THE BOX AS A CONTAINER FOR POTATOES¹

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Our usual system of harvesting potatoes in Maine consists of several operations each of which causes mechanical injuries. All tubers are picked by hand into a basket which is emptied into a barrel. The barrels are then trucked to a storage and the contents emptied into a bin.

A survey of handling methods was made by Schrumpf (2) in 1931 and 1932. He reported that emptying the contents of picking baskets into barrels injured 8.16 per cent by weight of the tubers whereas an additional 19.12 per cent were injured when the potatoes were placed in bulk storage. The movement of the potatoes from the bin to the grader after storage further injured 13.27 per cent of the tubers.

When potatoes are picked from the ground into boxes and the box is used as a storage container the operations of emptying baskets into barrels and emptying barrels into storage are eliminated. For several years the potatoes were handled and stored in boxes at Aroostook Farm of the Maine Agricultural Experiment Station. Edgar (1) reported on a comparison of the use of boxes to the conventional method of barrel handling and bulk storage. The use of boxes resulted in an increase from 64.9 per cent to 72.7 per cent of the potatoes meeting Fancy grade which he attributed to a reduction of grade injuries from handling operations. However, considerably more labor was required to stack the boxes in the storage than to fill bulk bins. In addition, there was a somewhat higher shrinkage rate in the boxed potatoes as well as a reduction of storage capacity through the use of boxes.

When a program of potato handling research was undertaken by the Maine Agricultural Experiment Station the previous experiences with box-handled potatoes led to a further study of the subject. The boxes used are similar to apple boxes in construction with a capacity of approximately 60 pounds of potatoes. In 1950 Katahdins were picked from the ground into boxes and placed in storage. Of the 200 boxes filled, ten were selected at random for examination by a Federal-State Inspector who classified the contents into the following groups:

1. Culls — all tubers under 1½ inch in diameter and all larger tubers which would be disqualified from U. S. No. 1 grade because of defects other than mechanical injuries. Some examples of such defects are sunburn, growth cracks and rot.

2. Major Injury — tubers which were disqualified from U. S. No. 1 grade because of mechanical injuries.

3. Minor Injury — tubers with mechanical injuries which penetrated the flesh but were not sufficiently serious to disqualify the tubers from U. S. No. 1 grade.

4. Uninjured — U. S. No. 1 tubers without mechanical injuries.

The boxes whose contents had been examined were distributed throughout the pile as they were stacked in the farm storage. After approximately 120 days the potatoes were removed from storage and the

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sample boxes were re-examined by the same inspector. The potatoes were graded, washed and weighed to determine the percentages of U. S. No. 1's and culls.

In 1951 a direct comparison of box and bulk storage was undertaken. Two adjoining bins, each 10 feet x 6½ feet x 14 feet deep were selected to obtain comparable conditions in each bin. All potatoes were dug from one field with the same digger. The bulk-stored potatoes were picked by hand into baskets which were emptied into unpadded barrels. At the storage the barrels were emptied and the potatoes conveyed to a canvas chute containing baffles through which they dropped into the bin. As the bin was filled six boxes containing known weights of field run potatoes were placed at three levels near the center of the bin. Vertically, the boxes were located near the bottom, at the center and near the top of the bin. A thermocouple was fastened to each box in order that temperatures during storage might be obtained.

The boxes were filled from picking baskets because partially filled boxes are difficult to move along the row. Twenty-three samples were selected at random from a total of 272 boxes. The samples were examined by the same inspector as in the previous year. As the boxes were stacked 12 high in the bin the samples were distributed throughout the pile. Thermocouples were placed near the center and top of the bin in locations comparable to the bulk-stored bin. An inadequate supply of thermocouple wire prevented the placing of thermocouples in the bottom of the bin and also prevented the taking of temperature readings in either bin for approximately the first month of storage. Temperature readings were then taken in both bins at intervals of about one week.

After a storage period of approximately 160 days the bins were emptied. The contents of the boxes buried in the bulk bin were re-weighed for shrinkage determinations. The sample boxes in the box-stored lot were re-examined by the same inspector. The contents of the bins were graded, washed and weighed to determine the percentages of U. S. No. 1's and culls. While the bulk bin was being emptied ten samples were selected and examined for injuries. A comparison with the box-stored samples indicates that there was no significant difference in the extent of either minor or major injuries between the two methods.

In table 1 the observed shrinkage rates for the two storage methods are presented. The shrinkage of bulk-stored potatoes during the 1950-1951 season was obtained from sample boxes which were buried in bins for another experiment. These data indicate a higher shrinkage rate for the box-stored potatoes. Edgar (1) concluded that the shrinkage loss of stored potatoes is dependent upon the length of storage period, average saturation deficit (difference in vapor pressure of air of a given temperature at (a) 100 per cent relative humidity and (b) at the actual relative humidity) and the curing temperature for the first two weeks. His studies indicated that a curing temperature of 56° to 60° F is desirable. Werner (3) stated: "Effective wound healing does not occur at a temperature below 55° F., and takes place slowly and incompletely if the relative humidity is below 75 per cent."

Unfortunately, temperature records could not be obtained during the first month of storage in the second season. However, the rate of temperature decline after observations were begun indicates that the