TIGHT-FILL FRUIT PACKING*

By Rene Guillou, Gordon Mitchell, H. B. Richardson, and Noel F. Sommer

University of California, Davis

Summary

A tight-fill fruit pack is produced by filling a container with fruits in random positions to a predetermined weight, settling by a few seconds of vibration, and pressing down and fastening the cover. With fruits to which it is adapted this pack eliminates hand packing, reduces injury in transit, and saves labor in retail markets or in wholesale preparation of consumer units. Tight filling is in full scale commercial use with pears, has been used on a limited scale with apricots and plums, and is in the laboratory stage with peaches and grapes. It is apparently not suitable for apples. Padding, vibration settling, and tightness of fill must be adapted to the kind of fruit.

Tight-fill defined.

The term "tight-fill" is used to designate a pack produced by filling fruit into random positions in a container, settling it by vibration, and pressing down and fastening the cover. For fruits with which it can be used successfully, this procedure offers three advantages as compared with most hand-placed packs. It reduces injury to the fruit in transit, it eliminates the labor of hand placing, and it can greatly reduce labor in retail markets.

Transit injury reduced.

Looseness in any pack can result in serious injury in fruit shipments that are exposed to severe or long-continued vibration. Roller bruising in plums and surface discoloration of pears are

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familiar examples. Vibration injury in some other fruits is not so commonly recognized. A characteristic shallow bruising of apples, apricots, peaches, and nectarines is easily produced by repeated light impacts and is quite different from the deeper bruises caused by excessive pressure or by single severe impacts. Vibration of loosely packed grapes causes shatter, wetness and loss of color, the latter being very similar to sulfur dioxide injury.

Vibration injury can be prevented by skillful hand packing. Bulged packs of pears and grapes are held tight by spring of the box lids. Pattern packs of plums, peaches, and nectarines are held tight by lateral pressure. If well made and handled with reasonable care, these packs carry without material settling or loosening. However, a growing scarcity of experienced fruit packers is making it difficult to turn out uniformly good hand-placed packs. This is reflected in complaints about arrival condition, although receivers frequently do not identify the real cause of injuries that they see.

Tightness of a tight-fill is fixed by weight of fill, vibration settling, and mechanical closing. Mechanical adjustment of these factors turns out a uniform pack independently of human skills.

Hand packing eliminated.

It is hardly necessary to say that elimination of the labor involved in hand placing is also important. Mechanization of former hand operations in all fields has given rise to the expression "Mechanize or die". There is no reason to believe that the fresh fruit trade can disregard this maxim. Tight-filling commonly reduces the cost of containers and accessories. On the other hand, it usually requires the purchase and installation of new equipment. The effect of a change-over on costs in any particular plant depends on the extent to which equipment for hand placing has been written off and on the rate at which tight-filling equipment is to be depreciated.

Savings to receiver.

A change to a well planned tight-fill probably offers greater savings in labor and in total costs in the retail market than in the packing house. Display of hand-placed packs in a retail market soon results in an unsightly accumulation of wraps, cups, trays, shims or collars. To avoid this condition and the labor of cleaning it up, it is a common practice to unpack fruits and hand place them in displays in the market. This may involve several times as much labor as was

used to pack the fruit in the first place. Some wholesale and retail dealers repack fruit in consumer units. The presence of wraps, cups, trays, etc. slows this operation. The repackers may spend as much time in handling the packing accessories as in handling the fruit.

An attractively designed tight-filled container can be used for retail display, entirely eliminating rehandling of individual fruits, and there is nothing to dispose of but the container and perhaps a pad in its bottom. Repackers can work from tight-fill containers with no motions wasted on unwrapping or on disposing of accessories.

Advertising to buyers desirable.

Buyers, however, are reluctant to believe that a tight fill can deliver fruit to them in better condition than a hand-placed pack. They commonly think of any kind of bulk fill as a cheap way of handling inferior fruit and do not even consider its labor saving and convenience in the retail market. Receivers who have given tight fill a fair trial apparently see in its use a competitive advantage and do not broadcast their experiences. We were once told by a buyer that transcontinental shipment of pears in a tight fill would ruin the fruit, although at that time a large chain in a nearby city had been buying tight-filled pears for several years and receiving them in uniformly beautiful condition. Tight-fill packing seems destined to make slow progress unless means can be devised for advertising its advantages to receivers.

Tight fill for pears.

Turning now to specific developments in tight filling, this method of shipment was first devised as a result of injury to pears shipped loose in cartons to eastern markets in 1955. Figure 1 shows injury to pears packed in three different ways and subjected to impacts and vibration in the laboratory, to simulate a transcontinental shipment. Injury in this and subsequent tests was evaluated by scoring each individual fruit on a scale of zero for no injury and five for unsalable, and calculating an average for each box. The superiority of the tight fill in this test led to a trial shipment in 1957 from Walnut Grove to New York, in which tight-filled cartons were spaced apart in a rail car to provide for cooling. Some of the cartons bulged into the air channels and loosened the packs, with somewhat disappointing results (marked "New York" in figure 2). In a second trial shipment from Placerville to Hartford, the cartons were room-

cooled and then loaded solidly in the car. These pears arrived in significantly better condition than those in the rest of the car, which were wrapped and hand placed in standard wooden boxes. The scores are marked "Hartford" in figure 2.

In 1957 and succeeding years, a tight-fill pack has been used by Kelseyville Packing Company for a substantial part of their eastern pear shipments. Current practice is to assemble half-slotted telescope cartons with pads in the covers, placing them in a mechanical sizer and filler with the covers down and the body upward with its flaps open. The filler automatically stops the flow of pears at a set weight, ejects the full carton, and starts to fill another. An operator corrects the weights if necessary and quickly hand levels the fruit before the cartons go to a case sealer. Emerging from the case sealer, the cartons are vibrated for a few seconds to settle the pack. A machine then presses down the covers and staples them in place. The pads used are paper envelopes filled with excelsior or redwood bark.

Pads in the top of the box as shipped are desirable to take up small differences in the fill and to keep the top fruits from moving. Pads in the bottom of the box have not been found necessary for pears and are not used. Pears tight filled in nailed wooden boxes, stiff enough to hold the pack tight, have been compared with cartons in simulated transit tests, with no significant difference in injury.

Cooling tight-filled pears in rail cars was an unsolved problem until the past season, when it was suggested that the cartons might be provided with top and bottom vents, with two narrow pads placed one on each side of the top vents. The cartons would then be loaded solidly, with the top and bottom vents lined up, so that the car fans would force cold air downward through the load. A half-car loaded in this way cooled faster than the standard wrapped pack in the other end of the car, and arrived in Scranton with less injury, as shown by the scores in figure 3.

Apricots, plums, apples.

Tight-fill packs of apricots and plums can be made up just as with pears, with top pads only, and in simulated transit tests show less injury than occurs in the usual Los Angeles lugs or four-basket crates. At least one packer shipped tight-filled apricots on a limited scale in 1961, and the receivers were well satisfied.

Possible use of tight fill for other fruits was investigated at Davis in 1961 by means of simulated transit tests. Apples are the

one fruit with which tight fill has been found inferior to the conventional pack. Apple-to-apple contact in a tight fill has resulted in impact bruises that can be avoided by the use of pulp trays.

Peaches.

Efforts to level the top surface of a tight-filled peach pack by vibration resulted in considerable injury to the fruit. Better results were obtained by a very short period of vibration, about three seconds, sufficient to settle the pack but not to level the top surface. The top was then leveled by filling the voids with loose excelsior. This, in combination with an excelsior or bark pad in the bottom of the box, produced a pack that was less injured by simulated transit than was the usual cup pack. Figure 4 shows measured injury in a season's testing. Tight-fill packing of peaches should be regarded as promising but not proven until tested in trial shipments, such shipments may be arranged in 1962.

Grapes.

Work with grapes in 1961 has been of a preliminary nature only. Indications are that considerable transit injury to grapes as hand placed in lugs results from settling of the pack in transit and subsequent vibration of the fruit. Possibly an important advantage of the very shallow boxes, toward which the trade has been moving, is that settling is controlled. Preliminary settling by vibration before the lid is applied can almost eliminate settling thereafter. This may control transit injury, even in a deeper and more economical box than has been considered feasible in the past. Figure 5 shows injury in one simulated transit test in which a tight-fill nine inches deep was compared with conventional 28-pound lidded lugs. More work is needed to determine the best tightness, depth of fill, and type of padding, particularly for a large-berried variety like the Ribier. Cooling and sulfur penetration must also be investigated. Information adequate for trial shipments is not likely to be available until late in the 1962 season, at the earliest.

Vibration and closing.

Success of tight-fill packing depends on adequate settling before the container is closed. Proper vibration is necessary. Figure 6 shows approximately the relation of settling to time vibrated, which is

roughly the same for the various fruits studied to date. Vibration after filling was more effective than vibration while filling, though both together were most effective. In these tests vibration while filling and after filling was at the same severity. In commercial operations vibration while filling must usually be at reduced severity - and effectiveness - to avoid injury from long-continued vibration of the first fruits placed in the containers. Five to ten-seconds vibration after filling has given good settling with no visible injury to the fruit, except that three seconds has proved safer for peaches.

Figure 7 shows the relation of settling to the frequency and stroke of the vibrator. Shorter strokes and higher frequencies appear to be better for the smaller fruits. The relation is not critical in the vicinity of 800 cycles per minute, but direct operation with a 1750 rpm motor, as sometimes used, is much too fast. Other tests have shown best results from vibrating after filling, with a light pressure of around 10 pounds per square foot on the top surface of the fruit. Vibration while filling has reduced the final depth of the pack by about two per cent. Hand leveling before the final vibration has reduced the final depth by one per cent. Vibration while filling, followed by hand leveling and no further vibration, has reduced the depth by two per cent less than vibration after filling only.

Closing pressure for best tightness of fill varies from two pounds per square inch commercially used with pears to one-half pound per square inch indicated by tests with peaches. Specific figures have not been determined for other fruits, though around one pound per square inch appears to be satisfactory for plums and apricots.

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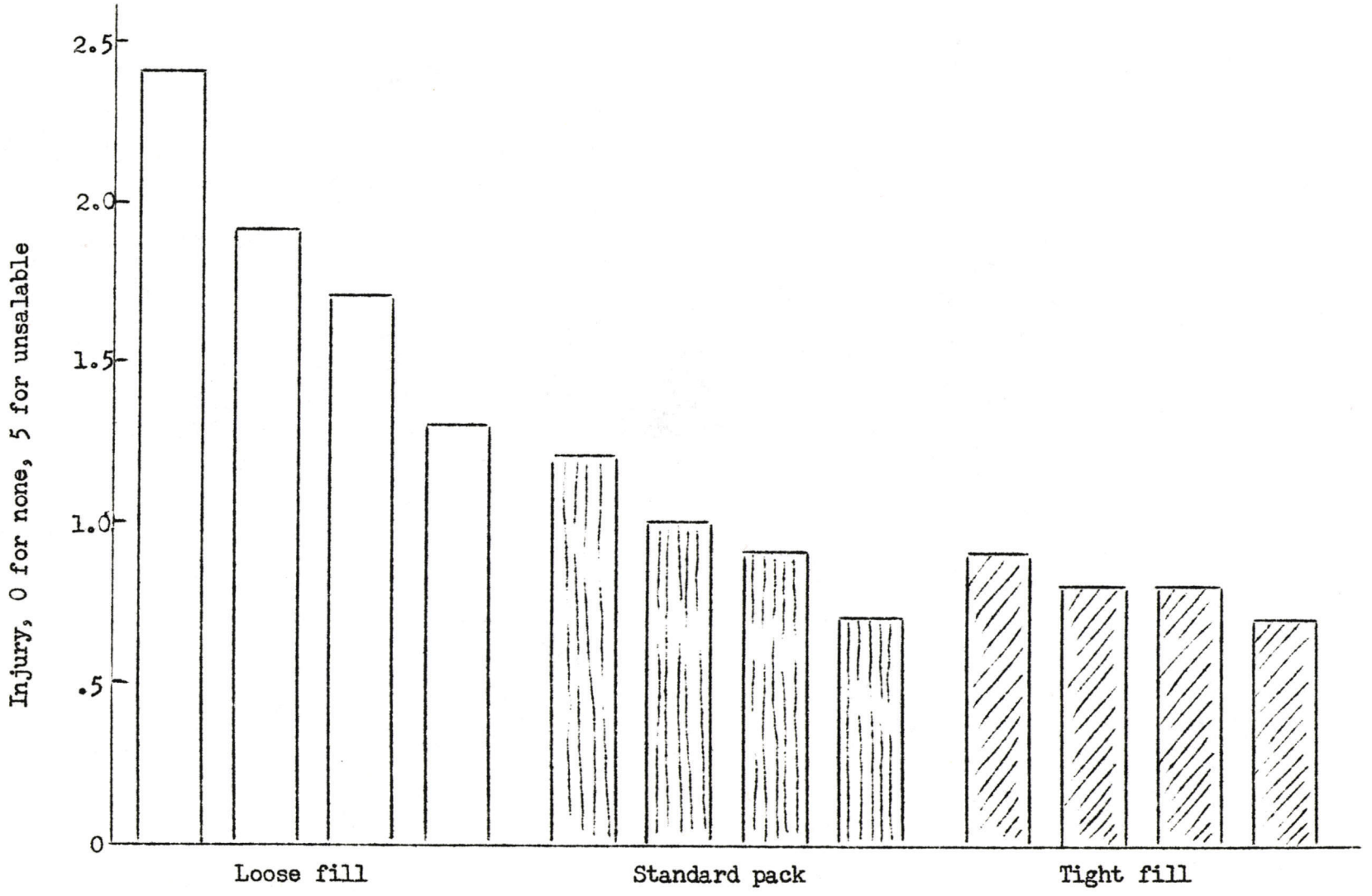


Figure 1. Injury to Bartlett pears in simulated transit tests.

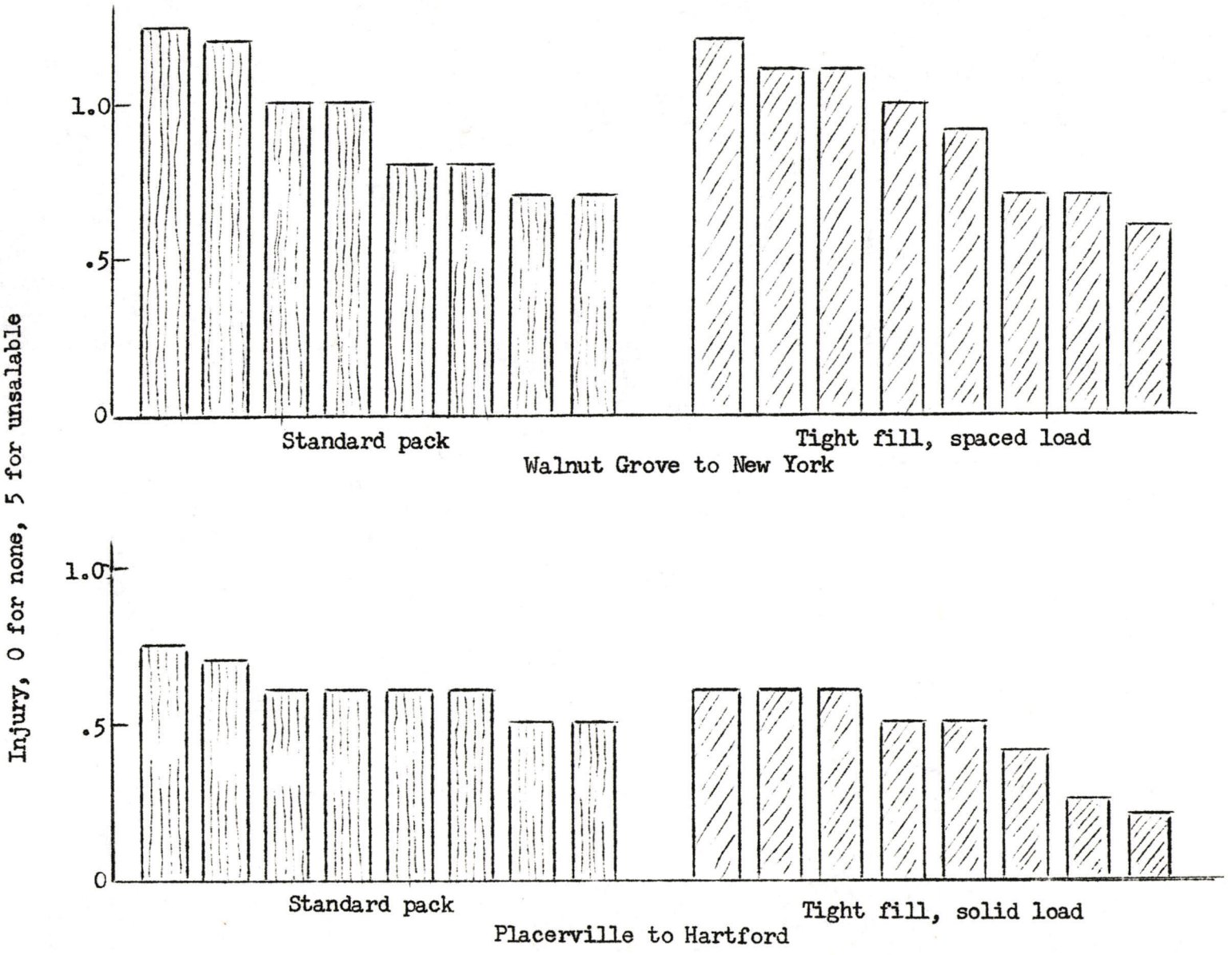


Figure 2. Injury to Bartlett pears in test shipments

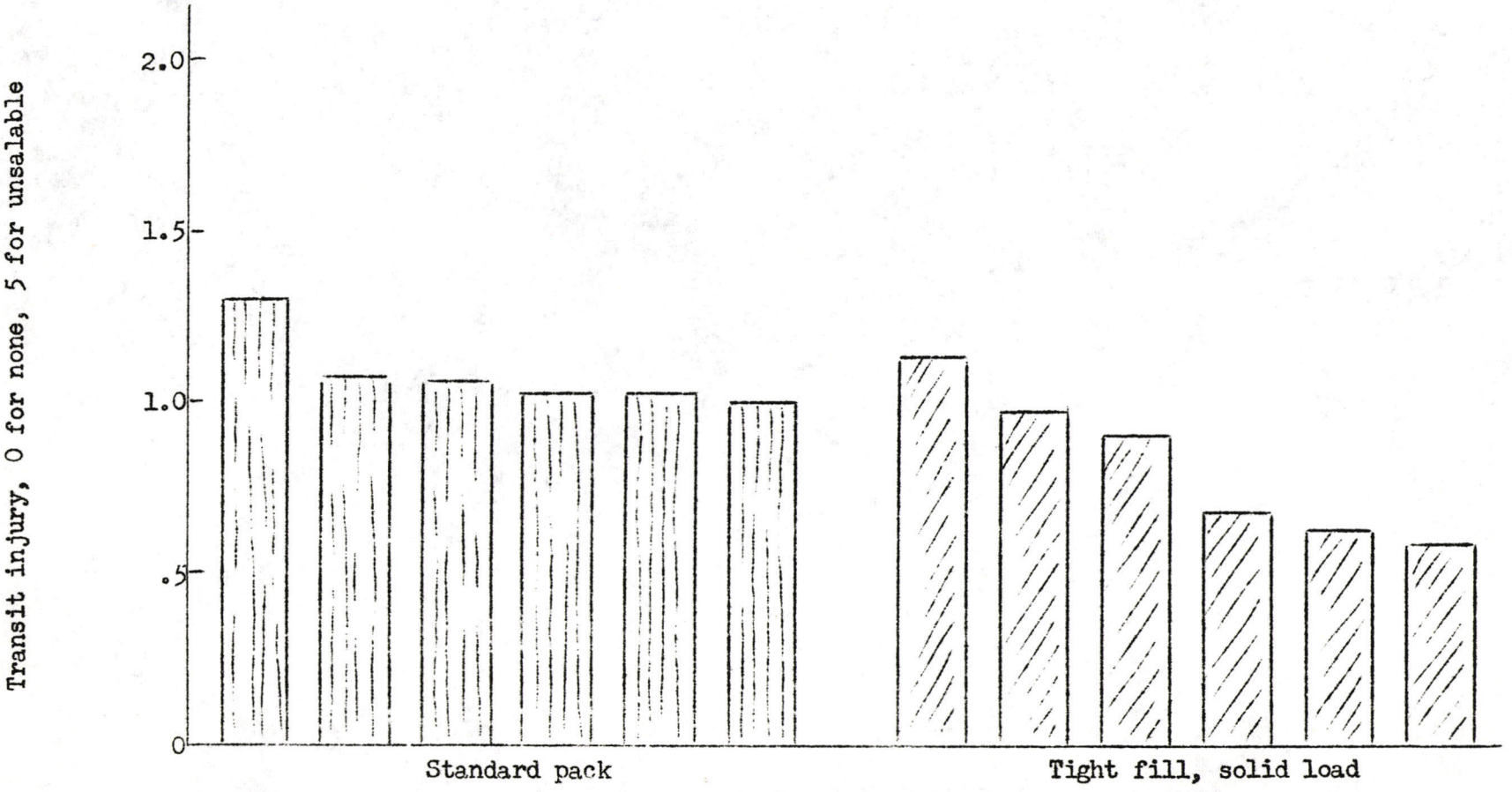


Figure 3. Injury to Bartlett pears in test shipment, Dantoni Orchard to Scranton

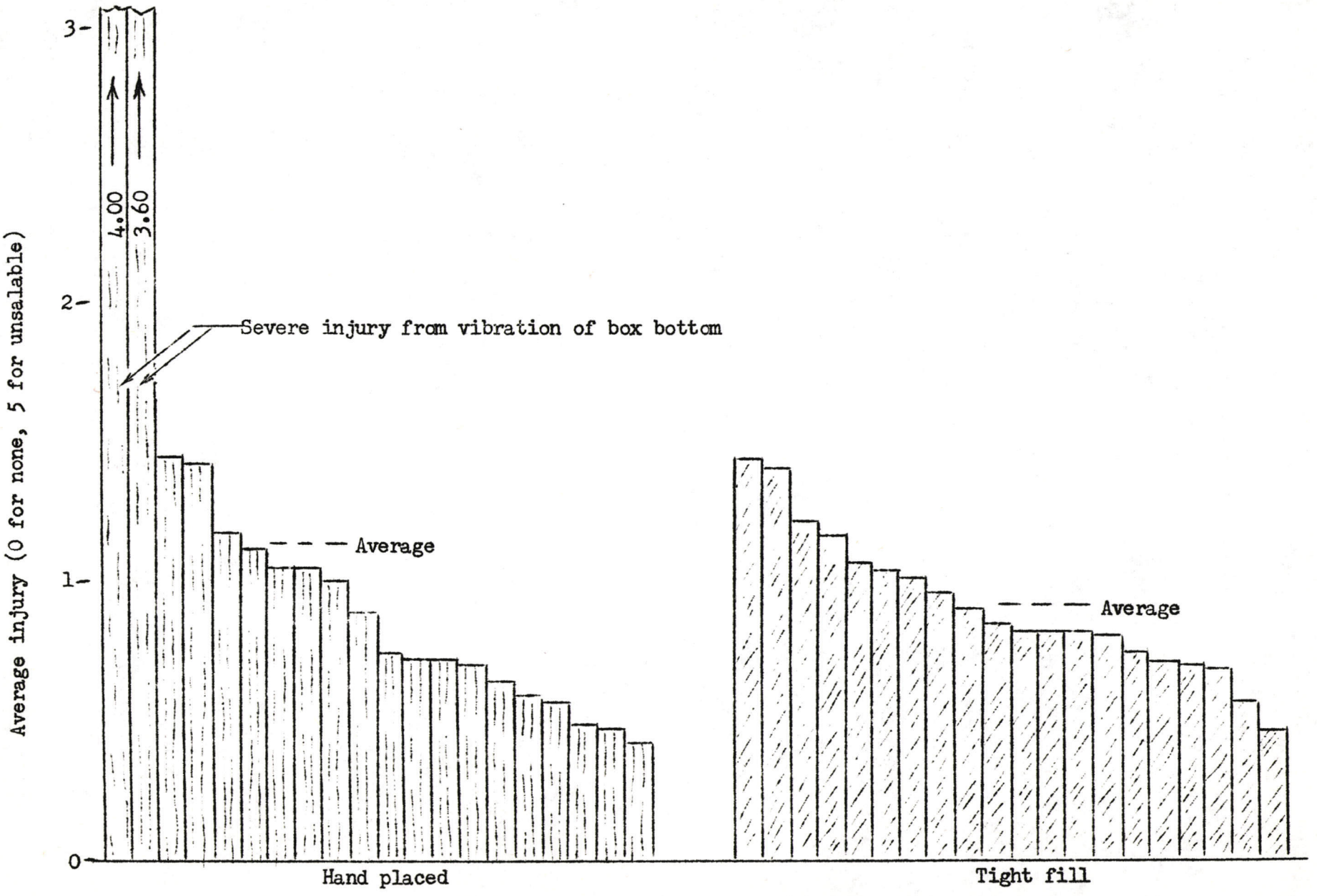


Figure 4. Injury to peaches in simulated transit, six varieties.

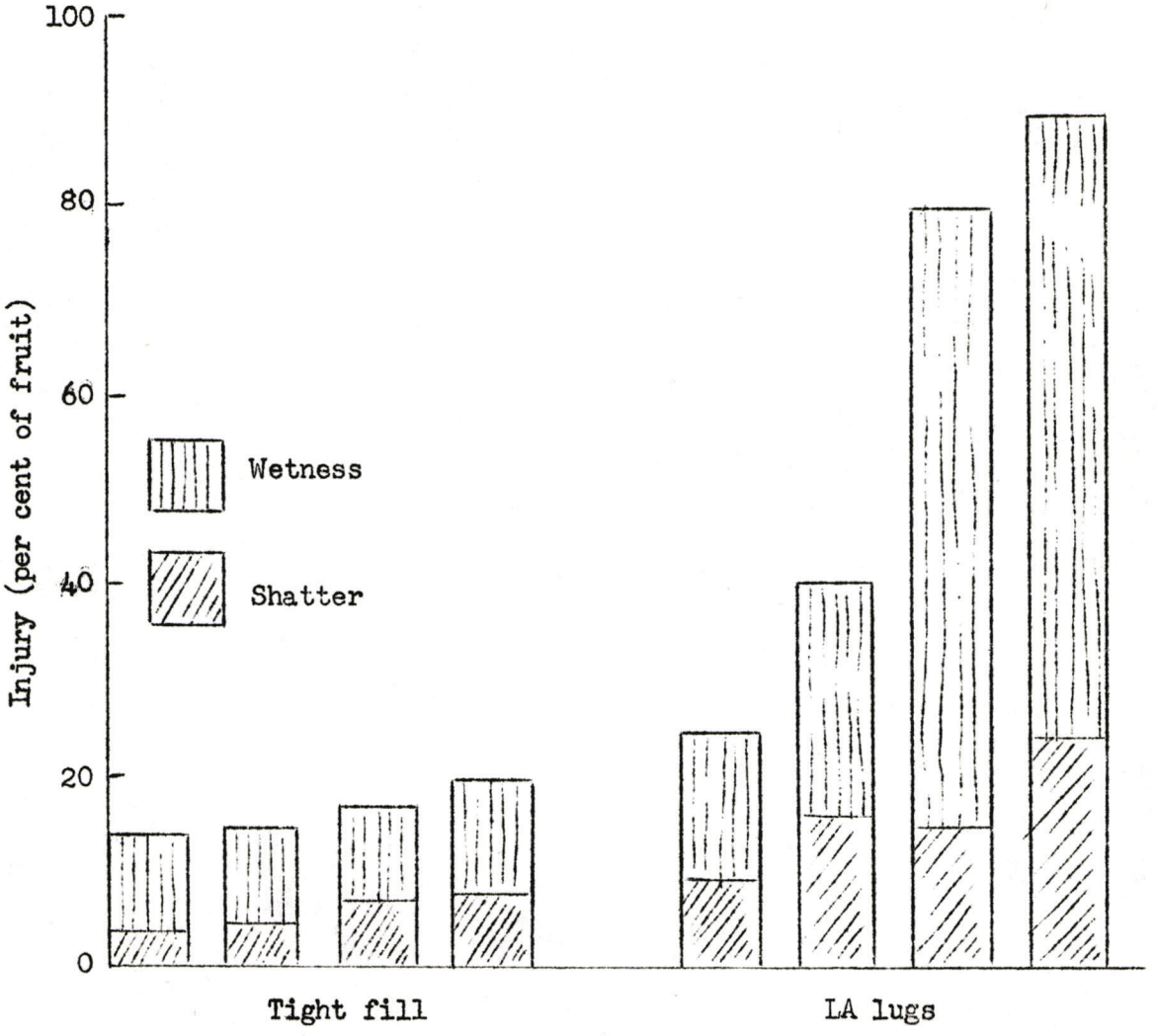


Figure 5. Injury to Thompson seedless grapes in simulated transit.

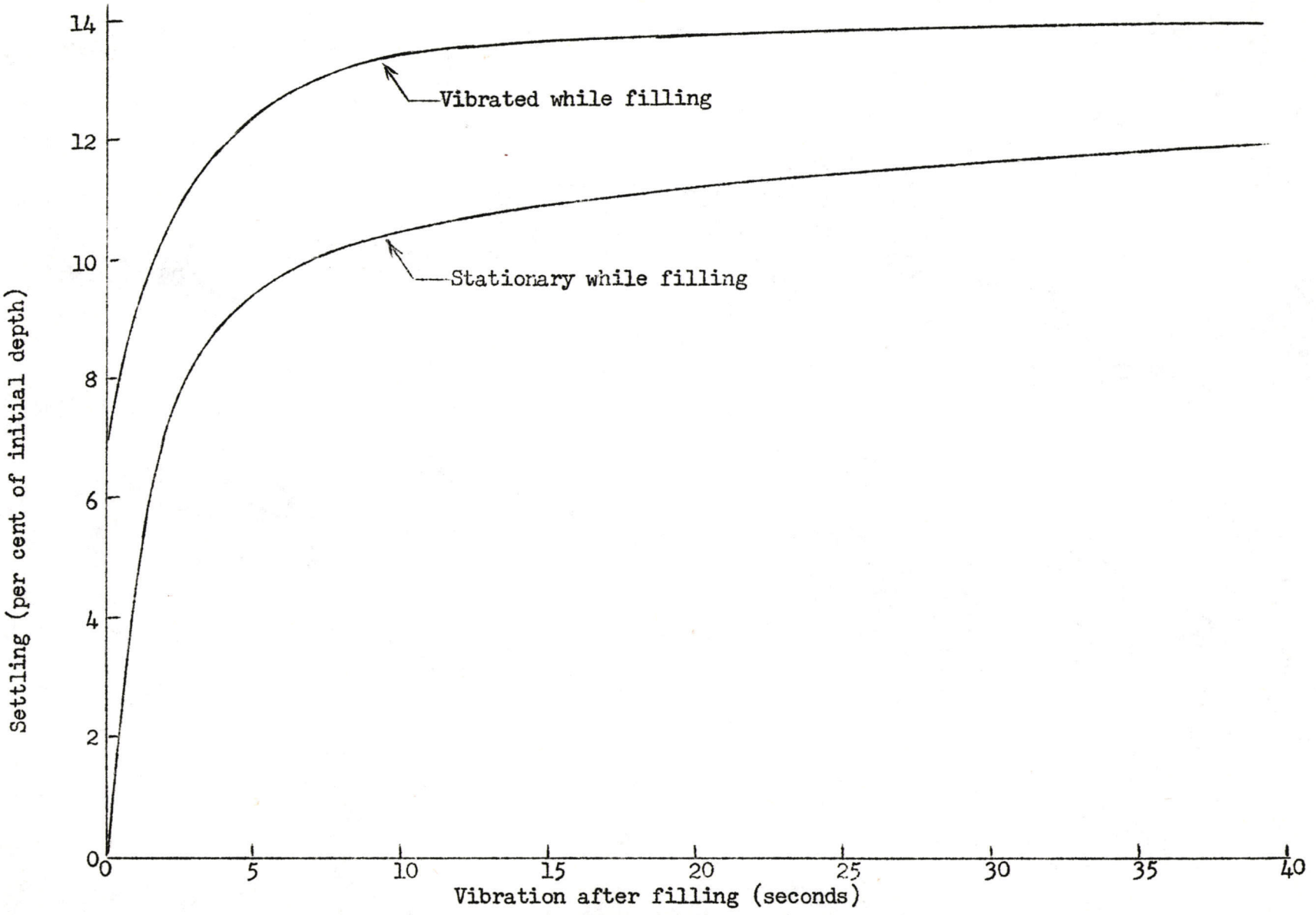


Figure 6. Settling plums by vibration at 776 cycles per minute, 1/4-inch stroke.

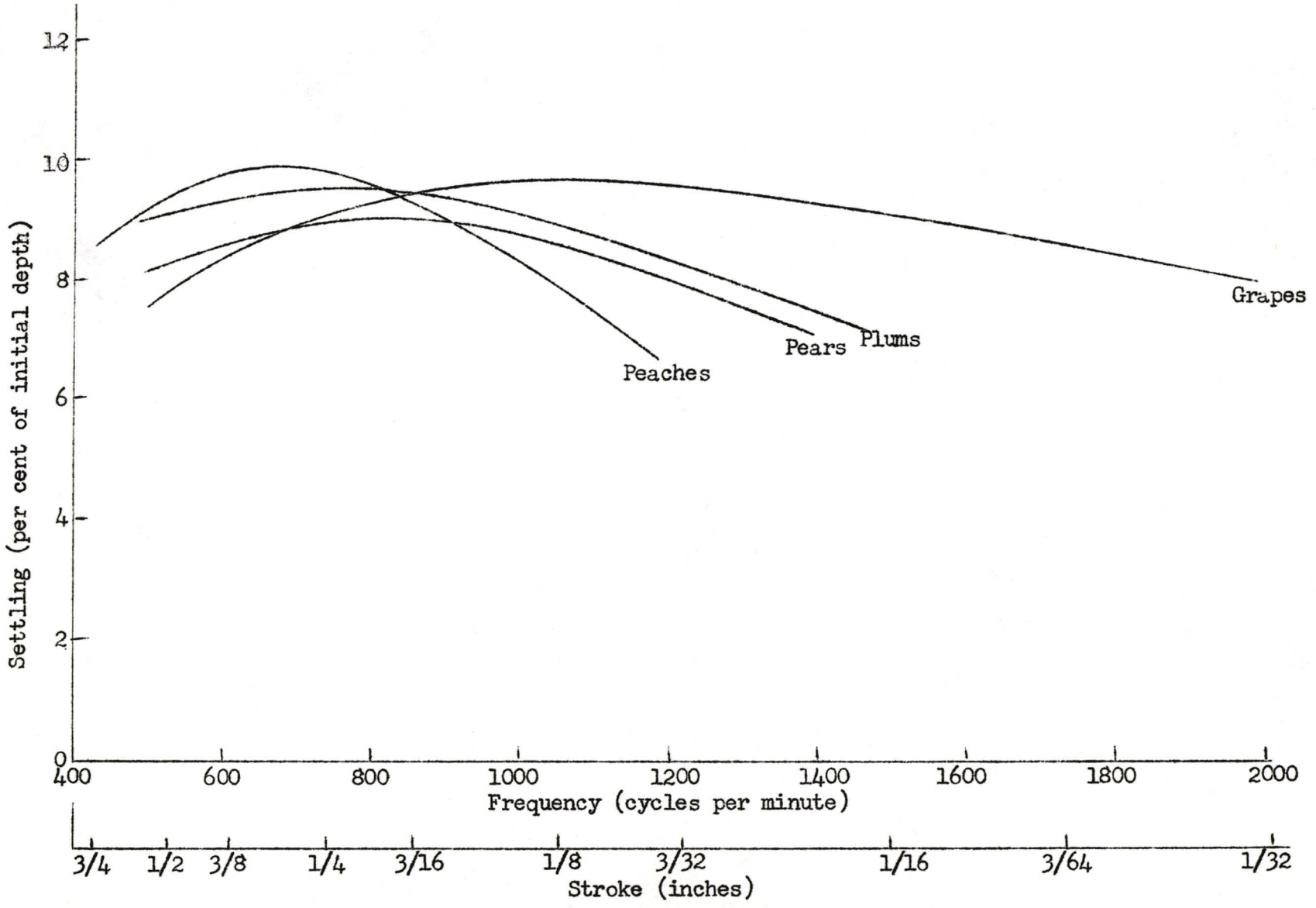


Figure 7. Settling by 5 seconds vertical vibration at 2 g peak acceleration.