BULK POTATO SHIPPING STUDIES

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Potatoes can be shipped successfully in bulk during winter. The Bangor and Aroostock Railroad, and more recently Washington State University, using one of the BAR bulk potato cars, and the Western Fruit Express Co., using a specially-constructed car, have done so. Since the major portion of Washington-grown potatoes are harvested and shipped during the summer and early fall, cars originating in Washington must be iced, not heated. Warm-air movement within the car during transit would not necessarily follow the same pattern as cold-air movement; therefore, it was necessary to determine if warm, immature, washed tubers could be successfully shipped during the warmer time of the year.

Washington Agricultural Experiment Stations began construction of a bulk potato car in 1961. Repeated construction problems forced cancellation of its use during that season. Construction was completed early in the spring of 1962. The car arrived in Othello, Washington, in July and was used to ship the first bulk load of potatoes in August from the Skone and Conners Produce Co. plant in Warden, Washington. Two additional loads were shipped, one in September from Basin Produce Co., Moses Lake, and one in October from Lovins Produce Co., Moses Lake. These shipments originated on two railroad lines; the Milwaukee Road, and the Northern Pacific. Tubers were shipped to the Safeway Foods Stores, Incorp., PrePakt warehouse in Los Angeles, California. Each of the three shipments consisted of a carload of sacked potatoes and a carload of bulk potatoes for comparison studies. The bulk potato car was a standard ice-bunker car similar in almost all respects to the sack car except that it was equipped with special loading and unloading equipment.

Ryan recording thermographs were placed at specific locations in the bulk car and in sacks in the sack car. Tuber sampling areas were spotted at random throughout the car. These sampling areas were used to determine pulp temperatures at different locations in the car and for internal injury evaluation.

Tubers from the same growers lot were shipped in the two cars. In one shipment, the flow of tubers from each truck load was split on the grading line, one-half going into the bulk car and one-half into sacks. In the other shipments, the bulk and sack cars were loaded concurrently. Tuber samples were collected at the grading line just before tubers fell into sacks or onto conveyors. These samples were used to determine tuber temperatures at the time of loading and to determine the amount of blackspot injury occurring up to that point. Sacking operations were carried on exactly as normally practiced. For loading the bulk car, conveyors were connected from the sacking line to the railroad car. Tubers were directed through one of the sacking outlets onto the conveyors. Since these conveyors were not specially-designed for this operation and had to be arranged in a very make-shift and often unsatisfactory manner, no attempt was made to evaluate the amount of injury caused by each. The entire movement of tubers from the end of the grading

line up to the time they were unloaded was considered as the shipping operation and injuries were compared on this basis.

Marked tubers in the bulk car and marked sacks in the sack car were randomly located. Upon arrival in Los Angeles, sacks were opened and tubers dumped by hand onto a conveyor which was brought into the car from inside the packing shed. The same conveyor was connected to the unloading conveyor in the bulk car. Tubers were taken in marked sampling areas as the car was being unloaded. Pulp temperatures of these tubers were taken immediately and the same tubers were saved and later peeled to determine the amount of internal blackspot injury.

Tubers were conveyed directly from the cars to the packing line where rotted tubers and tubers with external injuries serious enough to make them unsaleable were thrown into sacks. In this way, the external injury caused by either method of shipment could be compared. The rest of the tubers went into 10 pound polyethylene bags. In one shipment, tubers from the bulk car were put into special bags and sent to different retail stores in the Los Angeles area. This was done to determine the extent of tuber injury caused by the handling operations in the warehouse and in the retail stores. Also, excessive breakdown which might show on the consumer shelves at a later date could be ascertained.

While the data has not yet been completely analyzed, some trends are apparent. External injury, severe enough to cause tubers to be discarded was greater in the sack car than in the bulk car. Internal blackspot was at least twice as bad on tubers taken from the sack car as on tubers taken from the bulk car. Cold air movement as shown by Ryan recorders followed the same general pattern in both car except that the spread in temperature throughout the car was greater in the sack car than in the bulk car. More uniform air movement was also indicated by tuber temperatures taken in different sampling areas within the car at the time of unloading. These data are shown in the following table.

Average tuber temperatures in sampling areas in the bulk and sack cars taken on arrival in Los Angeles

	Shipments: 1		2		3	
	Bulk Car	Sack Car	Bulk Car	Sack Car	Bulk Car	Sack Car
High	43.0[1]	45.3	39.3	46.0	37.5	42.8
Low	41.1[1]	42.0	36.9	35.0	35.7	36.5
Average	42.0	43.6	38.5	39.8	37.0	39.0
Range (High - Low)	1.9	3.3	2.4	11.0	1.8	6.3

[1]High and low temperature figures are for the averages of the highest and lowest sampling areas (25 tubers each). The average temperature figure is for the total of 625 tubers (25 sampling areas of 25 tubers each).

Average car temperatures indicated that the overall temperature of tubers in the bulk car was lower than in the sack car in all three trials. It is also interesting to note the greater range between the lowest and the highest average sampling area temperatures within the sack car than within the bulk car.

Tubers from the bulk car, which were put into retail stores, showed considerable tuber injury due to handling in the receiving warehouse and in the retail store. They did not breakdown when stored for two weeks at room temperature or in cold storage at 40°F in the retail stores. No complaints on breakdown in quality were received from other retailers receiving these tubers.

Actual running time required to load the bulk car in the first two shipments was approximately 2.5 hours. In the last load, the grade-out of No. 1 tubers was very high, wide conveyors were used, and the grading equipment was adjusted to get maximum movement of potatoes onto the conveyors. The bulk car in this third shipment was loaded with 24 tons of tubers in one hour and two minutes. At no time was the car equipment overloaded. Unloading time was determined by the type of pack being put up and by the number of people on the packaging line. It took between 1 and $1\frac{1}{2}$ hours in each of the three shipments to unload and pack 24 tons of potatoes into 10-pound bags. In a processing plant where tubers would go directly into a holding bin or a large even-flow bin, the unloading time could likely be cut in half.

Although economic investigations pertaining to bulk shipments have not been conducted, there are certain advantages of bulk shipping that can be noted. The cost of sacks is eliminated. One or two men with proper equipment could do the work of the 8 to 10 men now used to sack and load sacks into railroad cars. Freight rates would be lower due to the ability to increase load limits from the present 40-45,000 pound minimums to 60-65,000 pounds. External and internal blackspot injury was less. Receivers cut labor costs. Carriers can use fewer cars to carry potatoes from any one area, thereby cutting capital investment and overall maintenance costs. Bulk potato cars could be used for shipping other fruits and vegetables in bulk.

There are still many problems, both economic and operational, to be solved by all segments of the potato industry before bulk shipping becomes an important marketing procedure in Washington. However, recent developments have made it imperative that these studies be continued. The Western Fruit Express Co. has now built 75 bulk potato cars. These cars are used by the Great Northern Railway to ship potatoes from the Red River Valley to chip manufacturers in Texas. These cars are similar to the BAR and Washington State University cars, but they have been modified and are now more efficient and cheaper to construct. Also, the University of Idaho is scheduled to begin bulk shipping studies in February, 1963.

The expansion of bulk shipping as an important marketing procedure will depend largely upon the demand by receivers. Carriers and shippers must then find a way to satisfy these demands. The Washington potato industry, through the Washington State Potato Commission and Washington State University, has taken the first steps in that direction. They will continue to assist the shippers and carriers of this area in preparing for such an eventuality.