PEAR PACKAGE CLOSURE SYSTEMS[1/]

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Bartlett pears are sensitive to surface marking (transit bruising) as a result of fruit movement within packages during transport to market. Studies in recent years have identified certain changes in packing line design and operation and in container design that may contribute to an increasing problem of surface marking. Other studies have related some surface marking problems to field to packinghouse transport, and have shown a potential benefit for the use of plastic bin liners. Variability in fill weight of packages has been identified as another problem that is contributing to increased transit bruising by allowing fruit movement within packages during transport.

While the tight-fill packing system was designed specifically to immobilize fruit within the package to avoid transit injury, all of the above variables can add to the injury problem and reduce fruit acceptance upon arrival in market. During the evaluation of procedures to reduce the level of transit bruising, certain changes in packaging equipment were identified as having some promise of better controlling package closure, and thus reducing the opportunity for fruit looseness within the package as compared to the commonly used systems. This test was designed to compare the effect of top flap taping with gluing, and of package closure by strapping with side stapling. Treatments were included to compare various combinations of flap closure and package closure, and to compare use of one and two straps for effectiveness in package closure.

Sized pears in the Sacramento River and Lake districts were filled to exact weight in two piece AFM tight-fill pear cartons, padded with wood excelsior pads selected for weight uniformity, and settled in place on a vibrator adjusted to 1/4 inch stroke and 1,000 cpm frequency, giving an acceleration of approximately 3.5 g. Settling was for 6 seconds with top pressure applied after about 2 seconds' free vibration.

Flap closing and packing closing were applied according to treatment. Flap gluing was with hot-melt glue and top pressure to assure bonding; taping was by an automatic tape applicator with flaps folded and drawn together. Side stapling was by a retractable anvil stapler with lids firmly seated before stapling; strapping was with a tension strapping machine. The single strap was placed around the middle of the package; the double straps were placed at about one-third positions along the package.

Packages were placed in 32°F storage, stacked so every treatment received equal exposure to stacking stresses. After 2, 6 and 12 weeks, 8 packages of each treatment were removed, subjected to a simulated transit test, held at least 24 hours for injury development, scored for injury and fruit reweighed.

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The simulated tests consisted of exposing each package to 30 vertical two-inch drops, 30 horizontal 2 mph impacts and 30 minutes' vibration at 1.1 g acceleration. Scoring was on a 0-5 scale; 0 = no injury, 5 = unmarketable, scores of 3 or higher representing serious injury. Each fruit was subjectively scored and mean package scores calculated. With 2 tests, 3 evaluations and 8 packages per evaluation, a total of 48 packages of each treatment was evaluated.

Results.

Injury scores were relatively high indicating a high level of transit injury susceptibility in 1986. During early storage, weight loss was about equal for River and Lake district fruit -- 1.6% after 2 weeks' and 3.0-3.2% after 6 weeks' storage. However, while rate of weight loss slowed for Lake district fruit with prolonged storage, this did not happen with River district fruit; at 12 weeks weight loss was 4.1% for Lake district, compared with 6.0% for River district fruit.

When top gluing and taping are compared for all packages there is a slight advantage for taping (Table 1). This advantage, though small, was consistent across all storage periods.

When side stapling was compared to strapping for all packages there is an overall slight advantage for strapping (Table 2). The data are variable across storage periods, with the greatest advantage after the longest storage period. Comparisons of 1 and 2 straps were inconsistent, with slight advantage for a single center strap following the longest storage period.

When all combinations of flap and package closure are compared, there is a trend toward lowest scores by use of flap taping and strap closure of packages (Table 3). Here again the advantages appear after prolonged storage, at which time all alternatives show improvement over the standard flap gluing and side stapling procedures. After 12 weeks, packages which were taped and strapped showed about 12-16% lower injury scores than the control (glue and side-staple) treatment.

Discussion.

There were no consistent differences in the effect of the package closure systems until the 12 week storage evaluation. By that time both flap taping and package strapping showed some benefits, with the combination capable of a moderate reduction in injury levels in tight-filled Bartlett pears.

The equipment used for strapping tests had only limited capability for varying strap tension, and all tests were evaluated with the maximum tension that could be used without strap breakage. It is possible that shorter-term differences could have been detected were greater tension control available in the strapping equipment.

A major problem in long-term storage of pears was weight loss, which can directly loosen the contents, increasing their injury potential. Even Lake district fruit lost about 1-1/2 pounds per package during the 12 week storage period. The magnitude of this loss can only be determined by weighing pears and package components separately, because the package gains weight as the fruit loses it.

There was considerable variability in injury scores among individual packages, and only by combining the results of 2 tests (16 packages) could the injury level pattern be clearly seen. Limited scale tests or observations may lead to inadequate or erroneous conclusions about treatment value.

The conclusions of these tests are that any advantage of changes in the package closing system are modest, and will become greater with time in storage. When added to the modest gains found in recent years for other handling modifications (plastic bin liners, modified tight-fill packingline, improved fill weight adjustment) the total benefit can be substantial. More effective control of weight loss during long-term storage could be more important than package closure procedures in reducing transit injury. Past studies have shown that Bartlett pear injury susceptibility also increases with time in storage, but no treatment to negate this change has been identified.

Table 1. Comparison of flap closure by gluing and taping on transit injury levels of tight-fill packed Bartlett pears.

	Average Injury Scores[1/]			
	Weeks' Storage at 32°F			
Treatment	2	6	12	Average
Flap gluing	1.02	1.32	2.47	1.60
Flap taping	0.96	1.24	2.32	1.51

[1/] Fruit scored on 0-5 scale; 0 = no damage, 5 = unmarketable, 3 or higher = serious injury.

Table 2. Comparison of package closure by side stapling and strapping on transit injury levels of tight-fill packed Bartlett pears.

	Average Injury Scores[1/]			
	Weeks' Storage at 32°F			
Treatment	2	6	12	Average
Side staples	0.96	1.24	2.54	1.58
1 strap	1.04	1.38	2.26	1.56
2 straps	0.96	1.20	2.40	1.52

[1/] Fruit scored on 0-5 scale; 0 = no damage, 5 = unmarketable, 3 or higher = serious injury.

Table 3. Effect of various combinations of flap closure and package closure on transit injury levels of tight-fill packed Bartlett pears.

Treatment	Average Injury Scores[1/] Weeks' Storage at 32°F 2	6	12	Average
Glue/staple	0.96	1.24	2.64	1.62
Glue/1 strap	1.08	1.48	2.30	1.62
Glue/2 straps	1.00	1.23	2.47	1.57
Tape/staple	0.96	1.23	2.42	1.54
Tape/1 strap	1.00	1.29	2.22	1.51
Tape/2 straps	0.92	1.18	2.32	1.46

[1/] Fruit scored on 0-5 scale; 0 = no damage, 5 = unmarketable, 3 or higher = serious injury.