

POTATO TUBER DAMAGE IN PACKING SHEDS

by
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Bruising impacts every part of the potato industry. Bruises cost fresh pack growers, shippers and retailers by increasing shrink, rot and cullage; and by decreasing quality, shelf life, consumer acceptance, and demand. Bruises which occur during the packing and shipping of potatoes to retail markets can be especially important in affecting the quality of potatoes delivered to consumers. Bruises which occur during packing and shipping are not easily detected and are not removed during grading. Bruises which occur during the packing operation do not heal as readily as those in freshly harvested potatoes, and are sites for soft and dry rot pathogens to infect the tuber.

A survey of USDA receiving point inspection certificates (1) indicates that various types of bruises, and both soft and dry rot are common defects found in shipments at terminal markets (Table 1). This same survey found that of the 716 shipments of Long Russet potatoes from Washington to New York City inspected during the 1972-1980 period, 54 (7.5%) contained more blackspot bruise than allowed for the U.S. No. 1 grade. Several loads contained more than 20% blackspot. This indicates that in just this one market area, buyers were receiving an average of at least 7 shipments each year which were out of grade due to bruise. Not only could this affect the sales of Washington potatoes into this market, but the direct costs to the shipper (and therefore to the growers) can be very high. It has been estimated that \$1,600 to \$22,500 in revenue is lost for each rejected truckload, depending on whether the load can be sold at a discount, resorted, or must be dumped (3).

All fresh pack potatoes coming out of Washington must pass a USDA inspection at the time of shipment. This indicates that enough additional bruise must have developed between the time of inspection and the time of receipt of the shipment to make some loads out of grade. It is likely that some bruise is occurring at each handling operation during packing, loading, transit and unloading. Eliminating bruise during the packing operation is one way shippers can take a direct role in helping reduce losses due to bruise.

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To get a better idea of the factors most commonly associated with bruising during the packing operation, a survey of 16 warehouses in the San Luis Valley of Colorado was conducted during October and November of 1986. Samples were collected at 5 to 7 sites along each packing line, beginning at the storage or truck from which potatoes were being packed. The samples were evaluated after 3 days using the Catechol test to separate bruises into slight, moderate and severe categories (2). Severe bruises were the only category considered to affect grade. The results of the survey were taken back to each warehouse within one week of sampling. Areas considered to be causing bruise in the warehouse were pointed out to the manager.

Most of the bruise found in the warehouses was in the slight and moderate categories, which would not directly affect grade, but can affect quality. The percentage of unbruised potatoes decreased by 16% during the packing operation (Figure 1). Slight and moderate bruise increased an average of 12% and severe bruise by 4% during packing. The majority of the 16 warehouses sampled had no significant increase in severe bruise during the packing operation.

A bruise score was also calculated for each location sampled based on the percentage of slight and moderate bruise, and the total number of severe bruises present. This score allows a comparison of the relative amount and severity of bruise occurring at each location. The bruise score gradually increased at the 5 common sites sampled in each warehouse (Table 2). It should be noted that the largest portion of the bruise score could be attributed to bruises already present on the potatoes before the packing operation begins. This is due to bruises incurred in the harvesting, bin filling, and in the case of the loads coming into the warehouses in trucks, the bin unloading operations.

The factors listed below were the most common causes of bruise in the warehouses surveyed.

Excessive Belt Speed:

Belt and chain speeds were measured in all warehouses. Speeds ranged from less than 0.5 mph to 3.6 mph. Increases in bruise during the packing operation were often associated with belt or chain speeds in excess of 1 mph. One of the warehouses with the lowest bruise levels did not have a single belt or chain traveling over 1 mph, and yet was packing 5000 to 6000 cwt per day at peak capacity. This indicates that belt speeds can be slowed down to reduce bruising and still move potatoes to the packing equipment, provided the belts are filled to capacity. Elevators with flights were especially damaging when running over 1 mph. At these higher speeds the flights threw the potatoes onto the next belt, causing considerable bruising. Loading potatoes from a slow belt onto a fast moving belt also causes bruising. Because of the difference in speed the potatoes tumble and bounce as they off-load onto the faster belt. Sizing rollers were often running at speeds in excess of 2 mph. At these speeds the potatoes tend to bounce across the rollers before being dropped onto the next belt. Sizing rollers should be run at speeds which allow a gradual flow of potatoes across the rollers.

Excessive Drops:

Drops over 6 inches in height are areas where considerable bruising can occur. Loading potatoes into an evenflow bin was one of the primary areas where bruise was identified in this survey. The only methods observed which reduced bruising in evenflow bins were to keep them full at all times and to use a stair-step arrangement of padding to reduce the drop into the bin. Many warehouses had excessive drops at the main elevator into the warehouse. These drops could be reduced by moving the drive sprocket down into a dog-leg arrangement or using something other than flighted chain, such as a V-belt or hugger belt, to elevate the potatoes.

Worn or Missing Padding and Flights:

Many warehouses had placed padding on metal deflectors and other areas where potatoes can strike a metal surface. In some instances this padding was worn and was no longer protecting the potatoes from injury. All areas of the packing line where potatoes can strike bare metal should be protected with padding affixed with rounded bolts. Broken flights and finger links on elevators were other areas where bruise was occurring. Broken flights and finger links allow excessive rollback to occur, resulting in high bruise levels.

Low Pulp Temperature:

Cold potatoes are significantly more susceptible to all types of bruise. Pulp temperatures of potatoes moved out of storage should be at least 45°F. The average pulp temperature of potatoes coming out of storages or trucks into the packing line was 47°F. However some lots were as cold as 40°F. Most lots were warmed by about 2°F as they moved through the warehouse.

Operator Awareness:

Everyone from the manager to the forklift driver needs to be aware that bruising affects quality. Potatoes can be bruised just as easily by people as by machinery. Potatoes can still be bruised after they are placed in the sacks or cartons.

The factors causing bruise in most warehouses could be easily modified. One of the warehouses made some of these suggested changes in their line after an initial visit. A survey taken after the changes were made indicated a significant reduction in bruise (Table 3). Even though there was more bruise initially in storage in the lot of potatoes packed on November 14 there was less bruise occurring on the packing line after the changes were made.

Although some warehouses appeared to have less bruise occurring during their packing operations than others, all warehouses had some areas where bruise could be reduced. The warehouses are not being singled out as a particular area in which bruise is a major problem.

Potatoes can be bruised anytime they are handled, sorted or moved and both warehouse managers and growers need to work together to minimize bruising. Most of the modifications recommended for bruise reduction involve simple techniques which are already used to reduce bruising during harvest. The cooperators in this survey have taken the first step in improving quality by becoming more aware of bruise on their packing lines.

LITERATURE CITED

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Table 1. Disorders present in 13,757 shipments of potatoes to the New York market between 1972 and 1980.

Diseases		Injuries	
Bacterial Soft Rot	5,208	Bruising	2,002
Fusarium Tuber Rot	2,535	Punctures & Cuts	1,853
		Blackspot	923

Table 2. Average bruise score for 16 San Luis Valley potato warehouses at 5 common sampling sites.

Sampling Location	Bruise ¹ Score	% Increase From Previous Site
Storage or Truck	102	----
First Elevator	117	14.7
Picking Table	131	12.0
Sizing Rollers	139	6.1
Carton or Sack	142	2.0

¹ Bruise score calculated as 1 X %tubers w/ slight bruises + 2 X %tubers w/ moderate bruises + 3 X no. of tubers w/ severe bruises.

Table 3. Effect of equipment modification on bruise damage during packing in one warehouse.

Date: 9-24 Location	No Bruise	Slight/Moderate Bruise %	Severe Bruise
Storage	40	50	10
Carton	0	70	30
Date: 11-14			
Storage	20	70	10
Carton	10	80	10

Figure 1. Change in percentage of tubers in each of three bruise categories during the packing operation (ave. for 16 warehouses).

