

Surface Discoloration of Pears

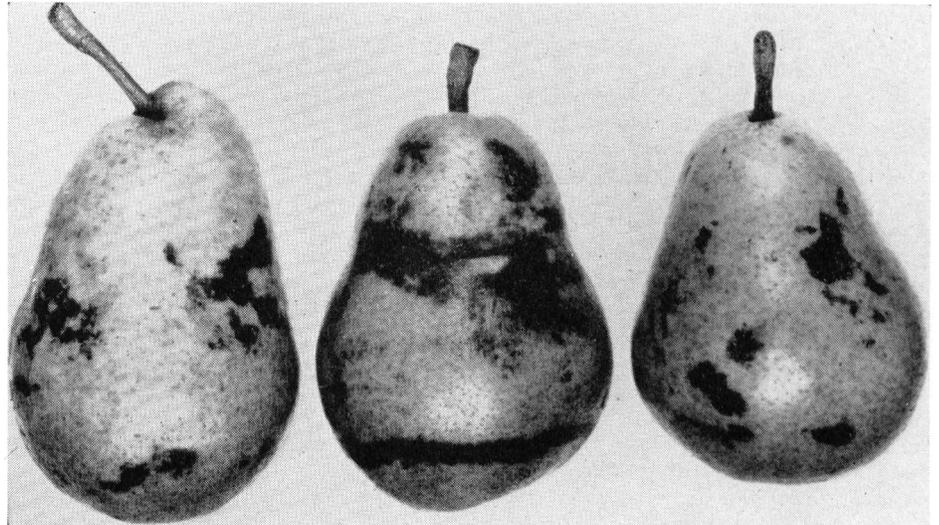
compression pads between fruit and carton lid effectively prevent transit bruising of jumble-packed Bartlett pears

Noel F. Sommer

Brown surface discoloration damage to Bartlett pears shipped in jumble-packed fiberboard cartons—during the 1955 season—caused complaints in eastern markets, particularly following rail shipments. Consequently, laboratory tests were conducted during the 1956 pear season to obtain information on the nature of the discoloration and its prevention.

Providing discoloration damage can be avoided, shipping a jumble-pack—non-wrapped fruit placed in the container without regard to any pattern—in fiberboard cartons may be possible at greatly reduced packing costs. Fiberboard cartons are less expensive than wooden boxes, and all sizing, filling, and closure operations may be accomplished by machines.

Studies indicate that surface discoloration is a type of bruise that results from injury apparently caused by vibration or impact of one fruit against another or against the container. Sometimes the injury is limited to the outer skin—the epidermis—but tissue just below the epidermis is frequently involved. Only a few minutes following injury, a darkening of the tissue can be detected. Ultimately the surface color may become dark brown. The flesh of the fruit is not damaged but the altered external appearance



Photograph by California Tree Fruit Agreement.

California Bartlett pears exhibiting surface discoloration upon arrival at the Chicago market.

may seriously affect marketability. The injured surface allows more rapid moisture loss from the fruit which frequently results in a distinct shriveled appearance by the time the fruit is offered the consumer. Furthermore, fruit with considerable surface discoloration may ripen slightly faster than uninjured

pears, and its shelf life is thus shortened. Surface discoloration is far different from the injury associated with common pressure bruises. The latter are more extensive and ordinarily injure the fruit flesh while the surface may often appear relatively uninjured.

During rail transit, the fruit in shipment is subjected to certain vibrations that cause movement of fruit not held tightly in place. These vibrations sometimes cause fruit to turn or roll continually, and the discoloration develops as concentric bands around the fruit. More commonly, irregular darkened areas appear. During truck shipments, vibrations and impacts are not severe and less discoloration occurs.

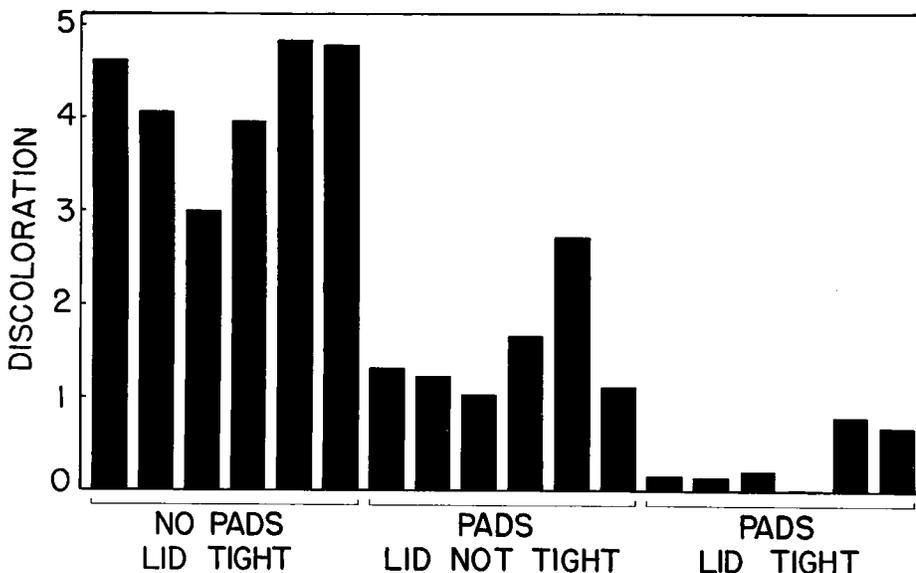
Transit Tester

To determine means of reducing or preventing surface discoloration of pears, a simulated transit tester was used to develop a standardized method of producing the injury.

Cartons of the type most frequently used—inside dimensions of about $8\frac{1}{2} \times 11\frac{1}{2}$ holding 36 to 38 pounds of pears—were selected for the tests. When constructed of 325-pound-test fiberboard, the body of the carton is sturdy

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Surface discoloration injury to Bartlett pears in cartons after a simulated transit test. Zero represents no discoloration while 5 indicates total discoloration.



DISCOLORATION

Continued from preceding page

and capable of withstanding considerable abuse. The tester was adjusted to impart vibrations to the cartons of $\frac{1}{4}$ " amplitude both horizontally and vertically at a frequency of 510 cycles per minute, producing an acceleration of one G—G signifies an abbreviation for a force equal to gravity. Nonwrapped pears jumble-packed in cartons were seriously discolored after 45 minutes on the tester. From reports and photographs of fruit at the terminal markets, it is believed that this treatment produces more discoloration than a transcontinental rail shipment. To provide even more severe conditions, a $1\frac{1}{2}$ -hour test period was most frequently used. Within the duration of this test, each fruit presumably was subjected to 183,600 impacts which were enough to seriously discolor every fruit in the container. A 3-hour test used in a few cases was believed unnecessarily destructive.

Comparison of the extent of discoloration—in relation to the position of the fruit in the carton—invariably showed that the fruit in the bottom half was less seriously damaged, suggesting that these pears were held in place to some extent by the weight of fruit above. When pears in contact with the carton wall were compared with fruit in the interior of the package, differences in discoloration were very small. Evidently rubbing against the wall of the fiberboard container is not—to any important extent—more damaging than rubbing against other fruit.

Measures designed to prevent surface discoloration involved either an attempt to stabilize the fruit in the container or the use of protective materials on the pear surface to prevent injury when movement occurs.

Loose packing materials—including shredded paper, shredded polyethylene film, and polyethylene discs of 1" diameter cut from polyethylene film—placed in the carton with the fruit reduced the amount of discoloration but ordinarily did not prevent it.

Of the various measures tested, the use of padding was by far the most promising. It was found that injury could be almost entirely prevented if an inexpensive, commercially available pad—a kraft paper envelope filled with shredded paper or excelsior—was placed over the fruit and compressed in place by tightly fastening the carton lid. The compressed pad thus appears to function in a manner similar to the bulge of a standard wooden box. Pads under the fruit were relatively ineffective. Even above the fruit, the pads failed to provide sufficient protection without some compression.

The effectiveness of this packing pro-

cedure depends upon maintaining the slight compression of the pad over the top of the fruit throughout the transit period. If the compression is lost—by failure to fill the container sufficiently, by failure to fasten the lid tightly, or by the settling of fruit during transit—discoloration damage can be expected.

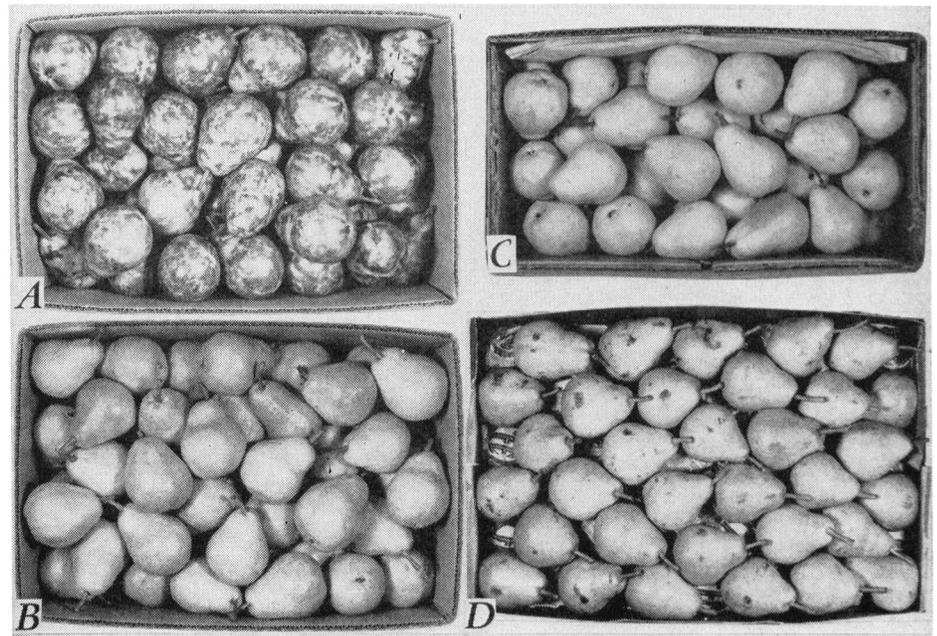
The carton lid can be closed effectively with a strong filament-type adhesive tape, but staples are probably equally effective and may prove a more convenient method of closure.

In one controlled test, 18 cartons—each holding 36 pounds of jumble-packed pears—were given an identical $1\frac{1}{2}$ -hour test on the simulated transit tester. The

much better than none at all. The fruit in the six cartons without pads was almost all badly discolored. The average score was 4.24. These data were found to be highly significant.

Pears of various stages of maturity were packed by the first of these three methods. All rode equally well as nearly as could be determined in these tests, including near ripe fruit that had a Magness-Taylor pressure test of only six pounds. While nearly ripe pears are apt to be much more severely damaged if allowed to move in the container, the degree of ripeness apparently has little effect upon the ease of holding fruit tightly in place.

Pears after a $1\frac{1}{2}$ -hour simulated transit test. A. Carton without a compression pad. B. Carton with a compression pad and lid fastened. C. Carton with side removed to show compression pad in place. D. Standard wooden box with wraps removed from pears in the top layer to reveal discoloration injury.



first six cartons were provided with top padding and the lid fastened to compress the pad. Another six cartons were provided with identical pads but the lids were not fastened in place. The remaining six cartons were not provided with pads.

At the end of the $1\frac{1}{2}$ -hour test, the individual pears were rated as to severity of skin discoloration according to an arbitrary scale of 0-5. Zero represented the complete absence of discoloration, while five indicated almost complete surface discoloration. On this scale, fruit in the six padded and tightly fastened containers received an average score of 0.33. Only a few pears showed any trace of discoloration even upon careful inspection. Fruit in the six cartons with pads but with the lids not fastened suffered intermediate damage. The average score of 1.51 indicates that discoloration was prevalent but that loose pads were

The use of padding in the cartons does not greatly increase the cost of the package.

In a few trials, wrapped fruits were hand-placed in the cartons, but the wraps were not effective in preventing discoloration. Only when compression pads were also used on top of the fruit was discoloration eliminated. Furthermore, the hand-wrapping of fruit would detract from a major advantage of the carton, which is its suitability for mechanized operations.

In several tests, wax was applied to provide a protective coat to the surface of the fruit. The reduction of discoloration, however, was too small for wax treatment to be considered a promising means of control.

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