BULLETIN No. 284
October 1957

NEW IDEAS IN PACKING POTATOES

Contents

Kermit Bird

EXPERIMENT STATION

TEACHING RESEARCH SERVICE

UNIVERSITY OF IDAHO

College of Agriculture

Grading

GRADING, as an operation in packing potatoes, uses a lot of labor, and improvements in this area may mean a large dollar cost saving to packers. Quite often, too, grading may be a bottleneck holding up the rest of the packing operation. Any device, then, making grading more efficient may have the effect of helping the whole packing operation become more efficient.

A recent innovation in grading is the roller grading table. It is sometimes called the float-roll grading table and is now being used in grading potatoes in other areas. It is also used in grading citrus and apples in several states. The table was developed by the U.S. Department of Agriculture for use in grading apples, but does a good job with other fruits and vegetables. It is now commercially available and is more efficient than grading equipment now in use in Idaho.

Why This Bulletin

POTATO marketing losses run into tens of thousands of dollars every year. They are particularly important in Idaho where potatoes account for 15 to 20 percent of total crop production. Some of these losses attract notice. For instance, potatoes are damaged, frozen, or otherwise mishandled because of lack of protection, lack of knowledge, or plain carelessness. But other losses, not so obvious, occur through inefficiencies, outmoded facilities, or obsolete handling techniques. Both types of losses cost money in packing potatoes. Both may be reduced by knowledge gained through marketing research.

The purpose of this bulletin is to show how others in the vegetable and fruit packing industry have cut costs. You may be able to cut costs by studying the methods used in other sections of the country. Some of the suggestions described here may have little application to your set up. Others may fill a current need. Some may be worth considering for future application.

Fruit and vegetable operations in Washington, the Red River Valley, and California were combed for ideas which you might adapt to help cut your potato costs. This is not a complete description of each method, nor does it cover all new ideas. Enough information is given about each machine or method to tell you its price, what it will do, and how it may be used to cut costs. These ideas are practical, workable methods used by progressive packers in other states. One or more may help in cutting your potato packing costs.

Advantages of Roller Table

The table may be used in several ways. First, it may be used as an ordinary grading belt. In addition, **the potatoes revolve as they move forward.** Secondly, dividers can be attached to the roller and lanes established so that each grader can work in one lane and be responsible for grading a particular group of potatoes. This division of work makes for efficiency in grading and each person does not have to look at potatoes already examined by other graders. Advantages of this table are:

(1) Potatoes revolve and graders can examine all sides of the tubers without turning them by hand. Tests by the U.S. Department of Agriculture reveal that the new table increased sorting efficiency by about 17 percent over that of the next best grading table compared.[1]

(2) Crowding of potatoes is avoided. Potatoes that have a space between them are more easily graded than those close together.

(3) Most rollers are made of aluminum and a light colored background is easier on the eyes than the conventional black rubber belt.

(4) If dividers are used, U.S. Department of Agriculture tests show grading efficiency may be improved by establishing tempo and rhythm.[2] Of course, dividers may be used on an ordinary rubber belt to increase efficiency.

Costs of the Roller Table

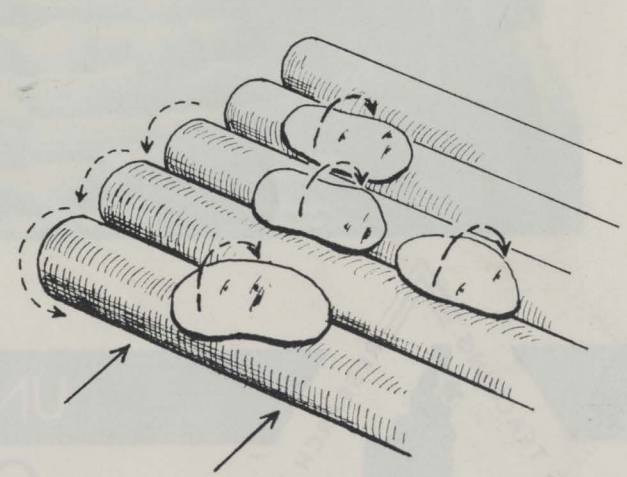
A 20-foot table costs about $1850. This table, 18 inches wide, has two 3/16-inch Sheradized rolls

[1] *Marketing Activities*, May 1955, Agricultural Marketing Service, United States Department of Agriculture.

[2] See previous footnote.

Figure 1—Potatoes revolve as they move forward. No hand turning of potatoes.

Chart A—Rollers move forward and revolve backward. This turns potatoes forward.



that are rust-proof. The rollers have bronze bushings and the distance between centers of the rollers is 3⅓ inches. Also included is a 1-horsepower worm-gear-drive motor with a speed of 58 rpm. Motor mounting, sprocket drive, and guard are included in the quoted price. Not included in the quotation are supports, chutes, delivery, installation, and taxes.

Speed of Rollers

Since rotation of potatoes as they pass the grader improves the probability of defects being observed, it is important to know what combinations of speed of motion past the grader (translation) and what rotating motion give the desired inspection efficiency and lowest labor requirements. Laboratory tests[3] from the University of California give the following recommendations regarding translation and revolving speeds:

1. Translation speeds of 75-90 feet per minute appear most desirable. To prevent dizziness, maximum speed should be 120 feet per minute.

2. Potatoes should be rotated at least ¾ to 1 revolution per foot of translation, per row of potatoes. In other words, if one grader has to look at four rows of potatoes, the potatoes should turn 3-4 times per foot of translation distance. Maximum speed recommended is 40 revolutions per minute.

3. Forward rotation is desirable to avoid "belt sickness" which occurs when certain speeds of backward rotation are used.

4. Grader should be responsible for a maximum of four rows of potatoes. Dividers can be put on the belt to apportion rows among the graders.

5. Grader should not be closer than 8 inches to the potatoes. A grader can't see potatoes too close to his body.

The chart and photos show several examples of how roller tables are used. The big savings from their use result from the revolving of the potatoes as they move along in front of the grader. With this table, graders use both hands to remove potatoes, rather than having to turn potatoes by hand. As a general principle, anytime you can ha[illegible] a machine do the work of a person, you can [illegible] costs.

Disadvantages of the roller table are that it costs more to buy and more to maintain than conventional belt tables.

Lane Sorters

The lane sorter is a simple device dividing the conveyor belt into lanes. This device makes it easier for graders to sort and grade potatoes. It concentrates the attention of the grader in a smaller area and permits more effective sorting. It may be used on the flat belt or on the roller-grading table described above.

The device was designed by researchers in the Agricultural Marketing Service of the U.S. Department of Agriculture.[4] Their lane sorter divided a 24-inch belt into three 8-inch lanes. The sorting device was tested in several plants and proved efficient where used. At the same time, it allowed a greater degree of quality control than when a 24-inch wide belt was used for grading.

The lane sorter offers several advantages: (1) It concentrates attention of the grader upon a smaller area, thereby increasing the efficiency of sorting, (2) It permits the belt to run at a higher speed eliminating pileups, (3) It does away with overlap of one sorter with another on the belt thereby eliminating duplication of effort, (4) It may be used with the usual flat belt or may be used with the roller grading table.

[3] Visual Inspection of Products for Surface Characteristics in Grading Operations, U.S.D.A., Production and Marketing Administration and the University of California Institute of Engineering Research, Marketing Research Report No. 45, June 1953.

[4] *Agricultural Marketing*, January 1957, U.S.D.A. Agricultural Marketing Service.

Chart B—Lane sorters on a grading table divide table into lanes and concentrate attention of grader in a smaller area.

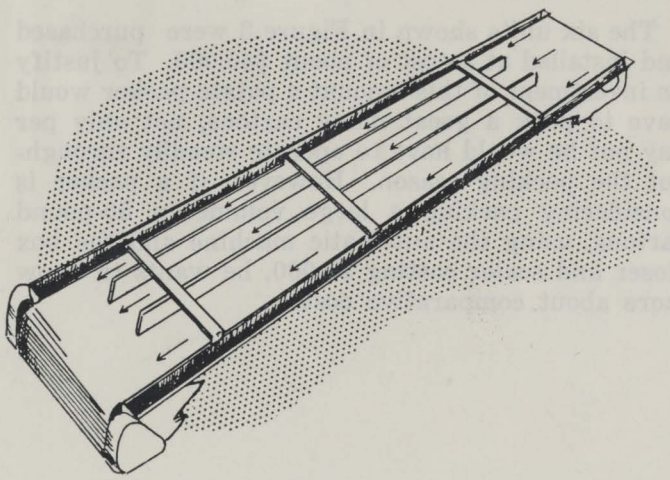


Figure 2—Tables such as these improve grading efficiency 17 percent.

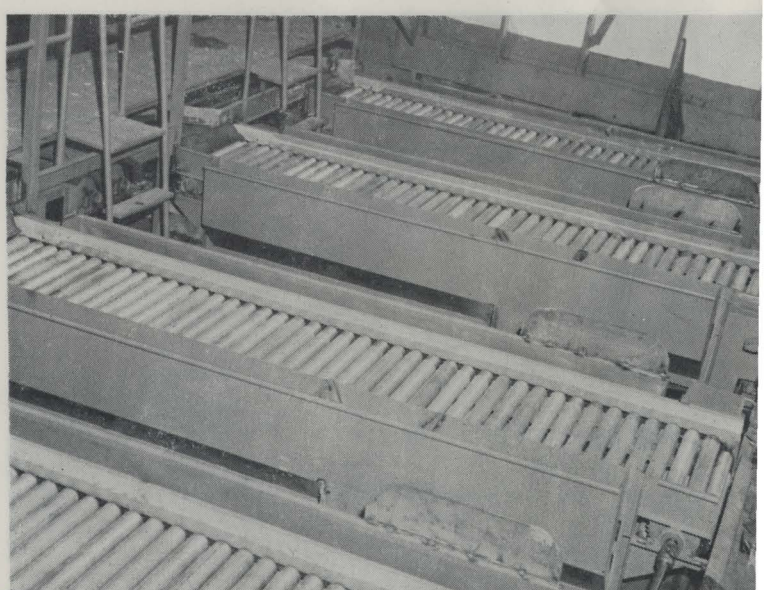


Figure 3—Automatic box filling machine. These machines are used in lemon packing.

ANOTHER possible improvement may be found in using fiberboard containers instead of sacks for packing potatoes. Few Idaho potatoes are being packed for the fresh market in rigid type containers. However, there is a national trend to ship more and more fresh fruits and vegetables in boxes and cartons. Fiberboard has the advantage of offering more protection to the produce, thus cutting down on bruising resulting from handling and from shifting in the car. Packers now ship limited amounts of potatoes in 50-pound boxes, but they find that the box cost and labor expense of packing is high and the operation is too costly except for bakers, hand-wrapped potatoes, gift packages, or overseas shipments. If modern methods of box filling were used, could packing costs be lowered to the point where a larger percentage of Idaho potatoes could be shipped in boxes? If machine box fillers were used, how would costs then compare with the conventional methods of filling 100-pound burlap bags? We will try to answer these questions, but first let's look at some machines for filling boxes.

Figure 4—Semi-automatic box filling machine. This type requires one worker for each machine.

Fiberboard Containers

Photographs shown here illustrate several newer methods of packing boxes. The machine shown in Figure 3 is completely automatic. Boxes are assembled on an upper level, come down to the machine on a gravity roller conveyor. When the fiberboard box is in position, the gate opens allowing produce to fill the box. At the required fill-weight the solenoid controlled gate closes, an empty box moves into position, and the cycle is repeated. One worker, plus the box assemblers, can keep six of these machines in constant operation.

The filled box moves on to the lid closing machine. It opens lids, applies glue, closes lids, and holds them closed until the glue is dry. (Figure 5) Boxes are automatically stamped indicating contents, size and grade. (Figure 6).

Handling of filled boxes is largely done by machine if adequate equipment is available and used correctly. Filled boxes are loaded on pallets from a conveyor belt, and the pallets moved to storage or car by power fork-trucks. Many fork-trucks are of the large size (electric or gasoline), but some are of the "walkie" type with the operator walking ahead steering the truck. In crowded quarters or where little lifting is to be done this latter type is desirable and is more economical to purchase and operate.

A second type of box-filling machine is shown in Figure 4. It is not completely automatic, but in many potato packing sheds could be more economical than the previous automatic type illustrated because it costs less to buy. Purchase price is an important consideration to a packing shed with a small volume. A worker places empty cartons on platforms balanced within the machine. When the platform goes down, indicating the box is filled with the correct weight, the machine diverts the flow to the empty box. The filled box is manually lifted off the platform and set on a conveyor and an empty one put in its place.

A disadvantage of this machine, compared with the previous filling machine, is that it requires the attention of one worker for each unit.

Cost of Machines

The six units shown in Figure 3 were purchased and installed at a cost of about $40,000. To justify an investment of this amount a potato packer would have to pack a great many cartons, not only per day but he would have to operate steadily throughout the packing season. However, if a packer is considering packing a large volume in 50-pound cartons, using the automatic machine and the box closer and sealer costing $5,000, he wants to know more about comparative costs.

and Handling Methods

The six automatic box packing machines observed had a working capacity of about 1000 40-pound lemon boxes per hour. If similar machines could operate at the same capacity in potatoes we expect a working capacity of about 800 50-pound boxes per hour, an adequate output for most Idaho sheds.

Fixed costs per year include 10 percent depreciation, 9 percent repairs, 3 percent interest, and 2 percent insurance and taxes. This 24 percent of replacement costs ($45,000) is $10,800. A plant packing boxes at nine-tenths capacity (360 cwt. per hour) for 1200 hours per year has fixed machine costs of $.09 per cwt.

Boxes themselves cost $.56 per cwt. (this assumes two 50-pound cartons at $.28 apiece).

Costs of labor for three men at $1.25 per hour would be $.01 per cwt. One man supervises the six machines, two men assemble boxes.

Total packing costs per cwt. are $.56 for the boxes, $.01 for labor, $.09 for machine, and $.005 for glue. These add up to $.665 per cwt. This is box packing cost only and does not include grading, building costs, carloading, or wages of foremen, managers, or clerical help. However, in our comparison these overhead costs may be omitted as they would be constant regardless of method of packing.

Comparable costs for packing 360 100-pound burlap sacks per hour would be: Fixed machine costs of $.01 per cwt.; labor $.02 per cwt.; burlap $.18 per cwt.; twine $.005 per cwt. These costs total $.215.

From a packing cost standpoint it is cheaper to pack in burlap ($.215 per cwt. for burlap vs. $.665 per cwt. for two 50-pound cartons).

However, there are other considerations. Boxes offer better protection than burlap against mechanical damage from handling and shifting in cars. This additional bruising cost, estimated to be $.244 per cwt., is based on No. 1's being worth $3.75, No. 2's at $1.75, and culls valueless. It assumes boxed potatoes have 8.5 percent less bruising than sacked potatoes.

Cost estimates may be summarized as follows:

Cost item	Costs per cwt. 50-lb. carton	100-lb. burlap
Packing		
Labor	$.01	$.02
Fixed machinery	.09	.01
Containers	.56	.18
Miscellaneous	.005	.005
	.665	.215
Damage in burlap in excess of that in boxes	.....	.244
Total	$.665	$.459
	Difference =	$.21

Figure 5—Box lid being closed automatically.

In comparing the two packing methods, carton packing costs are $.21 higher than burlap packing costs.

Even though shipping in fiberboard containers is uneconomical with our present price structure, it may be profitable to ship in cartons if a buyer wants the extra quality obtainable. He may want this type shipping container even if he has to pay a premium of $.21 for the potatoes.

One other point that might be mentioned in this connection is the long-run effect on consumption (and demand) if quality at the retail level were improved. It is quite possible that the housewife would be willing to pay higher prices for potatoes and buy more potatoes if they were shipped so they arrived at the retail store in better condition. If this were true there would be increased consumption of potatoes and the whole potato industry would benefit—farmers, packers, wholesalers, and retailers.

Figure 6—Lids have had glue applied and rollers hold lids tight until glue dries.

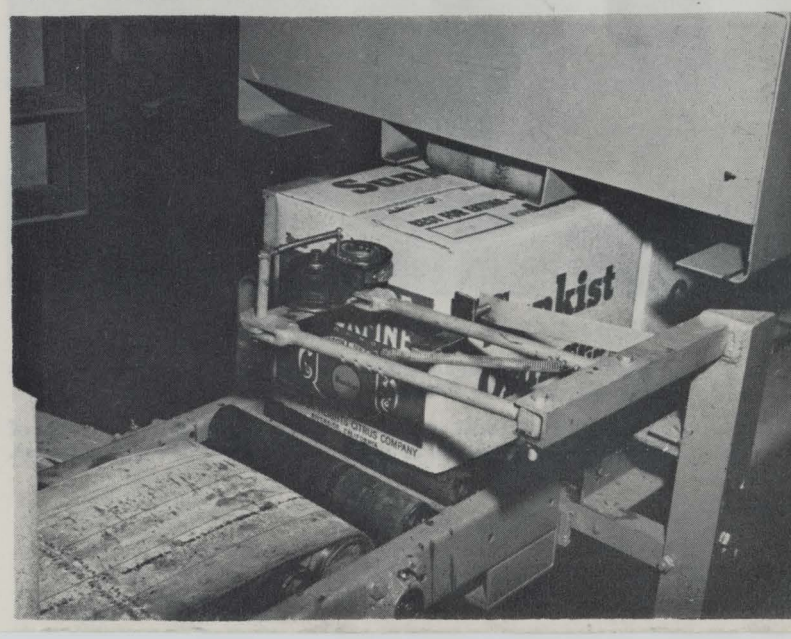


Figure 7—Bulk truck being unloaded.

Figure 8—Overhead hoist unloading potatoes. Truck is easily converted to flatbed.

Figure 9—Bulked potatoes being unloaded into vat of water. Water prevents bruising and soaks soil from potatoes.

Trucks and

A THIRD innovation concerns machines and handling methods bringing potatoes from the field or cellar to the packing plant.

Most bulk-handled potatoes in Idaho are hauled from field to cellar and from cellar to packing plant in V-type bulk trucks. These bulk trucks have endless conveyor chains in the bottom of the bed. Chains are operated by power take-off from the truck by a motor temporarily attached to the truck. Thus unloading is done without manual labor, except for the job of removing the boards in place above the chain. These trucks have proven to be efficient, economical, and superior to hand methods previously used. They do have the disadvantages of being more or less limited in use to the potato enterprise, and of causing some mechanical damage to potatoes.

Other bulk trucks are capable of doing the hauling and unloading jobs more efficiently than V-type beds. California and some Idaho packers use a bulk truck showing possibilities. It is similar to beet bulk trucks in use in Idaho; having a rectangular box. The box bed is hinged on one side. Potatoes are unloaded by elevating the free side, allowing them to flow through a gate opening on the hinge side. Figures 7 and 8 show trucks of this design being unloaded. The box may be removed from the bed giving the trucker or the farmer a flatbed truck for other uses. A disadvantage of the box bed is that it does not provide a means of throwing out vines, soil, and inferior potatoes. A possible solution to this problem would be provided by using even-flow hoppers or a temporary unloading box.

Advantages of this type of bulk truck are:

1. It is easily convertible to a flatbed truck. Thus, its use is not limited to the produce hauling business.

2. The box bed may be used to haul other types of farm produce. Examples: beets and grain.

3. Unloading time is fast. One of these trucks may be unloaded in about 5 minutes if temporary dump storage is available. This compares with 15-20 minutes for the V-type bed.

4. Bulk box beds may be constructed with local labor.

Dumping

Dumping Into Water

To facilitate the unloading process, some packers, when delivering potatoes to a packing shed, unload bulk trucks into water. The vat pictured in Figure 9 holds about two truckloads of potatoes. The water serves several purposes:

1. It cushions the fall of the potatoes and reduces mechanical damage incurred in unloading.
2. It acts as a reservoir to hold potatoes from the time they are unloaded until they are graded.
3. Potatoes are partially washed. This soaking process is valuable if potatoes come from clayey soils.

Potatoes to be stored should not be dumped into water if they are damaged or diseased for there is the danger of innoculating healthy potatoes with rot organisms.

Potatoes need not be unloaded into water. Figure 10 shows a box bulk truck being unloaded onto a conveyor. However, the truck can be unloaded only as fast as the conveyor can take the potatoes away.

Cull Trucks

The handling of cull potatoes has become a large business in Idaho. Packers separate culls from the marketable grades of potatoes and haul them to feedlots or starch plants. Hauling these potatoes is a major operation and it is in the interest of haulers to be as efficient as possible.

A cull truck of unusual design is shown in Figure 11. This semi-trailer has a bed 35 feet long, 6 feet wide, and 5 feet high. It holds about 20 tons of potatoes. The bottom of the bed is in the shape of an inverted "V," enabling dumping from either side through hinged doors.

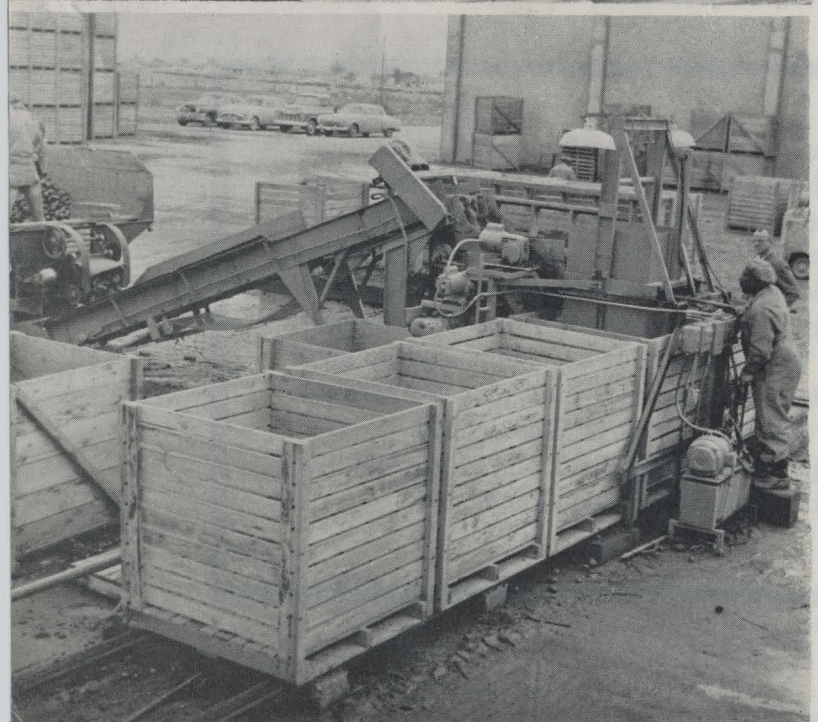
Figure 10—Bulk trucks may be unloaded onto conveyor.

Figure 11—Cull truck holds 20 tons. Doors permit emptying on either side.

OTHER bulletins pertaining to efficiency in potato packing may be obtained by writing to the University of Idaho Agricultural Extension Service, 317½ North 8th Street, Boise, Idaho or to the Agricultural Experiment Station, University of Idaho, Moscow, Idaho. Suggested titles are: Bulletin 247, "Packing Idaho Potatoes," and Bulletin 265, "Packing 10-pound Sacks of Idaho Potatoes."

This study was a phase of Western Regional Marketing research project, WM-25, "Case Studies in the Impact of Technology." It was supported by state funds and by funds allocated to the western region under the Hatch Act, amended. The other state cooperating in this regional study is Washington.

Figure 23 is an Oregon State College photo, Figures 19, 20, and 21 are U.S. Department of Agriculture pictures, and Figure 12 is from Union Pacific R.R.



Pallet Handling

AN INNOVATION showing possibilities for future use in potato operations is the fork truck. Fork trucks may be used in several ways, with pallets or pallet boxes.

Few potatoes are now being handled with fork trucks and pallets in Idaho. After potatoes leave the state, however, many of them are unloaded from cars by pallet methods. Advantages of the pallet to a wholesaler or buyer are that he can do the unloading job quicker and cheaper than by hand methods. Figure 12 shows palleted potatoes being stacked after they have been unloaded from the car. In the car, potatoes were loaded by hand onto pallets, moved from car to dock by hand fork trucks, and stacked by power fork trucks.

An obvious disadvantage of such a method is that in unloading cars the sacks of potatoes have to be lifted by hand onto pallets. If the potatoes had been put on pallets at the packing plant before leaving the state, shipped on pallets, and unloaded with fork trucks, the whole loading and unloading operation would be more efficient. Studies in other industries have shown this to be true. A drawback, though, is the problem of returning empty pallets. Wooden pallets are a nuisance to ship back and the whole method becomes fairly expensive and inefficient cost-wise if pallets are not returned to shippers.

Paper Pallets

Recently a disposable paper pallet has been developed. It may be one answer to the problem of how to ship potatoes on pallets. The disposable pallet consists of a Kraft paper sling and two spiral-wound tubes which fit into sleeves preformed by looping two side edges of the sling. Tubes permit easy access by bayonet type forks. These forks are easily attached to any fork truck.

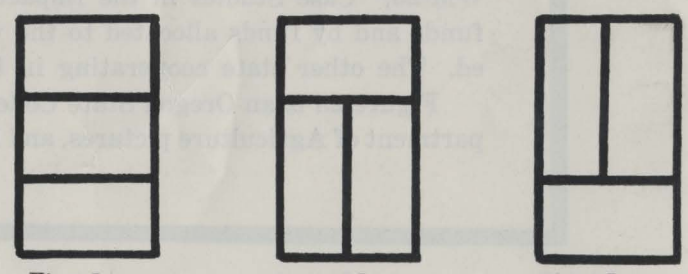
Pallets of this type come in a variety of sizes and patterns, but a common size is 50 inches long and 33 inches wide. A pallet this size would be large enough to hold three 100-pound sacks per layer. Stacked five layers high, a pallet would hold 15 cwt., and 24 pallet loads would fill a car with 360 cwt.

Figure 12—Pallet handling of potatoes at wholesaler's warehouse. System is unsatisfactory because of bruising damage.

Figure 13—Paper sling pallet used in handling sugar. Pallet is disposable and need not be shipped back.

Figure 14—Filling bulk boxes using vertical retarder chute.

Chart C



and Bulk Boxes

If sling pallets were used, buyers would not return the pallet. They are cheap enough so they may be thrown away after use. Although there are no research results to back up the statement, this method appears to have cost-saving possibilities. Shippers and receivers would have to cooperate, but both would benefit by using the cheaper loading and unloading technique.

Figure 13 shows sugar sacks being high piled with a fork truck. This truck is equipped with bayonet type forks and slings are being used as pallets. A suggested method of loading potato sacks on a pallet sling is illustrated in the drawing. The pallets should be packed tight in the car to prevent excess shipping damage.

Bulk Boxes

Many fresh fruits and vegetables as well as grains, beans, and peas are now being handled in bulk boxes. Recent studies show produce can be handled at considerable cost savings by replacing field crates with bulk boxes; in fact, engineering studies by the U.S. Department of Agriculture,[5] show these savings in apples amount to about 13 cents per bushel over field-crate handling.

Some potato packers have started handling their potatoes in bulk boxes. These boxes may be used in several ways. Box storage has always seemed promising because it reduces the number of handling steps. Farmers bring potatoes to the combination storage-shed packing plant in either bulk trucks or half-sacks. Bulked potatoes are put in the bulk boxes by means of conveyor and a retarder chute filling machine. Sacked potatoes are dumped directly from the truck bed into bulk boxes.

Figure 14 shows a bulk truck being unloaded onto a conveyor. From this conveyor the potatoes drop through a vertical retarder chute into the box. Flow is regulated by the chute, preventing potatoes from being bruised in the filling process. It takes only 3 minutes to place, fill, and remove the box to storage. A bulk truck may be unloaded into boxes in 15 minutes.

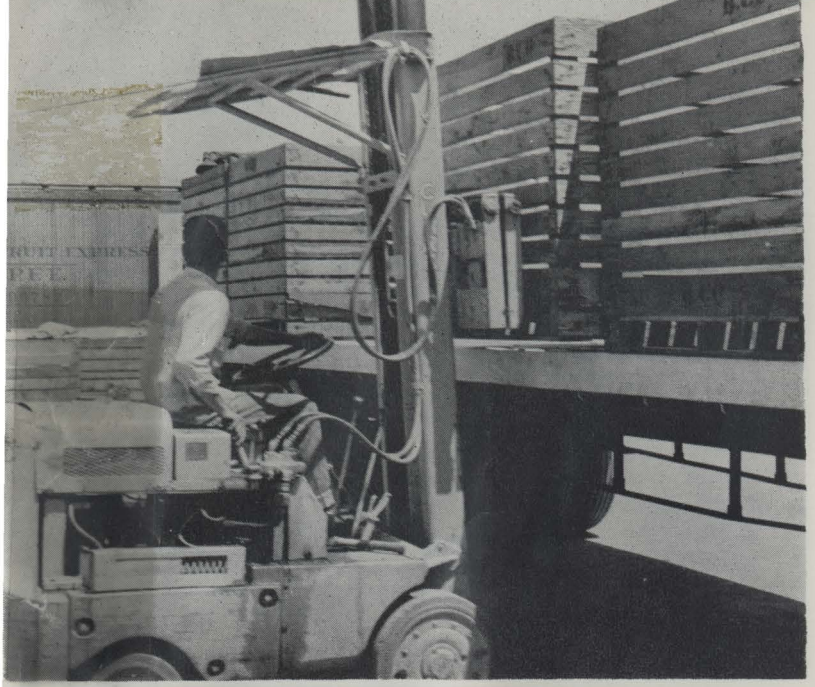
Figure 15 shows potatoes being dumped from half-sacks on the truck bed to the filling box. The fork truck, in the left foreground, is an essential part of the bulk box operation. After a box is filled, the fork truck carries the box into the storage shed where boxes are stacked four or five high. Later, when the potatoes are ready to be packed they are again moved by fork truck, this time to a hopper where they are fed to the packing line. Machines

[5] U.S.D.A. Agricultural Research Service News Release No. 3574, January 12, 1957.

Figure 15—Filling bulk boxes from half sacks.

Figure 16—Filling one ton boxes with No. 2 potatoes from grading belt.

Figure 17—Fork trucks are an essential part of bulk box operation.



to dump bulk boxes are now being developed at the Red River Valley Potato Research Center. They give promise of reducing labor costs and quality losses in handling potatoes.

An advantage of bulk box storage is that storage space is used more efficiently than conventional low bin storage. This does not imply that deep bin storage is undesirable, for this type storage has worked well if potatoes are carefully put in the bin. Each box, 4 feet by 4 feet by 4 feet, holds a ton of potatoes. Thus an area 4 by 4, with boxes piled 3 high, contains 3 tons of potatoes. If stacked 4 high, 4 tons would be stored in this 4 by 4 square space. Potatoes in bulk boxes may be "piled" higher without the danger of bruising and damage resulting from the pressures of high piles.

A second advantage of this type of storing is the ventilation and humidity control possible. Aisles need not be left between stacks of boxes, for air circulation is by convection upward through the boxes.[6] Box bottoms should be slotted but slots in the box sides are not necessary since air movement is vertical. Thus boxes made of plywood panel sides serve satisfactorily.

Another potato packer uses bulk boxes in moving No. 2 potatoes to be used in making potato chips to a nearby city. This plant has its No. 2 belt leading to the machines filling the bulk boxes (Figure 16). Potatoes enter an inclined retarder gate chute, are lowered to bulk boxes arranged so boxes can be filled in rotation. The fork truck in Figure 17 is moving the bulk box away from the retarder filling chute.

The fork truck carries a filled box to a flat bed

[6] Personal talks with Alfred Edgar, Senior Agricultural Engineer, Red River Valley Potato Research Center, April 1957.

Figure 18—Unloading empty bulk boxes from truck. This trailer holds 18 boxes.

Figure 19—Picker dumping apples into bulk box.

Figure 20—Tractor fitted with lift loads boxes on truck. Boxes are easy to handle and require one operator to load.

Figure 21—Fork lift unloads bulk boxes at plant. No hand labor necessary.

semi-trailer, loads box on trailer, and returns with an empty. The semi-trailer shown in Figure 18 holds 18 of these filled bulk boxes. Each box is 4 by 4 by 4 and holds 2200 pounds, a pay load of 20 tons. Saved by this operation is the sacking, cost of bags and the extra labor of handling sacks instead of boxes.

In handling apples, U.S. Department of Agriculture researchers find bulk boxes cut costs. Figure 19 shows pickers dumping apples into bulk boxes. These boxes are moved to orchard loading dock or farm truck by a tractor fitted with lift. Boxes save time, money, and labor and cost less than an equal number of field crates and pallets required to hold the same amount of apples. Four feet square and 32 inches deep, these bulk boxes hold 24 bushels.

Figure 20 shows a tractor, fitted with hydraulic lift, loading bulk boxes on a truck in an apple orchard. Bulk boxes with built-in pallets are easy to handle and require only one loading operator at the orchard dock. Here the grower saved 2½ cents per bushel. It is possible that bulk boxes could be used in handling potatoes in the harvesting process. Empty boxes would be loaded on a truck or trailer and filled directly by the field combine. This has successfully been tried in other areas.

At the processing plant a fork-lift truck unloads the bulk boxes of apples, Figure 21. Savings, as reported by the U.S. Department of Agriculture total about 13 cents per bushel for orchard to plant handling. Bulk boxes help get apples into cold storage quickly and eliminate excessive loading and unloading by hand.

Cost of Boxes

The cost of bulk boxes depends somewhat on local lumber prices and on local wage rates. Costs also vary depending on the quality and size of the box. Boxes shown in Figures 14 and 15 were made in the Northwest and may be of a quality and size desired by potential users in Idaho. These 4 by 4 by 4 boxes cost the packer $12.00 apiece. The operation uses 7,000 of them and total investment in boxes is about $84,000. Boxes depreciated over a 12-year period would cost $1.00 per box per year. Balanced against this box investment a packer has to save at least this much in labor, in quality savings, and in construction costs of storage buildings.

What are the prospects for use of pallet handling and bulk boxes in Idaho? Fork truck operations have disadvantages. They require considerable investment and empty boxes are a nuisance to handle. Also pallets and boxes may not stack as tightly as desired. But if a packing plant manager were making extensive changes to modernize his set up, he would probably want to consider boxes or pallets. In comparing the relative efficiency of various methods of inplant handling, a fork truck pallet system shows lower costs than either hand truck or conveyor handling methods.[7]

[7] *Material Handling Analysis*, from an article by H. A. Stevenson in 1956-57 volume of Flow Directory.

Vertical Elevators

MANY potato packing sheds are built on two levels. These buildings have advantages, particularly if the lower floor is used for unloading farm trucks. However, getting potatoes from lower to upper floor sometimes presents difficulties. The common way is to have a conveyor belt or chain running from one floor to the other. This conveyor takes up quite a lot of floor space since the steepness must be gradual enough that rollback does not occur.

One way of saving floor area, in a plant where space is needed, is to install a vertical elevator. Figure 24 shows a vertical elevator being used to raise potatoes from a basement washer to the upper floor. Total floor area needed for this type elevator is about 8 square feet, 2 feet wide by 4 feet long.

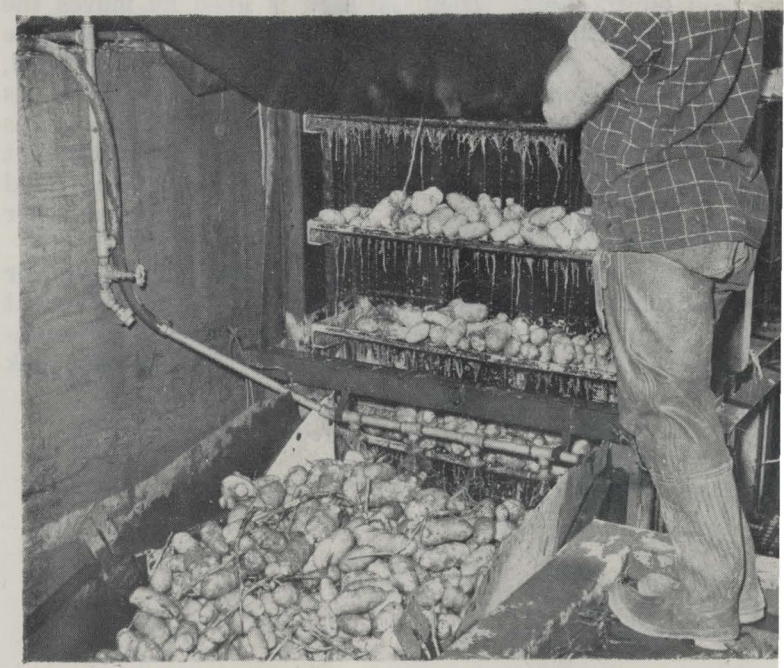


Figure 24—Vertical elevator takes little floor space.

Figure 22—Jigging and sewing 100-pound sacks. This is the common way of filling burlap.

Figure 23—Filling device shuts off when sack reaches 100 pounds. Weighing operation eliminated.

Filling 100-pound Sacks

IN IDAHO the 100-pound sack has been filled in about the same way for many years. This has been a fast and efficient method, and there has been little incentive to improve. Figure 22 illustrates the method now in common use. The worker on the left, the "jigger," fills the sack with potatoes coming off the belt. When the sack is filled he moves the slide so the flow of potatoes is directed into the empty sack. While this empty sack is being filled, he detaches the filled sack, hooks an empty in its place, lifts the filled sack to the scale, and adjusts the weight of the sack by adding or taking out potatoes. He then returns to the sack being filled and repeats the cycle. Sacks are sewed by another worker.

Recently a new machine has been developed for filling 100-pound sacks. The operation is somewhat similar to the one described above except the weighing scale is attached to and is a part of the sack holder (Figure 23). Potatoes come off the belt and enter the sack through the chute as pictured. When the sack is filled to 100 pounds, potato flow is automatically diverted to the empty sack. The filled sack is unhooked and set aside for sewing. An empty sack is attached and the process repeated. A second worker sews sacks.

Work is simplified because manual weighing is eliminated. One worker unhooks the filled sacks, moves it to the second worker, and hooks an empty. The second worker sews filled sacks and pushes them onto the moving conveyor belt. In some plants, workers sew while sacks move upright on the belt.

These machines are reasonable in price. Although complete data is not available on their relative efficiency, or weighing accuracy, preliminary tests show them to be more efficient than the method now in use.