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College of Agriculture

Mechanical Injury To Potatoes From Harvester To Consumer

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IDAHO Agricultural
Experiment Station

Bulletin 280
June 1957

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Recommendations

BRUISED potatoes result from carelessness, improper handling procedures, inadequate equipment, or insufficient and improper protection. Careful and conscientious supervision, together with proper management of equipment, will practically eliminate damaged tubers.

1. Use proper cultural practices from plowing to digging.
2. Slow down the equipment—digger to $1\frac{1}{2}$ miles per hour forward speed or digger chain to 150 feet per minute or less.
3. Adequately pad the truck bed. Run unloading chain and piler chains not more than 70 feet per minute.
4. Wet cellar down each fall prior to the storage season. Soil should be moist but not muddy. Potatoes should never be placed in a warm, dry storage.
5. Remove all tubers having cuts, serious bruises, water rot, or field frost. Uninjured tubers store well without much trouble. Injured tubers require special attention.
6. The tubers in the center of the bin must be below 40° F. At 40° F with high humidity, sprouting may occur in late February or early March.
7. Maintain a relative humidity of 85 to 95 percent in the cellar to reduce moisture loss.
8. Warm tubers above 40° F before handling or sorting. Cold tubers are easily injured.
9. Inform, instruct, and train all personnel that potatoes injure easily. Potatoes are not hardware; they are fragile.
10. Don't stack loaded pallets without adequate protection between layers. This bruises and breaks potatoes.
11. Handle, load, unload, grade, and distribute potatoes gently. Don't abuse them.
12. Don't load crates on top of sacked potatoes. Provide adequate protection for the tubers during distribution.

Acknowledgment

THE author wishes to acknowledge with sincere gratitude the use of facilities and the cooperation of personnel of Safeway Stores, Inc., Easwest Produce Co., and Rexford Prepakt Co. The use of equipment of T. S. Vanderford; U.S.D.A. Marketing Service; The Pacific Fruit Express Co.; Dahlman Manufacturing Co.; Lockwood Graders, Inc.; and the Union Pacific Railroad.

Mechanical Injury To Potatoes From Harvester To Consumer

WALTER C. SPARKS*

IDAHO'S Russett Burbank potatoes have occasionally received unfavorable criticism from retailers and consumers because of the prevalence and seriousness of mechanical injuries appearing on the tubers in retail markets. How is it possible to find so many injured and cull potatoes on the retail markets when it is required by law that all potatoes shipped from the State of Idaho must pass federal-state inspection? In order to answer this question, a study, jointly sponsored by the University of Idaho and Safeway Stores, Incorporated, was initiated. The purpose of this project was to determine where, and to what extent, mechanical injury occurred on Idaho Russett Burbank potatoes from the time the potatoes were harvested until they arrived in the hands of the consumer.

This investigation was one of the largest and most extensive studies of its kind ever undertaken. It included a comparison of three different methods of harvesting:

1. The tubers were picked up by hand using both baskets and picking sacks.
2. The tubers were dug and sacked by a digger-picker designed and built at the Aberdeen Branch Experiment Station.
3. A bulker-combine harvester dug the tubers and elevated them into a truck.

Each harvester was used on each of three soils which differed in the amount of clods present at time of harvest. One soil contained no clods at harvest time, another had few to several clods, and the third had many clods. The quantity of potatoes harvested by each machine on each field was large enough to be stored and handled in a commercial manner.

After harvest, the tubers from each of the nine lots of potatoes were transported by truck to the same storage cellar where they were stored in bins. At the end of 3½ months storage, the potatoes were removed from the bins with potato forks, partly graded in the storage cellar, then transported to the warehouse for washing, grading, and packaging. The tubers were packaged in 100-pound burlap sacks, after which they were loaded into refrigerated cars and shipped to Dallas, Texas. Upon arrival, the potatoes were unloaded by using pallets and fork-lift trucks and placed on the warehouse floor. From here they were transported to the retail stores in trucks.

This same procedure was followed for three years. The amount of injury found in any one year was only slightly different from that found in any other year. The trend, however, showed

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a light decrease in injury each year the study was in progress. This seems to indicate that education of the personnel handling potatoes will reduce the amount of bruising and breakage. There was an indication that tubers from the field with no clods had slightly fewer injuries than those from the cloddy fields.

Sampling Procedure

Not less than 1000 pounds of tubers from each of the nine lots of potatoes were taken at random at each of 10 sampling points as follows:

1. As the potatoes came from the harvester
2. Immediately after the potatoes had been put into the storage bin at harvest time
3. As the tubers were taken from the storage bin after 3½ months storage
4. After the potatoes had been "scalped" or "rough graded" in the storage cellar
5. After the potatoes had been dumped into the "even-flo" hopper at the warehouse, before grading
6. Off the grader after washing and grading by the commercial or normal grading crew
7. Out of the refrigerator car at shipping point, i.e., after the sacks had been loaded and were ready for shipment
8. Out of the refrigerator car at destination
9. Off the warehouse floor after the sacks had been unloaded and were waiting to be distributed
10. Out of the retail store after distribution from the warehouse.

The tubers were carefully graded and the amount of injury found at each sampling point was recorded. The sampling points were considered in three groups because of commercial procedures; i.e., some of the culls are removed when the tubers are removed from storage and the rest at the time of washing and packaging at shipping point. Also, the responsibility or direct control of injury falls into three separate phases.

The first phase (Figure 1) consists of the harvesting and storing operations. Injuries inflicted at these points are under the direct control or management of the farmer.

In the second phase (Figure 2) the crew is under the control of the shipper. It includes the injuries occurring during the removal of tubers from storage, the rough grading in the farm cellars, and the hauling and handling from storage to packaging warehouse.

The responsibility for the injury caused during the third phase (Figure 4) is divided among the shipper (loading the car), the railroad (transportation), the broker (unloading and holding), and the retailer (distribution). This phase includes all points from washing and grading by the commercial grading crew at shipping point to the retailer at destination.

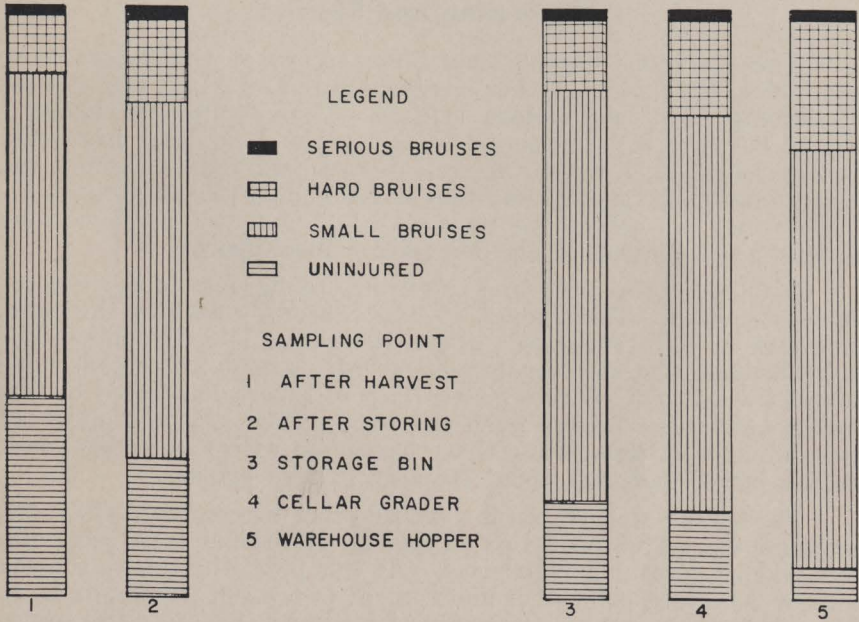


Figure 1.—Injury due to harvesting and storing.

Figure 2.—Injury due to removing from bin and hauling to warehouse.

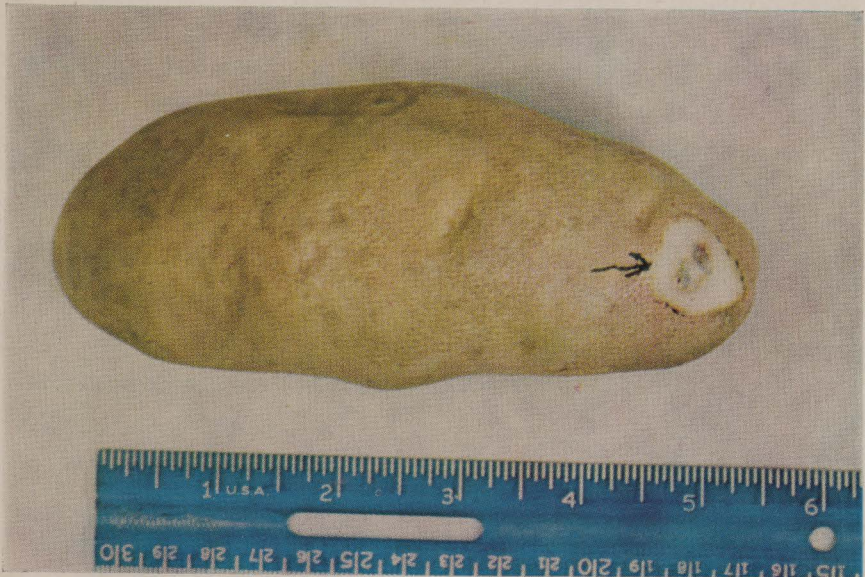


Figure 3.—Black spot due to injury during harvesting and handling.

Harvesting and Storing

These studies showed that 11.5 percent of the tubers were injured badly enough during harvesting and storing to be classed as having hard and serious bruises. This resulted in about 1 pound out of every 100 pounds of U. S. No. 1 potatoes harvested being classified as culls. These injuries occurred in getting the tubers out of the ground and into sacks or bulk trucks (Figure 1). The farmer can reduce the amount of injury caused at harvest by careful management of the harvesting machinery.

Another factor affecting the injury at harvest is the type of harvester used. The amount of culls caused by each of the three methods of harvesting was about the same, but the amount of hard bruises was significantly different. About 22 percent hard bruises were found at the storage bin in tubers harvested by the bulker-combine. Tubers from the hand-picked lots had about 12 percent hard bruises, while those harvested with the rubber-roller digger-picker had only about 10 percent hard bruises.

Filling the storage bin is another place where the farmer can save money. This operation caused an additional 1 percent cullage and 3.4 percent hard bruises. At this point the tubers showed almost 2 percent culls (2 pounds out of every 100 pounds of U. S. No. 1 potatoes) and 14 percent hard bruises. According to previous studies*, about 20 percent of these badly bruised tubers will

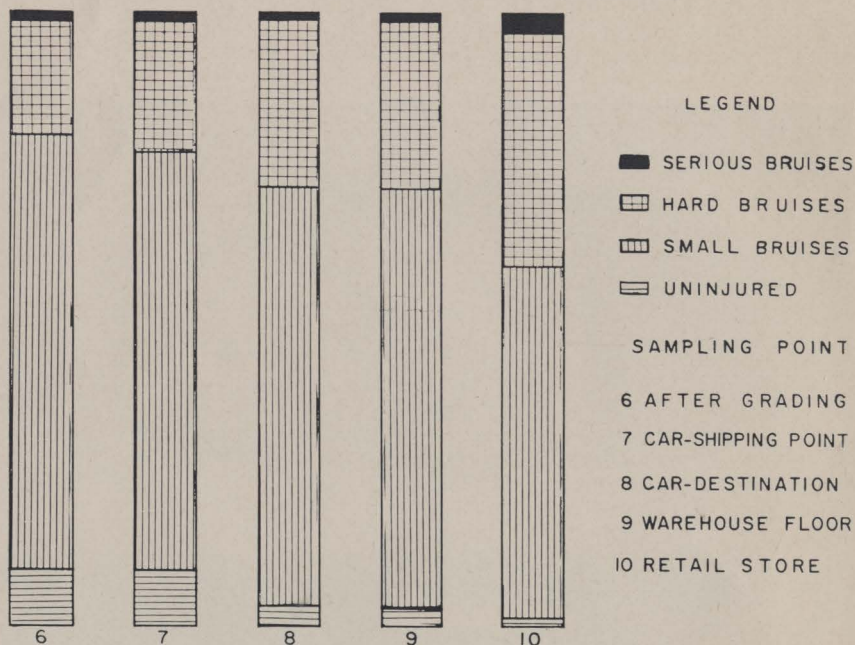


Figure 4.—Injury due to loading, shipping and distribution.

* Sparks, Walter C. 1954. Effects of mechanical injury upon the storage losses of Russet Burbank potatoes. Univ. of Idaho Agr. Expt. Sta. Bul. 220.

be lost during storage because of rot and moisture losses. By the time the tubers were in the storage bin only 23 percent of the tubers were found to be entirely free from bruises.

Removal from Storage and Hauling to the Warehouse

The responsibility for the injury caused during this phase or stage of the potato handling process rests upon the shipper. It is usually a crew under the direction of the shipper that actually handles the tubers and causes the bruises, but all losses incurred during these operations come out of the grower's pocket since he still owns the potatoes. Removing the tubers from the storage bin and hauling them to the warehouse increased the hard and serious bruises by more than 9 percent (Figure 2). About 4.5 percent of this was caused while getting the potatoes out of the bin and into sacks or bulk trucks. The other 4.5 percent injury was caused during the hauling to the warehouse and dumping into the evenflow hopper. Thus, by the time the potatoes were in the hopper at the warehouse about 23 percent of them had received hard or serious bruises. Even though only about 1½ to 2 percent of the tubers were actually culls, only 5.5 percent remained uninjured and free from any bruising.

Sacking, Loading, Shipping and Distribution

This is the only portion of the entire potato marketing process in which the farmer does not directly absorb the loss caused by injured or damaged tubers. This injury is a result of a lack of protection, improper handling procedures, or just plain carelessness.

The injury found at each sampling point of the marketing process is shown in Figure 4. After the tubers had been washed and graded by the commercial grading crew, 20 percent hard and serious bruises were still present. Of this 20 percent, only about 1.3 percent were actually culls, showing that the grading crew had done a fairly good job. It is the remaining 18.7 percent of hard bruises that results in excessive peeling waste and an unattractive product for the housewife (Figure 3). These are bruises which may not look bad at the time they leave the shipping point but which may be most unattractive at destination.

The process of loading the car at the shipping point is important for two different reasons. First, a certain amount of bruising is actually caused during this operation. Hard and serious bruises increased by 2.5 percent during the loading operation (Figure 4). Secondly, the method of loading dictates to some extent the amount of injury caused during transportation. It was found that sacks placed in the cars by hand had less injury and arrived at destination in better condition than those put in by the usual dump-loading method. A great many of the sacks that were dump loaded had holes rubbed through the burlap, whereas, very few hand loaded sacks had holes in them. The dump-loaded sacks

were looser and allowed more shifting to take place than did the hand-stacked type of load.

The actual transporting of the potatoes from shipping point to destination showed an increase in hard and serious bruises of 5 percent (mean of both hand and dump type loads). The data from impact registers showed that some cars received much more bouncing and jostling than did others. Occasionally cars were hit hard enough to completely shift the load. Normally, if tubers are jolted when they are cold, bruises result.

The unloading of the sacks from the railroad car at destination caused less injury than any other operation in the entire study. The sacks were placed on wooden pallets and the pallets were lifted and carried into the warehouse by fork-lift trucks. Fifteen sacks were placed on each pallet. Only when the pallets were stacked two high did excessive bruising occur.

The distributing operation caused more bruising than any other operation. This step increased the hard and serious bruises by 12.8 percent. The increase in culls was almost 2 percent. This means that 2 pounds out of every 100 pounds of U. S. No. 1 Russet Burbank potatoes were reduced to culls in getting the potatoes from the warehouse to the retail store. The amount of injury caused at this point was reduced considerably when the type of container was a box or a 10-pound bag in a box. In fact, in this and in a previous study* it was found that the burlap sack gave less protection than any other type of container. This is one point where increased protection and proper handling could greatly reduce losses.

Effect of Temperature on Injury

One of the most important and pleasing results from this research was the amount of injury that **could be prevented** by merely warming the tubers before they were handled. During the three years of this study, potatoes handled when the tuber temperature was 35° F had an average of 41 percent hard and serious bruises on the retail market. The tubers warmed to 40° F had only 35 percent and those warmed to 45° F had only 33 percent. The cullage caused when the tuber temperature was 35° F amounted to 3.8 percent as compared to 1.8 percent when the temperature was 40° F or 45° F. By merely warming the tubers from 35° F to 40° F the percentage of culls was reduced by 2 percent. In terms of sacks of potatoes, this means that 7.2 sacks of U. S. No. 1 tubers were saved in each carload by warming the tubers 5° F. There is no easier, better, or cheaper way to save money and good potatoes than by warming the tubers to at least 40° F before sorting or handling.

The tubers can be warmed by merely closing the ventilators and turning off the cooling fans a week or so before the potatoes are to be removed from storage. **Take the temperature of the tubers and do not handle them if their temperature is below 40° F.**

* Sparks, Walter C. 1950. Injury studies on Idaho grown Russet Burbank potatoes. Part I. Shipping and Handling. Amer. Potato Jour. 27: 287-303.