Clusters of Thompson Seedless grapes placed loosely in a shipping container (left) and vibrated for several seconds settle into place with little berry shatter (right).

Vibration packing of Thompson Seedless grapes

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The method results in up to one-half to two-thirds less berry shatter than hand-packing

Berry shatter (breaking loose from the cluster) of Thompson Seedless grapes for fresh market causes losses sometimes reported to exceed 10 percent of the fruit received at retail. Added to the direct loss in weight of marketable fruit is the poor appearance of severely shattered clusters. Additional trimming costs are often incurred in preparing such fruit for retail display.

Since a previous study showed that most shatter occurs during packing and unpacking, vibration settling might reduce the problem, provided that specific packing procedures and vibration characteristics could be developed. The tests reported here explored the feasibility of using vibration settling to reduce Thompson Seedless berry shatter during packing, and investigated filling techniques, vibration characteristics, and unpacking procedures to minimize shatter.

Vibration settling, as applied to Thompson Seedless grapes, involves placing clusters loosely in the shipping container (not packing), vibrating the container for several seconds at a selected frequency and stroke, and applying light top pressure after vibration has begun. When properly done. the procedure settles the fruit into place with little berry shatter.

Test procedures

Grapes for these tests were obtained from commercial vineyards in the southern San Joaquin Valley. Hand-packing, when used, was done at time of harvest by commercial packers. Other fruit of the same lot was harvested into field picks for subsequent use in preparing the vibrated packs. Fruit was protected from warming and rough handling during transfer to Davis, stored at 41°F, and then warmed before testing until "sweating" (from moisture condensation) ended.

Except in one test comparing container types, fruit for the vibrated packs was placed in standard 5½-inch-high, paper-wood laminated (veneer) grape lugs of 13½- by 16⅛-inch horizontal dimensions. Individual clusters were hand-trimmed and placed loosely in the container. Because containers were not hand-packed, they appeared considerably overfilled before vibration.

Vibration settling was on a laboratory model fruit vibrator, of identical characteristics to those used for commercial tight-fill fruit packing, having two opposing-eccentric weight systems capable of adjustment for both frequency and stroke. Vibration was for six seconds, with a light top pressure applied by a hand-held plywood platten during the last three to four seconds. All containers were covered with standard paper-wood laminated lids. Settling efficiency was determined after vibration by measuring the height of the pack on a grid pattern across the inner container surface.

Unless otherwise specified, unpacking was by inversion, whereby the lid

TABLE 1. Effect of fill density on berry shatter of vibrated-pack Thompson Seedless grapes

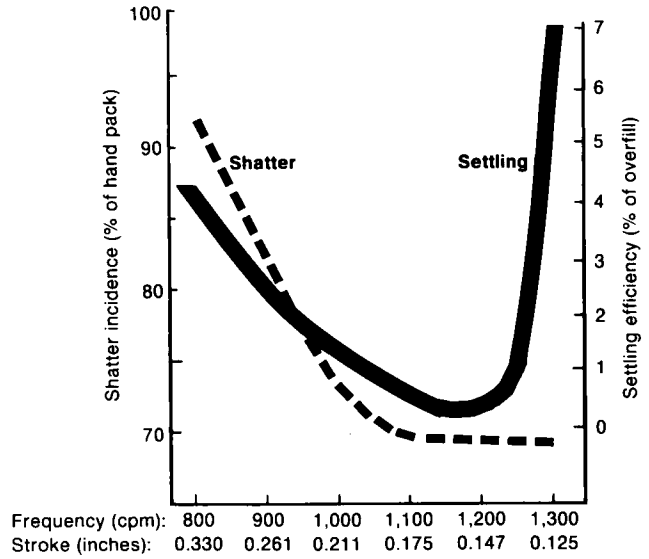
Fill weight in 5½-inch lug	Fill density	Mean shattered berries/container*
lb	*lb/ft³*	*number*
20	28.7	54 c
21	30.1	53 c
22	31.6	61 bc
23	33.0	78 b
24	34.4	110 a

*Values not followed by the same letter are significantly different at the 5 percent level as measured by Duncan's Multiple Range Test.

TABLE 2. Comparison of shattering under three unpacking methods

Packing method	Berries shattered		
	Cluster removal	Inversion	Dumping
	%	%	%
Vibration	1.5	1.9	3.9
Hand	3.9	4.1	7.0

VIBRATION SETTLING OF THOMPSON SEEDLESS GRAPES



Best settling occurred at frequency and stroke adjusted to produce 3 g acceleration. Minimum shatter was at 1,100 cycles per minute (cpm) or above.

was removed, the container inverted with the fruit hand-held in place, and the container then lifted from the mass of fruit. One test compared unpacking by inversion with dumping and cluster removal. Where unpacking was by dumping, the open container was inverted from a height of about six inches above the counter. Unpacking by cluster removal started with pulling the "key" cluster in hand-packing, and a random cluster in the vibrated pack.

Shatter was determined by lightly shaking and turning each cluster after unpacking and then counting and/or weighing the shattered berries from each container. Normally 10 replications of each treatment were used in each test.

Results

Preliminary tests indicated that Thompson Seedless grapes loose-filled into standard lugs could be satisfactorily settled by vibration. The vibrated pack was similar to the hand pack in overall appearance. It was not difficult to contain the fruit during vibration.

With regard to vibration characteristics, poor settling occurred at 2.5 gravities (g), and increased shatter occurred at 3.5 g acceleration. Best vibration settling was at 3 g acceleration with a frequency of about 1,200 cycles per minute (cpm). Minimum shatter occurred at frequencies of 1,100 cpm or above (see graph). Using 1,200 cpm frequency, a stroke of about 0.15 inch is required to produce an acceleration of 3 g.

Fill densities ranging from 20 to 24 pounds in the 5½-inch grape lug were compared. The 20- and 21-pound fill weights appeared slack and underfilled; heavier packs appeared well filled. Shatter counts were considerably less in the lower density packs (table 1). The 22-pound fill weight in the 5½-inch grape lug appears to provide the best compromise between pack appearance and berry shatter.

In the comparison of unpacking methods, for either hand- or vibrated-pack, unpacking by cluster removal was best (table 2). Unpacking by inversion may be acceptable. Unpacking by dumping (which is sometimes observed in retail stores) is unacceptable because of extensive shatter losses.

The container comparison tested vibration settling in the standard grape lug, a full telescope corrugated container, and an expanded polystyrene ("foam") container. Fruit was vibrated into the container and subsequently removed by inversion. Settling efficiency and shatter counts were judged to be about equal in all containers.

Hand- and vibration-packing were compared for incidence of shatter, by using the accumulated information on vibration settling characteristics, fill density, and unpacking. Fruit in this test was more shatter-prone than that in previous tests. Shatter was 8.5 percent in hand-packed and 2.6 percent in vibration-packed grapes, a 70 percent reduction.

Conclusions

The Thompson Seedless grape shatter problem is closely associated with packing. Vibration packing can reduce berry shatter by one-half to two-thirds, with results about equal in the standard grape lug, the corrugated telescope container, and the "foam" lug.

Fruit for vibration packing must be loosely placed in the container after trimming — not packed. The opposing-eccentric vibrator used for tight-fill packing of tree fruits works well for settling grapes if adjusted to 3 g acceleration, using 1,200 cpm frequency and 0.15-inch stroke. The fruit is vibrated for about six seconds, with two to three seconds of free vibration, followed by three to four seconds of light pressure applied through a top platten. Top pressure is maintained until vibration ceases. Fill density is about 22 pounds in the standard 5½-inch grape lug (31.6 pounds per cubic foot).

Unpacking of any grape pack by cluster removal or inversion minimizes further loss. Free dumping of the fruit should always be avoided.

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