REDUCING SURFACE INJURY ON PEARS

F. Gordon Mitchell & Gene Mayer
Pomology Department, University of California at Davis

Surface marking is a major cause of rejection and reduced value of Bartlett pears in the marketplace. Transit vibration from packer to market has long been recognized as an important contributor to this, and tight-fill packing was designed to minimize this problem. Unstudied have been the effects of modifying procedures from field to packer to reduce such injury accumulation prior to packing.

This study had as its major objective the evaluation of field handling procedures to reduce injury. Secondary objectives were to observe packinghouse effects on the accumulation of injury, and to observe possible problems associated with the tight-fill packing procedures as currently practiced. Work was also coordinated with a parallel study of the Pear Committee which monitored injury accumulation from packer to market.

Transport Vehicles

Many pears move on semi-trailers and double trailers, so evaluation concentrated on these. In only one case was partial air suspension available for study, and this resulted in the lowest acceleration measurements among vehicles evaluated. Data on acceleration and injury on air suspension equipped vehicles and on various types of carriers used for stone fruits should be applicable here. There was a large difference in acceleration levels among the pear trailers evaluated (Table 1):

Table 1. Acceleration measurements on trucks moving Bartlett pears from field to packer.

Trailer Length feet	Distance miles	Avg Speed mph	Acceleration Avg g	Acceleration Peak g
24*	17	50	.18	.36
20	18	45	.24	.52
24a**	22	50	.32	.82
24b	22	35	.28	.95
24a**	24	50	.56	1.20
24b	24	50	.26	.56

*Air suspension tractor only; all others leaf suspension.

**Each set consists of 2 truck-trailers traveling identical routes.

Because each test is independent it is difficult to duplicate all conditions to allow comparison between tests. However, two sets of paired comparisons were conducted using different equipment and traveling the same identical routes. These show as much variation among equipment of the same type as between types of equipment. Evaluations of the effect of load suggest that

partial loads should be avoided when possible. Because front and rear truck positions showed greater acceleration and injury on stone fruits, when partial loads are transported they should be centered on the trailer. There were no apparent differences between top and bottom bin positions.

Bin Liners

Some corrugated bin liners and a few plastic side liners are used to move pears from field to packer. Early tests showed that bin liners may have a major influence on injury accumulation, thus many tests were conducted comparing nonlined bins, corrugated liners and a variety of plastic liners. The large number of tests allowed the pooling of data for direct comparison (Table 2):

Table 2. Effect of bin liners on injury of Bartlett pears moving from field to packer.

Treatment	Total Observation	Mean injury Score*	Standard Deviation
Unlined bins	55	0.68	0.31
Corrugated liners	42	0.66	0.48
Plastic liners	47	0.14	0.12

*Injury scored on 0.5 scale: 0 = no injury, 5 = unmarketable. Score shown is a mean of a 50-fruit sample.

The 144 total observations represent measurements on many vehicles. Because of the strong position effect, limited comparisons are possible on any one vehicle. The plastic liners greatly outperformed corrugated liners, which caused injuries equal to unlined bins. Among plastic liners there were no differences between the single sheet (so called "one way") liners and small (3/16-inch thick) or large (1/2-inch thick) bubble liners. All reduced injury (of fruit in contact with bin sides) by 80 to 85%. In the approximately 25 mile transit, pears, unlike stone fruits, did not show significant fruit marking except in contact with the bin.

Antioxidants

Tests were conducted to evaluate the effect of antioxidants in reducing surface marking on Bartlett pears. To explore the effect on transport after storage, the tests were continued for three months after harvest. Ethoxyquin, an anti-scald treatment for pears, provided a slight but insignificant injury reduction during the first 2 months following use; other materials showed no benefit, except that DPA (diphenylamine) showed a slight initial effect.

Injury Through the Packingline

Forty-eight samples of fruit were drawn at the end of the packingline from 7 packers. Mean injury scores of the 7 packers ranged from 0.20 (very slight) to 1.62 (approaching severe surface marking), and averaged 0.66. Thus considerable surface marking accumulated through some field and packing systems.

Evaluation of Test Shipment

In coordination with the study of injury in transit to market, samples submitted by cooperators were evaluated prior to shipment. A total of 44 packages from 6 packers (ranging from 4 to 12) were submitted for evaluation. Injury scores ranged from 0.33 to 1.28, and averaged 0.79, slightly higher than sampled from the packinglines.

Net weight measurements of the 44 test containers ranged from 32.5 to 39.1 pounds. While containers are marked 36 pounds net weight, they are designed to hold about 37 pounds to allow for shrinkage. Thirty percent of the containers ranged from 32.5 to 36.2 pounds and would probably all be underweight upon arrival. Another 12% ranged from 38.4 to 39.1 pounds. The light weights provide opportunity for movement within the package during transport which may result in added injury before arrival in the destination market.

Effectiveness of Tight-Fill Packing

Careful observation of tight-fill pack equipment operation suggests serious problems arising from packaging changes of recent years. With the advent of the tray-form body and automatic setup, containers now enter the vibrator right-side-up rather than inverted as formerly. This position does not facilitate holding the lid off of the fruit at the start of vibration settling. This allows damping of vibration of the fruit, and settling does not occur. This can result in side and top bulge and may cause jamming of the case sealer. The obvious immediate solution is to reduce fill weight, which may explain the 30% underweight containers found in package sampling. Both the incomplete settling and light weights allow fruit movement during transit and probable increased transit injury.

Conclusions

Transit injury from field to packinghouse was reduced substantially by use of any of several types of plastic side bin liners. The choice will depend on economics and ease of use. In the short hauls evaluated in this test (up to about 25 miles) there was no surface injury except against bin sides. With longer hauls, top padding such as is now used may provide considerable protection based on evaluations this season with stone fruit. Transport vehicles vary widely in level of acceleration, and there may be considerable advantage in replacing spring suspension with air suspension. There is considerable variability among packinghouses in the injury level of pears at the completion of packing. Packaging changes have not been accommodated by changes in the tight-fill packing process, and updating is needed to assure complete fruit settling within the container. More attention must be given to weight checking to assure the uniform filling of containers.