Mechanical injury to

Potato Tubers
during harvesting

Mike Zahara, John G. McLean, and David N. Wright

Damage to potatoes during field harvesting and hauling operations often amounts to 40%-50% before the tubers reach the packing shed.

To determine the extent of the injuries and at what points they occurred, a recent study was concentrated on field harvesting operations in six Kern County fields.

Four samples of potatoes were taken at five different points of the harvest operation: from the ground after digging, out of the stub sacks, from the end of the loader, out of the truck bed, and after the load was dumped at the shed. Conditions of the drop from the loader to the truck bed were duplicated at the Shafter Field Station.

All samples were stored in a shed for seven days before the potatoes were examined for injuries. Tubers damaged by small cracks, less than 1/2" in length, and by very small bruises would not cause any appreciable market loss and were classified as slightly injured. The classification of moderate injury included tubers with cracks between 1/2" and 1 1/2" long and tubers with medium sized bruises. Tubers with cracks or cuts longer than 1 1/2" and tubers with severe bruises were classified as severely injured.

Four of the six fields included in the study, especially Field III, were cloudy. Field IV was sandy and relatively damp. Field V was sandy and dry. In Field III, numerous clods and a digger with a high speed digging chain caused a large percentage of injured tubers.

### Tubers Injured in Each Harvesting Operation (Percentages)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Field</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digging</td>
<td></td>
<td>18</td>
<td>28</td>
<td>44</td>
<td>20</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Picking</td>
<td></td>
<td>4</td>
<td>12*</td>
<td>11**</td>
<td>2</td>
<td>6</td>
<td>39**</td>
</tr>
<tr>
<td>Handling to shed, except digging</td>
<td></td>
<td></td>
<td></td>
<td>14**</td>
<td>15**</td>
<td>16**</td>
<td>12*</td>
</tr>
<tr>
<td>L.S.D. at 5% = 8.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.S.D. at 1% = 11.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The loading machine can do a good job without causing too much injury. However, in Field VI, the damage by the loader increased the injury from 20% to 59% and caused 60% of the total injury for the field. In Field VI, the potatoes were dumped directly onto the conveyor chain, but the short pad in the loader was not long enough to protect the tubers.

The above table presents the percentages of tubers injured in each harvest operation. The height of drop into the truck and the care taken in loading affect the amount of injury. The drop was 4' in Field I, 2' in Field II, and 3' in the other four fields. The increased percentages of injury in samples taken at the shed after unloading showed the injury caused by the drop from the loader to the truck, by loading, and by unloading. Lowering the end of the boom of the loader down into the truck would prevent some of the injury.

Occasionally a man walks on the potatoes in a truck to facilitate unloading at the shed. Moderate injury was caused to 19% of the potatoes unloaded in this way and severe injury to 11%, a total of 30%.

Bumping the stub sacks with the loader in the picking-up operation caused a 4% increase in injury. A 3/4" thick rubber pad in the bottom of the hopper of the loader reduced bumping injury by 12%.

---

J. M. Tinley is Professor of Agricultural Economics, University of California, Davis.

D. B. DeLoach is Professor of Agricultural Economics, University of California, Davis.

The above progress report is based on the detailed Giannini Foundation Research Report No. 243, An Economic Analysis of the Feasibility of Processing Potatoes in California, by the same authors.
Sulfur requirement of soils for control of Scab Disease of Potatoes estimated rapidly by new method

P. F. Pratt

Coarse-textured noncalcareous soils of southern California often require the addition of sulfur to acidify the soil for the control of scab disease of potatoes. Below a comparatively narrow range of pH—relative acidity—values, toxic concentrations of soluble manganese or aluminum, or both, seriously reduce the growth of the potato plant and above this range the scab disease is not adequately controlled. The upper and lower limits of the control range depend on the sensitivity of the potato variety to the disease and the manganese and aluminum properties of the soil, but the usual desired range is between 4.8 and 5.4.

A method of estimating the correct amount of sulfur to add to the soil is necessary to avoid adding too little or too much.

For the purpose of having a specific target for developing a rapid evaluating method, the sulfur requirement was arbitrarily selected as the sulfur needed to bring the soil pH to 5.2 measured on the saturated paste of the calcareous soil. Since soils depress the pH, and most growers use acidifying fertilizers, the pH of the soil in the field will be below 5.2 if the sulfur requirement is accurately measured and the irrigation water used is free of bicarbonate.

Sixteen soils were incubated with measured amounts of sulfur until pH values no longer changed with further incubation, which required about three months for most soils. Each soil was treated with four levels of sulfur, the amounts of sulfur depending somewhat on the original pH and the cation-exchange capacity of the soil. After the incubation period the soils were leached with a volume of water equal to five times the volume of the soil sample and the pH was measured again. The pH of the leached soil was plotted against the amount of sulfur added and the sulfur required to acidify to pH 5.2 was estimated from the resultant graph. The sulfur requirement obtained by this method was used as a standard with which to test the more rapid buffer method.

A number of acid buffers were prepared and tested by adding a given volume of buffer to a given weight of soil and measuring the change in pH of the buffer at various intervals of time. The change in pH of the buffer was plotted against the sulfur requirement by the incubation method to learn how well the two were correlated.

The buffer solution which gave the best correlation was prepared by dissolving 2.0 grams of calcium acetate monohydrate, 1.8 grams of p-nitrophenol, 3.0 grams of potassium chromate, 4.7 grams of potassium acid phthalate and 1.0 milliliter of 88% formic acid in about 800 milliliters of water. The p-nitrophenol dissolved best when added separately to about 200 ml. of hot water. The pH of the solution was adjusted to 2.0, using 6 N hydrochloric acid, and then diluted to 1.0 liter. When 5.0 ml. of the solution are diluted with 35 ml. of water the pH should be 2.50.

Forty grams of air-dry soil were put into a beaker and 35 ml. of water added followed by 5.0 ml. of buffer. Then the wet soil and the mixture were stirred thoroughly. After 30 minutes the pH of the soil-buffer suspension was measured. The estimated sulfur requirement is equal to 100 pounds sulfur per 2,000,000 pounds of soil for each 0.10 pH unit above pH 3.70. For example, if the pH of the soil-buffer suspension was 4.70 the sulfur requirement would be 1,000 pounds per 2,000,000 pounds. At all times the pH meter was adjusted to pH 2.50 using a solution made by diluting 10 ml. of buffer with 70 ml of water.

The difference in pH before and after leaching to remove salts was relatively large for the soil represented in the upper

Covering the bottom of the truck bed with a ¼" rubber pad could reduce the injury for the 2', 3', and 4' drops by 5%, 10%, and 18%. Increasing the drop to the truck bed from the conveyor chain of the loader increased the amount of injury. Dropping tubers from a 4' height caused 20% more injury than dropping them from 3'.

Each time the potatoes were handled some injury occurred, but the digger and the loader caused the largest single increase in injury. In field IV the injury after digging was less than 4%. Slower operation of the diggers and loaders, thorough padding, and careful handling could eliminate much of the mechanical injury to potato tubers during harvesting.

Mike Zahara is Assistant Specialist in Vegetable Crops, University of California, Davis.
John G. McLean is Extension Vegetable Crops Specialist, University of California, Davis.
David N. Wright is Farm Advisor, Kern County, University of California.