal shading indicates shatter, vertical shading indicates wetness.